How to Navigate the Technical Sessions

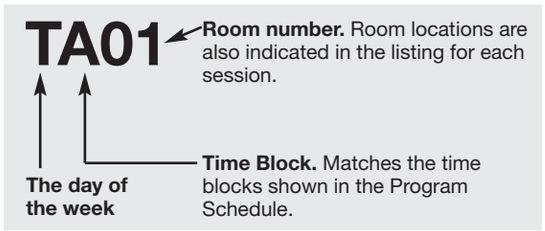
There are four primary resources to help you understand and navigate the Technical Sessions:

- This Technical Session listing, which provides the most detailed information. The listing is presented chronologically by day/time, showing each session and the papers/abstracts/authors within each session.
- The Author and Session indices provide cross-reference assistance (pages 501-542).

Quickest Way to Find Your Own Session

Use the Author Index (page 501) — the session code for your presentation will be shown along with the room location. You can also refer to the full session listing for the room location of your session.

The Session Codes



Time Blocks

Sunday - Tuesday

A — 8:00am - 9:30am
B — 11:00am - 12:30pm
C — 1:30pm - 3:00pm
D — 4:30pm - 6:00pm

Wednesday

A — 8:00am - 9:30am
B — 11:00am - 12:30pm
C — 12:45pm - 2:15pm
D — 2:45pm - 4:15pm
E — 4:30pm - 6:00pm

Room Locations /Tracks

All tracks and technical sessions will be held in the Hilton Hotel and Parc 55. Room numbers are shown on the Track Schedule and in the technical session listing.

Sunday, 8:00am - 9:30am

■ SA01

Hilton- Golden Gate 6

Analysis in Support of National Security

Sponsor: Military Applications Society

Sponsored Session

Chair: Richard Deckro, Professor of Operations Research, Air Force Institute of Technology, AFIT/ENS;Bldg 641, 2950 Hobson Way, Wright-Patterson AFB, OH, 45433, United States of America, richard.deckro@afit.edu

1 - A Markov Decision Process Model for the Optimal Dispatch of Military Medical Evacuation Assets

Matthew Robbins, Assistant Professor, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, matthew.robbins@afit.edu, Sean Keneally, Brian Lunday

We develop a Markov decision process model to examine optimal military medical evacuation dispatch policies in a combat environment, considering complicating aspects to include the priority level of each casualty, multiple-casualty events, threat conditions at service locations, and the option for armed helicopter escort. We present the results of applying a relative-value iteration dynamic programming algorithm to instances representative of medical support to ground operations in Afghanistan.

2 - Reducing Cognitive Load on the UAS Controller

Jasmine Morgan, DSE/USMA, Bldg 752, 4th Floor, West Point, NY, 10996, United States of America, Jnikole08@yahoo.com, Michael J. Kwinn, Jr.

This is a final senior year capstone project for four US Military Academy Cadets. They were asked by the Product Manager for Unmanned Aerial Systems (PM-UAS, Army) to develop ideas to reduce the cognitive load on the currently required two operators for small UASs by redesigning the controller station. The team went a bit further by looking at a leap in technology from what the system currently employed.

3 - Utilizing Wargaming in Unrestricted Warfare: Benefits and Limits

David Smalenberger, Air Force Institute of Technology, Department of Operations Research, AFIT/ENS; Bldg 641, 2950 Hobson Way, Wright-Patterson AFB, OH, 45433, United States of America, David.Smalenberger@afit.edu, Richard Deckro

Wargaming (WG) enables doctrine and weapon systems evaluation in variable and replicable environments. This provides early warning detection of fallacies and capability limitations with scientific rigor. Capabilities testing through WG is therefore limited to interpolation of the current state. Unrestricted warfare (UW) provides a rebalancing of asymmetric advantages enjoyed by technologically advanced forces. This presentation discusses UW and the use of WG in the UW environment.

■ SA02

Hilton- Golden Gate 7

Harvesting Big Data for Technology Intelligence

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Tugrul Daim, Associate Professor, Portland State University, Eng'g and Tech Mgmt Dept, Portland, United States of America, tugrul@etm.pdx.edu

1 - Trigger-based Location-Based Services: A Viral Geo-fencing Approach to Direct Digital Marketing

Robert Harmon, Professor of Marketing & Service Innovation, Portland State University, School of Business, P.O. Box 751, Portland, OR, 97207, United States of America, harmonr@pdx.edu, Robert Brown

The viral growth behavior of social media-based interactions has raised the potential for harnessing these epidemic-like communication dynamics as a digital marketing approach in the context of trigger-based geo-fencing LBS strategies. Recent developments in the integration of social networking dynamics, big data analytics, text mining, semantics, dynamic behavioral profiling, and real-time trigger-based geo-sensing capabilities are enabling the next generation of high performance LBS.

2 - Action Research of Bibliometrics in Public R&D Programs – Lessons Learned

Yuya Kajikawa, Tokyo Institute of Technology, 3-3-6 Shibaura, Minato-ku,, Tokyo, Japan, kajikawa@mot.titech.ac.jp

Science of science policy is becoming a new field of research. Decision making based on scientifically analyzed evidence is crucial and there are much rooms for bibliometrics analyzing papers and patents to contribute in policy making process of public R&D programs. In this contribution, results of action research utilizing bibliometrics for planning and management of public R&D projects are presented and lessons learned there are discussed.

3 - Technology Mining for Lighting Technologies

Nazrul Islam, School of Management and Business, Aberystwyth University, Rheidol Building, Aberystwyth, UK, mni@aber.ac.uk, Kevin van Blommestein, Tugrul Daim

An Energy Efficiency Technology Roadmap was develop to provide a direction for future R&D investments. This paper provides an analysis of a part of this roadmap with objective of identifying the right experts for providing input for the roadmap development. The research integrates the use of bibliometrics, patent analysis and social network analysis.

4 - Innovation Measurement Framework to Determine Innovativeness of a Company: Case of Semiconductor I

Kenny Phan, Assistant Professor, Portland State University, 1900 SW 4th Ave LL 50-02, ETM Dept - Portland State Univ, Portland, OR, 97201, United States of America, kenny4660@gmail.com, Dundar Kocaoglu

Innovation is one of the most important sources of competitive advantage. Because of its importance,companies need to manage it.This paper develops a framework to determine the innovativeness of a company in semiconductor industry by using output indicators. A hierarchical decision model (HDM) was constructed for the framework. The top three sub-factors are revenue from new products, market share of new products, and products that are new to the world.

■ SA03

Hilton- Golden Gate 7

Entrepreneurship and Innovation

Cluster: Business Model Innovation

Invited Session

Chair: Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, serguei.netessine@insead.edu

1 - Inclusive Innovation: Broader Market Coverage for Innovative Products with Deliberate Supply Chain

Oleksiy Mnyshenko, University of California - San Diego, 9500 Gilman Drive, La Jolla, United States of America, omnyshenko@ucsd.edu, Vish Krishnan, Hyoduk Shin

How can we achieve broader market coverage for innovative products, i.e., inclusive innovation? Grounded in industrial practice, we show that deliberately choosing the contract leader and the investor in a multi-tiered supply chain can have a significant impact on market coverage. We discuss leadership handovers along the product life cycle.

2 - Optimal Time Allocation for Process Improvement and Growth for Entrepreneurs

Steve Yoo, UCL Department of Management Science and Innovation, Gower St, London, onesun.yoo@ucl.ac.uk, Charles Corbett, Guillaume Roels

Entrepreneurs are often reported to pay too little attention to process improvement before growing their business. In this paper, we characterize a dynamic model of time allocation for process improvement in small growth-oriented entrepreneurial firms. We find that entrepreneurs should first engage themselves in process improvement activities, which would save them future time, and then on revenue enhancement activities, which would make them earn future money, before harvesting profit.

3 - Business Model Innovation

Christophe Pennetier, Student, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Christophe.Pennetier@insead.edu, Serguei Netessine, Karan Girotra

Using a novel dataset that combines information form 3 different sources (VentureSource, CrunchBase, AngelList), we study the success of start-ups through the lean start-up angle: how should entrepreneurs implement and use the key drivers of business model innovation that will mitigate the uncertainty risks putting any new venture at stake?

4 - The Role of Uncertainty and Bounded Rationality in Selecting Scientific Research Projects

Karim Lakhani, Harvard Business School, k@hbs.edu, Kevin Boudreau, Eva Guinan, Chris Riedl

We theorize & test how uncertainty surrounding innovative research projects shapes evaluations. We predict how uncertainty affects evaluations using data from a grant proposal process at a medical school with randomized assignment of evaluators and proposals. We find evaluators who judge proposals closer to their own specialized knowledge to give systematically more negative scores & highly novel research proposals to receive more critical evaluations.

■ SA04

Hilton- Continental 1

Managing Systems with Random Yields

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Saurabh Bansal, The Pennsylvania State University, Business Building, University Park, United States of America, sub32@psu.edu

1 - Optimal Policies for a Utility under the Renewable Portfolio Standard

Sha Liao, Ph.D. Candidate, University of British Columbia, 202-8640 Shaughnessy St, vancouver, Canada, sha.liao@sauder.ubc.ca, Tim Huh, Mahesh Nagarajan

A utility needs to supply a percentage of its energy from renewable resources, and will demonstrate its compliance by holding Renewable Energy Certificates (RECs). We formulate a single utility's problem as a dynamic stochastic program, and study its choice between renewable and regular energy, as well as its trading policy in the REC market. Explicit formulas are derived for the optimal purchasing quantities under different scenarios, along with monotonicity analysis.

2 - Sustainable Product Line Design under Co-production Technology

Yen-Ting Lin, Assistant Professor, University of San Diego, San Diego, 92110, United States of America, linyt@sandiego.edu, Haoying Sun, Shouqiang Wang

We consider a monopolist who produces a product using a scarce material such as wood. The quality of material varies by nature. The monopolist considers introducing only one product or multiple products using co-production technology. We examine how the monopolist's optimal product line design depends on consumers' valuation on resource sustainability. We also study the impact of consumers' sustainability awareness on material consumption and quantity of waste generated.

3 - Wine Analytics: Fine Wine Pricing and Selection under Weather and Market Uncertainty

Mert Hakan Hekimoglu, Syracuse University, 721 University Avenue, Syracuse, NY, United States of America, mhekimog@syr.edu, Burak Kazaz, Scott Webster

We investigate a distributor's portfolio selection problem of fine wine futures and bottles. Using Liv-ex.com data, we first empirically show how the evolution of futures prices for young wines can be predicted by changes in weather and market conditions. We then examine the distributor's investment decisions in futures, bottles, and cash position analytically using a Value-at-Risk measure.

4 - Sequential Capacity Management and Random Yield

Mahesh Nagarajan, Associate Professor and Division Chair, University of British Columbia, Henry Angus 478,, Sauder School of Business,2053 Main Mall, vancouver, BC, Canada, mahesh.nagarajan@sauder.ubc.ca, Saurabh Bansal

We discuss the problem of determining the optimal capacity allocation and lot sizes for two sequential production runs, where each production run is subject to random yield. We first provide an analytical solution to the problem and then discuss its structural properties. We use this to construct heuristics with a provable worst case performance that can be used in these setting effectively.

■ SA05

Hilton- Continental 2

Empirical Studies of Service Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Robert Batt, Asst. Professor, UW-Madison, 975 University Ave., Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

1 - Retail in High Definition: using Video Analytics in Salesforce Management

Marcelo Olivares, Assoc. Professor, Columbia University, Broadway 3027, New York, United States of America, molivares@columbia.edu

In some product categories, assisting customer can be an important factor to generate a sale (for example, in apparel and electronics). Our research develops an empirical approach to estimate the impact of assisting customers on sales, combining sales transaction with video analytics tracking customer shopping paths in stores. These empirical results are used to support decisions related to store staffing and personnel training.

2 - The Persistence of Customer Misalignment: Evidence from a Retail Bank Acquisition

Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu, Dennis Campbell

In the event a firm acquires a customer whose needs and preferences are misaligned with the operating system, will the customer's preferences conform over time? Will the customer defect? Or, will the misalignment persist? To answer this question, we leverage a natural experiment created when one nationwide retail bank acquired another. Our results highlight the persistence of incompatible customers and their downward effect on operating performance.

3 - Third Party Ownership and the Adoption of Solar Energy Systems in the U.S. Residential Market

Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, United States of America, jguajardo@haas.berkeley.edu, Ernesto Guerra

We analyze the role of business models in the adoption of solar PV systems in the U.S. residential market. We formulate an empirical model to characterize the drivers and effects of Third Party Ownership in the adoption of solar systems, in the context of government incentives and supply-side determinants.

4 - Who's Next?: An Empirical Study of Doctor-patient Selection in an Emergency Department

Robert Batt, Asst. Professor, UW-Madison, 975 University Ave., Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

We study an emergency department where physicians have the freedom to choose which patients to take on as their own and which to ignore. We empirically examine the operational and behavioral factors that influence these decisions. We also examine the impact of the patient selection decisions on patient flow.

■ SA06

Hilton- Continental 3

Stochastic Modeling In Healthcare Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Masha Shunko, Purdue University, 403 W. State Street, West Lafayette, IN, 47906, United States of America, mshunko@purdue.edu

1 - Critical Care in Hospitals: When to Introduce a Step Down Unit?

Mor Armony, New York University, marmony@stern.nyu.edu, Carri Chan, Bo Zhu

Step Down Units (SDUs) provide an intermediate level of care between the Intensive Case Units (ICUs) and the general medical wards. There is an ongoing debate in the medical community as to whether and how SDUs should be used. An SDU alleviates ICU congestion by providing a safe environment for post-ICU patients, but it also takes capacity away from the ICU. We find that under some circumstances the optimal size of the SDU is zero, while in other cases, having a sizable SDU may be beneficial.

2 - Pareto Improving Policies in EMS Flow Control

Masha Shunko, Purdue University, 403 W. State Street, West Lafayette, IN, 47906, United States of America, mshunko@purdue.edu, Hung Do

In decentralized queueing systems, a performance improving coordination policy is sustainable only if it benefits all service agents. Using Emergency Medical Setting as motivation, we find classes of coordination policies for ambulance traffic that improve performance of the system according to multiple objectives and guarantee that all agents are better off.

3 - Pareto Improving Flow Control Policies for Multi-Server Emergency Departments - New Perspectives

Hung Do, University of Vermont, Burlington, Burlington, United States of America, hdo@bsad.uvm.edu, Masha Shunko

Using Emergency Medical Services setting as motivation, we design and analyze flow control policies for service systems with N multiple-server queues. We focus on policies that improve performance of the system and that are also beneficial to all involved entities. We propose a new perspective on performance measures, conduct analysis and reveal managerial insights that help design such Pareto improving policies in practice.

4 - Human Resource Collaboration: An Empirical Study of Capacity Loss

Lu Wang, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, l-wang@kellogg.northwestern.edu, Jan Van Mieghem, Itai Gurvich

Collaboration and resource sharing in processing networks may introduce a capacity loss due to synchronization. To investigate this phenomenon, we conduct a model-based empirical study of collaboration and synchronization in a large hospital. In the presence of individual and collaborative tasks, doctors must decide which to process next. Combining a queueing network model and the hospital data, we study the impact of doctors' prioritization rules on the capacity loss induced by synchronization.

■ SA07

Hilton- Continental 4

Using Complementarity Modeling for Planning and Policy Analysis of Electricity & Energy Markets

Cluster: Tutorials

Invited Session

Chair: Ben Hobbs, Professor, Johns Hopkins University, 3400 N Charles St, Baltimore, MD, 21218, United States of America, bhobbs@jhu.edu

1 - using Complementarity Modeling for Planning and Policy Analysis of Electricity & Energy Markets

Ben Hobbs, Professor, Johns Hopkins University, 3400 N Charles ST, Baltimore, MD, 21218, United States of America, bhobbs@jhu.edu, Antonio J. Conejo, Steven A. Gabriel, Carlos Ruiz, J. David Fuller

Complementarity models can represent the simultaneous optimization problems of one or several interacting decision makers, and have become a powerful tool for formulating and solving bottom-up energy market models. An overview is provided of complementarity-based formulations (including MPECs and EPECs), followed by illustrative electricity market applications, including oligopolistic generation markets, transmission infrastructure planning, and environmental policy.

■ SA08

Hilton- Continental 5

2014 INFORMS Prize Winner: Mayo Clinic

Cluster: 2014 INFORMS Prize

Invited Session

Chair: Jeff Winters, UPS, Timonium, MD, 21093, United States of America, jwinters@ups.com

1 - 2014 INFORMS Prize Winner: Mayo Clinic

Amy Donahoe- Anshus, Mayo Clinic, Rochester, MN, United States of America, donahoeanshus.amerett@mayo.edu, Janine Kamath, Mark Hayward, Brian Klute, Dustin Kuchera, Tarun Mohan Lal

Mayo Clinic was awarded the 2014 INFORMS Prize for sustained excellence in clinical care, research and education through the effective integration of advanced analytics and operations research. This presentation will highlight the legacy, sophisticated infrastructure, novel application and dissemination of learning. Key success factors for leveraging analytics and engineering to address the formidable challenges in health care today and tomorrow will be discussed.

■ SA09

Hilton- Continental 6

Empirical Healthcare Operations

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Diwas KC, Emory University, 1300 Clifton Road, Atlanta, GA, 30322, United States of America, diwas.kc@emory.edu

1 - A Text Mining Analysis of Patient Portals

Hessam Bavafa, Assissant Professor, Wisconsin School of Business, 975 University Ave, Madison, WI, 53706, United States of America, bavafa@wharton.upenn.edu, Christian Terwiesch

We study the micro-structure of electronic communication between patients and providers through patient portals. We examine detailed information about the patients, providers, and communication details, e.g., message timing and text, to establish a better understanding of their role in primary care.

2 - Priority and Predictability

Jillian Berry Jaeker, Harvard Business School, Morgan Hall, Soldiers Field, Boston, MA, 02163, United States of America, jjaeker@hbs.edu

We explore how patient admission characteristics moderate the effects of high workload and demand, specifically, probability for admission for scheduled vs. emergent incoming patients. We find that while scheduled surgical patients, who are less emergent, are more likely to be postponed as the occupancy nears the hospital maximum, but are also more likely to cause the early discharge of currently convalescing patients as occupancy increases.

3 - Pacing Work under Goals and Deadlines: Econometric Analysis of an Outpatient Department

Sarang Deo, Assistant Professor, Indian School of Business, Hyderabad, 500032, India, sarang_deo@isb.edu, Aditya Jain, Pradeep Pendem

We draw upon psychology literature to build hypotheses regarding the impact of progress toward goals and deadlines on work pace and empirically test them in a high volume, tertiary care OPD. We find that teams regulate their effort in response to the discrepancy between intermediate subgoals and their performance toward them. Moreover, teams speed up closer to the deadline. Finally, teams are less likely to regulate their effort in response to a discrepancy closer to the deadline.

4 - Testing Patient Patience: Role of Time to Appointment on Patient Flow

Diwas KC, Emory University, 1300 Clifton Road, Atlanta, GA, 30322, United States of America, diwas.kc@emory.edu

Using data from over 900 providers, we examine the extent to which time to appointment impacts patient flow and overall clinic throughput.

■ SA10

Hilton- Continental 7

Consumer Behavior and Revenue Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Gustavo Vulcano, New York University, 44 West Fourth St, Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu

1 - Inventory Management with Buy-Online-Pickup-in-Store

Fei Gao, The Wharton School, University of Pennsylvania, Philadelphia, United States of America, feigao@wharton.upenn.edu, Xuanming Su

Many retailers offer customers the option to buy online and pickup in store. We study the impact of this new initiative on inventory management in both online and offline channels. We identify situations when this initiative may hurt profits and offer recommendations to retailers.

2 - Loss Aversion and Reference Dependence: Evidence from Performing Arts Industry

Senthil Veeraraghavan, senthilv@wharton.upenn.edu, Necati Tereyagoglu

We hypothesize that not only the past price but also the observed sales for a seating area determines the utility of a customer from buying a ticket for a show in this industry. We test the reference effects for both prices and sales using customer level transaction data from an organization, and show that customer decisions are driven by the position of the seating alternatives relative to price and sales expectations. Finally, we find that the revenue effects of referencing are significant.

3 - Operating a Group-buy Mechanism in the Presence of Strategic Consumers

Gustavo Vulcano, New York University, 44 West Fourth St, Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu, Navaporn Surasvadi, Chris Tang

We consider a group-buy mechanism under which a retailer offers multiple units at both a regular price and a lower price that will be activated when a pre-specified number of reservations has been made. Forward-looking consumers arrive over time, and if both prices are still offered, they must decide which one to pay. We analyze the subgame among consumers, and through an extensive numerical study, we show the convenience of this mechanism.

4 - Quantity Competition in the Presence of Strategic Consumers

Yuri Levin, Queen's School of Business, 143 Union Str., Kingston, Canada, ylevin@business.queensu.ca, Mikhail Nediak, Andrei Bazhanov

Retailers choose initial inventories of undifferentiated limited-lifetime product offered to strategic consumers. A manufacturer sets full price, while market clearing determines discount price. A complete characterization of symmetric pure-strategy rational expectations equilibria yields: increasing strategic behavior can benefit retailers and hurt consumers; increasing competition may harm local economy; and strategic behavior may protect against sales at salvage value.

■ SA11

Hilton- Continental 8

Information and Incentives in Supply Chains

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Fuqiang Zhang, Washington University, Olin Business School, St. Louis, United States of America, fzhang22@wustl.edu

1 - Public Forecast Information Sharing in a Market with Competing Supply Chains

Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Noam Shamir

Studying the motivation to publicly announce forecast information, we show that by making forecast information publicly available to both his manufacturer and the competitor, a retailer is able to credibly share his forecast information - an outcome that cannot be achieved by exchanging information within the supply chain.

2 - Offshoring Versus Reshoring: Supply Flexibility, Market Proximity, and Operational Levers

Bin Hu, Assistant Professor, University of North Carolina, Chapel Hill, NC, 27519, United States of America, bin_hu@kenan-flagler.unc.edu, Li Chen

The existing offshoring literature mostly focuses on cost advantages and market proximity. We instead note that a reshoring manufacturer may lose some supply flexibility that it once enjoyed when offshoring, and show that even without any cost differences, supply flexibility and market proximity can influence the manufacturer's preference between offshoring and reshoring. We further discuss operational levers that can tilt the preference either way.

3 - An Optimal Procurement Mechanism with Post-Bid Cost-Reduction

Patrick Nestor, University of Michigan, 1205 Beal Avenue, Room 2778, Ann Arbor, MI, 48105, United States of America, psnestor@umich.edu, Damian Beil, Izak Duenyas

We consider a procurement auction setting where the buyer may, after seeing the suppliers' price bids, exert effort to identify cost reduction opportunities with one or more suppliers, before selecting the contract winner. The buyer seeks to minimize her total procurement costs, namely the contract payment plus the cost of investigation effort. Using optimal mechanism analysis, we derive the optimal auction and cost investigation policy.

4 - Forecast Accuracy, Risk Aversion, and Information Sharing in Supply Chain

Fuqiang Zhang, Washington University, Olin Business School, St. Louis, United States of America, fzhang22@wustl.edu, Yifan Xu, Baojun Jiang, Lin Tian

In many distribution channels, the manufacturer may possess superior demand-forecast information than the downstream retailer. This paper studies the impacts of the manufacturer's accuracy and the retailer's risk aversion on information sharing between the channel members.

■ SA12

Hilton- Continental 9

Sustainability and Supply Chains

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Robert Swinney, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27516, United States of America, robert.swinney@duke.edu

1 - Impact of Electricity Pricing Policy on Renewable Energy Investments and Carbon Emissions

Safak Yucel, PhD Student, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, safak.yucel@duke.edu, Gurhan Kok, Kevin Shang

We investigate the impact of electricity pricing policies on renewable energy investments and carbon emissions from the perspectives of different investors. We show that the time-invariant (flat) pricing policy usually promotes renewable energy investments and reduces carbon emissions. Moreover, our results indicate that the pricing policy that leads to higher investments may not reduce carbon emissions.

2 - Inducing Environmental Disclosures: A Dynamic Mechanism Design Approach

Shouqiang Wang, Assistant Professor, Clemson University, 100 Sirrine Hall, Clemson, SC, 29634, United States of America, shouqiw@clemson.edu, Peng Sun, Francis de Vericourt

When regulating a revenue-maximizing firm who is subject to a privately observable stochastic environmental hazard, compliance benefits (e.g., subsidy) and inspection are two commonly used instruments to induce voluntary disclosure. We examine the regulator's problem of designing an efficient dynamic regulation policy using these two instruments. The optimal policy, featured by a cyclical structure, depends critically on the precision of the inspection technology.

3 - Managing Social Responsibility in Multi-tier Supply Chains

Lu Huang, PhD Student, Fuqua School of Business, Duke University, 700 Bolinwood drive, Chapel Hill, NC, 27514, United States of America, lu.huang2@duke.edu, Robert Swinney, Jing-Sheng Song

We consider a multi-tier supply chain in which a Tier 2 supplier potentially violates social and environmental standards, resulting in both capacity and demand loss for a downstream (Tier 0) firm. We analyze the efficacy of both direct (Tier 0 to Tier 2) and indirect (Tier 0 to Tier 1 to Tier 2) mechanisms to improve responsibility of the Tier 2 supplier, and determine under what conditions the downstream firm should delegate responsibility management to intermediate suppliers.

4 - The Effect of Sourcing Policies on a Supplier's Sustainable Practices

Deishin Lee, Boston College, Carroll School of Management, Chestnut Hill, United States of America, deishin.lee@bc.edu, Vishal Agrawal

We investigate the sourcing decisions of firms who want to source sustainably-produced parts, e.g., organic ingredients, in order to offer sustainable products. We examine how the firm's sourcing policy and competition can influence an upstream supplier's decision to convert to a new sustainable processing standard.

■ SA15

Hilton- Exec. Boardroom

Two-stage and Fuzzy DEA Topics

Cluster: Data Envelopment Analysis

Invited Session

Chair: Wade Cook, Wade D. Cook Schulich School of Business, York University, Toronto, Ontario M3J 1P3, Canada, wcook@schulich.yorku.ca

1 - A Framework for a Sustainable Sourcing: A Flexible Cross Efficiency Evaluation in Fuzzy DEA

Pegah Khoshnevis, Master Student, Université Catholique de Louvain, 34 Voie du Roman Pays, L1.03.01, Louvain-la-Neuve, 1348, Belgium, pegah.hajimirza@Student.uclouvain.be, Per Agrell, Constantin Blome, Adel Hatami-Marbini

Nowadays, customer attitudes focus on sustainability of the products/services regarding environmental, social and economic aspects. In this study, we propose a product-based framework for sustainable supplier sourcing in SCM, which considers sustainability, operational and organizational criteria in terms of the outsourced product. We develop a flexible cross efficiency evaluation DEA for effectively discriminating suppliers along with using fuzzy sets to tackle the vagueness information.

2 - A Fully Fuzzified Two-stage DEA

Adel Hatami-Marbini, Université Catholique de Louvain, 34 Voie du Roman Pays, L1.03.01, Louvain-la-Neuve, 1348, Belgium, adel.hatamimarbini@uclouvain.be, Joshua Ignatius, Ali Ebrahimnejad

There is a growing literature in DEA where researchers are opening the black box to evaluate the efficiency performance of internal processes. Within this context, we study a relational two-stage DEA model where there is imprecision in the representation of the input and output data. The imprecision is captured using fuzzy sets and the models are evaluated with this representation. Insights are provided and future research directions are outlined.

3 - Two-Stage DEA: When Intermediate Measures Can Act as Outputs from the Second Stage

Wade Cook, wcook@schulich.yorku.ca, Sonia Aviles-Sacoto, Raha Imanirad, Joe Zhu

This paper investigates efficiency measurement in a two-stage data envelopment analysis (DEA) setting. While in the conventional closed serial system, the only role played by the outputs from stage 1 is to behave as inputs to stage 2, the current paper examines a variation of that system where the set of final outputs is comprised not only of those that result from stage 2, but can include, in addition, certain outputs from the previous (first) stage.

4 - Two-Stage Financial Risk Tolerance Assessment using Data Envelopment Analysis

Joseph Paradi, Professor Emeritus, University of Toronto, 200 College Street, Toronto, On, M5S3E5, Canada, paradi@mie.utoronto.ca, Angela Kingyens

In Canada Securities Acts in each Province include the "Know Your Client" rule. This requires FSIs to consider an investor's personal and financial status and comfort level for risk before recommending investments. They use questionnaires to create a risk profile so an appropriate investment portfolio can be recommended. The exact value of these risk profiles is unknown since questionnaires vary widely. This work introduces DEA to this process with significant improvements to any existing model.

■ SA16

Hilton- Franciscan A

Risk Management in Supply Chains

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Xuan Zhao, Associate Professor, Wilfrid Laurier University, 75 University Ave. W., Waterloo, Canada, xzhao@wlu.ca

1 - The Value of Audit in Managing Supplier's Process Improvement

Mohammad Nikoofal, PhD Student, McGill University, 1001 Sherbrooke Street West, Bronfman Building, Montreal, QC, H3A 1G5, Canada, mohammad.nikoofal@mail.mcgill.ca, Mehmet Gumus

Besides the benefits of outsourcing, firms are concerned about the lack of information regarding their suppliers. Moreover, suppliers may take certain actions that affect their supply risks without informing their buyers. We study the effectiveness of incentive- and audit-based contracts in dealing with such suppliers.

2 - Strategic Risk Management in Spot Market for Supply Chains under Competition

Xuan Zhao, Associate Professor, Wilfrid Laurier University, 75 University Ave. W., Waterloo, Canada, xzhao@wlu.ca, Wei Xing, Shanshan Ma

This paper studies two risk management strategies related to spot market to mitigate firms' exposure to demand uncertainty, namely, operational hedging and financial hedging. We consider a supplier sells an intermediate good to two manufacturers, who use it to produce a final product and compete with each other in the final product market with uncertain demand.

3 - Price-matching Guarantees in Dual Channels

Arcan Nalca, arcan.nalca@business.queensu.ca

Price-matching guarantees (PMGs) are policies by which firms promise to match any lower price offered by the competition. The impact of PMGs between a retailer and a supplier is disregarded in the literature since previous studies concentrate PMGs between competing retailers. We address this gap by shedding light on the following research question: Why and when, i.e., under which market and industry conditions, does the retailer and/or the supplier offer PMG in a dual channel?

4 - Retailing in the Presence of Valuation Uncertainty and a Peer-to-Peer Marketplace

Benny Mantin, Assistant Professor, University of Waterloo, 200 University Ave. W., Waterloo, Canada, bmantin@uwaterloo.ca, Stanko Dimitrov, Lifei Jiang

Consumers oftentimes face uncertainty regarding their valuation for the goods they seek to purchase. A peer-to-peer marketplace can potentially mitigate the valuation uncertainty faced by consumers by allowing them to resell unwanted goods and at the same time it introduces competition to the retailer. We derive the equilibrium outcomes and characterize the conditions under which a marketplace can be bene?cial (or detrimental) to the retailer, the consumers, and the overall welfare.

■ SA17

Hilton- Franciscan B

Consumer Behavior in Services

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Pnina Feldman, UC Berkeley, Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu

1 - Lifting the Veil: How Cost Transparency Increases Purchase Intentions

Bhavya Mohan, Doctoral Candidate, Harvard Business School, 27 HBS Mail Center, 500 Soldiers Field Road, Boston, MA, 02163, United States of America, bmohan@hbs.edu, Leslie John, Ryan Buell

Firms typically do not reveal details of their cost structures to their consumers. However, a handful of online retailers are experimenting with cost transparency on their retail websites, by revealing the costs incurred during the production of a good. In a field experiment and series of lab studies, we examine when and how a firm's decision to disclose its costs influences a consumer's willingness to purchase.

2 - Inventory Announcements with Strategic Customers: A Structural Estimation Approach

Kate Ashley, UC Berkeley, Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, 94720, United States of America, kate_ashley@haas.berkeley.edu, Jun Li, Pnina Feldman

Does inventory announcement affect the timing of consumer purchases? Using data from the airline industry, we estimate a structural model that accounts for the impact of a firm's inventory announcement policy on customer purchase decisions. We analyze the extent to which customers treat messages from the firm as cheap talk or as credible information, and characterize the market conditions under which various types of announcement policies are preferred by the firm.

3 - Managing Customer Expectations and Priorities with Delay Announcements

Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Qiuping Yu, Achal Bassamboo

We study in a service environment, how to manage customers' expectations and to prioritize customers appropriately to maximize the firm's profits. Specifically, we focus on a setting where the firm uses only delay announcements and study the opportunities and limitations of this mechanism. We are particularly interested in when and how the customers can be influenced by delay announcements.

4 - Blind Queues: The Impact of Consumer Beliefs on Revenues and Congestion

Shiliang Cui, Georgetown University, McDOnough School of Business, Washingrton, DC, 20057, United States of America, shiliang.cui@georgetown.edu, Senthil Veeraraghavan

In many service settings, customers have to join the queue without being fully aware of the parameters of the service provider. We analyze a firm serving customers making decisions under arbitrary beliefs about the service parameters, and show while revealing the service information to customers improves revenues under certain customer beliefs, it may however destroy consumer welfare or social welfare.

■ SA18

Hilton- Franciscan C

Choice Models in Revenue Management and Pricing I

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: William Cooper, Professor, University of Minnesota, Industrial and Systems Engineering, Minneapolis, MN, 55455, United States of America, billcoop@umn.edu

1 - Assortment Optimization under Consider-then-choose Models

Ali Aouad, PhD Candidate, MIT, 99 1/2 Myrtle St Apt 2, Boston, MA, 02114, United States of America, aaouad@mit.edu, Retsef Levi, Vivek Farias

One classical approach to modeling choice in marketing explains that customers faced with a purchasing decision follow a two stage, consider-then-choose behavior. This work attempts to operationalize several models commonly used in marketing with assortment decisions. We investigate the combinatorial structure of the assortment optimization problem resulting from the incorporation of specific behavioral heuristics and devise exact polynomial time algorithms for such underlying choice structures.

2 - Near Optimal Algorithms for Constrained Assortment Optimization

Vineet Goyal, 304 S.W. Mudd Building, Columbia University, New York, NY, 10027, United Statesvg2277@columbia.edu, Antoine Desir

We consider the capacitated assortment optimization problem where each product has a given weight and there is a capacity constraint on the assortment. We present a fully polynomial time approximation scheme (FPTAS) for the capacitated assortment problem for a large family of choice models including the MNL model, Nested logit model, and the mixture of constant number of MNL models. We also show that the capacitated assortment optimization is NP-hard even for the special case of MNL model.

3 - Assortment Optimization under the d-Level Nested Logit Model

Paat Rusmevichientong, Associate Professor, University of Southern California, Marshall School of Business, Los Angeles, CA, United States of America, rusmevic@marshall.usc.edu, Huseyin Topaloglu, Guang Li

We provide a new formulation of the d-level nested logit model using a tree of depth d. We establish structural properties and develop an efficient algorithm for computing the optimal assortment. For a d-level nested logit model with n products, the running time of the algorithm is O(d n log n).

4 - Pricing for a Multinomial Logit Model with Network Effects

William Cooper, Professor, University of Minnesota, Industrial and Systems Engineering, Minneapolis, MN, 55455, United States of America, billcoop@umn.edu, Zizhuo Wang, Chenhao Du

We consider an extension of a classical MNL assortment pricing problem to network goods. For such network goods, the overall purchase quantities are not an explicit function of the prices. Rather, the quantities arise as an equilibrium outcome characterized by the consistency of the purchase quantities with the MNL choice probabilities. We describe the solution of the assortment pricing problem and discuss insights from the model.

■ SA19

Hilton- Franciscan D

New Frontiers in Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Robert Phillips, Columbia University, rp2051@columbia.edu

1 - Pay-per-unit vs. Subscription Pricing for Experiential Products under Competition

Varun Gupta, University of Texas at Dallas, Campbell road, Richardson, United States of America, varun.gupta@utdallas.edu, Ozalp Ozer, Alp Muharremoglu

In a market where distributors compete to sell experiential products (e.g.; movies and music), should they use pay-per-unit pricing or use subscription pricing? We study market dynamics when a content provider is selling to two distributors which are using different pricing modalities and characterize conditions where both can co-exist profitably, where only one can make money and where price wars would be expected. We also investigate the role of the contractual powers of the players.

2 - "Big-Data" Revenue Management
Robert Phillips, Columbia University, rp2051@columbia.edu

In the spirit of Rudin and Vahn's "Big Data Newsvendor" (2013), we present a machine-learning approach to the single-resource revenue management problem that can accommodate a large number of features relative to the number of resource. The approach is non-parametric and can easily be made adaptive. We illustrate the effectiveness of the approach through numerical examples.

3 - The Effectiveness of Field Price Discretion: Empirical Evidence from Auto Lending
A. Serdar Simsek, Instructor/Researcher, Cornell ORIE, 282 Rhodes Hall, Ithaca, NY, United States of America, as2899@cornell.edu, Garrett van Ryzin, Robert Phillips

How much (if any) pricing discretion headquarters should grant local salespeople is a topic of debate. We used a unique data set from an auto lender and estimated the local sales force adjusted prices in a way that improved profits by 11%. A counterfactual analysis shows that using a centralized pricing optimization system could improve profits even further, up to 20% over current profits. Hence, centralized pricing –if appropriately optimized– can be more effective than field price discretion.

4 - Estimating Willingness-to-Pay in a Negotiated Selling Environment
Neil Biehn, Vice President, PROS Solutions, 3100 Main Street, ,Suite 900, Houston, TX, 77002, United States of America, nbiehn@pros.com

In this talk, we'll explore the definition of Willingness-to-Pay (WTP) and what the literature has to say about estimating it. Recent tests and interviews with customers and sales people reveal that many B2B companies are purposefully under-pricing. Alternate approaches to estimating WTP are examined with a new WTP model presented along with numerical examples.

■ SA20

Hilton- Yosemite A

Economics of Information Systems

Sponsor: eBusiness
Sponsored Session

Chair: Byungwan Koh, Assistant Professor, University of Calgary, 2500 University Drive NW, Calgary AB T2N 1N4, Canada, bkoh@ucalgary.ca

Co-Chair: Yasin Ceran, Santa Clara University, 500 El Camino Real, Santa Clara CA, United States of America, yceran@scu.edu

1- Customer Churn Prediction in a Noncontractual Setting
Yasin Ceran, Santa Clara University, 500 El Camino Real, Santa Clara CA, United States of America, yceran@scu.edu, Debora Donato, Xiaojing Dong, Oytun Eskiyenturk

Under a noncontractual setting,customers conduct business with the firm as they wish and they donot need to declare when they become inactive.It is therefore challenging for the firm to reduce customer churn rate.In this study, we obtained a unique dataset from a social media website.Using a stochastic process model based on the Pareto/NBD framework, we developed a methodology that allows us to predict the churn probability, and identify efficient activities to prevent the customer from leaving.

2 - The Influence of Direct and Indirect Experience on Somatosensory Technology Adoption
Pei-Lee Teh,Senior Lecturer, Monash University, Jalan Lagoon Selatan, Bandar Sunway, Selangor 46150, Malaysia, teh.pei.lee@monash.edu, Pervaiz K. Ahmed, Emily Yim Lee Au, Soon-Nyean Cheong, Ravindra S. Goonetilleke, Wen-Jiun Yap

This study investigates the influence of direct and indirect experience on somatosensory technology adoption in two research settings (video demonstration versus product trial). Our findings provide an important implication for somatosensory technology marketers that product trial (direct experience) engenders more reliable inferences than does exposure to video demonstration (indirect experience).

3 - The Impact of IT on the Production Structure
Fengmei Gong, University of Calgary, MGIS Area, Haskayne School of Business, Calgary AB T2N 1N4, Canada, fgong@ucalgary.ca, Byungwan Koh, Barrie Nault

Information sharing and coordination as captured by supply chain members' IT investment has made product design and production methods possible that are not possible without information sharing. Consequently, industries are able to develop supply chains with different industries than they did before, and this can possibly change the production structure of the economy. We examine whether IT is responsible for the change in the production structure.

■ SA21

Hilton- Union Sq 1

Design of Transportation and Supply Chain Networks

Sponsor: Transportation Science & Logistics
Sponsored Session

Chair: Weijun Xie, Georgia Institute of Technology, Atlanta, GA, United States of America, xieweijun06@gmail.com

1 - Capacitated Relay Network Design with Generalized Imbalance Constraints
Halit Uster, Southern Methodist University, Lyle School of Eng., Dallas, TX, 75275, United States of America, uster@smu.edu, Panitan Kewcharoenwong

We introduce a relay network design problem under link capacity and flow imbalance considerations with applications in Less-than-Truckload (LTL) and and Truckload (TL) transportation. We present an efficient Lagrangean Decomposition algorithm for model solution and computational results to illustrate the performance of the approach and the impact of using relay networks in freight transportation.

2 - Freight Transportation Network Design in Urban Areas
Mehmet Pancaroglu, Research Assistant, Middle East Technical University, ODT Universiteler Mahallesi, Dumlupinar Bulvari No:1, Ankara, 06800, Turkey, mpancar@metu.edu.tr, Sinan Gürel, Haldun Süral

In this study, we investigate urban freight transportation under the perspective of City Logistics. From a strategic point of view, we aim to design low-cost and efficient urban freight transportation network. We try to decide on the number and location of distribution centers, fleet size and routes to make last mile delivery.

3 - Truck Line Network Optimization Based on Big Data Analytics
Hongbo Li, Manager, IBM Research - China, Diamond Building, ZGC Software Park #19,, Beijing, 100193, China, hboli@cn.ibm.com, Xin Shi, Hongwei Ding, Shuang Ren

Nationwide truck line network is the key infrastructure to supply high-level logistics service for large-scale 3PL company. It's very challenge to make a tradeoff between timeliness and cost for the transportation network designer. We present an improved method to optimize truck line network. Wherein, we integrate huge historical demand orders, waybills data, truck line information, transit ports data and so on to mine the frequent load patterns and find out the optimal transportation network.

4 - Optimal Spatial Layout of Transshipment Facilities on An Infinite Homogeneous Plane
Weijun Xie, Georgia Institute of Technology, Atlanta, GA, United States of America, xieweijun06@gmail.com, Yanfeng Ouyang

This paper studies optimal spatial layout of transshipment facilities and their corresponding service regions on an infinite homogeneous Euclidean plane that minimizes the total cost for facility set-up, outbound delivery and inbound replenishment transportation. This paper provides a tight bound for the Gersho's conjecture (1979) with the inbound transportation cost, which can be archived by elongated cyclic hexagons. Numerical study further verifies the analytical findings.

■ SA22

Hilton- Union Sq 2

Real-Time Information in Transportation

Sponsor: Transportation Science & Logistics
Sponsored Session

Chair: Dong Yoon Song, Purdue University, 610 Purdue Mall, West Lafayette, IN, United States of America, song50@purdue.edu

1 - Risk Equitable Routing and Prohibition Stratesis for Hazardous Materials Transportation
Ashrafur Rahman, Visiting Assistant Professor, Bunknell University, 116 Court Street, New Haven, CT, 06511, United States of America, arahman@engr.uconn.edu, Nicholas Lownes

A new risk measure for hazardous materials transportation is proposed. The new risk measure is used in mathematical modeling considering equity concept to suggest routing and prohibition strategies for hazmat transportation.

2 - Real-time Support System for Stranded Commuters Considering Traffic Conditions

Wenlong Yu, PhD Candidate, Graduate School for Creative Cities, Osaka City University, Room 408, 1-4-3 Sugimoto, Sumiyoshi-ku, Osaka, 558-0022, Japan, yule_tt@yahoo.co.jp, Hiroyuki Ebara, Raito Matsuzaki, Venkatesh Raghavan, Daisuke Yoshida

We propose a Real-time Support System based on GPS and wireless LAN function of mobile devices. In this system, we aim to support for stranded commuters in an earthquake disaster. We perform simulations with modeling systems considering traffic conditions.

3 - Psychological Benefits of Real-Time Travel Information under Heterogeneous Drivers

Dong Yoon Song, Purdue University, 610 Purdue Mall, West Lafayette, IN, United States of America, song50@purdue.edu, Srinivas Peeta

Psychological benefits of real-time travel information are affected by the heterogeneous characteristics of drivers. A modeling framework is proposed to accommodate the heterogeneity issue by introducing latent classes to represent different types of drivers. Driving simulator based experiments are used to analyze the behaviors and the effects of information provision.

■ SA23

Hilton- Union Sq 3

Less-than-Truckload Optimization Problems

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Ming Ni, University at Buffalo (SUNY), Buffalo, NY, United States of America, mingni@buffalo.edu

1 - Solving the Integrated Shipment Routing Problem of a Less-than-truckload Carrier

Okan Orsan Ozener, Özyegin University, Istanbul, Turkey orsan.ozener@ozyegin.edu.tr

We study a less-than-truckload (LTL) transportation network and investigate the potential benefits of implementing an integrated solution approach for shipment routing throughout this network. In LTL transportation, shipments are first delivered to local hubs to be consolidated, then transferred to another hub, and finally sent to their destinations. This routing planning process involves three routing decisions: (i) from origins to hubs, (ii) between hubs, and (iii) from hubs to destinations. These decisions are usually handled in a sequential manner due to the complexity of these individual problems, which may result in suboptimal solutions. In this study, we develop an integrated framework for solving all of these decision problems simultaneously. We propose an optimization-driven approach that can efficiently handle large instances with thousands of loads and provides solutions with significant cost savings over the sequential approach.

2 - Freight Put Option-Based Collaboration for Less-than-Truckload Carrier Logistics

Choungryeol Lee, lee1210@purdue.edu, Srinivas Peeta

We propose an option-based paradigm for carrier-to-carrier collaboration to manage the uncertainty in operational demand and supply. This leads to a mutually beneficial situation for collaborative LTL freight carriers. Numerical experiments illustrate that carrier-to-carrier collaboration with freight put options has the potential to improve the profitability, thereby enhancing the reliability and resilience of the LTL freight system.

3 - Operational Optimization at Con-way Freight

Olga Raskina, Con-way Freight, 2211 Old Earhart Rd, Ann Arbor, United States of America, Raskina.Olga@con-way.com

Con-way Freight is a premium LTL carrier operating the largest LTL network in North America. We manage an extensive network comprised of hundreds of service centers, thousands of tractors, trailers, and drivers, and hundreds of thousands of distinct origin-to-destination combinations. Every day as we pick up customers freight we need to decide the most cost-efficient way to move it while maintaining high customer service standards. In this talk we discuss the challenges of the decision support process and implementation lessons learned.

4 - Order Fulfillment from Collaborative Local Stores

Ming Ni, University at Buffalo (SUNY), Buffalo, NY, United States of America, mingni@buffalo.edu, Ruixia (Sandy) Shi, Qing He, Jun Ru

Instead of building new expensive distribution center, utilizing the brick and mortar stores to fulfill online order is good fulfillment option. We introduce algorithm and mechanism that combine the new inventory policy within store warehouse and collaboration between stores to achieve affordable and effective delivery.

■ SA24

Hilton- Union Sq 4

Advances in Traffic Flow Theory

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Jorge Laval, Associate professor, Georgia Institute of Technology, 790 Atlantic Dr. NW., Atlanta, GA, 30332, United States of America, jlaval3@ce.gatech.edu

1 - Stochastic Approximations for the Macroscopic Fundamental Diagram on Inhomogeneous Corridors

Jorge Laval, associate professor, Georgia Institute of Technology, 790 Atlantic Dr. NW., Atlanta, GA, 30332, United States of America, jlaval3@ce.gatech.edu

This paper proposes analytical estimates of the Macroscopic Fundamental Diagram using probabilistic methods to tackle networks with different block length and signal timing. It is found that the distribution of the MFD depends mainly on two dimensionless parameters, the average block size and the average red to green ratio.

2 - Probabilistic Model for Estimating Vehicle Trajectories using Sparse Mobile Sensor Data

Peng Hao, haop@cert.ucr.edu, Kanok Boriboons, Guoyuan Wu

A stochastic model is proposed to estimate the second-by-second trajectories using sparse mobile sensor data that is under low penetration rate and low sampling frequency. We investigate all possible driving mode sequences between data points. The likelihood of each scenario are quantified with mode-specific priori distributions. Detailed trajectories are reconstructed based on the optimal driving mode sequences. They are expected to improve the accuracy of mobility and emission evaluation.

3 - Real-Time Traffic State Estimation using a Second-order Lagrangian Model and Online Filtering Method

Zhouyang Zhou, evergreen8710@gmail.com, Kerem Demirtas, Pitu Mirchandani

Traditional approaches for the real-time traffic state estimation use Eulerian measurements. Recently, as the Lagrangian measurements become available, researchers in this area began to look at Lagrangian estimators but limited by first-order Lagrangian traffic flow models. In this study we first propose a new second-order Lagrangian traffic flow model, and then integrate it into the filtering framework for real-time traffic state estimation. Experimental analysis results show the effectiveness of the second-order Lagrangian traffic flow model and the new estimator.

■ SA26

Hilton- Union Sq 6

Location Analysis

Sponsor: Location Analysis

Sponsored Session

Chair: Zvi Drezner, California State University, 800 N. State College, Fullerton, CA, 92834, United States of America, zdrezner@fullerton.edu

1 - A Case Study on the Location of Logistics Parks

Joy Bhadury, Professor, Univ of North Carolina at Greensboro, Dept of ISSCM, Bryan School, P.O. Box 26170, Greensboro, NC, 27402-6170, United States of America, j_bhadur@uncg.edu, Samuel Troy

This talk will focus on the results of a statewide project in North Carolina, USA. The objective was to locate high-capacity logistics parks in the southeastern region of the state. Project details including situational analysis, methodology and recommendations will be presented.

2 - An Efficient Approach for Solving Uncapacitated Facility Location Models with Concave Operating Cost

Robert Aboolian, Cal State San Marcos, 333 S. Twin Oaks Valley Road, San Marcos, United States of America, raboolia@csusm.edu, Emilio Carrizosa, Vanesa Guerrero

We consider the Uncapacitated Facility Location Problem with Concave Operating Cost (UFLPCOC), which is a nonlinear version of the UFLP. The total cost to be minimized is the sum of linear transportation costs and operating costs, which are non-decreasing concave functions of the demand at the facilities. An exact solution approach is presented. This approach is based on successive lower and upper bound improvements for UFLPCOC until convergence is obtained. Computational results are presented.

3 - A Location-Allocation Problem with Concentric Circles
Jack Brimberg, Royal Military College of Canada, Kingston, Ontario, Canada, Jack.Brimberg@rmc.ca, Zvi Drezner

We consider the problem of locating p circles to serve a set of demand points. Each demand point is serviced by the closest circle. The objective is to minimize the sum of weighted distances between demand points and their closest circle. A rigorous algorithm solved the largest tested problem with 1000 demand points in about 3.5 hours. The faster heuristic version solved it in about two minutes getting the same solutions.

4 - The Multidimensional Component Commonality Problem: Re-visiting Facility Location Problems.
Mozart Menezes, Associate Professor, University of Calgary, 2500 University Dr. NW, Calgary, AB, T2N1N4, Canada, mozart.menezes@utoronto.ca, Diego Ruiz-Hernandez, Renato Guimaraes

We investigate the component commonality problem. Different variations of a particular part may allow it to be used in different SKUs. The more SKUs a part can be used, the more unnecessary cost the part carries to each particular SKU. A SKU-specific part can be made to reduce the part cost to a minimum but increases complexity and fixed cost for certification. We model this problem as a facility location problem and take advantage of well-known approaches for solving real size problems.

■ SA27

Hilton- Union Sq 7

Railway Application Section Student Paper Award

Sponsor: Railway Applications

Sponsored Session

Chair: April Kuo, Manager Operations Research, BNSF, 2400 Western Center BLVD, Fort Worth, TX, 76034, United States of America, April.Kuo@BNSF.com

1 - Double Ended Crew Modeling
April Kuo, Manager Operations Research, BNSF, 2400 Western Center Blvd, Fort Worth, TX, 76034, United States of America, April.Kuo@BNSF.com

A typical railroad hump yard contains multiple layers of complex operations.This talk presents a time-expanded multi-layer network flow model to describe the connection between different layers of yard operations. A mixed integer programming is developed to schedule the humping and pullback engine activities by jointly considering tightly interconnected components.

■ SA28

Hilton- Union Sq 8

Data Mining in Aviation

Sponsor: Aviation Applications

Sponsored Session

Chair: Yi Liu, University of California, Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com

1 - Categorization and Visualization of Safety Reporting Data using Topic Models and Tableau
Anil Yelundur, Technical Staff Member, MITRE Corporation, 7515 Colshire Drive, McLean, VA, 22102, United States of America, ayelundur@mitre.org, Danijela Nardelli, Michelle Harper

Text-based safety reporting data are often inconsistently categorized due to variations in the manual application of taxonomies. For automated categorization of such data; the team developed a multi-algorithm modeling process including NLP processing customized to aviation terminology, Principal Component Analysis and Latent Dirichlet Allocation using stochastic variational Bayes optimization. Tableau was used to visualize the topics and document categorizations.

2 - Predicting the Initiation of a Ground Delay Program
Yi Liu, University of California, Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com, Michael Seelhorst, Mogeng Ying, Alexey Pozdnukhov, Mark Hansen

In this work, we apply and compare three statistical techniques for predicting GDP initiation. Two types of data are used: current conditions and forecasts of future conditions. The methods are illustrated with a case study at EWR airport. Results from this research reveal the importance of each variable (such as actual weather variables) on GDP initiation and provide a means for flight operators to predict GDP initiation.

3 - Supporting Airline Revenue Management Decisions with Data-Driven Market Analysis
Catherine Cleophas, RWTH Aachen University, Kackertstr. 7, Raum 240, Aachen, 52072, Germany, catherine.cleophas@rwth-aachen.de, Claus Gwiggner

Airline revenue management uses demand forecasts to optimize offers. Performance measurement is difficult: Existing methods suffer from over-determination and rely on unrealistic system assumptions. We propose an approach comparing markets based on process data. It combines principal component analysis and clustering techniques to map the heterogeneity of markets. We validate our approach in simulation experiments and demonstrate its applicability on a large empirical data set.

4 - Ground Delay Program Analytics with Behavioral Cloning and Inverse Reinforcement Learning
Michael Bloem, Research Aerospace Engineer, NASA Ames Research Center, P.O. Box 1, Mail Stop 210-15, Moffett Field, CA, 94035-0001, United States of America, michael.bloem@nasa.gov, Nicholas Bambos

We used historical data to build behavioral cloning and inverse reinforcement learning models that predict hourly implementation of Ground Delay Programs (GDPs), a type of strategic air traffic management control. We will review the quality of the predictions and discuss insights the models provide into how and why GDPs are implemented. For example, the models suggest that GDP implementation decisions are primarily based on conditions now or conditions anticipated in the next couple of hours.

■ SA29

Hilton- Union Sq 9

JFIG Paper Competition I

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: J. Cole Smith, Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, jcsmith@clemson.edu

Co-Chair: Shengfan Zhang, Assistant professor, University of Arkansas, United States of America, shengfan@uark.edu

1 - Competition Introduction
J. Cole Smith, Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, jcsmith@clemson.edu

The 2014 JFIG paper competition features paper submissions from a diverse array of talented junior faculty members. The prize committee evaluated submissions based on the importance of the topic, appropriateness of the approach, and significance of the contribution. After careful review, the prize committee selected a group of finalists to present their research in one of the two JFIG sessions. For information on the finalists and their papers, please refer to the online program.

2 - A Large-scale Multi-server Fork-Join Network with Non-exchangeable Synchronization
Guodong Pang, Penn State University, College of Engineering, University Park PA, United States of America, gup3@engr.psu.edu, Hongyuan Lu

We study a large-scale fork-join network of stations with multiple servers where tasks are only synchronized when all the tasks associated with the same job are completed, i.e., non-exchangeable synchronization. The main mathematical challenge is the resequencing of arrival orders after service completion at each service station. We present a new framework to analyze the queueing and synchronization processes when all service stations are operating in the many-server asymptotic regimes.

3 - Two-term Disjunctions on the Second-order Cone
Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh PA 15213, United States of America, fkilinc@andrew.cmu.edu, Sercan Yildiz

We study the convex hull of a two-term disjunction applied to second-order cone (SOC). By identifying the structure of tight minimal valid linear inequalities for the disjunction, and using conic duality, we introduce a technique on deriving closed-form expressions for convex inequalities describing the convex hull. Our study highlights that there are various cases when a single convex inequality is sufficient, when this inequality can be expressed in conic form, and as well as much more complicated cases where multiple convex inequalities are needed.

4 - Multistage Adaptive Robust Optimization for Electric Power Systems Operation

Andy Sun,Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA 30332, United States of America, andy.sun@isye.gatech.edu, Alvaro Lorca

The growing uncertainty associated with the increasing penetration of wind and solar power has presented new challenges to the operation of electric power systems. Motivated by this, we present a multistage adaptive robust optimization formulation for the critical daily operation of power systems under uncertain electricity load and renewable generation. We discuss the concept of simplified affine policy and develop an efficient solution method. Promising computational results will be shown.

■ SA30

Hilton- Union Sq 10

Project Scheduling: Stochastic And Game Theoretic Aspects

Cluster: Scheduling and Project Management

Invited Session

Chair: Erik Demeulemeester, Professor, KU Leuven, FEB, KBI, Naamsestraat 69, Leuven, Belgium, Erik.Demeulemeester@kuleuven.be

1 - A Public-private Partnership Pipeline: The Government's Way to Go for Proper Incentive Creation?

Dennis De Clerck, KU Leuven, FEB/KBI, Naamsestraat 69, Leuven, 3000, Belgium, Dennis.DeClerck@kuleuven.be, Erik Demeulemeester

The risky features of public-private partnerships and the high bidding costs inhibit contractors from entering the tender. Governments favor mechanisms that might increase the competition. This paper investigates whether a project pipeline positively affects the contractors' bidding behavior. The output of the Nash equilibrium approximation algorithms supports that an increase in the number of projects lowers the required mark-up percentages but the effect on investment incentives is limited.

2 - An Oracle-based B&B Algorithm for Chance-constrained Programming with Applications to the RCPSP

Patricio Lamas, KU Leuven, Research Centre for Operations Managemen, Leuven, Belgium, Patricio.LamasVilches@kuleuven.be, Erik Demeulemeester

The chance-constrained resource-constrained project scheduling problem (C-C RCPSP) is a generalization of the traditional deterministic RCPSP, where the activity durations are random variables with known probability and the schedule is feasible with a given probability. We present a b&b algorithm for solving this complex problem, which is based on an optimization oracle for the deterministic RCPSP. Our algorithm can be applied in any chance-constrained problem with random right hand side.

3 - A New Set of Valid Inequalities for Chance Constraint Programs: An Application to Proactive RCPSP

Morteza Davari, KU Leuven, Research Centre for Operations Managemen, Leuven, Belgium, Morteza.Davari@kuleuven.be, Erik Demeulemeester, Patricio Lamas

Chance constraint programming has become an attractive topic in the field of stochastic optimization. In this paper, we propose a new set of valid inequalities for chance constraint programs. We formulate the proactive RCPSP as a chance constraint program. A branch and cut algorithm exists in the literature to solve this problem. Initial results show that the proposed set of inequalities improves the speed of this algorithm.

■ SA31

Hilton- Union Sq 11

Modeling Co-creative Systems

Sponsor: Service Science

Sponsored Session

Chair: Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 24061, United States of America, ralphb@vt.edu

1 - Modeling Smart Service Systems with Analytics and Cognition

Haluk Demirkan, Associate Professor of Service Innovation & Business Analytics, Unviersity of Washington, 1900 Commerce Street, Box 358420, Tacoma, Wa, 98402-3100, United States of America, haluk@uw.edu, Jim Spohrer

Smart service systems can be characterized by the types of offerings to their consumers, the types of roles, and the types of returns they offer stakeholders, through improved use of technology, talent, or organizational and governance forms, which create (dis)incentives that (re)shape behaviors. This research presents Abstract Entity Interaction Outcome Universals (AEIOU) framework for innovation of smart service systems that enable value co-creation with analytics and cognitive systems.

2 - Integration Service Quality Gap in Service Network Systems

Stephen Kwan, Professor, San Jose State University, One Washington Square, San Jose, CA, 95192, United States of America, stephen.kwan@sjsu.edu, Peter Hottum

Service providers often have to construct networks of partners to fulfill service obligations to customers. We introduce an integration service quality gap that represents the difference between customer service quality expectation and perceived service quality in his service journey in a service system network. The integration service quality gap is incorporated with traditional service quality gaps to form a more complete treatment of service quality metrics in such an environment.

3 - Multi-agent Control in Service Systems

Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 24061, United States of America, ralphb@vt.edu

This paper builds on previous research on the trajectories of service recipients through service system hypernetworks. These trajectories are guided by the client's decisions in evaluating and accepting or rejecting service propositions. We extend this research by considering similar decisions by the agents of resource integrators and service providers. The viability of service systems is examined as an outcome of how these multi-agent decisions influence the trajectory of the service.

■ SA32

Hilton- Union Sq 12

Stochastic Models in Service Science

Sponsor: Service Science

Sponsored Session

Chair: Yan Xia, University at Buffalo, 342 Bell Hall, Buffalo, NY, 14260-2050, United States of America, yanxia@buffalo.edu

1 - Ambulance Dispatching, Redeployment and Reallocating

Seyed Amir Ali Nasrollah Zadeh, Clemson University, 206 Campus Drive, Apt. A, Central, SC, 29630, United States of America, snasrol@g.clemson.edu, Amin Khademi, Maria Mayorga

Larger cities, expensive medical cares and heavy traffics have led to an increasing number of medical emergency calls and associated costs. In this work we develop an optimization model to find near-optimal solutions to ambulance dispatching, redeployment and reallocation problem to minimize the total expected waiting time of patients. We calibrate our model using real data and compare our policies with current ones via a simulation model.

2 - Optimization of Imperfectly Timed Maintenance Actions

Kai He, Ph.d Student, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, kah167@pitt.edu, Lisa M. Maillart, Oleg Prokopyev

We consider a class of maintenance optimization problems in which preventive maintenance (PM)actions may not be performed "on time." We assume that the time when PM is performed follows some known distribution about the prescribed time and formulate cost rate-minimizing models that anticipate this "noncompliant" behavior. We establish analytical relationships between the resulting policies and policies with perfect compliance for both age replacement and block replacement with minimal repair.

3 - Pricing Option-based Restoration for Stochastically Degrading Systems

Yan Xia, University at Buffalo, 342 Bell Hall, Buffalo, NY, 14260-2050, United States of America, yanxia@buffalo.edu, Murat Kurt, Osman Ozaltin

This talk addresses the problem to optimize the wholesale price of a restoration service for stochastically degrading systems. We model the system operator's maintenance problem as a Markov decision process, based on which we derive models that determine the operator's purchase decisions. The service provider's pricing problem is then modeled as a bi-level optimization problem, for which we provide an exact algorithm. We illustrate the efficiency of the algorithm through numerical study.

4 - Stocking and Pricing Policies of the Newsvendor Problem under Mean-Variance Considerations

Javier Rubio-Herrero, Rutgers University, 100 Rockafeller Rd, Piscataway, NJ, 08854, United States of America, javier.rubioherrero@rutgers.edu, Melike Baykal-Gursoy

We consider the classical newsvendor problem under a mean-variance criterion with two decision variables, namely price and stock quantity. The demand is assumed to be additive with respect to the price. We present conditions under which the objective function is concave and has a unique optimal solution. Furthermore, we provide numerical examples that aim to endorse the theoretical results herein explained and compare our results to others previously published.

■ SA33

Hilton- Union Sq 13

Microfoundations of Innovation in Supplier Driven and Crowd Driven Contexts

Cluster: New Product Development

Invited Session

Chair: Anant Mishra, George Mason University, 5034 Dequincey Drive, Fairfax, Vi, 22032, United States of America, amishra6@gmu.edu

1 - Initiating and Sustaining Supplier Involvement in Development Projects: Behavioral Aspects

David Wuttke, EBS University, Konrad-Adenauer-Ring 15, EBS University, ISCM, Wiesbaden, De, 65187, Germany, david.wuttke@ebs.edu, Enno Siemsen, Karen Donohue

Using a combination of analytic models and laboratory experiments, we study the effectiveness of buyer contract mechanisms, including breach penalties and profit sharing, on incentivizing product innovation at the supplier level. Our results provide insight into how the mechanisms can be altered to better account for supplier-specific behavior.

2 - Do Incentives Help or Hurt Competition in Innovation Contests?

Anant Mishra, George Mason University, 5034 Dequincey Drive, Fairfax, Vi, 22032, United States of America, amishra6@gmu.edu, Cheryl Druehl, Jesse Bockstedt

Innovation contests allow firms to harness specialized skills and services from participants with diverse economic and cultural backgrounds to solve challenging business problems. In this study, we use data from a popular online logo-design contest setting and country-level archival data to examine the implications of incentives on the competitive environment in innovation contests.

3 - Staffing Decisions and Performance an Analysis of the Functional and Customer Domains of Experience

Juan Pablo Madiedo Montanez, IE Business School, Calle Maria de Molina, 12, 5ʃ, Madrid, Spain, jpmadiedo.phd2014@Student.ie.edu, Aravind Chandrasekaran, Fabrizio Salvador

This study examines the importance of accumulated levels of experience working on a specific functional domain and with a particular customer in a knowledge intensive work environment. We analyze the interplay among workers, managers and customers as sources of experience and its effect on task staffing decisions and performance. We use a dataset with information on over 4500 software maintenance tasks collected from a global IT and consulting corporation for testing our model.

■ SA34

Hilton- Union Sq 14

Homeland Security Applications I

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Paul Kantor, Professor, Rutgers/CCICADA, 4 Huntington St, New Brunswick, NJ, 08901, United States of America, paul.kantor@rutgers.edu

1 - Optimal Selection of Configurations to Test Radiation Detectors

Paul Kantor, Professor, Rutgers/CCICADA, 4 Huntington St, New Brunswick, NJ, 08901, United States of America, paul.kantor@rutgers.edu, Christie Nelson, Fred Roberts, Ashish Jain, Siddartha Dalal

The performance of radiation detectors (Portal and RIID) depends on scores of variables, and can be measured according to several criteria. This research presents an extension of Combinatorial Experimental Design (CED) to the efficient design of experiments. CED works well when outcomes are binary (PASS|FAIL) and inputs take only a few discrete values. This new approach combines CED with expert elicitation to maximize the aggregate benefit of a design, while controlling the cost of experiments

2 - Optimal Boat Allocations with Sharing

Brian Nakamura, CCICADA/DIMACS, Rutgers University, 96 Frelinghuysen Road., 4th Floor, CoRE Bldg., Piscataway, NJ, 08854, United States of America, bnaka@dimacs.rutgers.edu, Jacob Baron, Endre Boros, Chad Conrad, Robert DeMarco, Kevin Hanson, Paul Kantor, Curtis McGinity, Christie Nelson, Matthew Oster, Brian Ricks, Fred Roberts, James Wojtowicz, Wang Yao, Patrick Ball, Thomas Rader

The US Coast Guard (USCG) allocates boats to stations annually. We present a model that allows boat allocations where stations share boats. A key innovation is to characterize the problem in terms of "sharing paths." The model uses Mixed Integer Programming to capture a subtle set of constraints and finds a boat sharing plan that minimizes either number of boats or total cost. The underlying problem is NP-complete, but current USCG operations permit adequate solution on a large laptop.

3 - ACCAM: Simulating Stochastic Effects of Maintenance and Missions on Aircraft Availability for USCG

Curtis McGinity, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, curtis.mcginity@gmail.com, Endre Boros, Paul Kantor, Fred Roberts, Christie Nelson, Brian Ricks, Kevin Hanson, Patrick Ball, Chad Conrad, Thomas Rader, Brian Nakamura

We present a model and discrete event simulation of USCG Air Stations, accounting for the mission demands and maintenance procedures of USCG aircraft. The simulation provides aircraft availability distributions and mission performance metrics for varying Air Station scenarios. The model is novel in its renewal-based treatment of maintenance procedures, mitigating the need for modeling of subprocesses. Simulations are consistent with historical data and offer insights into hypothetical scenarios.

4 - Relevance Feedback: A Better Boolean Approach

Justin Del Vecchio, Research Scientist, CUBRC, 4455 Genesee St., Buffalo, NY, 14225, United States of America, delvecchio@cubrc.org, Paul Kantor, Endre Boros

Experiments use the PLAD learning system to infer Boolean queries from judged items, and we estimate the statistical significance of the patterns.

■ SA35

Hilton- Union Sq 15

Challenges of Post-Disaster Humanitarian Logistics

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Felipe Aros-Vera, Rensselaer Polytechnic Institute, 110 8th st, Troy, NY, 12180, United States of America, arosvm@rpi.edu

1 - A New Method to Evaluate the Damage Degree and Forecast the Demand of the Disaster Areas

Buhao Li, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, China, lbh123@hust.edu.cn, Haijun Wang

Emergency logistics nowadays attracts great attention, but there are rarely papers concerning about the forecast of the disaster areas.We conduct a new method that clusters multiple sources of data about disaster areas,to evaluate damage of degree in disaster areas. Taking the degree of different disaster areas and the amount of total relief materials into consideration, we estimate the demand of the disaster areas.

2 - Real-time Optimization in Casualty Transportation Post-disaster

Armin Lüer-Villagra, PhD Candidate, Pontificia Universidad Catolica de Chile, Department of Electrical Engineering, Av. Vicuña Mackenna 4860, Santiago, 7820436, Chile, arminluer@gmail.com, Pamela P. Alvarez, Andres Bronfman

A problem in a post-disaster situation is health care in field and the movement of victims to medical facilities. This issue contains the complexities of disaster logistics. Based on real-time optimization models, this study applies a methodology to solve the problem of minimizing the response time and number of deaths from lack of medical care. The methodology considers prioritization of the affected people by the urgency in to be attended and different transport modes and medical centers.

3 - The Role of Access Restoration on Humanitarian Logistics
Felipe Aros-Vera, Rensselaer Polytechnic Institute, 110 8th St, Troy, NY, 12180, United States of America, arosvm@rpi.edu, Jose Holguin-Veras

This paper describes the problem of access restoration (AR) after disasters, develops a mathematical formulation capable of incorporating its main characteristics, and describes the role of AR in Humanitarian Logistics. The mathematical model uses deprivation cost functions to account for the impact on people by the decisions made in the process of AR. Numerical examples include a case study in Manhattan, NY.

■ SA36

Hilton- Union Sq 16

Panel Discussion: Teach Sports Analytics

Sponsor: SpORts

Sponsored Session

Chair: Edward Kaplan, Yale School of Management, New Haven, CT, United States of America, edward.kaplan@yale.edu

1 - Teaching Sports Analytics
Moderator:Edward Kaplan, Yale School of Management, New Haven, CT, United States of America, edward.kaplan@yale.edu, Panelists: Michael Magazine, James Cochran, Nils Rudi, Jeffrey W. Ohlmann

This session brings together five professors who teach sports analytics to different audiences at different levels of technical sophistication to accomplish different learning objectives. Each speaker will discuss his material, and show how a specific sports topic is covered in class. A lively discussion with audience participation will follow.

■ SA37

Hilton- Union Sq 17

Analyzing Social Networks and Social Media I

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Kang Zhao, Assistant Professor, University of Iowa, S224 PBB, Iowa City, IA, 52242, United States of America, kang-zhao@uiowa.edu

1 - Predicting User Engagement in Online Health Communities Based on Social Support Activities
Xi Wang, The University of Iowa, United States of America, xi-wang-1@uiowa.edu, Kang Zhao, Nick Street

Online health communities (OHCs) have become a major source of social support for people with health problems. This research tries to build a predictive model of members' engagement in OHCs. We are especially interested in whether different types of social support (e.g., informational support, emotional support and companionship) activities a user was involved in can contribute to such prediction. The outcome of study will have implications for the management and design of an OHC.

2 - User Analysis and Recommendation in Online Health Communities
Mi Zhang, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, mz349@drexel.edu, Christopher Yang

Many online communities are developed to support communication between health consumers. We focus on QuitStop, a smoking-cessation forum, to investigate how users interact with each other, and recommend discussion topics for them. First, we analyze user interaction patterns and behaviors with qualitative analysis and social network analysis. Second, we use classification and recommendation techniques to detect user interests and discussion topics in the community, and recommend threads to users.

3 - Sociotechnical Behavior Mining: Challenges, Opportunities, and Beyond
Nitin Agarwal, Professor, University of Arkansas at Little Rock, 2801 S University Ave., EIT 553, Little Rock, AR, 72204, United States of America, nxagarwal@ualr.edu

Social media platforms have profoundly impacted the behavior and the lifestyle of humans revealing novel sociotechnical behaviors, e.g. "hacktivism", crowdsourcing, flash mobs, citizen journalism, "tweetcasting" etc. Although these behaviors have been widely observed, they haven't been scientifically explained. We examine these behaviors afforded by the social cyber systems, leveraging a truly interdisciplinary research with deep roots in social science theories and computational underpinnings.

■ SA38

Hilton- Union Sq 18

Capacity Management in Operating Rooms and Clinics

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Vikram Tiwari, Assistant Professor of Anesthesiology, Vanderbilt University, 1211 21st Ave. S, MAB 403G, Nashville, TN, 37212, United States of America, vikram.tiwari@vanderbilt.edu

Co-Chair: Linda LaGanga, Director of Quality Systems & Operational Excellence, Mental Health Center of Denver, 4141 East Dickenson Place, Denver, CO, 80222, United States of America, linda.laganga@mhcd.org

1 - Patients Inpatient Preoperatively Account for Most Total Cancelled Operating Room Time
Franklin Dexter, The University of Iowa, 200 Hawkins Drive, Iowa City, IA, 52242, United States of America, franklin-dexter@uiowa.edu, Johannes Ledolter, Richard Epstein

At 21 US private hospitals, patients inpatient preoperatively represented 16.2% ± 0.5% of total operating room (OR) minutes but 49% ± 2% of total cancelled minutes. Results were insensitive to % of outpatients [preoperatively] making physical visit to preoperative clinic vs. only preoperative phone call ($P = 0.58$). At academic hospitals, patients inpatient preoperatively accounted for 22.3% ± 0.4% of scheduled minutes but most ($P < 0.0001$) total cancelled minutes (70% ± 2%).

2 - Predicting Daily Surgical Service Volume using Provider-Away Information
Vikram Tiwari, Assistant Professor of Anesthesiology, Vanderbilt University, 1211 21st Ave. S, MAB 403G, Nashville, TN, 37212, United States of America, vikram.tiwari@vanderbilt.edu, Warren Sandberg

Identifying available block time in advance is the first step in dynamically reallocating it to services that can rearrange their schedules to use it. Using a simulation methodology, we predict 6 weeks in advance, daily case volume for each surgeon, and the entire service, using historical data of case volume distributions, probability of surgeons' OR days, and information about surgeon availability. Results from model's selective implementation highlight the challenges and next steps.

3 - Multi-objective Operating Room Scheduling
Srimathy Mohan, Associate Professor, Arizona State University, Tempe, United States of America, Srimathy@asu.edu, Qing Li, Mohan Gopalakrishnan, John Fowler

This research models the operating room (OR) planning and scheduling problem as a mixed integer program with multiple objectives. A multi-objective simulation-optimization approach is developed for the problem to address uncertainties in surgery and recovery durations and patient no-shows. This approach guides the search of "Pareto optimal" solutions.

4 - Practical Application of a Scheduling and Overbooking Model in a Clinical Setting
Linda LaGanga, Director of Quality Systems & Operational Excellence, Mental Health Center of Denver, 4141 East Dickenson Place, Denver, CO, 80222, United States of America, linda.laganga@mhcd.org, Steve Lawrence, Ken Bellian, Don Penning

Patient no-shows continue to trouble outpatient and hospital service delivery. We build on our earlier research by applying our overbooking scheduling model in a hospital's scheduling practice to test the model's performance in improving productivity and reducing costs. We incorporate medical practice experience to develop realistic estimates of costs and their effect on the selection of high-performing scheduling alternatives.

■ SA39

Hilton- Union Sq 19

Patient Monitoring at Hospital and at Home

Sponsor: Health Applications

Sponsored Session

Chair: Benjavan Upatising, PhD, Research Scientist, Regenstrief Center for Healthcare Engineering, Purdue University, 203 S. Martin Jischke Drive, West Lafayette, IN, 47906, United States of America, benjavan@purdue.edu

1 - Practical Considerations in Black-box Models for Patient Monitoring

Bruce W. Morlan, MS Statistician, Health Care and Policy Research, Mayo Clinic, 200 First Street SW, Rochester, MN, 55905, United States of America, brucewmorlan@gmail.com, Matthew Johnson, Joel Hickman, James Naessens, Jeanne Huddleston, Santiago Romero Brufau

Gradient Boosted Models have proven useful to create complex models. We use GBM to create a black box algorithm for use in an automated alerting system. The model is to be used to increase monitoring on patients predicted to have the highest absolute risk. We explored the variables using univariate models, then Poisson models are used to create the final GBM ensemble model. This model is then reduced by a series of simplifications, and we tracked concordance to demonstrate the loss in fidelity.

2 - Diurnal Cycle and Insulin Dosing in the Intensive Care Unit

Ying Zhang, Massachusetts Institute of Technology, 32 Vassar Street, Room 32-257, Cambridge, MA, 02139, United States of America, yingz@mit.edu

Critically-ill patients normally experience stress-induced hyperglycemia, which could be controlled by IV insulin; however, blood glucose concentration has to be closely monitored and insulin dosage promptly adjusted to prevent acute hypoglycemia. Data from the ICUs at a tertiary teaching hospital suggest diurnal cycles in patient response to IV insulin. This study develops tools to extract patterns in these cycles and to assist clinicians in timely dosing adjustment during night shifts.

3 - Cost Comparison between Home Telemonitoring and Usual Care of Older Adults

Benjavan Upatising, PhD, Research Scientist, Regenstrief Center for Healthcare Engineering, Purdue University, 203 S. Martin Jischke Drive, West Lafayette, IN, 47906, United States of America, benjavan@purdue.edu, Walter K. Kremers, PhD, Paul Y. Takahashi, MD, MPH, Sharon L. Christ, PhD, Douglas L. Wood, MD, Yuehwern Yih, PhD, Gregory J. Hanson, MD

Older adults incur more healthcare expenses than any other age group, could home telemonitoring be a potential solution to reduce these costs? The analysis of direct medical cost was conducted based a 12 months randomized clinical trial. We compared the total cost as well as the inpatient, outpatient and ED costs between the telemonitored group and the group that received usual care.

4 - A General Framework to Automatically Extract Medical Knowledge

Yuan Luo, yuanluo@mit.edu, Peter Szolovits, Yu Xin, Ephraim Hochberg, Rohit Joshi

We propose subgraph augmented non-negative tensor factorization (SANTF) to automatically extract knowledge from EMRs. SANTF composes a tensor using patients, higher-order features (e.g., relationships among the medical concepts) and atomic features (e.g., words in the clinical narrative text). SANTF identifies the groups for patients and different feature types and simultaneously models group interactions. SANTF demonstrates improved clustering performance and better interpretable models.

■ SA40

Hilton- Union Sq 20

Medical Decision Making and Public Policy

Sponsor: Health Applications

Sponsored Session

Chair: Mariel Lavieri, Assistant Professor, University of Michigan, 1205 Beal Avenue, 2783 IOE, Ann Arbor, MI, 48105, United States of America, lavieri@umich.edu

Co-Chair: Greggory Schell, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, schellg@umich.edu

1 - Preference-Sensitive Risk Cutoff Values for Prenatal Integrated Screening Test for Down Syndrome

Jia Yan, Student, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, jyan40@gatech.edu, Pinar Keskinocak, Turgay Ayer, Aaron Caughey

Down syndrome (DS) is the most common chromosomal abnormality. Currently a risk of 1/270 is commonly used in DS screening to identify high-risk women and recommend an invasive confirmatory test, such as amniocentesis. However, evidence suggests that this one-size-fit-all cutoff value does not reflect different preferences among pregnant women with respect to pregnancy outcomes. In this study, we assess the impact of women's preferences on optimal DS risk-cutoff-values of integrated screening.

2 - Optimal Copayment Restructuring for Hypertension Pharmacotherapy

Greggory Schell, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, schellg@umich.edu, Mariel Lavieri, Jeremy Sussman, Rodney Hayward

With increasing healthcare expenditures in the United States, employers, government agencies and insurers are looking for new cost containment methods, such as copayment restructuring. Using the principles of value-based insurance design, we develop an optimization model for determining the ideal hypertension medication copayment levels for a heterogeneous patient population serviced by an insurance provider.

3 - An Outbreak Prediction Model to Inform Intervention Policy

Lauren Gardner, University of New South Wales, UNSW, Sydney, 2052, Australia, l.gardner@unsw.edu.au, David Rey

We seek to identify the most likely infection patterns in a contact network when only a subset of the infection case reports are available. The problem is represented using a maximum likelihood model and formulated as an integer program. The objective of the model is to identify a set of most likely directed trees that spans to the set of known infected nodes, which may or may not include additional nodes. Simulated contagion episodes are used to evaluate the performance of the solutions.

4 - Optimal Treatment Policies for Pelvic Organ Prolapse in Women

Yueran Zhuo, Ph.D. Candidate, University of Massachusetts Amherst, 121 Presidents Drive, 226, Amherst, MA, 01003, United States of America, yzhuo@som.umass.edu, Senay Solak, Oz Harmanli

Pelvic organ prolapse (POP) is a prevalent disease impairing women's health and quality of life. We develop a quantitative approach for long term POP treatment planning to maximize the patient's expected quality of life. A Markov Decision Process framework is adopted to capture the chronic features of POP development. Both numerical and analytical analyses have been performed to derive general guidelines and assess their effectiveness for the treatment of POP.

■ SA41

Hilton- Union Sq 21

Transplantation and Organ Allocation

Sponsor: Health Applications

Sponsored Session

Chair: Sommer Gentry, Associate Professor, United States Naval Academy, 572-C Holloway Road, Mailstop 9E, Annapolis, MD, 21402, United States of America, gentry@usna.edu

1 - Optimal Screening Strategies of Patients on the Kidney Transplant Waiting List

Alireza Sabouri, University of British Columbia, Vancouver, BC, V6T 1Z2, Canada, alireza.sabouri@sauder.ubc.ca, Tim Huh, Steven Shechter

The health condition of patients on the kidney transplant waiting list deteriorates while they are waiting for an organ arrival and hence they may no longer be suitable for transplant. Therefore, transplant centers screen waiting patients at various intervals to identify ineligible patients. We propose a model for finding screening strategies that minimizes the expected screening cost and the expected penalty cost associated with transplanting an organ to an ineligible patient.

2 - Exploring the Structure of the Kidney Paired Donation Pool

Wenhao Liu, PhD Candidate, Stanford University, 475 Via Ortega, Stanford, Ca, 94305, United States of America, owenliu@stanford.edu, Marc Melcher

We target to identify the truly hard-to-match pairs in a kidney paired donation pool. By applying a simple variation of PageRank algorithm, we manage to define a new measure of Paired Match Power that takes into considerations the global structure of the matching pool.

3 - Mitigating Information Asymmetry in the Liver Allocation System
Sepehr Nemati, Ivey School of Business, University of Western Ontario, 1225 Western Rd., London, ON, Canada, sproon@ivey.uwo.ca, Zeynep Icten, Lisa M. Maillart, Andrew Schaefer

We address the information asymmetry in the liver allocation system in the U.S. due to patients' gaming ability who may exploit the flexibility in the current health reporting requirements. We propose a model to simultaneously minimize measures of societal welfare associated with the information asymmetry, and data-processing burdens. We determine the exact frontier of Pareto-optimal updating requirements using clinical data.

4 - Redistricting to Reduce Geographic Disparity in Liver Allocation
Sommer Gentry, Associate Professor, United States Naval Academy, 572-C Holloway Road, Mailstop 9E, Annapolis, MD, 21402, United States of America, gentry@usna.edu, Dorry Segev

Studies have documented persistent geographic disparity in the allocation of livers by disease severity (MELD score). We partition the U.S. into optimal compact districts with the explicit goal of reducing disparity in MELD at transplantation, guided by years of interaction with the United Network for Organ Sharing. Our approach eliminates repeated cycles of suggesting and testing new policies by finding the policy most suited to the transplant community's values, determined a priori.

■ SA42

Hilton- Union Sq 22

Dynamic Scheduling

Sponsor: Health Applications

Sponsored Session

Chair: Bjorn Berg, George Mason University, Fairfax, VA, United States of America, bberg2@gmu.edu

Co-Chair: Van-Anh Truong, Assistant Professor, Columbia University, 500 West 120th St, New York, NY, 10027, United States of America, vt2196@columbia.edu

1 - A Simulation Based Approximate Dynamic Programming Approach to Multi-class, Multi-resource Surgical
Jonathan Patrick, Associate Professor, University of Ottawa, 55 Laurier Avenue, Ottawa, ON, K2G 3A6, Canada, patrick@telfer.uottawa.ca, Davood Astaraky

We present a model for scheduling in a multi-class, multi-resource surgical system. Given a master block schedule, we provide a surgical scheduling policy that seeks to minimize a combination of the lead time between patient request and surgery date, overtime in the operating room and congestion in the wards. We formulate it as a MDP model and develop a version of the Least Squares Approximate Policy Iteration algorithm and test our model on data from a local hospital.

2 - The Impact of Hourly Discharge Rates and Prioritization on Timely Access to Inpatient Beds
Hari Balasubramanian, University of Massachusetts Amherst, 160 Governors Drive Amherst MA 01003, Amherst, MA, 01002, United States of America, hbalasub@admin.umass.edu, Asli Ozen

We develop an empirically calibrated hospital-wide simulation model to represent a time-varying, multi-server queuing network. We use this model to demonstrate the impact on admission queues of (a) hourly discharge capacities, and (b) a dynamic, threshold-based prioritization rule.

3 - Fast Approximations for Online Scheduling of Outpatient Procedure Centers
Bjorn Berg, George Mason University, Fairfax, VA, United States of America, bberg2@gmu.edu, Brian Denton

We present a new model for online decision making for problems motivated by outpatient procedure centers. The dynamic extensible bin packing problem is formulated as a multi-stage stochastic integer program. We present insights into the optimal solutions as well as provide bounds for the problem. Results, including the evaluation of approximation methods, are presented as part of a case study based on a real outpatient procedure center.

■ SA43

Hilton- Union Sq 23

Joint Session ICS/OPT: Global Optimization and Mixed-Integer Nonlinear Programming

Sponsor: Computing Society & Optimization

Sponsored Session

Chair: John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, On, K1S 5B6, Canada, chinneck@sce.carleton.ca

1 - Extending the Scope of Algebraic MINLP Solvers to Black- and Grey-box Optimization
Nick Sahinidis, John E. Swearingen Professor, Carnegie Mellon University, Department of Chemical Engineering, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, sahinidis@cmu.edu, David Miller, Alison Cozad

We propose a methodology to optimize in the absence of algebraic models. The methodology relies on the automatic learning of algebraic NLP and MINLP models from data. We rely on linear and nonlinear integer programming techniques for simultaneous determination of the parameters and structure of the unknown models. We also develop techniques that account for partial theoretical understanding of the system under study in an otherwise data-driven optimization approach.

2 - Parallelizing the Master Problem in Benders Decomposition
Alexandra M. Newman, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, anewman@mines.edu, Antony Tarvin, Wood Kevin

When (generalized) Benders decomposition (BD) is applied to solve a stochastic program (SP) or a min-max model, each with binary first-stage variables, explicit enumeration may solve the BD master problem. We parallelize that enumeration and demonstrate order-of-magnitude computational speedups on a two-stage SP and a (non-convex) network-interdiction problem; both single-cut and multi-cut master problems are accommodated. For certain problem types, we have broken the long pole in the BD tent.

3 - Tightening Concise Linear Reformulations of 0-1 Cubic Programs
Richard Forrester, Associate Professor of Mathematics, Dickinson College, 5 North Orange Street, Carlisle, PA, 17013, United States of America, forrestr@dickinson.edu

One of the most compact linear representations of 0-1 cubic programs is based on a repeated application of the linearization method for quadratic programs introduced by Glover. We develop a pre-processing step that strengthens the LP bound provided by this model. The proposed scheme involves using optimal dual multipliers of a partial level-2 RLT formulation to rewrite the objective function of the cubic program before applying the linearization. Extensive computational experience is provided.

4 - A Fast Heuristic for Global Optimization and MINLP
John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, On, K1S 5B6, Canada, chinneck@sce.carleton.ca, Mubashsharul Shafique

Steps in our heuristic: random initial points, rapid movement towards feasibility, clustering to identify disjoint feasible regions, simple search to improve cluster points, and local optimization. It is well-suited to large nonconvex models, and runs quickly due to parallelism and very few local solver launches. The algorithm is extended to MINLP by adding spatial and integer branching to return a solution using very few local optimizer launches. Promising empirical results are given.

■ SA44

Hilton- Union Sq 24

Digital Channels and User Behavior

Sponsor: Information Systems

Sponsored Session

Chair: Beibei Li, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, HbH 3026, Pittsburgh, PA, 15213, United States of America, beibeili@andrew.cmu.edu

1 - Network-biased Technical Change: Evidence from the Adoption of Social Media in a Consulting Organization
Lynn Wu, The Wharton School, 3730 Walnut St, JMHH 561, Philadelphia, PA, 19104, United States of America, wulynn@wharton.upenn.edu

Similar to skill-biased technical change (SBTC) in which information technology complements skilled and educated workers, network-biased technical change complements social capital. With the rapid adoption of enterprise social media tools, individuals with high network diversity can have greater return for using social media. At the same time, senior employees are worse off as social media

replace their deep organizational knowledge and eliminate their opportunity to arbitrage information.

2 - Zoom in iOS Clones: Examining the Antecedents and Consequences of Mobile App Copycats

Beibei Li, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, HbH 3026, Pittsburgh, PA, 15213, United States of America, beibeili@andrew.cmu.edu, quan wang

We examine the drivers and impacts of mobile app copycats based on 10,100 action game apps from iOS app store over 5 years. We find significant heterogeneity in the interactions between copycats and original apps. Non-deceptive copycats are reluctant to enter the market when the original app is popular and free. High quality copycats have a negative effect on original app downloads. Interestingly, low quality deceptive copycats have a positive effect, suggesting a positive spillover effect.

3 - Hiring Biases in Online Labor Markets: The Case of Gender Stereotyping

Jason Chan, NYU Stern School of Business, New York, NY, United States of Americajcc534@stern.nyu.edu, Jing Wang

The exponential growth of online labor markets holds important social and economic implications, as the hiring decisions made on these online platforms implicate the incomes of millions of workers worldwide. Using a novel proprietary dataset from a leading online labor platform, we investigate the impact of gender-based stereotypes on hiring outcomes using a matched sample approach and quasi-experimental technique. Interestingly, we find a robust hiring bias working in favor of female workers.

■ SA45

Hilton- Union Sq 25

Remembrances of Susan Hong Xu

Cluster: Special Sessions

Invited Session

Chair: Yalcin Akcay, Assoc. Professor, Koc University, Sariyer, Rumelifeneri Yolu Sariyer, Istanbul, 34450, Turkey, yakcay@ku.edu.tr

1 - Dynamic Assignment of Flexible Service Resources

Anant Balakrishnan, McCombs School of Business, University of Texas at Austin, 2110 Speedway, Austin, TX, 78712, United States of America, anantb@utexas.edu, Yalcin Akcay, Susan Xu

In service contexts that require dynamically deciding whether to accept incoming jobs and what resource to assign to each accepted job, harnessing the benefits of resource flexibility requires using effective methods for making these operational decisions. In this paper, we address the dynamic job acceptance and resource assignment problem for systems with general resource flexibility structure, and propose three optimization-based approximate policies.

2 - Managing an Available-to-Promise Assembly System with Dynamic Short-Term Pseudo Order Forecast

Long Gao, University of California, School of Business Administration, Riverside, United States of America, long.gao@ucr.edu, Susan Xu, Michael Ball

We study an order promising problem in a multi-class ATP system with pseudo orders, whose properties change dynamically over time. We show that the optimal order acceptance policy is characterized by class prioritization, resource imbalance-based rationing and capacity-inventory-demand matching. The value of the short-term forecast is high when resource is moderate and customer heterogeneity is high.

3 - Accelerating Phase I Clinical Trial through Efficient Patient Recruitment Process and Trial Design

Hui Zhao, Penn State University, Smeal College of Business, University Park, United States of America, huz10@psu.edu, Leon Xu, Susan Xu

80% of clinical trials run overtime, causing drug companies millions of dollars daily in delay to market. In this paper, we look at mitigating clinical trial inefficiency in Phase I trial. We formulate it as a Markov Decision Process and propose different strategies to conduct the trials in order to reduce Phase I time.

■ SA46

Hilton- Lombard

Remembrances of Manfred Wilhelm Padberg

Cluster: Remembrances of Manfred Wilhelm Padberg

Invited Session

Chair: Karla Hoffman, khoffman@gmu.edu

1 - Remembrances of Manfred Wilhelm Padberg

Karla Hoffman,George Mason University, Fairfax VA, United States of America, khoffman@gmu.edu–
Remembrances of Manfred Wilhelm Padberg

This session will consist of many of Manfred Padbergs's closest researchers and friends providing remembrances of him. This will be a celebration of his life. All are welcome to attend, provide stories, anecdotes and thoughts about how they interacted with Manfred.

■ SA47

Hilton- Mason A

Topics in Stochastic Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Angelo Mancini, PhD Candidate, University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, amancini@chicagobooth.edu

1 - Optimality of Quasi-Open-Loop Policies for Discounted Semi-Markov Decision Processes

Angelo Mancini, PhD Candidate, University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, amancini@chicagobooth.edu, Dan Adelman

Quasi-open-loop (QOL) policies consist of Markovian decision rules that are insensitive to one component of the state space. We consider a semi-Markov decision process in which one state component is an exogenous multiplicative compound Poisson process, and provide an almost-everywhere condition on the reward function sufficient for the optimality of a QOL policy. In some cases, we can replace the almost-everywhere condition with a weaker one that holds only in expectation.

2 - Budget Allocation Strategies to Minimize Expected Operational Risk Losses in Financial Institutions

Yuqian Xu, NYU Stern School of Business, New York, United States of America, yxu@stern.nyu.edu, Jiawei Zhang, Michael Pinedo

This paper analyzes budget allocation strategies to minimize OpRisk losses in banks under deterministic and stochastic settings. We provide an alternative formulation of OpRisk that incorporates major investment variables. We show how decision scenarios influence the dominant power of investment parameters and provide some guidelines for banking regulation.

3 - Optimal A-B Testing

Nikhil Bhat, Columbia University, nbhat15@gsb.columbia.edu, Vivek Farias, Ciamac Moallemi

We consider the problem of A-B testing when the impact of the treatment is marred by a large number of covariates. Randomization can be highly inefficient in such settings, and thus we consider the problem of optimally allocating test subjects to either treatment with a view to maximizing the efficiency of our estimate of the treatment effect. Our main contribution is a tractable algorithm for this problem in the online setting.

4 - Exponential Approximations in Network Revenue Management

Christiane Barz, UCLA Anderson School of Management, 110 Westwood Plaza, None, Los Angeles, CA, 90095, United States of America, christiane.barz@anderson.ucla.edu, Dan Adelman, Canan Uckun

Although it is well-known that the value function in network revenue management is not linear, most of the literature on approximate dynamic programming is based on an affine approximation. We extend his work by allowing for exponential basis functions. In contrast to other work in approximate dynamic programming, we do not predetermine the basis functions but generate them dynamically for a given problem instance. Computational results show that our approach improves the bound significantly.

■ SA48

Hilton- Mason B

Applications of Distance Geometry: Nanostructures, Astrometry, and Big Data

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Carlile Lavor, Associate Professor, University of Campinas, IMECC - UNICAMP, Campinas, Brazil, clavor@ime.unicamp.br

1 - Practical Algorithms for Graph Embedding from Unassigned Distance Lists

Phil Duxbury, Chairperson and Professor, Physics and Ast. Dept., Michigan State Univ., East Lansing, MI, 48824, United States of America, Duxbury@pa.msu.edu, Saurabh Gujarathi

The matrix completion problem is NP-hard for imprecise assigned distance geometry problems, and the unassigned variant of this problem adds an additional layer of combinatorial complexity. A recent publication by our group describes practical algorithms for constructing graph embeddings in the plane, using only unassigned distance lists. In this paper we extend these algorithms, and bounds on their performance, to graph embedding in three dimensions.

2 - The Small-Field Astrometric Point-Pattern Matching Problem

Claudio Santiago, Postdoctoral Researcher, Lawrence Livermore National Laboratory, 7000 East Ave, Livermore, CA, 94551, United States of America, pratas@gmail.com, Alberto Krone-Martins, Carlile Lavor

The small-field astrometric point-pattern matching problem is a fundamental problem in astrometry that can be described as finding the common stars in two given lists arising from different observations performed at different times. We devised an algorithm based on the normalization of distance matrices that can be used to identify stars that are common to both lists. Our approach consists of finding a suitable normalization factor that allows us to identify pairs of stars with equal distances.

■ SA49

Hilton- Powell A

Network Optimization and Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Neng Fan, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, nfan@email.arizona.edu

1 - Assessing Complex Network Vulnerability under Cascading Failures

Yilin Shen, benoit.shen@gmail.com, My Thai

The assessment of network vulnerability is of great importance in the presence of unexpected disruptive events or adversarial attacks. We provide an in-depth probabilistic analysis for assessing the network vulnerability on the two well-known complex networks and show that, under random failures, power-law networks are no longer robust while small-world networks are more robust due to their homogeneous degree sequences. We also devise an effective approach to identify the most vulnerable nodes.

2 - Survivable Network Design with Vertex and Edge Connectivity Constraints

Elham Sadeghi, Graduate Research Assistant, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, sadeghi@email.arizona.edu, Neng Fan

In this talk, we present and prove several equivalent theorems to ensure a minimum-cost graph to be (k,l)-connected. A graph is (k,l)-connected if removal of certain numbers (related to k,l) of vertices and edges will not disconnect the graph. Based on these theorems, we present integer programming formulations and cutting plane algorithm to solve the minimum-cost network design problem.

3 - Analysis of Budget for Interdiction on Multicommodity Network Flows

Pengfei Zhang, Graduate Student, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, 85721, United States of America, pfzhang@email.arizona.edu, Neng Fan

In this talk, we concentrate on computing several critical budgets for interdiction on the multicommodity network flows in the case of worst-case arc failures, and studying the interdiction effects of the changes of budget. Numerical experiments are performed to verify our conclusions.

4 - Simulating the Dynamics of Networks via Optimization

Tiago Schieber, University of Florida - Center for Applied Optimization, University of Florida, Gainesville, FL, 32611, United States of America, tischieber@gmail.com, Martìn Ravetti

The analysis of topological evolution of complex networks plays a crucial role in predicting their future. While an impressive amount of work has been done on the issue, very little attention has been so far devoted to the investigation of how information theory quantifiers can be applied to characterize networks evolution. With the objective of dynamically capture the topological changes of a network's evolution, we will present the Copycat model.

■ SA50

Hilton- Powell B

Optimization in Graphs and Digraphs

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Baski Balasundaram, Associate Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, baski@okstate.edu

1 - The Minimum Spanning k-core Problem with Bounded CVaR under Probabilistic Edge Failures

Juan Ma, Ph.D. Student, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, juan.ma@okstate.edu, Baski Balasundaram, Vladimir Boginski, Foad Mahdavi Pajouh

Given a non-negative integer k, a graph of minimum degree at least k is called a k-core. The concept of k-cores can be used to design resilient networks that preserve low diameter and high vertex-connectivity upon random graph component failures. This talk focuses on the minimum spanning k-core problem under probabilistic edge failures using the risk measure conditional-value-at-risk. Polyhedral reformulations and algorithms to solve the problem will be discussed.

2 - Network-Based Models for Optimization in Reliability

Kelly Sullivan, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, United States of America, ksulliv@uark.edu

Reliability of a system can be increased by adding redundant components. We seek to maximize the reliability of such systems subject to restrictions on the number and types of redundant components that can be installed. Representing the system as a binary decision diagram (a type of network) yields an exact mixed integer linear program for a general form of this problem. Computational results demonstrate that this approach is effective for structured (e.g., series-parallel) systems.

3 - Solving the Maximum Weighted Multiple Clique Problem: A Branch-Price-and-Cut Approach

Seyed Javad Sajjadi, University of South Florida, 4202 E Fowler Ave, Tampa, FL, 33620, United States of America, ssajjadi@mail.usf.edu, Bo Zeng, Xiaoning Qian

Deriving a collection of cliques with the maximum total weight in a general network where both nodes and arcs are weighted is considered and applied for biomarker identification in bioinformatics. An algorithm integrating column generation, branch-and-bound and cutting plane methods is developed for efficient computing. We also present numerical results on random and real-world networks.

4 - Maximum Degree-based Gamma-quasi-Clique Problem

Grigory Pastukhov, University of Florida, 303 Weil Hall, Gainesville, United States of America, gpastukhov@ufl.edu, Alexander Veremyev, Oleg Prokopyev, Vladimir Boginski

We consider the problem of finding the maximum-cardinality degree-based quasi-clique in a graph. A degree-based gamma-quasi-clique is a subgraph where the degree of each vertex is at least gamma times the highest possible degree. We prove the NP-completeness of the considered problem and propose an IP formulation and exact algorithms for solving this problem. Extensive computational experiments demonstrate that the proposed approaches perform very well on both random and real-world networks.

■ SA51

Hilton- Sutter A

Large-Scale Nonlinear Optimization Algorithms

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Frank E. Curtis, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, frank.e.curtis@gmail.com

1 - Orthant Based Method for L1 Regularized Optimization

Nitish Shirish Keskar, Northwestern University, 2145 Sheridan Road, Room C210, Evanston, IL, 60208, United States of America, nitishkeskar2012@u.northwestern.edu, Andreas Waechter, jJorge Nocedal, Figen Oztoprak

The problem of minimizing a composite function consisting of a smooth loss and a non-smooth penalty has been studied extensively in the last few years. In this talk, we propose a new Orthant-based method for solving the L1 regularized problem. The algorithm proposed consists of a new active-set identification strategy which has a predictive-corrective loop allowing for rapid changes while maintaining descent properties. Comparisons and numerical results on standard test cases are presented.

2 - New Inexact Versions of the ADMM

Wang Yao, Student, MSIS and RUTCOR, Rutgers University, 100 Rockafeller Rd, Piscataway, NJ, 08854, United States of America, yaowang74@gmail.com, Jonathan Eckstein

We present three new, more practically verifiable approximate versions of alternating direction method of multipliers (ADMM). One version is based on Douglas-Rachford operator splitting and an existing inexact version of the proximal point algorithm, and requires one of the ADMM's two minimization steps to be exact. The other two versions are based on a Lagrangian splitting analysis and use absolute summable and relative error criteria, respectively. We also present numerical experiments.

3 - A Primal-Dual Active-Set Framework for Large-Scale Convex Quadratic Optimization

Zheng Han, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, zhh210@lehigh.edu, Frank E. Curtis

We present a primal-dual active-set framework for large-scale convex quadratic optimization. The framework is flexible in that it allows multiple simultaneous changes in the active-set estimate during each iteration. By employing iterative methods and allowing inexactness to each reduced subproblem solve, our method is promising for large-scale optimization. Theoretical results for an important problem class and numerical results on a variety of problems illustrate the framework's efficacy.

4 - Handling Negative Curvature in Spectral Gradient Methods for Unconstrained Optimization

Wei Guo, Ph.D. Candidate, ISE department, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, weg411@lehigh.edu, Frank E. Curtis

A gradient-descent method is proposed for unconstrained nonlinear optimization. Emphasis is placed on techniques used to compute appropriate step sizes when negative curvature is present. The method extends the well-known "two-point step size" method of Barzilai and Borwein and some of its variants. Global convergence is guaranteed under mild assumptions. Numerical results are presented to illustrate the benefits of the method in the presence of negative curvature.

■ SA52

Hilton- Sutter B

Applications of Conic Optimization

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Henry Wolkowicz, Professor, University of Waterloo, University of Waterloo, Waterloo, ON, N2L 3G1, Canada, hwolkowicz@uwaterloo.ca

1 - Geodesic Distance Maximization via Convex Optimization

De Meng, University of Washington, Electrical Engineering, Seattle, WA, United States of America, demeng@u.washington.edu, Maryam Fazel, Pablo Parrilo, Stephen Boyd

Given a graph with fixed edge weights, finding the shortest path, also known as the geodesic, between two nodes is a well-studied network flow problem. We introduce the Geodesic Distance Maximization Problem (GDMP), i.e., the problem of finding the edge weights that maximize the length of the geodesic, subject to convex constraints on the weights. We show that GDMP is a convex optimization problem for a wide class of flow costs and develop an ADMM for its solution.

2 - Robust Convex Relaxation for the Sparse Planted Clique Problem

Brendan Ames, Assistant Professor, University of Alabama, Department of Mathematics, Tuscaloosa, AL, 35487, United States of America, bpames@ua.edu

The planted clique problem seeks to distinguish between graphs containing a single large clique and random graphs. We present a convex relaxation for the planted clique problem under additive and deletive noise. Our relaxation, which can be thought of as nuclear norm regularized linear programming, can detect planted cliques with sizes matching the current state of the art. Moreover, when the noise is sparse, we show that we can detect significantly smaller planted cliques.

3 - Quadratic Programming and Semidefinite Programming Bounds for Vertex Separators

Henry Wolkowicz, Professor, University of Waterloo, University of Waterloo, Waterloo, ON, N2L 3G1, Canada, hwolkowicz@uwaterloo.ca, Ting Kei Pong, Hao Sun, Ningchuan Wang

We consider the problem of partitioning the nodes of a graph into k sets of given sizes in order to minimize the cut obtained by removing the k-th set. This problem is closely related to the graph partitioning problem. In this talk, we look at lower and upper bounds obtained from two convex relaxation techniques: the quadratic programming bounds based on recent successful bounds for the quadratic assignment problems, and semidefinite programming bounds obtained via lifting.

■ SA53

Hilton- Taylor A

Optimal Control in Finance

Cluster: Optimization in Finance

Invited Session

Chair: Naveed Chehrazi, Assistant Professor, McCombs School of Business, 2110 Speedway Stop B6500, Austin, TX, 78705, United States of America, naveed.chehrazi@mccombs.utexas.edu

1 - Optimal Control of Multi-agent Consumption Patterns using Approximate Dynamic Programming

Greg Kaplan, Assistant Professor, Princeton University, Fisher Hall, Princeton, NJ, 08544, United States of America, gkaplan@princeton.edu, Jesus Fernandez-Villaverd, Erick Chen, Warren Powell, Daniel Jiang

We formulate and solve the multi-agent consumption problem using the modeling and algorithmic framework of approximate dynamic programming. The model captures accumulated assets, the state of the economy, wages, and current employment, along with the distribution of assets across the population. We use approximate dynamic programming to produce high quality policies without sacrificing the accuracy of the transition function.

2 - The Valuation of Storage

Long Zhao, McCombs School of Business, Austin TX 78705, United States of America, Long.Zhao@phd.mccombs.utexas.edu

We use moving boundary method to give the numerical optimal strategy of storage with transaction costs.

3 - Dynamic Credit-Collection Optimization

Naveed Chehrazi, Assistant Professor, McCombs School of Business, 2110 Speedway Stop B6500, Austin, TX, 78705, United States of America, naveed.chehrazi@mccombs.utexas.edu, Thomas Weber, Peter Glynn

We develop a dynamic model of consumer repayment behavior on delinquent credit-card loans using a marked point process. The intensity of this point process can be controlled by a sequence of impulses. A semi-analytic solution of the HJB equation is obtained.

■ SA54

Hilton- Taylor B

Quantitative Methods in Finance

Sponsor: Financial Services Section

Sponsored Session

Chair: Nan Chen, The Chinese University of Hong Kong, 609 William Mong Engineering Building, Hong Kong, Hong Kong - PRC, wyu@se.cuhk.edu.hk

1 - Fire Sale in Financial Networks

Haoshu Tian, Princeton University, PACM Fine Hall, Princeton, NJ, 08544, United States of America, htian@princeton.edu, Weinan E

Defaulting can be transmitted through two channels: inter-bank liability contagion and fire sale. When banks rush to sell the same asset, they may fall into a Nash equilibrium in which they sell the asset at an artificially low price to compete for liquidity. In this paper, a model that incorporates these two channels is developed and analyzed theoretically. An algorithm for finding the state in which both the market and the inter-bank liability network are in equilibrium is proposed and tested.

2 - Optimal Portfolio Selection under Counterparty Risk

Agostino Capponi, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, 21218, United States of America, acappon1@jhu.edu

We develop a portfolio allocation framework to assess the impact of counterparty risk on optimal investment decisions. When purchasing CDS upfronts, the investor receives collateral from her protection seller and uses it to mitigate losses arising when the counterparty defaults. We find that the investor may not take any credit exposure and simply invests all his wealth in the money market account, depending on credit risk and contagion effects between reference entity and counterparty.

3 - The Ross Recovery Theorem and Quasi-Stationary Distribution

Yiwei Wang, The Chinese University of Hong Kong, William M. W. Mong Engineering, Shatin, N.T., Hong Kong - PRC, ywwang@se.cuhk.edu.hk, Nan Chen

We analyze the Ross recovery theorem in the presence of absorption state when all assets in the market devalue completely. We find an interesting relation between the recovery theorem and quasi-stationary distribution.

■ SA55

Hilton- Van Ness

Sigmoidal and Geometric Programming: From Aircraft Design, to Virus Propagation, to Political Elections

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Amir Ali Ahmadi, Princeton University, 329 Sherrerd Hall, Dept. of Operations Research&Fin. Eng., Princeton, NJ, 08540, United States of America, a_a_a@princeton.edu

1 - Geometric Programming for Aircraft Configuration Design

Warren Hoburg, Assistant Professor, MIT Dept. of Aeronautics and Astronautics, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, whoburg@mit.edu

Modern aircraft represent some of the most complex, performance-driven engineering systems ever conceived and built. Surprisingly, many fundamental relationships and constraints on aircraft performance can be encoded via the feasible set of a geometric program. This observation gives us a reliable and efficient way to solve conceptual design problems, and may provide decision-makers with better understanding of tradeoffs, design spaces, and performance sensitivities.

2 - Optimal Resource Allocation for Network Protection against Spreading Processes

Victor Preciado, Assistant Professor, University of Pennsylvania, 3330 Walnut Street, Levine Hall 360, Philadelphia, PA, 19103, United States of America, preciado@seas.upenn.edu, Michael Zargham, Chinwendu Enyioha, Ali Jadbabaie, George Pappas

We study the problem of containing spreading processes in arbitrary directed networks by distributing protection resources throughout the nodes of the network. We consider two types of protection resources: (i) Preventive resources, and (ii) corrective resources. We study the problem of finding the cost-optimal distribution of resources throughout the nodes of the network. We show that the optimal resource allocation problems can be solved in polynomial time using Geometric Programming (GP).

3 - Maximizing a Sum of Sigmoids

Madeleine Udell, PhD Candidate, Stanford University, 350 Serra Mall, Stanford, CA, 94305, United States of America, udell@stanford.edu, Stephen Boyd

The problem of maximizing a sum of sigmoids over a convex constraint set arises in many application areas. We propose an approximation algorithm (using a branch and bound method) to find a globally optimal approximate solution to the problem. To illustrate the power of this approach, we compute the optimal positions which might have allowed the candidates in the 2008 United States presidential election to maximize their vote shares.

■ SA56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - ProbabilityManagement.org - The SIPmath-Modeler Tools

Sam L. Savage, Executive Director, ProbabilityManagement.org, 3507 Ross Road, Palo Alto, CA, United States of America, sam@probabilitymanagement.org

The Open SIPmath Standard from non-profit ProbabilityManagement.org allows uncertainties to be communicated as big data for driving interactive simulation in native Excel and other environments without add-in software. We will demonstrate the SIPmath Modeler Tools, which facilitate the generation of such models in Excel, and also how to import and export results from @RISK, Crystal Ball, Risk Solver and MATLAB to leverage those packages. Visit the SIPmath page of SIPmath.org for videos and example files.

2 - IBM Decision Optimization - IBM Innovations that Simplify Application Development

John Chaves, IBM Decision Optimization Solutions Architect, IBM, 3031 N Rocky Point Drive West, Tampa, FL, 33607, United States of America, john.chaves@us.ibm.com

Web deployment of optimization applications requires integrating tasks such as data access and job control as well as optimization into an overall architecture. Learn how basic representational state transfer (ReST) APIs can be used to develop such an architecture.

■ SA64

Parc- Cyril Magnin I

Stationarity in Many-server Queues

Sponsor: Applied Probability Society

Sponsored Session

Chair: Itai Gurvich, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu

1 - Heavy-traffic Limits for the Initial Content Process

Yunan Liu, NC State University, Raleigh, NC 27695, United States of America, A. Korhan Aras, Ward Whitt

In a queueing system with i.i.d having non-exponential service times, the state of the initial content can be described by specifying the elapsed service times of the remaining initial customers. We establish a heavy-traffic functional central limit theorem (FCLT) for the initial content process, assuming a FCLT for the initial age process, with the number of customers initially in service growing in the limit. For each time, including time 0, the conditional remaining service times, given the ages, are mutually independent but in general not identically distributed.

2 - Stochastic Comparison Approach to Multi-server Queues

David A. Goldberg, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, dgoldberg9@isye.gatech.edu

We prove several results for multi-server queues using a stochastic comparison approach. First, we demonstrate that there are two limiting sub-regimes embedded within the Halfin-Whitt heavy-traffic regime. We describe a novel lower bound for the FCFS M/G/n queue, which we combine with other bounds to characterize the qualitative properties of these sub-regimes. We conclude by discussing several open questions, and (time permitting) recent progress on queues with heavy tails and abandonments.

3 - A Flexible-server System in the Halfin-Whitt Regime: Tightness of Stationary Distributions

Alexander Stolyar, Bell Labs, Alcatel-Lucent, 600 Mountain Ave., 2C-322, Murray Hill, NJ, 07974, United States of America, Sasha.Stolyar@alcatel-lucent.com

We consider a so-called "N" flexible server system (as well as its generalization) under a priority discipline, in the Halfin-Whitt asymptotic regime. Tightness of diffusion-scaled stationary distributions is proved. The approach is based on constructing a single common Lyapunov function and deriving bounds on its derivatives.

4 - Diffusion Models and Steady-state Approximations for Exponentially Ergodic Markovian Queues

Itai Gurvich, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu

Motivated by queues with many-servers, we study Brownian steady-state approximations for continuous time Markov chains (CTMCs). Our approximations are based on diffusion models (rather than a diffusion limit). Within an asymptotic framework, in which a scale parameter n is taken large, a uniform Lyapunov condition is proved to guarantee that the gap between steady-state moments of the diffusion and those of the properly centered and scaled CTMCs, shrinks at a rate of the square root of n.

■ SA65

Parc- Cyril Magnin II

Control of Queues

Sponsor: Applied Probability Society

Sponsored Session

Chair: Hayriye Ayhan, Professor, Georgia Institute of Technology, School of ISyE, Atlanta, GA, 30332, United States of America, hayhan@isye.gatech.edu

1 - Dynamic Resource Management for Parallel Queues with Shared Pool of Flexible Servers

Ravi Kumar, PhD Candidate, Cornell University, 292 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, rk454@cornell.edu, Mark Lewis

We consider the problem of how servers can be dynamically allocated in a system with parallel queues and multiple demand streams. The system incurs holding costs, server usage cost and set-up cost for switching stations. A central controller has access to a fixed number of flexible servers and needs to dynamically decide how many servers to use and where to allocate their effort to minimize operating costs. We characterize the optimal allocation policy and develop practical heuristics.

2 - Combining Queueing and Scheduling Theories – A Flexible Server Study

Douglas Down, McMaster University, Department of Computing and Software, Hamilton, Canada, downd@univmail.cis.mcmaster.ca, Daria Terekhov, Tony Tran, Christopher Beck

Using an example of a flexible server model (where service times are known upon arrival), we discuss how one can use queueing-theoretic knowledge to help guide online scheduling. The result is a hybrid scheduling model that demonstrates better performance than standard online scheduling approaches. In addition to discussing performance, we discuss stability properties of various scheduling approaches, including our hybrid approach.

3 - Optimal Admission Control for Markovian Loss Systems of Two Stations

Daniel Silva, Georgia Tech, 755 Ferst Dr, Atlanta, GA, United States of America, dfsi3@gatech.edu, Bo Zhang, Hayriye Ayhan

Consider a system of two Markovian queues in tandem with finite buffers. Losses are incurred when a customer is rejected upon arrival to the first station or when the second station is full upon service completion at the first station. We present two special policies and give necessary conditions for these to be optimal. We also provide some results on the structure of the optimal policy. Finally, we present heuristic policies that yield near optimal cost performance.

4 - Processor Sharing in Non-Collaborative Queueing Networks

Tugce Isik, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, tugceisik@gatech.edu, Sigrun Andradottir, Hayriye Ayhan

We study processor sharing (PS) in queueing networks where multiple servers cannot work at the same station. For tandem lines with two stations, two servers, and infinite buffers, we show that either a dedicated or a PS policy maximizes the throughput, and the optimal PS policy can be achieved as a limit of round-robin policies. For systems with general topology, we evaluate how the performance of round-robin policies depends on the quantum of time spent at each station and the buffer size.

■ SA66

Parc- Cyril Magnin III

Joint Session QSR/ENRE: Statistical Modeling and Analysis in Renewable Power Systems

Sponsor: Quality, Statistics and Reliability & Energy Natural Resources and the Environment

Sponsored Session

Chair: Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu

Co-Chair: Arash Pourhabib, Assistant Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, arash.pourhabib@okstate.edu

1 - Wind Plant Design under Uncertainty

Katherine Dykes, NREL, 15013 Denver W Pkwy, Golden, CO 80401, United States of America, Katherine.Dykes@nrel.gov

Many sources of uncertainty affect wind plant performance and cost. This study looks at bringing those uncertainties upfront into the plant development process at the point of turbine selection and layout design. The result is the ability to optimize the plant cost of energy not just by minimizing a deterministic cost but an expected cost or even risk threshold. This work leverages new integrated wind plant modeling capability to explore optimization of wind plant design under uncertainty.

2 - A Bayesian Optimization Approach for Wind Farm Monitoring and Power Maximization

Jinkyoo Park, Ph.D Student, Stanford University, 473 Via Ortega, Stanford, CA, 94305, United States of America, jinkyoo.park@gmail.com, Kincho Law

The wakes formed by upstream wind turbines decrease the power outputs of downstream wind turbines by reducing wind speed, which results in deterioration of wind farm power. The total wind farm power can be improved by minimizing wake interference by coordinated control actions of wind turbines. In this study, we determine the optimal, coordinated yaw offset angles and induction factors for wind turbines by applying Bayesian optimization (BO), a data-driven statistical optimization algorithm.

3 - Data-driven Spatial-temporal Modeling of Local Wind Fields

Arash Pourhabib, Assistant Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, arash.pourhabib@okstate.edu, Yu Ding, Jianhua Huang

Effective wind power system operation hinges on comprehending the near ground behavior of wind in a wind farm and particularly the wind speed. We present a data-driven spatial-temporal model for analyzing local wind fields. Our model, which is an extension of the Vector Autoregression (VAR) by imposing structure to the coefficient matrix, is constructed based on measurements coming from a large number of turbines in a wind farm, as opposed to aggregating the data into a single time-series.

4 - Spatial Modeling and Analysis for Wind Farms – Preliminary Investigation

Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu, Mingdi You, Giwhyun Lee, Judy Jin

This study focuses on developing analytical and statistical models for a wind farm with multiple wind turbines. In a wind farm, turbines in downwind rows in large-scale farms are impacted by wind speed deficit, thus capturing less energy (called wake effects). We quantify such under-performance of wind turbines in a wind farm.

■ SA67

Parc- Balboa

Nonlinear Dynamics and Chaos (Tutorials and Research)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Nonlinear Dynamics and Chaos (Tutorials and Research)

Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

This session will present the state-of-the-art methods and tools on Nonlinear Dynamics and Chaos, including both tutorials and research as follows: Part I – Nonlinear dynamical systems and chaos; Part II – Recurrence analysis of complex systems; Part III – Multiscale recurrence analysis; Part IV – Recurrence and complex networks;

2 - Recurrence Plot-based Control Chart for Nonlinear Profile Monitoring and Diagnosis

Cheng Zhou, PhD candidate, University of Science and Technology Beijing, 30 Xuyaun Road, Haidian District, Beijing, China, czhou88@gmail.com, Jianjun Shi, Kaibo Liu, Weidong Zhang

This paper proposes a novel nonlinear profile monitoring and fault diagnosis schemes by using the recurrence plot (RP) method. First, a multivariate CUSUM control chart is constructed to monitor the profile change based on RPs. Then, a simulation studies evaluate the performance of the control chart. Meanwhile, a process fault diagnosis scheme is proposed to localize the fault. A case study of progressive stamping processes is implemented to show the performance of the proposed schemes.

■ SA68

Parc- Davidson

Nanomanufacturing and Nanoinformatics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Avenue, Los Angeles, CA, 90089, United States of America, qiang.huang@usc.edu

1 - Interaction-based Modeling of Nanowire Growth Process Toward Improved Yield

Faranak Fathi, The University of Arizona, 3125 E Bellevue St, Unit 4, Tucson, AZ, 85716, United States of America, faranakfathi@gmail.com

In this research, we study a nanowire-interaction physical-statistical model that helps determine the minimum pitch (inter-wire distance) to ensure independent growth of nanowires and improve process yield and uniformity of nanowires.

2 - Process Design of Carbon Nanotube Synthesis Based on Fast Monte Carlo Simulation

Changqing Cheng, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ccheng@tamu.edu, Satish Bukkapatnam

Carbon nanotube (CNT) geometric features are determinant to its various properties, and process design and features control during the synthesis processes pose an immense challenge to improve the yield rate and quality for such nanostructures. We investigated process design for CNT synthesis based on fast Monte Carlo simulation to maximize the stiffness of CNTs.

3 - Analysis and Optimization of Edge Effects for Nanostructure Growth

Yanqing Duanmu, University of Southern California, 3715 McClintock Avenue, Los Angeles, 90089, United States of America, duanmu@usc.edu, Qiang Huang

In this talk we present a scheme to model the edge effect during nanostructure growth. The improved model captures well the nanowire length distribution across the substrate. Physical interpretation of skirt area effect is provided using the diffraction theory. With the established model, we provide a method to optimize the skirt area width to improve the structure uniformity.

■ SA69

Parc- Fillmore

Decision Analysis for Energy Systems

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Todd Levin, Computational Engineer, Argonne National Laboratory, 9700 S. Cass Ave., Bldg. 221, Argonne, IL, United States of America, tlevin@anl.gov

1 - Optimal Hydroelectric Dispatching with Metaheuristic: A Genetic Algorithm and Ant Colony Comparison

Paulo Correia, Professor, University of Campinas, Energy Department, Fualculty of Mechanical Engineering, Campinas, SP, 13083-860, Brazil, pcorreia@fem.unicamp.br, Jessica Fernandes, Regiane Barros, Ieda Hidalgo

Usually, the units of a hydroelectric plants have the same design. However, circumstantial details, arising as them are manufactured and installed, result in actual different efficiency curves. Besides efficiency maximization, the dispatching could aim to minimize the units' start-up and shut-down. So the problem is formulated as a mixed integer non-linear multicriteria program. This paper discuss the results obtained with two approaches: genetic algorithm and ant colony.

2 - Optimization of Roof and Ground Greening Strategies to Mitigate the Urban Heat Island

Jean-Michel Guldmann, Professor Emeritus, The Ohio State University, 275 West Woodruff Avenue, COLUMBUS, OH, 43210, United States of America, guldmann.1@osu.edu, BumSeok Chun

The urban heat island (UHI), with temperatures in urban areas often much higher than in surrounding areas, induces heat stress, ozone formation, and increased power plant pollution and greenhouse gas emissions. A non-linear programming model, derived from a spatial statistical model estimated over a grid in downtown Columbus, Ohio, selects roof-top and ground areas for greening to maximize total temperature reduction in Columbus center, subject to a greening budget and other constraints.

3 - Risk-aware Load Shifting and Optimized Chiller Operation for Cooling Systems with Thermal Storage

Jeonghan Ko, Associate Professor, Ajou University, Korea and The University of Michigan-Ann Arbor, USA, Department of Industrial Engineering, Suwon-si, Gyeonggi-do, Korea, Republic of, jko@ajou.ac.kr, Yin Guo, Ehsan Nazarian, Kamlakar Rajurk

This research investigates the risk related to demand forecasting for production and inventory of chilled water in cooling systems. Thermal storage is used as chilled water inventory to reduce the peak loads of a cooling system, but increases the operation cost. We present new methods for robust demand prediction and optimal chilled water production and inventory. We also evaluate the trade-off between the peak demand reduction and operation cost increase.

4 - Utility-maximizing Financial Contracts for Distributed Rural Electrification

Todd Levin, Computational Engineer, Argonne National Laboratory, 9700 S. Cass Ave., Bldg. 221, Argonne, IL, United States of America, tlevin@anl.gov, Valerie Thomas

We develop a cost-benefit framework for extending rural electricity access. An economic model is developed to compare three financial mechanisms that make capital intensive electrification technologies more accessible in rural areas. These contracts are compared on their ability to increase consumer utility for a given cost to the provider. We show that a subsidy is preferred when the desired subsidization is high and that microloan and rental programs can profitably improve energy access.

■ SA70

Parc- Hearst

Copper Mining Applications

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Timothy Matis, Associate Professor, Texas Tech University, PO Box 43601, Lubbock, TX, 79409, United States of America, timothy.matis@ttu.edu

1 - Optimizing Capacity and Production in Copper Mining

Melanie Ruegg, Graduate Student, Texas Tech University, Box 43061, Lubbock, Tx, 79409, United States of America, melanie.ruegg@ttu.edu, Pablo A. Miranda, Milton Smith, Jose Ceroni, Timothy Matis

The copper mining industry may be characterized as having capital intensive fixed costs, long planning horizons, and variability in returns due to market fluctuations. In this presentation, we will discuss research related to optimizing capacity planning and production policies under variability in profit margins for refined and concentrate product.

2 - Sustainable Mining

Stefan Voss, University of Hamburg, IWI - Von-Melle-Park 5, Hamburg, 20146, Germany, stefan.voss@uni-hamburg.de

Operations related to and in mining are nowadays unthinkable without efficient use of information technology and appropriate optimization methods. As the sustainable use of natural resources has achieved undoubted importance, we describe and classify processes and operations in sustainable mining and provide methods for their optimization. This refers to constructing a mine, running it, and finally shutting it down, also including energy efficiency, supply chain optimization and risk management.

3 - A Simulation Based Integrated Model to Evaluate Supply Chain Maintenance Planning Policies

Jose Ceroni, Pontificia Universidad Catolica de Valparaiso, Av. Brasil 2241, Valparaiso, Chile, jceroni@ucv.cl, Monica Lopez-Campos, Pablo A. Miranda

We propose an integrated approach to evaluate maintenance policies considering the spare parts supply chain, based on simulation of the maintenance system for a copper concentrate shipping operation. The model considers spare parts inventory costs and decisions, for evaluating combined strategies for maintenance and spare parts inventory. Analysis consists of a bi-objective evaluation of system performance indicators: spare parts inventory and supply costs, and equipment availability.

■ SA71

Parc - Lombard

Auctions and Trading Agents

Cluster: Auctions

Invited Session

Chair: Wolf Ketter, Professor, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, wketter@rsm.nl

1 - Impact of Mari on Multi-unit Sequential Dutch Auctions

Yixin Lu, Rotterdam School of Management, Erasmus University Rotterdam, Burgemeester Oudlaan 50, T9-16, Rotterdam, 3062PA, Netherlands, ylu@rsm.nl, Alok Gupta, Wolf Ketter, Eric van Heck

We examine the performance of two auction formats which are widely used for selling perishable goods, the traditional multi-unit sequential Dutch auction mechanism and a variation of it which involves an additional stage called "Mari" where non-winning participants can purchase goods at the same price as the winner in the previous round. Using a lab experiment, we show that the inclusion of Mari can significantly speed up the auction process at a negligible cost of allocative efficiency.

2 - Intelligent Virtual Power Plant Control: Electric Vehicles for Flexible Load Balancing

Micha Kahlen, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, kahlen@rsm.nl, Jan Dalen van, Wolf Ketter

We study an intelligent agent based trading strategy for the electricity wholesale market. This trading strategy schedules the charging of Electric Vehicles, as well as when electricity from the Electric Vehicles storage should be provided to the grid to meet peak load. Several Electric Vehicles are aggregated to a Virtual Power Plant that reacts in real-time to changing load conditions. We make an optimal tradeoff between Electric Vehicle driver's mobility needs and the exploitation of storage.

3 - An Ascending Dynamic Auction for Team-based Assignments

De Liu, University of Kentucky, 550 S Limestone St,, Lexington, KY, 40506, United States of America, de.liu@uky.edu

Many assignment problems involve assigning an object to a team of individuals. Examples include sending teams of workers to multiple project sites and assigning dorm rooms to students. I propose a dynamic ascending auction for assigning objects to teams of individuals.

■ SA72

Parc- Stockton

Energy Management Analytics in the Demand Side

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Young Lee, Manager, IBM Research, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, ymlee@us.ibm.com

1 - Harnessing the Electric Load Flexibility of Energy-conscious Intelligent Transportation Systems

Mahnoosh Alizadeh, Postdoctoral Research Fellow, Stanford University, Packard EE Building, Room 372, 350 Serra Mall, Stanford, CA, 94305, United States of America, malizade@stanford.edu, Tara Javidi, Yueyue Fan, Hoi To Wai, Andrea Goldsmith, Anna Scaglione

In this talk, we model the electric vehicle trip planning and charge problem under dynamic traffic conditions and locational and time-varying electricity pricing. We discuss how load management strategies used by the power system operator could affect path planning problems solved by individual users or a social planner, and discuss the necessity of a joint view of intelligent transportation systems and the smart grid.

2 - Optimizing Energy Storage in Microgrids with Renewables

Arnab Bhattacharya, University of Pittsburgh, 1077, Benedum Hall of Engineering, Pittsburgh, PA, 15261, United States of America, arb141@pitt.edu, Jeffrey Kharoufeh

We consider the problem of optimally and dynamically procuring and storing energy in residential microgrids in the presence of renewable sources and dynamic pricing. A multi-stage, stochastic optimization problem is formulated to minimize a consumer's finite horizon electricity costs while accounting for uncertainties in distributed energy demand and intermittent supply.

3 - A Network Modelling Approach to Energy Efficiency Optimization in Industrial Systems

Niloofar Salahi, PhD Candidate, Rutgers The State University of New Jersey, 308 Green Hill Manor Dr, Franklin Park, NJ, 08823, United States of America, niloofar.salahi@gmail.com, Mohsen Jafari

This work focuses on energy efficiency optimization for industrial systems.The problem is formulated as a network optimization where nodes are interlinked by energy and performance dependencies.A node can represent a process, a machine or equipment.Solution to this model is energy efficiency share of each node.For illustration,a manufacturing facility with a production line and a technical building is used.The model integrates building energy dynamics with labor productivity and thermal comfort.

4 - A Data Driven Approach to Optimal Control of Building Energy Use

Seyed Vaghefi, PhD Candidate, Rutgers University, 96 Frelinghuysen Road, CoRE Building, Room 201, Piscataway, NJ, 08854, United States of America, vaghefi@rutgers.edu, Jack Brouwer, Yan Lu, Jianmin Zhu, Mohsen Jafari

We propose an optimal framework for forecasting and optimization of building energy consumption. It consists of two main phases. First, a set of offline data is used to construct an energy forecast model. Then, in the next phase, the model is fed into an optimal control strategy to find the optimal set points for a finite horizon. The optimization model is a Multi-objective Dynamic Programming that minimizes total energy cost as well as total deviation from thermal comfort bounds.

5 - Optimal Control of HVAC Systems for Demand Response

Young Lee, Manager, IBM Research, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, ymlee@us.ibm.com, Leo Liberti, Rui Zhang, Young Tae Chae, Raya Horesh

Building HVAC systems account for over 40% of the total energy consumption of buildings in the U.S. A method that dynamically computes the optimal control profile of HVAC Systems considering real-time electricity price, desired occupant comfort level, building operational schedule, weather forecast and thermal mass of buildings is presented. The control strategy can substantially reduce energy consumption and costs of HVAC systems in buildings.

■ SA73

Parc- Mission I

Real Options in the Energy Sector

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Afzal Siddiqui, University College London, Gower Street, London, United Kingdom, afzal.siddiqui@ucl.ac.uk

1 - Optimal Decision to Invest in an Engine-CHP Plant: A Real Options Approach in the Context of the German Regulatory Framework

Reinhard Madlener, Full Professor of Energy Economics and Management, RWTH Aachen University, FCN, Mathieustrasse 10, Aachen, 52074, Germany, RMadlener@eonerc.rwth-aachen.de, Freia Harzendorf

We develop a 2-dimensional real options model for the irreversible investment in an engine-CHP system. Fuel price and electricity price are subject to risk; heat revenues are assumed to be certain. On this basis of German Renewable Energies Act (EEG 2012) and Cogeneration Act (KWKG 2012) we determine and compare the investment in a natural gas- and a biogas-fired CHP plant by means of RO analysis. We also consider the biogas-fired engine-CHP plant as a 2-stage sequential investment option.

2 - Persist or Perish: Optimal Management of Alternative-Energy Technologies

Ryuta Takashima, Tokyo University of Science, 2641 Yamazaki, Noda, Chiba, 278-8510, Japan, takashima@rs.tus.ac.jp, Afzal Siddiqui

Policymakers have often backed alternative energy technologies, e.g., nuclear power, due to their relatively low operating costs and emissions. However, they have also been quick to respond to public perceptions about the safety of such plants by suspending construction or even decommissioning existing facilities. We address public concerns about physical plant risks along with stochastic market prices for energy by modelling investment in and decommissioning of alternative energy technologies.

3 - Investment and Capacity Sizing under Policy Uncertainty

Michail Chronopoulos, Norwegian School of Economics, Helleveien 30, Bergen, 5045, Norway, Michail.Chronopoulos@nhh.no, Verena Hagspiel, Stein-Erik Fleten

Frequent changes of support schemes and price uncertainty complicate investment decisions particularly when a firm must determine both the optimal time of investment and the size of a project. We analyse how investment timing and capacity sizing decision are affected by policy and price uncertainty for a project that can be completed in a single or multiple stages and find that policy uncertainty has an ambiguous impact on the required investment threshold and the corresponding optimal capacity.

4 - Anticipative Transmission Planning under Uncertainty

Afzal Siddiqui, University College London, Gower Street, London, United Kingdom, afzal.siddiqui@ucl.ac.uk, Trine Krogh Boomsma, Verena Hagspiel

Transmission system operators (TSOs) build transmission lines to take generation capacity into account. However, their decision is confounded by policies that promote renewable energy technologies. Thus, what should be the size of the transmission line to accommodate subsequent generation expansion? Taking the perspective of a TSO, we use a real options approach not only to determine the optimal timing and sizing of the transmission line but also to explore its effects on generation expansion.

■ SA74

Parc- Mission II

Market Issues for Hydro-Dominated Electricity Systems

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Ramteen Sioshansi, Assistant Professor, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, sioshansi.1@osu.edu

1 - Risk and Contracting in Hydro-dominated Electricity Markets

Andy Philpott, University of Auckland, Private Bag 92019, Auckland, New Zealand, a.philpott@auckland.ac.nz

Electricity markets with hydroelectricity are subject to energy shortages when there are low reservoir inflows. In perfectly competitive markets some of the risk of these shortages can be hedged by hydro generators trading contracts with agents with thermal plant that can perform a hydro-firming role, or with agents on the demand side. We examine the equilibrium outcomes of different types of contract when agents are endowed with coherent time consistent risk measures.

2 - Hydrothermal Scheduling with a Detailed Representation of River Channel Constraints

André Luiz Diniz, DSc, CEPEL - Brazilian Electric Energy Research Center, Av Horacio Macedo, 354, Cidade Universiteria, Rio de Janeiro, RJ, 21941911, Brazil, diniz@cepel.br

It is very important to have an accurate representation of reservoir cascades in power system operation, specially in predominantly hydro systems. We present a linear program to accurately model the river routing as well as several constraints - such as maximum level variation - along the water channels that connect reservoirs in cascade. Results for the short-term hydrothermal scheduling of the real large-scale Brazilian system show the high accuracy of our approach, with acceptable CPU times.

3 - Strategic Bidding for Price-Maker Hydro-Electric Producers

Steffen Rebennack, Colorado School of Mines, Division of Economics and Business, Golden, CO, United States of America, srebenna@mines.edu, Gregory Steeger, Luiz Barroso

Deregulation has led to the use of auction-based markets while a growing desire for efficient and renewable energy sources has rekindled modeling efforts in the energy sector. In this talk, we review and discuss approaches to maximize revenue in the production schedule for both single and multiple price-maker hydro-electric producers in a deregulated, bid-based market. We model the problem for a single price maker and for multiple price makers.

4 - Optimizing Offers for Cascaded Hydroelectric Generators in a Market with Centralized Dispatch

Ramteen Sioshansi, Assistant Professor, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, sioshansi.1@osu.edu

We examine the problem of offering generation and ancillary services from a set of cascaded hydroelectric units to a centrally dispatched market that does not account for watershed constraints. We formulate the problem as a stochastic bilevel optimization that maximizes generator profits under different demand and supply realizations. We use two numerical case studies to demonstrate the benefits of the proposed model.

■ SA75

Parc- Mission III

Simulation Optimization and Ranking and Selection

Sponsor: Simulation

Sponsored Session

Chair: Shane Henderson, Professor, Cornell University, School of ORIE, 230 Rhodes Hall, Ithaca, NY, 14850, United States of America, sgh9@cornell.edu

1 - A Comparison of Two Parallel Ranking and Selection Procedures

Eric Ni, Cornell University, 288 Rhodes Hall, Ithaca, NY, 14853, United States of America, cn254@cornell.edu, Shane Henderson, Susan Hunter

Traditional solutions to ranking and selection include two-stage procedures and sequential screening procedures. We migrate two representative procedures to a parallel computing platform to explore and compare their statistical validity, efficiency, and implementation in various settings. Inspired by the comparison results, we propose a framework for hybrid procedures that may further reduce simulation cost or guarantee to select a good system when multiple systems are clustered near the best.

2 - Feasibility Determination for Linearly Constrained Sets

Roberto Szechtman, Naval Postgraduate School, 1411 Cunnigham Rd, Monterey, United States of America, rszechtm@nps.edu, Enver Yucesan

We consider the problem of feasibility determination in a stochastic setting, where we wish to determine whether a system belongs to a given set based on a performance measure estimated through Monte Carlo simulation. We consider linearly constrained sets, and present a number of approaches that keep the expected number of incorrect determinations within a bound with certain probability. Our algorithms apply to random vectors with Gaussian, sub-Gaussian, and bounded support distributions.

3 - Selection of the Best through Sequential Subset Selection
L. Jeff Hong, Professor, Hong Kong University of Science and Technology, IELM Dept, HKUST, Clear Water Bay, Hong Kong - PRC, hongl@ust.hk, Weiwei Fan

Frequentist's formulations of selection-of-the-best problem include the indifference-zone (IZ) formulation and the subset-selection (SS) formulation. However, the first needs an IZ parameter that is often difficult to specify, and the second may result a subset that include more than one alternatives. To resolve such problems, we propose a sequential SS procedure based on the law of iterative logarithm. It does not need an IZ parameter but guarantees to select the best with a pre-specified PCS.

4 - Bias Issues in Simulation-based Stochastic Optimization
Peter Glynn, Stanford University, Huang Engineering Center 357, Stanford, CA, 94305, United States of America, glynn@stanford.edu

We discuss optimization bias and accompanying bias in the optimizer, in the setting of simulation-based optimization, both in the presence of parameter uncertainty in the underlying distributions and in its absence. We also introduce a new unbiased estimator for the optimum and its optimizer. This work is joint with Jose Blanchet,Danielle Davidian,Gerd Infanger,and Zeyu Zheng.

■ SA76

Parc- Embarcadero

Planning and S&OP Processes

Sponsor: The Practice Track

Sponsored Session

Chair: Rob Hall, Managing Partner, End-to-End Analytics, 2595 E. Bayshore Rd., Suite 240, Palo Alto, CA, 94303, United States of America, rob@e2eanalytics.com

1 - How to Speed ERP Implementation and Reduce Time to ROI
Warren McCullough, Director, Sales & Operations Planning, NetApp, 495 East Java Drive, Sunnyvale, CA, 94089, United States of America, warrenm3@me.com

Executives have a compelling desire to limit project scope of an ERP implementation to core system of record functions, to avoid biting off too much too soon. But, unless key processes are included, it is much harder to get your ROI. By including these three key tangential processes: master data management, S&OP, and supply chain collaboration in your business requirements, you can help speed ERP system adoption and decrease time to achieve ROI from an ERP implementation.

2 - Delivering Effective and Robust Planning Tools using Excel
Rob Hall, Managing Partner, End-to-End Analytics, 2595 E. Bayshore Rd., Suite 240, Palo Alto, CA, 94303, United States of America, rob@e2eanalytics.com

Many businesses continue to rely on individualized Excel spreadsheets for their planning activities. Excel is ubiquitous, easy-to-use, flexible, and powerful business tool. But spreadsheets developed by individuals are notoriously error-prone, fragile, inefficient, and not scalable. However, it is possible to develop and deploy robust, standardized, and scalable Excel tools to the user community. I share a practical example of such an approach.

3 - Achieving Supply Chain Excellence at Sandisk Corporation
Shiva Esturi Sathyanarayan, Director II, Operations Management, Sandisk Corporation, 951 Sandisk Drive, Milpitas, CA, 95035, United States of America, Shiva.EsturiSathyanarayan@Sandisk.com, Bo Liao

We discuss how supply chain excellence towards improving inventory turns and customer service level at SanDisk Corporation is achieved through a postponement strategy coupled with business segmentation, prioritized replenishments for constrained supply, and improving supply chain visibility and response to exceptions.

■ SA77

Parc- Market Street

Analytics Applications on Decision Making

Sponsor: Analytics

Sponsored Session

Chair: Juan Li, Research Scientist, Xerox Corporation, 800 Phillips Road, Webster, NY, 14580, United States of America, Juan.Li@xerox.com

1 - Dynamic Framework for the Design and Evaluation of Kidney Exchange (KE) Programs
Tulia Plumettaz, Xerox Corporation, 800 Phillips Rd, Bldg 128-257F, Webster, 14580, United States of America, Tulia.Plumettaz@xerox.com, Jay Sethuraman

Mechanisms are typically evaluated by their overall performance on a large exchange pool, based on which recommendations are drawn. We consider a dynamic framework to evaluate extensively used KE mechanisms. Our results suggest that some of the features that are critical in a mechanism in the static setting have minor impact in its long-run performance. Also features that are generally underestimated in the static setting turn to be relevant when we look at a dynamically evolving exchange pool.

2 - Exploration vs. Exploitation in the Information Filtering Problem
Xiaoting Zhao, Cornell University, Rhodes Hall, Ithaca, NY, 14850, United States of America, xz337@cornell.edu, Peter Frazier

We consider information filtering, in which we face a stream of items to voluminous to process by hand, and must rely on a computer system to automatically filter out irrelevant items. Modeled as a Bayesian sequential decision-making problem, we show how it may be solved to optimality using dynamic programming and a decomposition that exploits special problem structure. We then present an application of this method to a historical dataset from the arxiv.org repository of scientific articles.

3 - Condition-Based Spare Parts Inventory Management for Aircraft Engines
Jennifer K. Ryan, Associate Professor, Rensselaer Polytechnic Institute, 110 8th Street, Industrial & Systems Engineering, Troy, NY, 12180, United States of America, ryanj6@rpi.edu, Michelle Park, Robert Gao, Robert Tomastik, Ana Muriel

Lack of coordination between maintenance decision-making and the inventory management of spare parts can lead to increased inventory costs and unnecessary equipment downtime. To address this gap, we have developed a framework for incorporating real-time condition information into inventory decisions for spare parts that are subject to deterioration. While equipment condition monitoring is of relevance to many manufacturers, the application context of this research is commercial jet engines.

■ SA78

Parc- Mason

Stochastic Analytics Models and Methods

Sponsor: Analytics

Sponsored Session

Chair: Michael N. Katehakis, Rutgers University, Newark, NJ, United States of America, mnk@rutgers.edu

1 - Switching Curve Optimal Policy in an Infinite Server Farm Model
Herman Blok, PhD, Leiden University, Niels Bohrweg 1, Leiden, Netherlands, blokh1@math.leidenuniv.nl, Flora Spieksma

We wish to minimise the expected cost due to energy consumption. After completing service, a server can be put on standby and consume extra energy. Or turned off, which saves energy, but yields extra costs when turned back on. We model this as an MDP, which is challenging due to unbounded rates and transient policies. The only existing result concerns bounded jumps and discounted cost. We show how to carry these results to the unbounded model. We further exploit the model to get average results.

2 - Markov Decision Processes and Inventory Control
Eugene Feinberg, Distinguished Professor, Stony Brook University, Dept. of Applied Math. & Statistics, Stony Brook, NY, 11790, United States of America, eugene.feinberg@stonybrook.edu, Yan Liang

Recent results on Markov Decision Processes (MDPs) with general state and action sets provide direct tools for optimization of periodic review inventory systems. In this talk we describe general results on MDPs and their applications to particular inventory control problems.

3 - DES and RES Processes and their Explicit Solutions

Laurens Smit, Leiden University, Niels Bohrweg 2, Leiden, Netherlands, lsmit@math.leidenuniv.nl, Michael N. Katehakis, Flora Spieksma

We define and study the down entrance state (DES) and the restart entrance state (RES) classes of quasi skip free processes. We derive explicit solutions and bounds for the steady state probabilities of both processes. To motivate the applicability we present solutions for queueing and inventory problems. In addition we present a procedure to decompose Markov processes into separate thinned processes. We discuss applications when the thinned processes satisfy the DES and RES property and the original process does not.

4 - Dynamic Models Valuation and Utilization of Tax Loss Carryforwards and Carrybacks

Nilofar Varzgani, PhD Student, Rutgers Business School, 101 Bleeker Street, Newark, NJ, 07102, United States of America, nvarzgani@gmail.com, Michael N. Katehakis, Suresh Govindaraj

We present new models for valuation and utilization of tax loss-carryforwards (TCLFs) and carrybacks (TLCBs) under deterministic and stochastic tax code conditions. We investigate similarities between TCLFs and the existing literature on perishable inventory models and we provide an algorithmic discrete time framework for valuing TLCFs (TLCBs).

■ SA79

Parc- Powell I

The Next 50 Years of Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Jim Matheson, Chairman, SmartOrg, Inc., 855 Oak Grove Ave Ste 202, Menlo Park, CA, 94025, United States of America, jmatheson@smartorg.com

1 - Decision Engineering – The Next 50 Years

Jim Matheson, Chairman, SmartOrg, Inc., 855 Oak Grove Ave Ste 202, Menlo Park, CA, 94025, United States of America, jmatheson@smartorg.com

The next 50 years of evolution: embedding sound decision processes throughout organizations, for big and little decisions, for exigent and routine, for strategic and operational, for situations dominated by value questions, by uncertainty or by complexity. In addition, all of these situations need to be supported by embedded software that does not often require power users, and that integrates the analytics on big data about the past with human judgments about the future. Create the future!

2 - Societal Decisions: The Next 50 Years?

Warner North, President and Principal Scientist, NorthWorks, Inc., 1715 Taylor Street, San Francisco, CA, 94133, United States of America, northworks@mindspring.com

Where will application of DA to societal decisions be in 50 years? I hope such application will have become part of standard decision support practice, along with accounting, cost-benefit analysis, and planning for acceptable safety. Improvements in education are needed, including probability theory and behavioral economics. Engineering of complex systems needs to be linked to DA. To some extent this has happened, but more linkage is needed.

3 - Healthcare Business Analytics and Decision Support: The Next 50 Years

Don Kleinmuntz, Professor of the Practice of Business Analytics, University of Notre Dame, 452 W Huron St, Chicago, Il, 60654, United States of America, don@kleinmuntzassociates.com

Healthcare businesses and organizations of all types are discovering opportunities presented by growing pools of detailed data, but are still at a relatively early stage of development and deployment. This talk will outline how more sophisticated decision tools and processes can transform healthcare service delivery, and also address the challenges these efforts are likely to encounter.

4 - Military Decision Making: The next 50 Years

Greg Parnell, Professor, Dept of Industrial Engineering, University of Arkansas, Fayetteville, AR, 72701, United States of America, gparnell@uark.edu, Terry Bresnick

Military planners must respond to opportunities and threats. New technologies and vast amounts of information will be available to military operators to perform their global missions. However, our adversaries will use asymmetric warfare including weapons of mass destruction/disruption using kinetic and cyber-warfare to achieve their objectives. Decision analysis will continue to provide insights about future military systems required to underwrite our national security in the next 50 years.

5 - Space and Security Decisions: The Next 50 Years

Ali Abbas, Professor, University of Southern California, Industrial and Systems Engineering, Price School of Public Policy, Los Angeles, CA, United States of America, aliabbas@illinois.edu

In the next 50 years, decision analysis will play an important role in space discovery and national security decisions. Space discovery decisions include asteroid recovery missions, long time horizons, uncertainty about asteroid composition, and real time decisions based on data that will be observed out in space. National security decisions will require cyber security considerations as well as ethical considerations and a wealth of data along with the decision process.

■ SA80

Parc- Powell II

Military Applications of Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Michael J. Kwinn, Jr., Professor of Systems Engineering, Dept of Systems Engineering, US Military Academy, West Point, NY, 10996, United States of America, michael.kwinn@usma.edu

1 - Big Data's Role on Tomorrow's Battlefield – Lessons Learned from Operation Enduring Freedom

Brian Harris, Operations Research Analyst, Center for Army Analysis, 6001 Goethals Road, Fort Belvoir, VA, 22310, United States of America, brian.j.harris18.mil@mail.mil

The digitalization of the battlefield, and the proliferation of machine-generated data will greatly increase the volume, velocity, and variety of data available for analysis. This massive increase in available data offers a tremendous opportunity to provide more timely and extensive advice to commanders. This brief will examine specific challenges faced in Operation Enduring Freedom as well as technologies that will change the way analysts support future military operations.

2 - A Constructive Assessment Process Supporting Army Acquisition

Patrick J. Driscoll, Professor, U.S. Military Academy, Dept of Systems Engineering, Bldg 752 Mahan Hall, West Point, NY, 10996, United States of America, patrick.driscoll@usma.edu, Timothy Elkins, Michael Jaye

An user-focused assessment process was developed in response to disappointing system acceptance and use in deployed settings. The process - Warfighter Technology Tradespace Methodology (WTTM) - integrates multiple perspectives on constructed scales to assess technological performance, human systems integration, and logistics supportability factors to expose potential system vulnerabilities. Select results from a subset of over 400 systems will be presented and discussed.

3 - using Peer Support Groups to Reduce Suicides

Ashok Deb, Assistant Professor, US Army, 1568 Cherry Tree Drive, Clarksville, TN, 37042, United States of America, ashok.k.deb.mil@mail.mil

This research seeks to empower members of the DoD to work together to mitigate suicides by designing a Peer Support Group that will increase resilience and self-esteem within Service Members. By leveraging the Systems Design Process eight necessary components of the proposed Peer Support Group was identified. Each component was explored using analysis, statistics, surveys and review of previous research to determine the best recommendations for each of these components.

4 - Evaluating Geospatial Data Collection Tools for the Army

Megan Wilton, megan.catherine.anne.wilton@gmail.com, Alexandra Sutherland, Breawna Davis

This report will consider the tradeoffs associated with a number of geospatial data collection tools in order to recommend the most valuable and cost effective solution to the Army. Through the Systems Decision Process, a collaborative process that focuses on the needs and values of a stakeholder when dissecting and creating alternatives for a given initial problem, the BuckEye system will prove most valuable in the context of the guidelines set by our stakeholders.

■ SA81

Parc- Divisadero

Networks and Information

Cluster: Data and Information

Invited Session

Chair: Shayan Ehsani, Stanford University, MS&E Department, Stanford, United States of America, shayane@stanford.edu

1 - On the Socially-Optimal Design of Online Reviewing Platforms
Yiangos Papanastasiou, London Business School, Regent's park, London, United Kingdom, yiangosp@london.edu, Kostas Bimpikis, Nicos Savva

In an online reviewing platform, information on the quality of alternative service providers is both generated and utilized by the consumer population. Social inefficiency arises from the fact that information is generated as a byproduct of self-interested consumer behavior, rather than with the benefit of future consumers in mind. Within a classic multi-armed bandit framework, we study how this inefficiency relates to alternative policies of information-disclosure to the platform's users.

2 - Multi-retailer Inventory Problem with Batch Production
Hyun-Soo Ahn, University of Michigan, 701 Tappan St., Ann Arbor, MI, 48104, United States of America, hsahn@umich.edu, Yang Wang, Stefanus Jasin, Phil Kaminsky

Motivated by a problem in biopharmaceutical manufacturing, we consider a discrete time finite horizon inventory problem where several retailers place orders to meet stochastic demand, and in each period, the sum of order quantities across retailers must be a multiple of a standard batch size. We characterize structure of optimal policy, and develop data-driven heuristics with analytic bounds.

3 - Disruption and Diversification in Supply Chains
Alex Teytelboym, Postdoctoral Fellow, MIT, 77 Massachusetts Ave., 32-D632, Cambridge, MA, 02139, United States of America, t8el@mit.edu, Asuman Ozdaglar, Daron Acemoglu, Marco Scarsini

We analyze how supply chains form in the presence of shocks that can cause cascades of production disruption. Firms' inputs are imperfectly substitutable and input diversification is costly. Firms face a tradeoff between the cost of signing more input contracts and the possibility of production disruption. We show how the structure of input-output network affects firms' incentives and the efficiency of equilibria. We discuss the benefits of coordination in supply chain formation.

4 - Auctions with Dynamic Costly Information Acquisition
Negin Golrezaei, Marshall School of Business, University of Southern California, Los Angeles, United States of America, golrezae@usc.edu, Hamid Nazerzadeh

We study the mechanism design problem for the seller of an indivisible good in a setting where buyers can purchase the additional information and refine their valuations for the good. This is motivated by information structures in online advertising where advertisers can target users using cookie-matching services. For this setting, we propose a rich class of dynamic mechanisms, called Sequential Weighted Second-Price, which encompasses the optimal and the efficient mechanisms as special cases.

■ SA82

Parc- Haight

Robust Multiobjective Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Margaret Wiecek, Clemson University, Mathematical Sciences, Clemson, United States of America, wmalgor@clemson.edu

1 - Trade-Offs and Proper Optimality in Multiple-Criteria Optimization under Uncertainty
Anzhelika Lyubenko, Ph.D. Candidate, University of Colorado Denver, 1250 14th Street, Denver, CO, 80202, United States of America, anzhelika.lyubenko@ucdenver.edu, Alexander Engau

We present new results to characterize and compute objective trade-offs and a set of corresponding compromise solutions for multicriteria optimization problems that include elements of uncertainty. We compare our new solutions to those obtained from the alternative approaches of robust and stochastic programming on an example from financial portfolio optimization. We also summarize a few technical results that provide new theoretical insights into the closely related theory of proper optimality.

2 - Robust Biobjective Optimization with One Uncertain Objective
Andrea Raith, The University of Auckland, UniServices House, 70 Symonds St, CBD, Auckland, 1025, New Zealand, a.raith@auckland.ac.nz, Kenneth Kuhn, Anita Schöbel, Marie Schmidt

Standard robustness concepts are extended for biobjective optimization problems with one uncertain objective. The concepts are further refined to ensure robust efficient solutions are not dominated by another solution in all considered scenarios. We propose algorithms to identify robust efficient solutions for combinatorial problems and finitely many scenarios. Results of an application in modelling shipments of hazardous materials, a biobjective shortest path problem, are shown.

3 - Multiobjective Optimization under Uncertainty: Models and Robust Counterparts
Margaret Wiecek, Clemson University, Mathematical Sciences, Clemson, United States of America, wmalgor@clemson.edu, Erin Doolittle, Herve Kerivin

We study three models of uncertain multiobjective programs (MOPs): with uncertain coefficients in constraint functions, uncertain parameters converting MOPs into single-objective programs (SOPs), and uncertain objective functions. For each case, we propose a robust counterpart problem and reduce it into a computationally tractable deterministic MOP or SOP. We examine the relationships between the efficient sets.

■ SA83

Parc- Sutro

Doing Good with Good OR - Student Paper Competition

Cluster: Doing Good with Good OR - Student Paper Competition

Invited Session

Chair: Carri Chan, Columbia University Business School, 3022 Broadway, Uris 410, New York, NY, United States of America, cwchan@columbia.edu

1 - Doing Good with Good OR Student Competition
Ruben Proano, Assistant Professor, Rochester Institute of Technology, Rochester, NY, United States of America, rpmeie@rit.edu

Doing Good with Good OR - Student Paper Competition is held each year to identify and honor outstanding projects in the field of operations research and the management sciences conducted by a student or student group that have a significant societal impact.

2 - Volunteer Engagement in the Age of Analytics: A Case Study with American Red Cross, Greater Chicago Region
Andrew Fox, Northwestern University, Evanston, IL, 60208, United States of America, AndrewFox2014@u.northwestern.edu, Tessa Swanson

Many nonprofit agencies require volunteers as a resource for achieving operational objectives. Recognizing that volunteers can engage or disengage from an organization with relative ease, we study volunteer scheduling and dispatch at American Red Cross, Greater Chicago Region. We develop baseline metrics, predictive modeling, and scheduling policies to optimize the opportunities in which volunteers engage with the organization.

3 - Smarter Tools for (Citi) Bike Sharing
Eoin O'Mahony, Cornell University, Ithaca, NY, United States of America, eoin@cs.cornell.edu

Bicycle¨sharing systems provide a low-cost, environment-friendly urban transportation option. Efficient management of these systems poses a bicycle rebalancing problem comprising three questions: where do bikes need to be, when must they be there, and how can they get there? I apply operations research techniques to yield practical answers to these questions; my solutions optimize current operations at NYC (Citi)Bike.

4 - Resource Allocation and Optimization for Advanced Voting in Gwinnett County
Mehran D'Souza, Georgia Institute of Technology, Atlanta, GA, United States of America, mehsd969@gatech.edu

We develop a decision support tool for the allocation of resources in a queueing network for advanced voting in Gwinnett County, Georgia. Resources include clerks, laptops, and voting machines. To illustrate this tool, we show that a reduction of 1.8 hours of average wait time for a presidential election can be achieved for about $6,000, which impacts roughly 40,000 voters.

Sunday, 11:00am - 12:30pm

■ SB01

Hilton- Golden Gate 6

DIME/PMESII 1

Sponsor: Military Applications Society

Sponsored Session

Chair: Dean Hartley, Principal, Hartley Consulting, 106 Windsong Ln, Oak Ridge, TN, 37830, United States of America, DSHartley3@comcast.net

1 - Understanding DIME/PMESII

Dean Hartley, Principal, Hartley Consulting, 106 Windsong Ln, Oak Ridge, TN, 37830, United States of America, DSHartley3@comcast.net

I introduce DIME/PMESII and tools to support understanding it. The US has been and will continue to be involved in DIME/PMESII situations. Understanding these situations is a prerequisite to dealing with them well – and they are difficult to understand. The Army has developed some tools that will be useful. We can convert these tools into enablers to allow fewer people to do more with fewer resources, support Institutional Memory retention, and leverage current information gathering tools.

2 - Best Practices for Irregular Warfare (IW) Data Quality Control

Jeff Appleget, Senior Lecturer, Naval Postgraduate School, 1411 Cunningham Road GL-239, Monterey, CA, 93943, United States of America, jaappleg@nps.edu

US DoDI 5000.61 mandates that "Models, simulations, and associated data used to support DoD processes, products, and decisions shall undergo verification and validation (V&V) throughout their lifecycles." This presentation identifies the challenges with finding, using, and the quality control of data for Irregular Warfare Methods, Models, and Tools (MMTs), and recommends best practices for DoD organizations to adopt to ensure that IW data is quality controlled.

3 - using Complex Adaptive Systems Research to Analyze Al Qaeda's Terror Network

Charlie Graham, American Military University, 111 W. Congress Street, Charles Town, WV, 25414, United States of America, charlie.c.graham@gmail.com, Philip Fellman

The US response to Al Qaeda, following the 9/11 attack on the World Trade Center, has to some extent diminished the centralized command of Al Qaeda. At the same time that Al Qaeda's central organization has been undermined, the Salafist jihad has expanded into a host of distributed cellular networks across allied organizations. We use social network theory and the computational tools of social network analysis to analyze the behavioral characteristics of these various organizations.

■ SB02

Hilton- Golden Gate 7

Strategies for Developing Inventions and Profiting from Them

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Leonardo Santiago, Associate Professor, Federal University of Minas Gerais, Escola de Engenharia da UFMG, Av. Antonio Carlos 6627. Pampulha, Belo Horizonte, MG, 31270901, Brazil, lsantiago@ufmg.br

1 - Selling a New Product: The Role of Customer Learning Externality and Incumbent Reaction

Bilal Gokpinar, Assistant Professor, University College London, Gower Street, London, United Kingdom, b.gokpinar@ucl.ac.uk, Yufei Huang, Onesun Steve Yoo

We study an entrepreneur's optimal sales resource allocation strategy when selling a new product/service to rational customers who differ in their revenue potential and the level of influence on each other. We then consider the case of competition between a newcomer and an incumbent, and study the newcomer's customer acquisition and the incumbent's customer retention strategies in the presence of customer learning externality.

2 - Strategies for Technologies with Weak Patent Rights Revisited

Leonardo Santiago, Associate Professor, Federal University of Minas Gerais, Escola de Engenharia da UFMG, Av Antonio Carlos 6627. Pampulha, Belo Horizonte, MG, 31270901, Brazil, lsantiago@ufmg.br, Henrique Rocha, Jose Heleno Faro

In this paper we focus on strategies companies can adopt in order to prevent imitation of their technological innovations. We develop a game theoretical model to assess the key variables that can impact the firm's strategies for value appropriation or inhibit competitors from entering into the market. The results hinge on the competitor's absorptive capacity, and on it's choice between the alternatives for competing with a patented innovation.

3 - Is There a Doctor in the House?: The Impact of Users on Medical Device Innovation

Sruthi Thatchenkery, Stanford University, MS&E Department, Stanford, United States of America, sruthi@stanford.edu, Riitta Katila, Michael Christensen, Stefanos Zenios

We explore the innovation impact that users have in new firms. While users frequently advice firms as members of advisory boards or as external consultants, and commercialize their inventions by founding firms, we know little about how young firms can effectively leverage users in various other organizational roles. We draw on an extensive custom-collected dataset of 268 surgical instrument firms over a 31-year period.

■ SB03

Hilton- Golden Gate 7

Business Model Innovation: Operations and Information Management Perspectives

Cluster: Business Model Innovation

Invited Session

Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, United States of America, jguajardo@haas.berkeley.edu

1 - The Risk-driven Business Model: Four Questions that will Define Your Company

Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, serguei.netessine@insead.edu, Karan Girotra

We discuss our take on business model innovation based on the book "The Risk-Driven Business Model: Four Questions that Will Define your Company" www.defineyourcompany.com. We make an argument that the field of Operations Management should be moving away from how to manage a company in a steady-state and towards innovation: taking company to a drastically new level.

2 - New Service Business Models - Problems and Opportunities

Kamalini Ramdas, London Business School, Regent's Park, London, United Kingdom, kramdas@london.edu

I will describe new business models in a variety of services in areas such as healthcare, education, tax, utilities and banking and identify common features within groups of business models, with a view to identifying research opportunities for operations management and innovation researchers in the area of business model innovation.

3 - From Problem Driven to Data Driven Research

David Simchi-Levi, Professor, MIT, 77 Massachusetts Ave, Room 1-171, Cambridge, MA, 02139, United States of America, dslevi@mit.edu

Increased computing power and the explosion of data are changing the way organizations capture data, analyze information and make decisions. These changes provide opportunities for our community to analyze extensive data so as to identify new models that drive decisions and actions. In this talk, I will presents my view on these opportunities and challenges.

4 - Randomized Field Experiments in Mobile Advertising and Mobile Coupons

Anindya Ghose, NYU, Stern School, New York, United States of America, aghose@stern.nyu.edu

We present results from randomized field experiments that measure the ROI of mobile marketing and promotions. In the first one, we explore cross channel synergies between web and mobile advertising. In another set of field experiments involving a location based app for smartphones, we measure user redemption behavior of geo-targeted mobile coupons.

■ SB04

Hilton- Continental 1

Topics in Operations with Marketing Incentives

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Guoming Lai, Assistant Professor, McCombs School of Business, University of Texas at Austin, 2110 Speedway, Austin, TX, 78712, United States of America, Guoming.Lai@mccombs.utexas.edu

1 - Search for Information on Multiple Products

Tony Ke, UC Berkeley, IEOR, Etcheverry Hall, Berkeley, CA, 94720, United States of America, kete@berkeley.edu, Zuo-Jun Max Shen, Miguel Villas-Boas

When a consumer considers a purchase in a product category, she can gather information sequentially on several products. We develop a framework for continuous search for information on choice set of multiple alternatives, and apply it to consumer search in product market. We solve for the optimal search, switch, and purchase or exit behavior analytically. We show interesting implications of how product valuations, information correlation among products, and size of choice set influence sales.

2 - Customer Acquisition and Retention: A Customer Life Time Value Approach to Quality and Capacity

Azin Farzan, Univesity of Southern California, Univesity of Southern California, Bridge 401, Los Angeles, CA, 90089, United States of America, afarzan@usc.edu, Yong-Pin Zhou

We analyze the optimal decision set for a service provider. The firm chooses both capacity and quality levels and also the marketing strategy and investment level to maximize profit. Because the nature of the consumer behavior is heavily dependent on the operations and marketing strategy, there is a natural tradeoff between these strategies. We model the effects of operations and marketing decisions on both the customer acquisition and retention processes and create an elaborate service model.

3 - Agility and Proximity Considerations in Supply Chain Design

Ho-Yin Mak, Assistant Professor, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, hymak@ust.hk, Michael Lim, Zuo-Jun Max Shen

In the increasingly competitive online retailing market, competitive edge is built on short response times and high product availability. In this work, we investigate the impact of agility, the ability to responsively and flexibly allocate demand among stocking locations in the distribution network, on the optimal network configuration. Our results offer insights into optimal designs of agile supply chains that contrast sharply with classical results on conventional supply chains.

4 - Sourcing with Deferred Payment and Inspection

Guoming Lai, Assistant Professor, McCombs School of Business, University of Texas at Austin, 2110 Speedway, Austin, TX, 78712, United States of America, Guoming.Lai@mccombs.utexas.edu, Huaxia Rui

We study the deferred payment and inspection mechanisms for mitigating supplier product adulteration, with endogenous procurement decision and general defect discovery process. We derive the optimal deferred payment contract and the inspection equilibrium. We find that the deferred payment mechanism generally can outperform the inspection mechanism when either the market size is small or the profit margin is low.

■ SB05

Hilton- Continental 2

Retail Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Zumbul Atan, Eindhoven University of Technology, School of Industrial Engineering, Eindhoven, Netherlands, Z.Atan@tue.nl

1 - Understanding the Risks and Benefits of Radio Frequency Identification (RFID) in Managing a Seasonal

Ozgen Karaer, Assistant Professor, Middle East Technical University, Department of Industrial Engineering, Universiteler Mah. Dumlupinar Bulvari #1, Ankara, 06800, Turkey, okaraer@metu.edu.tr

Achieving inventory record accuracy through RFID (Radio Frequency Identification Technology) facilitates correct replenishment in a retail environment, which is expected to increase sales. We study the RFID impact on in-season management of a retailer of a seasonal product. We demonstrate how inventory discrepancy could hurt the retailer's revenue and quantify the value of RFID in this respect. We also study an imperfect RFID scenario to show it could adversely affect the benefits.

2 - An Efficient Algorithm for Capacitated and Stochastic Assortment Planning

Alexander Huebner, Professor, Catholic University, Auf der Schanz 49, Ingolstadt, 85049, Germany, Alexander.Huebner@ku.de, Heinrich Kuhn, Sandro Kuehn

Increasing product variety in the retail trade is in conflict with the limited shelf space. We identify the underlying category planning problems and formulate a Newsboy-based capacitated assortment problem with stochastic demand and substitution. We develop an epsilon-exact procedure which is capable of solving problem instances of practical relevance. The numerical analyses show that out-of-assortment and out-of-stock substitution effects have a significant impact on profit and solution.

3 - Effect of Shelf Capacity on Backroom Operations

Nesim K. Erkip, Bilkent University, Department of IE, Ankara, 06800, Turkey, nesim@bilkent.edu.tr, Zumbul Atan

Most retailers use backrooms as extra storage space. Backrooms are necessary when inventories do not fit to the available shelf space. Excess inventories are placed to the backrooms and used to satisfy customer orders when shelf inventory is depleted. We study a retailer with limited shelf capacity. Assuming a continuous review (r,q) policy with a given q, we investigate the optimal reorder level when unsatisfied customer demands are lost or backordered.

4 - Inventory Control with Shelf Space Consideration

Zumbul Atan, Eindhoven University of Technology, School of Industrial Engineering, Eindhoven, Netherlands, Z.Atan@tue.nl, Nesim K. Erkip, Tom Van Woensel, Jan C. Fransoo

We consider a retailer with limited shelf space. Assuming continuous restocking from a backroom, we study retailer's optimal replenishment decisions and the optimal shelf capacity. The main determinants of the optimal solutions are investigated through sensitivity analysis.

■ SB06

Hilton- Continental 3

Behavioral Research in Information Sharing

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Saibal Ray, Professor, McGill University, Desautels Faculty of Management, Montreal, Canada, saibal.ray@mcgill.ca

Co-Chair: Jud Kenney, PhD Candidate, McGill University, Bronfman Building, 1001 rue Sherbrooke Ouest, Montreal, QC, H3A 1G5, Canada, jud.kenney@mail.mcgill.ca

1 - Information Sharing under Supply Uncertainty

Jud Kenney, PhD Candidate, McGill University, Bronfman Building, 1001 rue Sherbrooke Ouest, Montreal, QC, H3A 1G5, Canada, jud.kenney@mail.mcgill.ca, Saibal Ray, Jim Engle-Warnick

This study investigates the behavior of manufacturers and suppliers sharing information when supply chain uncertainty is dominated by supply instead of demand. We elicit beliefs of both manufacturer and supplier roles and compare how subjects distort their information as manufacturers and compensate for the distortion as suppliers.

2 - On the Learning Process of a Newsvendor with Censored Demand Information

Yingshuai Zhao, Ph.D. Candidate, Tsinghua University, Shunde Building, Tsinghua University, Beijing, China, zhao-ys08@mails.tsinghua.edu.cn, Xiaobo Zhao

We conducted an experimental study to explore the decision process in a fully censored-demand-information scenario. With censored information, participants had no demand distribution knowledge while they could only observe censored demand in every period. An efficient learning effect is verified and an exponential-type learning model based on the experimental data. We have found that the learning process could be influenced by both information and profit configurations

3 - Experimental Investigation of Salesforce Pricing Decisions

Rashmi Sharma, PhD Student, The Pennsylvania State University, Business Building, University Park, United States of America, ros5253@smeal.psu.edu, Saurabh Bansal, Elena Katok, Peter Rimshnick

We model salesforce pricing decisions under the uncertainty of getting a contract, and various incentive schemes. We identify three classes of projects with specific risk profiles, and the incentive schemes best suited for each. Subsequently, we test pricing decisions in a lab to identify behavioral factors that influence pricing decisions.

4 - How Team Personality, Dynamics and Material Work Flow Policies Affect Team Performance

David Cantor, Associate Professor, Iowa State University, 2340 Gerdin Business Building, Ames, IA, 50011, United States of America, dcantor@iastate.edu, Paula Morrow

Supply chain and organizational behavior scholars are interested in understanding how individual differences such as personality traits and cognitive ability affect team performance. The focus of this study is on examining how individual differences affect team performance in material flow lines. This study seeks to answer the following research questions: How do team personality and dynamics affect team performance? Do material work flow policies moderate this relationship?

■ SB07

Hilton- Continental 4

Critical Infrastructure

Cluster: Tutorials

Invited Session

Chair: Dave Alderson, Associate Professor, Naval Postgraduate School, United States of America, dlalders@nps.edu

1 - Assessing and Improving Operational Resilience of Critical Infrastructures and Other Systems

Dave Alderson, Associate Professor, Naval Postgraduate School, United States of America, dlalders@nps.edu, Gerald Brown, Matt Carlyle

In this TutORial we quantify resilience for an infrastructure system to a set of disruptive events in terms of degradation of system function. We show how to build and solve a sequence of models to assess and improve the resilience of an infrastructure system to those disruptions. Through simple examples and real-world case studies, we provide motivation, details of the models, and solution algorithms.

■ SB09

Hilton- Continental 6

Incentive and Contracting in Healthcare Networks

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Retsef Levi, MIT Sloan School of Management, 100 Main Street, E62-562, Cambridge, MA, 02139, United States of America, retsef@mit.edu

1 - Online Algorithms for Dynamic Multi-priority Allocation Scheduling

Xinshang Wang, Columbia Business School, New York, NY, United States of America, xw2230@columbia.edu, Van-Anh Truong

In a dynamic allocation scheduling problem, patients arriving in each period are either served in the current period, or placed in a queue. The trade-off for this problem is between overtime resource expenditure required for immediate service and patient waiting time. We introduce the first online scheduling algorithm which is 2-competitive, the best possible ratio for this class of problems. We use simulation results to test the performance of our algorithm and its variants.

2 - Efficiency of Revenue Sharing Joint Ventures with Capacity Investment Decisions

Cong Shi, Assistant Professor, University of Michigan, 2797 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, shicong@gmail.com, Wei Sun, Retsef Levi, Georgia Perakis

We study capacity planning problems with resource pooling in joint ventures under uncertainties. When resources are heterogeneous, there exists a unique efficient revenue sharing contract under proportional fairness. This optimal contract rewards every player proportionally to her marginal cost. When resources are homogeneous, there does not exist an efficient revenue sharing contract. We propose a provably good contract that rewards each player inversely proportional to her marginal cost.

3 - Risk Sharing Pricing Contract between Healthcare Networks

Retsef Levi, MIT Sloan School of Management, 100 Main Street, E62-562, Cambridge, MA, 02139, United States of America, retsef@mit.edu, Fernanda Bravo, Georgia Perakis, Gonzalo Romero

Motivated by the pricing of referrals in healthcare, we present a new pricing contract for a service-based business interaction. Here, one firm provides a service to another firm, whereas the demand for that service is a priori uncertain. The model includes firm's risk valuation with respect to demand uncertainty, such that the new contract allows for better risk sharing. By modeling firms' interaction in a game theoretic framework, we fully specify the contract for general demand distributions.

■ SB10

Hilton- Continental 7

Product Assortment: Theoretical and Experimental Developments

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Aydin Alptekinoglu, Penn State, Smeal College, University Park, PA, 16802, United States of America, aydin@psu.edu

Co-Chair: Ali Parlakturk, Associate Professor, Kenan-Flagler Business School, University of North Carolina at CH, Campus Box 3490, Chapel Hill, NC, 27599, United States of America, Ali_Parlakturk@kenan-flagler.unc.edu

1 - Dynamic Assortment Competition and the Role of Supply Chain Responsiveness

Victor Martinez de Albeniz, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, valbeniz@iese.edu, Gurhan Kok

Fast fashion retailers can launch products inspired on popular trends and styles, while traditional retailers with longer lead times arrive late to the market for those items. We study dynamic assortment choices when retailers with different responsiveness capabilities compete. We find that shorter lead-times provide higher sales and higher margins. However, slow retailers may also benefit by entirely capturing the sales of products late in the product life cycle.

2 - The Effect of Contract Type on Retailer Product Choice

Anna Devlin, Assistant Professor, University of Alabama Huntsville, College of Business, Huntsville, Al, United States of America, anna.g.devlin@gmail.com, Wedad Elmaghraby, Rebecca Hamilton

In this research we study experimentally if the type of contract offered influences the level of risk a retailer engages in when making product decisions. We first test if contract type influences the retailer's decision between two products and then extend this to subsequent order quantity decisions.

3 - The Exponomial Choice Model

Aydin Alptekinoglu, Penn State, Smeal College, University Park, PA, 16802, United States of America, aydin@psu.edu, John Semple

We propose a new discrete choice model and explore its implications for assortment planning and pricing.

4 - Is Servicization a Win-Win Strategy?

Ali Parlakturk, Associate Professor, Kenan-Flagler Business School, University of North Carolina at CH, campus box 3490, Chapel Hill, NC, 27599, United States of America, Ali_Parlakturk@kenan-flagler.unc.edu, Vinayak Deshpande, Adem Orsdemir

We study profit and environmental implications of servicization, the practice of selling the functionality of the product rather the product itself. We contrast segmentation benefit of servicization to that of offering a product line.

■ SB11

Hilton- Continental 8

Operations Economics

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Gabriel Weintraub, Columbia Business School, gyw2105@columbia.edu

Co-Chair: Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu

1 - Network Effects in Conspicuous Consumption

Ruslan Momot, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Ruslan.MOMOT@insead.edu, Elena Belavina, Karan Girotra

We consider a firm selling goods to consumers who value the perception of the good by other consumers in their social network. Customers most value goods that their social connections are familiar with but are unable to acquire. Using recent advances in network games, we identify product launch and distribution strategies.

2 - Procurement Auctions for Differentiated Products: Design and Applications

Daniela Saban, Columbia University, Uris Hall, 4I, New York, United States of America, dhs2131@columbia.edu, Gabriel Weintraub

We study the problem of a procurement agency using an auction to build an assortment of differentiated products, offered by strategic suppliers and consumed by heterogeneous customers. This setting arises in "framework agreements" (FAs), commonly used in public and private procurement. Using mechanism design and auction theory, we propose recommendations to improve the design of FAs. We apply our results to the FAs run by the Chilean government to buy US$2 billion worth of goods per year.

3 - Managing Service Systems in Presence of Social Networks

Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Dennis Zhang

We study a service system with the presence of a social network. In our model, firms can differentiate resource allocations among customers, and customers learn the service qualities from the social network. We study the interplay among network structure, customer characteristics, and information structure, and characterize the optimal policy. We further calibrate our model with data from Yelp.com and quantify the value of social network knowledge empirically.

4 - The Economics of Uber

Gerard Cachon, Wharton University, Philadelphia, PA, United States of America, cachon@wharton.upenn.edu, Kaitlin Daniels, Ruben Lobel

Uber provides a market that matches "black car" drivers with passengers in need of transportation services. They are one of several recent companies contributing to a new "sharing economy" in which people earn revenue from their existing assets that otherwise would remain idle. This paper explores the impact of this new business model on the market.

■ SB12

Hilton- Continental 9

Sustainable and Socially Responsible Supply Chains

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Sang Kim, Yale School of Management, 165 Whitney Ave, New Haven, CT, 06511, United States of America, sang.kim@yale.edu

1 - Measurement and Improvement of Environmental Performance under Voluntary versus Mandatory Disclosure

Basak Kalkanci, Associate Professor, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, Basak.Kalkanci@scheller.gatech.edu, Erjie Ang, Erica Plambeck

When a firm exerts effort to evaluate its social & environmental impacts, it finds opportunities to reduce them (and hence its risks associated with future regulation). We investigate when a firm should learn and disclose its impact (accounting for the response from consumers and investors) and whether policy makers should mandate disclosure. Experimentally, we show that voluntary disclosure can boost sales.

2 - Design Incentives, Coalitional Stability, or Cost Efficiency? A Network Perspective on EPR

Luyi Gui, luyig@uci.edu, Atalay Atasu, Ozlem Ergun, Beril Toktay

Extended Producer Responsibility (EPR) is an environmental policy tool that mandates producers' financial responsibility for end-of-life treatment of their products. EPR has been regarded at its heart a policy to provide incentives for more environmentally-friendly design. We investigate the operational impact of collective EPR implementation on its product design outcome.

3 - Allocating Emissions among Co-Products: Implications for Procurement, Offsetting & Border Adjustment

Nur Sunar, University of North Carolina at Chapel Hill, Nur_Sunar@kenan-flagler.unc.edu, Erica Plambeck

A state with climate policy may impose a tax on imported products for greenhouse gas emissions that occur in production and transportation to its border (a so-called border adjustment) or a buyer may voluntarily commit to offset its upstream supply chain emissions. When a process yields co-products in ?xed proportions, how should emissions from the process be allocated among the co-products? We address that question from the perspective of a border adjustment policy maker and buyer, in turn.

4 - Managing a Responsible Supply Chain under Threat of Public Disclosure

Saed Alizamir, saed.alizamir@yale.edu, Sang Kim

We analyze a game-theoretic model in which a downstream supply chain member ("buyer") is penalized disproportionately due to a compliance violation by an upstream member ("supplier"). Buyer's ability to audit the supplier is limited, and she faces a risk of being publicly blamed after the supplier's violation is caught by a third party. Supplier exerts effort to enhance compliance in each period, but risks having his relationship terminated due to a stochastic compliance outcome.

■ SB15

Hilton- Exec. Boardroom

Environmental Efficiency

Cluster: Data Envelopment Analysis

Invited Session

Chair: Per-Olov Marklund, Umea University, Umea, 90187, Sweden, pelle.marklund@econ.umu.se

1 - Measuring Environmentally Sensitive Efficiency and Productivity Growth in the Urban Water Sector

Jayanath Ananda, Senior Lecturer, La Trobe University, School of Economics, Albury-Wodonga Campus, Wodonga, Vi, 3690, Australia, j.ananda@latrobe.edu.au, Benjamin Hampf

Using the global Malmquist-Luenberger index approach, this paper analyses the efficiency and productivity growth trends in the Australian urban water sector whilst incorporating an undesirable output – greenhouse gas emissions. Results indicate that the productivity growth of the sector has declined when greenhouse gas emissions are included. The findings call for a greater understanding of energy intensity of various water supply options and sewerage operations.

■ SB16

Hilton- Franciscan A

Operational Issues in Agriculture

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Onur Boyabatli, Singapore Management University, 50 Stamford Road 04-01, Singapore, Singapore, oboyabatli@smu.edu.sg

1 - Mitigating the Impact of Product Return Regulations in the Hybrid Seed Industry

Sripad Devalkar, Indian School of Business, ISB Campus Gachibowli, Hyderabad, India, sripad_devalkar@isb.edu, Milind Sohoni, Saurabh Bansal

Existing laws dictate that a hybrid seed manufacturer will accept all unsold seeds from the retailer. In the US market, manufacturers accept orders twice in the season, with the first order guaranteed but not the second because of yield uncertainty. This leads to inflated retailer orders and high return rates. We explore supply chain contracts that address the problem of over ordering and high return rates.

2 - Corn or Soybean: Optimal Farm Space Allocation under Yield and Price Uncertainties

Onur Boyabatli, Singapore Management University, 50 Stamford Road 04-01, Singapore, Singapore, oboyabatli@smu.edu.sg, Yangfang Zhou, Javad Nasiry

This paper analyzes the farm space allocation decision between corn and soybean in a multi-period framework. In each period, the farmer decides the allocation with respect to yield and spot price uncertainties. The crop yield is (stochastically) larger when the same product is not grown in the same farm space for two consecutive periods. We characterize the optimal allocation policy and investigate the impact of yield and price uncertainties on the farmer's profitability.

3 - Global Sourcing under Exchange-rate and Demand Uncertainty

Shahryar Gheibi, Syracuse University, 721 University Avenue, Syracuse, NY, United States of America, sgheibi@syr.edu, Burak Kazaz, Scott Webster

We consider a firm's capacity reservation decisions in the presence of demand and exchange-rate uncertainty. After observing the exchange rate, the firm determines what capacity to utilize for manufacturing under demand uncertainty. We characterize optimal solutions as onshore sourcing, offshore sourcing, and two dual sourcing strategies with rationing and excess capacity. We show that exchange-rate uncertainty can even make the firm reserve capacity only at the more expensive source.

■ SB17

Hilton- Franciscan B

Strategic Behavior in Service Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Amy Ward, Professor, USC, Marshall School of Business, BRI401H, Los Angeles, CA, 90089-0809, United States of America, amyward@marshall.usc.edu

1 - Compensation and Staffing to Trade off Speed and Quality in Large Service Systems

Dongyuan Zhan, PhD Student, USC, 2667 Ellendale Place, Apt 308, Los Angeles, CA, 90007, United States of America, Dongyuan.Zhan.2015@marshall.usc.edu, Amy Ward

Human servers often must trade off speed and quality. The faster they work, the more the quality may be compromised. For large service systems, we explore how the servers respond to compensation incentives and propose compensation and staffing design to minimize the system costs. We find that different optimal staffing regimes appear with different system cost structures.

2 - Leadership Structure and Free Riding in Team Projects

Morvarid Rahmani, Assistant Professor, Georgia Tech, 800 West Peachtree Street, N.W., Atlanta, GA, 30308, United States of America, Morvarid.Rahmani@scheller.gatech.edu, Guillaume Roels, Uday Karmarkar

In this paper, we consider a multi-agent project with finite deadline, as may arise, for instance, in consulting services. We investigate whether appointing a team leader helps alleviate or exacerbate free riding, relative to having team members making their effort decisions in a decentralized fashion. We find that appointing a team leader is beneficial when the project has high stakes and a short deadline.

3 - Trading Time in a Congested Environment

Luyi Yang, Booth School of Business, University of Chicago, 5807 S. Woodlawn Avenue, Chicago, IL, United States of America, luyi.yang@chicagobooth.edu, Laurens Debo, Varun Gupta

We consider an M/M/1 queueing system in which heterogeneous time-sensitive customers with private information about their delay costs trade their waiting positions through a profit-maximizing broker. We find that the broker's optimal mechanism would restrict trading among a pool of customers with moderate delay costs. These customers wait on average just as much as they would in a first-come-first-served system and they are indifferent to participation in trading.

4 - Skill and Capacity Management in Large-scale Service Marketplaces

Eren Cil, University of Oregon, 1208 University of Oregon, Eugene, OR, United States of America, erencil@uoregon.edu, Gad Allon, Achal Bassamboo

We characterize the optimal skill screening mechanism of a firm moderating a large-scale service marketplace where the ability of a service provider to cater customers, who can be of two classes, varies. We show that when the values that a service provider generates for each customer class are independent, the firm may need to refuse some of the service providers via its screening mechanism whereas this is never optimal when these values are perfectly correlated.

■ SB18

Hilton- Franciscan C

Choice Models in Revenue Management and Pricing II

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Hongmin Li, Assistant Professor, W.P. Carey School of Business, ASU, Tempe, 85287, United States of America, Hongmin.Li@asu.edu

Co-Chair: Tim Huh, Associate Professor, University of British Columbia, Sauder School of Business, Vancouver, BC, V6T 1Z2, Canada, tim.huh@sauder.ubc.ca

1 - Buy Now or Shop Around? Assortment Planning and Pricing with Search Cost

Ruxian Wang, Assistant Professor, Johns Hopkins Carey Business School, 100 International Dr, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu, Ozge Sahin

We consider assortment planning and pricing problems in the presence of consumer search cost. We show that the assortment problem with given prices is NP-hard and can be solved by dynamic programming. The multi-product pricing with search cost can be transformed to maximizing a set of unimodal single-variable functions of polynomial size. Finally, we investigate the effects of search cost in price competition.

2 - Quality Consistent Discrete Pricing and Assortment Optimization under the Nested Logit Model

James Davis, Ithaca, NY, United States of America, jamesmariodavis@gmail.com, David Williamson, Huseyin Topaloglu

We consider a joint assortment and pricing problem where relative product prices are constrained to match relative product quality. Each product price can be chosen from a discrete set of prices levels but higher quality products must have higher prices. We use the nested logit model to model purchase probabilities. Our objective is to choose an assortment of products, and quality consistent prices for those products, so that expected revenue is maximized.

3 - Quantity Pre-Commitment and Cournot Equivalence

Hongmin Li, Assistant Professor, W.P. Carey School of Business, ASU, Tempe, 85287, United States of America, Hongmin.Li@asu.edu, Amr Farahat, Tim Huh

Cournot equivalency established by Kreps and Scheinkman (1983) and Friedman (1988) indicates that the Cournot model applies when quantity and price decisions are sequential. However, the conditions they established preclude many commonly observed multi-product demand models. Our research expands the Cournot equivalency result to more general settings including the widely-adopted MNL demand model.

■ SB19

Hilton- Franciscan D

Topics in Pricing and Revenue Optimization

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Victor Araman, AUB, Beirut, Lebanon, va03@aub.edu.lb

1 - Revenue Models for Off-grid Energy Access

Ioana Popescu, Professor, INSEAD, Singapore, ioana.POPESCU@insead.edu, Bhavani Shanker Uppari, Serguei Netessine

One quarter of the world's population does not have access to electricity. Poor households spend up to half of their income, for about $37 billion/year on kerosene and biomass. Alternative technologies, such as solar-based solutions are healthier and offer greater value, yet they require significant one-time investments which are not affordable to people living on $2/day. We explore innovative approaches and alternative revenue models for serving this market, including a case study in Rwanda.

2 - Dynamic Pricing with Risk Sensitive Consumers and Social Learning

Mikhail Nediak, Assistant Professor, Queen's School of Business, 143 Union Str., Kingston, ON, K7L3N6, Canada, mikhail.nediak@queensu.ca, Jue Wang, Tanya Levina, Yuri Levin

We present a dynamic pricing model for a monopolist offering a durable product to risk-sensitive consumers. Consumers use social learning to determine the true quality of the product to make purchase decisions. We study the structure of the optimal pricing policy and evaluate the relative gains of offering free samples to high-influence individuals prior to the selling season. The proposed model of social learning is tested on a sample of recent movie data.

3 - Dynamic Pricing with Buybacks
Rene Caldentey, Professor, New York University, 44 West Fourth Street, 8-77, New York, NY, 10012, United States of America, rcaldent@stern.nyu.edu, Ying Liu, Guillermo Gallego

We consider a dynamic pricing revenue management problem in which the seller is able to buy back units from previous customers. These customers are willing to return their units as their private valuations change over time. The seller's problem is to dynamically adjust both selling and buyback prices to maximize total expected revenue. We study the impact of the return policy and show that the policy benefits both the seller and customers.

4 - Pricing a Non Perishable Product when Facing Varying Valuations
Victor Araman, AUB, Beirut, Lebanon, va03@aub.edu.lb

In many contexts, a buyer's valuation of a particular product changes over time due to more information gathered about the product or to other external factors. In this talk, we consider a seller looking at pricing through time a non perishable product facing consumers with varying valuations. The optimal pricing policy happens to be non tractable, yet interestingly simple periodic policies are proven to perform very well.

■ SB20

Hilton- Yosemite A

Empirical Market Design

Cluster: Matching and Market Design (in honor of Al Roth)

Invited Session

Chair: Ramesh Johari, Stanford University, Huang 311, Stanford, CA, United States of America, ramesh.johari@stanford.edu

1 - Quality Externalities and the Limits of Reputation in Two-Sided Markets
Steve Tadelis, Professor, UC Berkeley, Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, United States of America, stadelis@haas.berkeley.edu, Chris Nosko

Using data from eBay, we argue that platforms can mitigate externalities by actively screening sellers and promoting the prominence of better quality sellers. Exploiting the bias in feedback, we create a measure of seller quality and demonstrate the benefits of our approach through a controlled experiment that prioritizes better quality sellers to a random subset of buyers. .

2 - On the Near Impossibility of Measuring the Returns to Advertising
Randall Lewis, Economic Research Scientist, Google Inc., 1600 Amphitheatre Parkway, Mountain View, CA, 94043, United States of America, randall@econinformatics.com, Justin Rao

Firms have a hard time measuring the causal impact of advertising expenditures on profit. In twenty-five online field experiments, individual-level sales are volatile relative to the per capita cost of a campaign—a small impact on a noisy dependent variable can generate positive returns. Experiments can need more than ten million person-weeks. Further, small selection biases can severely bias observational estimates. Weak informational feedback and technological advances shape ad marketplaces.

3 - Corporate Prediction Markets: Evidence from Google, Ford, and Firm X
Bo Cowgill, UC Berkeley, 1931 Diamond St Apt 3, San Francisco, CA, 94131, United States of America, bo.cowgill@gmail.com, Eric Zitezwitz

We examine data from prediction markets run by Google, Ford and Firm X (a large private materials company). Despite theoretically adverse conditions, we find these markets are relatively efficient, and improve upon the forecasts of experts at all three firms by as much as a 25% reduction in MSE. The most notable inefficiency is an optimism bias in the markets at Google and Ford. The inefficiencies that do exist become smaller over time for reasons we document.

4 - At What Quality and What Price? Inducing Separating Equilibria as a Market Design Problem
John Horton, Professor, NYU Stern School of Business, Kaufman Management Center, 44 West Fourth St, 8-81, New York, NY, 10012, United States of America, john.joseph.horton@gmail.com, Ramesh Johari

A tool to promote revelation of buyers' price/quality preferences was experimentally introduced into an online labor market. In the treatment cells of the experiment, upon posting a job, buyers chose what price/quality level they were seeking from sellers. We find that buyers readily reveal their preferences and that this revelation—-which itself was experimentally manipulated—-strongly induced seller-side sorting.

■ SB21

Hilton- Union Sq 1

Routing Problems with Time Windows Constraints

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Shu Zhang, University of Iowa, IA, United States of America, shu-zhang-1@uiowa.edu

1 - A Branch-cut-and-price Algorithm for a Production-delivery Routing Problem
Iman Dayarian, École Polytechnique de Montréal and GERAD, Montréal, Québec, Canada H3C 3A7, iman.dayarian@gerad.ca, Guy Desaulniers

We study a rich production-delivery routing problem with time windows arising at a catering services company. The production part consists of assembling the meals to deliver. It considers release dates to ensure freshness of the products to be delivered and is also restricted by due dates incurred by the constructed routes. Delivery and production costs are minimized under various constraints. A cutting-edge branch-cut-and-price is proposed to solve real-life instances to optimality.

2 - Robust Inventory Routing with Flexible Time Window Allocation
Chengliang Zhang, Georgia Institute of Technology, 765 Ferst Drive, NW, Atlanta, GA, United States of America, czhang85@gatech.edu, George Nemhauser, Joel Sokol, Myun-Seok Cheon, Dimitri Papageorgiou

We study an inventory routing problem with delivery time windows for uncertain disruptions, where the length and placement of time windows are also decision variables. The goal is to generate robust routes and time windows to withstand the disruptions. We generate routes using robustness strategies, and determine time windows by solving a stochastic program that considers a set of disruptions and their recovery solutions. Extensive simulation results illustrate the benefits of our approach.

3 - The Cooperative Orienteering Problem with Time Windows
Melih Ozlen, School of Mathematical and Geospatial Sciences, RMIT University, Melbourne, Australia, melih.ozlen@rmit.edu.au, James Minas, Martijn Van der Merwe, John Hearne

We define a new class of the team orienteering problem; the cooperative team orienteering problem with time windows (COPTW). It is a generalisation that requires visits by multiple vehicles at the same time to collect the reward from a location. We present an efficient two-index mixed integer programming formulation of this problem that eliminates symmetry related inefficiencies. This new formulation of COPTW is demonstrated on a wildfire scenario from South Hobart, Tasmania, Australia.

4 - Dynamic Orienteering on a Network of Queues with an Application to Textbook Sales
Shu Zhang, University of Iowa, IA, United States of America, shu-zhang-1@uiowa.edu, Jeffrey W. Ohlmann, Barrett Thomas

Motivated by the daily decision making faced by textbook sales representatives, we study a variant of the orienteering problem with time windows in which the decision maker may experience uncertain wait times due to the existence of queues at customers. We formulate the problem as a Markov decision process with an objective of maximizing the expected profit. We examine dynamic solutions using a rollout policy framework and present computational results.

■ SB22

Hilton- Union Sq 2

Logistics Planning under Disruptions

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Hector Carlo, University of Puerto Rico - Mayaguez, Industrial Engineering Department, Call Box 9000, Mayaguez, PR, 00681-9000, Puerto Rico, hector.carlo@upr.edu

1 - Robust Hazmat Network Design Problems Considering Risk Uncertainty
Longsheng Sun, Ph.D. Student, University at Buffalo (SUNY), Industrial and Systems Engineering, Buffalo, NY, 14260, United States of America, lsun4@buffalo.edu, Mark Karwan, Changhyun Kwon

We study robust network design problems for hazardous materials transportation considering risk uncertainty. Risk uncertainty is considered in two ways: (1) uncertainty on each link across all shipments, and (2) uncertainty on each link for each shipment. We propose a Lagrangian relaxation heuristic to solve subproblems within a heuristic framework.

2 - Hybrid Optimization Model for the Humanitarian Aid Distribution Problem
Jaime Mora Vargas, jmora@itesm.mx

This work presents a model for humanitarian aid distribution in order to minimize delays, considering non-satisfied demand and reaching for balanced distribution aftermath. The model proposed solves the involved routing and distribution problems thorough a hybrid optimization metaheuristic that combines integer lineal programming and simulated annealing algorithm. The proposed model considers that the capacity of humanitarian aid storage at Distribution Points to satisfy the next period's demand, also considers that all vehicles are able to travel through several routes in each period, visiting the same Distribution Point within a single period.

3 - Road Network Restoration Optimization after Major Disruptions
Hector Carlo, University of Puerto Rico - Mayaguez, Industrial Engineering Department, Call Box 9000, Mayaguez, PR, 00681-9000, Puerto Rico, hector.carlo@upr.edu, Wilson Alvarez, Suzanna Long, Thomas Shoberg, Steven Corns

This study presents a mathematical model and heuristics to optimize road network restoration in the aftermath of major disruptions. The optimization problem consists of simultaneously assigning and scheduling repair crews to service damaged or destroyed road elements to minimize the expected delivery times in the network.

■ SB23

Hilton- Union Sq 3

Urban Logistics

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Tom Van Woensel, Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, t.v.woensel@tue.nl

1 - An Exact Method for the Fleet Composition Problem in Urban Areas
Anna Franceschetti, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, A.Franceschetti@tue.nl, Tom Van Woensel, Gilbert Laporte

We study the problem of managing a heterogeneous vehicle fleet for a logistics company which operates in an urban area subject to vehicle access restrictions. Using a continuous approximation approach we reduce the problem to an area partitioning problem. We propose an efficient procedure to find the optimal solution using dynamic programming. Our analytical results can be used to illustrate the tradeoffs between electric and diesel vehicles.

2 - Time-dependent Pollution Routing Problem with Path Flexibility in Mega-city Logistics
Yixiao Huang, Tsinghua University, Beijing, China, huangyx12@mails.tsinghua.edu.cn, Tom Van Woensel, Jean-Philippe Gross, Lei Zhao

Given the order of customers to visit, vehicles may choose different paths based on the traffic condition, in order to save fuel cost. The choice of paths, which is called path flexibility, is important in time-dependent vehicle routing. In this talk, we study the time-dependent pollution routing problem combined with a time-dependent shortest path problem, which is formulated as a two-stage stochastic mixed integer program. We construct the case study based on the network of Beijing urban area and historical traffic data.

3 - Heuristics for Same-day Delivery Routing
Jie Yang, Graduate Student, Northwestern university, 2145 Sheridan Road, Evanston, IL 60208, Evanston, Il, 60208, United States of America, jieyang2011@u.northwestern.edu, Diego Klabjan, Joe Schoenbeck

Same-day routing is a VRP problem including several extensions. We develop a VNS heuristic which has been tested on a real world dataset from a large big box retailer. We discuss the computational performance of the heuristic and conduct a business feasibility study.

4 - Ensuring Service Levels in Routing Problems with Time Windows and Stochastic Travel Times
Jan Fabian Ehmke, Assistant Professor, Freie Universitat Berlin, Garystr. 21, Berlin, 14195, Germany, JanFabian.Ehmke@fu-berlin.de, Ann M. Campbell, Timothy L. Urban

We explore how to route customers with a given service level in the environment of tight customer time windows and stochastic travel times. The service level defines the probability that each customer is visited within its time window. To be able to verify if the service level is satisfied, we investigate how arrival time distributions can be propagated throughout the tour given the presence of time windows. Computational experiments show how solutions change for different service levels.

5 - Branch-and-Price for a VRP with Time Windows Considering Driving and Working Hour Regulations
Tom Van Woensel, Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, t.v.woensel@tue.nl, Emrah Demir, Said Dabia

We consider restrictions on the amount of driving and working hours of truck drivers in the VRP model. A mathematical programming formulate is provided n and optimally solved using a specifically designed Branch-and-Price (B&P) algorithm. Results are presented.

■ SB24

Hilton- Union Sq 4

Mitigating Network Disruptions and Special Events

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Rui Ma, University of California, Davis, CA, United States of America, drma@ucdavis.edu

1 - Active Demand Management Network Design for Optimizing VMS Location and Diversion routing Plans
Monirehalsadat Mahmoudi, Arizona State University, Tempe AZ, United States of America, mmahmou2@asu.edu, Xuesong Zhou

Variable Message Signs (VMS) have been recognized as important tools for information provision about traffic conditions ahead on the highway such as incidents, construction, and special events. Since the installation, operation, and maintenance of a VMS is costly, this research focuses on finding an optimal set of locations for installing a limited number of VMS in a traffic network through path based and column generation approaches to minimize the total travel costs of the system.

2 - Using Social Media to Assist Traffic Flow Prediction for Scheduled Sport Event
Ming Ni, Arizona State University, Tempe AZ, University at Buffalo (SUNY), Buffalo, NY, United States of America, mingni@buffalo.edu, Qing He, Jing Gao

User-generated contents from social networks can be mined to deduce useful information about present or future travelers' behavior. For planned sporting events, the rates at which social media are created about these will measure people's attention about different games. With help of topic modeling, sentiment analysis and rates of social media, methods are developed to incorporate social media features into traffic flow prediction at the event site.

3 - How Urban Traffic Pattern Evolves? A Case Study on Fix50 Project using Crowd-sourced Taffic Data
Rui Ma, University of California, Davis, CA, United States of America, drma@ucdavis.edu, H. Michael Zhang

We present methods for using crowd-sourced traffic data to measure urban traffic performances and study the changes in traffic patterns under major highway reconstructions. The recent Fix50 project in the Sacramento metropolitan area is used as a case study to demonstrate the proposed methods.

■ SB25

Hilton- Union Sq 5

Transportation Network Assignment and Optimization

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Amit Kumar, Purdue University, West Lafayette, IN, United States of America, kumar44@purdue.edu

1 - Alternative Path Enumeration Algorithm for Public Transit Networks
Hector A. Vergara, Assistant Professor, Oregon State University, 204 Rogers Hall, Corvallis, OR, 97321, United States of America, hector.vergara@oregonstate.edu, SeJoon Park

Many people use transit networks of public transportation for commuting or travelling. Since public transportation networks are complex, it is difficult for a traveler to find optimal paths or alternative paths between origins and destinations when a limitation on travel time is considered. This research proposes a path enumeration algorithm that efficiently enumerates feasible alternative paths using a directed acyclic graph representation of the transit network. Results for randomly generated problem instances and a realistic test case are presented.

2 - Entropy Weighted Average Method for the Determination of Unique Path-flow Solution for Static Deterministic User Equilibrium Traffic Assignment Problem

Amit Kumar, Purdue University, West Lafayette, IN, United States of America, kumar44@purdue.edu, Srinivas Peeta

This study formulates entropy weighted user equilibrium (EWUE) to determine a unique path-flow solution to the static deterministic user equilibrium traffic assignment problem. The implementation simplicity of the EWUE represents an important benefit over the maximum entropy user equilibrium (MEUE) models proposed in the past. Computational experiments illustrate the characteristics of the EWUE solution.

3 - Estimating Link Travel Time Distribution Based on Network Entry/Exit Time Stamps of Trips

Kai Yin, Nomis Solutions, yinai1000@gmail.com, Wen Wang, Bruce X. Wang, Teresa Adams

We study the link travel time estimation problem on a road network, where each vehicle has a trip observation with entry and exit time stamp. Based on the observed trip travel times of individual travelers through the network, we aim to develop a framework to estimate the traffic conditions and learn the traffic patterns on roadway links. Therefore, a statistical framework is established under the likelihood principle. We examine the basic problem on how to extract travel time distributions from sufficient sample of trip observations, and then extend the model to the case with only partial information, where part of trip trajectories are unknown and we need to infer their traversed paths simultaneously. The latter shows a unified framework of statistical modeling and assignment optimization on a transportation network. Besides, we further investigate the Bayesian approach and its impact on the estimation results.

4 - Addressing the Observability Issue in Travel Demand Estimation

Yudi Yang, UC Davis, One Shields Avenue, Davis, CA, 95616, United States of America, ydyang@ucdavis.edu, Yueyue Fan

In this paper, we present a mathematical model for travel demand estimation that integrates multiple information sources. Through mathematical analyses, we identify critical information that is needed for ensuring the observability of the problem.

■ SB26

Hilton- Union Sq 6

Location Models

Sponsor: Location Analysis

Sponsored Session

Chair: Oded Berman, Professor, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, berman@rotman.utoronto.ca

1 - Capacity and Location Decisions in the Presence of Congestion and Disruptions

Oded Berman, Professor, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, berman@rotman.utoronto.ca, Opher Baron, Yael Deutch

We study the problem of choosing the optimal number, capacities and locations of facilities recognizing that customers may be blocked due to a finite waiting room and facilities may fail due to disruptions. The goal is to minimize the total cost that consists of the costs of travel, blocking, capacities, disruptions and opening. We obtain structural results for special cases and develop algorithms and heuristics for solving the problem on a network.

2 - Practical Benchmarks for Location-Routing Decisions via Approximation Algorithms

Mozart Menezes, Associate Professor, University of Calgary, 2500 University Dr. NW, Calgary, AB, T2N1N4, Canada, mozart.menezes@utoronto.ca, Vedat Verter

Practitioners frequently tackle large scale location-routing problems, where a pair of good feasible solution and a lower bound on the solution of the problem, rather than exact solutions, are sufficient for them in making strategic decisions. We present a simple methodology to derive such benchmarks for assessing the current distribution network. We show that the proposed analytical framework is amenable to develop managerial insights for fairly sizeable location-routing problems.

3 - Lagrangian Decomposition for Large Inventory-Location Problems

Samir Elhedhli, Professor, Universiy of Waterloo, Waterloo, ON, Canada, elhedhli@uwaterloo.ca, Ahmed Saif

We decompose the inventory-location problem to an uncapacitated facility location problem and a number of single-variable concave minimization problems. We give a closed form expression for the optimal Lagrangian multipliers; and obtain a feasible solution and the Lagrangian bound in a single step. The approach outperforms the current literature in terms of problem sizes and computational time. For the first time, the solution of very large instances with 500 and 1000 nodes is provided.

4 - A Network Design Problem For Hazardous Materials Routing And Emergency Response Units Locating

Masoumeh Taslimi, PhD Candidate, University at Buffalo (SUNY), Industrial and Systems Engineering, Buffalo, NY, 14260, United States of America, masoumeh@buffalo.edu, Rajan Batta, Changhyun Kwon

Hazardous materials (Hazmat) transports remains regulated due to its potential risk to health, safety and environment. A bi-level Hazmat network design model is proposed to determine the available road network to Hazmat carriers and to locate the Hazmat emergency response units, simultaneously. The goal is to investigate risk equity and carriers decisions to minimize the associated transport risk.

■ SB27

Hilton- Union Sq 7

RAS Problem Solving Competition

Sponsor: Railway Applications

Sponsored Session

Chair: Xiaopeng Li, Assistant Professor, Mississippi State University, PO Box 9546, 235L Walker Hall, 501 Hardy Road, Starkville, MS, 39762, United States of America, xli@cee.msstate.edu

1 - RAS Problem Solving Competition

Xiaopeng Li, Assistant Professor, Mississippi State University, PO Box 9546, 235L Walker Hall, 501 Hardy Road, Starkville, MS, 39762, United States of America, xli@cee.msstate.edu

This session is reserved for the finalists of the RAS problem solving competition. The presenters and their abstracts won't be determined until we finish the judging process, which is probably around mid-October. The selection committee will identify the top three teams who will present their results during the session.

■ SB28

Hilton- Union Sq 8

Modeling Airline Coordination and Competition for Improving National Airspace System Performance

Sponsor: Aviation Applications

Sponsored Session

Chair: Vikrant Vaze, Assistant Professor, Dartmouth, 14 Engineering Drive, Hanover, NH, 03755, United States of America, vikrant.s.vaze@dartmouth.edu

1 - Impact of Emission Trading System on US Aviation: A Future Story

Yi Liu, University of California, Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com, Vikrant Vaze, Antony Evans

Emission from aviation accounts for approximately 2% of the global total and its share of the pie is expected to increase in the future. Emission trading system as used in the European Union is a strategy to reduce emissions while allowing for considerable flexibility. In this study, we explore the impact that the emission trading system, if adopted in the US, may have on US aviation. The interesting aspects include impact on frequency, air fare and aircraft size.

2 - Efficiency, Equity and Reliability of Schedule Coordination at Congested US Airports

Alexandre Jacquillat, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-246, Cambridge, MA, 02139, United States of America, alexjacq@mit.edu, Vikrant Vaze, Amedeo Odoni

Schedule coordination at US airports can mitigate congestion but also constrains airline competition. We design and assess a schedule coordination mechanism that is non-monetary, efficient (minimizes interference with airline competition), equitable (balances fairly scheduling constraints across airlines) and reliable (meets delay reduction objectives). The approach considers operating stochasticity, the diversity of stakeholder incentives and the interdependencies of scheduling and operations.

3 - Performance-Based Air Traffic Management: Game Theoretic Models and Multi-Criteria Evaluation

Vikrant Vaze, Assistant Professor, Dartmouth, 14 Engineering Drive, Hanover, NH, 03755, United States of America, vikrant.s.vaze@dartmouth.edu, Antony Evans, Cynthia Barnhart

For designing airline-driven traffic management initiatives (TMI), we propose several mechanisms for collecting and combining airline inputs into implementable TMIs, e.g. averaging, voting and ranking. We propose multiple criteria for evaluating effectiveness of each approach, including profitability, system optimality, and equity. We apply a game-theoretic approach to examine the gaming potential and offer a broad evaluation of each approach, through theoretical and simulation-based insights.

4 - Integrated Airline Scheduling: Competition Effects from the Entry of the High-speed Rail

Luis Cadarso, Rey Juan Carlos University, Camino del Molino, s/n, Fuenlabrada, 28943, Spain, luis.cadarso@urjc.es, Vikrant Vaze, Cynthia Barnhart, Angel Marin

Airlines and high-speed rail are increasingly competing for passengers, which affects the number of served passengers and revenues. We develop an approach that generates airline schedules capturing the impacts of airlines' decisions on passenger demand. We evaluate scenarios involving the entry of high-speed rail, and validate our results using past market entries of high-speed rail. The developed model predicts the optimal decisions to retain passengers and to maximize profits.

■ SB29

Hilton- Union Sq 9

JFIG Paper Competition II

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: J. Cole Smith, Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, jcsmith@clemson.edu

Co-Chair: Shengfan Zhang, Assistant professor, University of Arkansas, United States of America, shengfan@uark.edu

1 - Competition Introduction

J. Cole Smith, Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, jcsmith@clemson.edu

The 2014 JFIG paper competition features paper submissions from a diverse array of talented junior faculty members. The prize committee evaluated submissions based on the importance of the topic, appropriateness of the approach, and significance of the contribution. After careful review, the prize committee selected a group of finalists to present their research in one of the two JFIG sessions. For information on the finalists and their papers, please refer to the online program.

2 - Performance Guarantee of Modified (r, Q) Policies for Stochastic Multi-echelon Serial Inventory Systems

Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St George Street, Toronto ON, Canada, Ming.Hu@rotman.utoronto.ca, Yi Yang

We consider the classic continuous-review N-stage serial inventory system. Any shipment to each stage incurs a fixed cost and takes a nonzero lead time. Finding a good performance guarantee remains an open problem. We construct a simple, efficiently computable, heuristic policy within a class of modified echelon (r,Q) policies and provide good provably primitive-dependent performance bounds. The heuristic is even likely to numerically outperform the optimal integer-ratio echelon (r,Q) policies.

3 - Optimal Learning with Non-Gaussian Rewards

Zi DIng, University of Maryland, Department of Mathematics, College Park MD 20742, United States of America, zding@math.umd.edu, Ilya Ryzhov

We present a new theoretical characterization of the optimal "Gittins index" policy in multi-armed bandit problems with non-Gaussian, infinitely divisible reward distributions. Our approach probabilistically interpolates the sequence of discrete-time rewards by a continuous-time, conditional Levy process, and uses optimal stopping theory to relate the value function to a free-boundary partial integro-differential equation (PIDE). We state the PIDE for exponential and Poisson rewards, prove continuity and monotonicity of the solution, and discuss numerical issues.

4 - Unbalanced Random Matching Markets: The Stark Effect of Competition

Itai Ashlagi, MIT, 100 Main St., Cambridge MA, United States of America, iashlagi@mit.edu, Yash Kanoria, Jacob Leshno

We characterize the core in random matching markets with unequal numbers of men and women. We find that even the slightest imbalance leads to harsh competition on the long side. With high probability the core is small, in the sense that a vanishing fraction of agents have multiple stable partners. Further, under any stable matching, approximately, the short side ``chooses" and the long side is "chosen". Simulations show that these features are observed even in small markets.

■ SB30

Hilton- Union Sq 10

Planning and Scheduling Issues in Service and Manufacturing Systems

Cluster: Scheduling and Project Management

Invited Session

Chair: Chelliah Sriskandarajah, Professor, Mays Business School, Texas A&M University, 320Q, Wehner Building, College Station, TX, United States of America, chelliah@mays.tamu.edu

1 - Scheduling Unit-trains for Minimizing the Cost of Deadheading and Lite Train Movements

Manoj Vanajakumari, Associate professor, Texas A&M University, 3367 TAMU, College Station, TX, 77843, United States of America, manojuv@tamu.edu, William Oates, Chelliah Sriskandarajah

Unit trains operate between two stations that are not on regular routes. Railroad companies face challenges in scheduling unit trains which include ensuring the availability of locomotives at the origin stations for the train movement. We solve a unit-train scheduling problem for a major North American railroad company the solution methodologies, and results.

2 - Outpatient Appointment Scheduling under Patient No-Shows and Patient Heterogeneity

Seung Jun Lee, PhD Student, Texas A&M University, 320M Wehner Bldg. Tamu, College Station, TX, United States of America, sjlee@mays.tamu.edu, Gregory R. Heim, Yunxia Zhu, Chelliah Sriskandarajah

In this study, we study an outpatient appointment scheduling system under patient no-shows and patient heterogeneity with different policies (base model, overbooking, and open-access model). We evaluate and compare the performances of these proposed policies based on our block scheduling policy to provide optimal policies for outpatient clinics.

3 - U.S. Coin Supply Chain: Supply, Recycling and Inventory Management

Yiwei Huang, Mays Business School, Texas A&M University, 320R, Wehner Building, College Station, United States of America, yhuang@mays.tamu.edu, Neil Geismar, Chelliah Sriskandarajah

We investigate operational issues in the U.S. Coin Supply Chain and develop models to make the recirculation of coins more economical and efficient for the society. From the social perspective, we propose a coin exchange mechanism to coordinate the U.S. Coin Supply Chain and to minimize the societal cost of supplying coins nationwide.

4 - Increasing the Efficiency of Currency Supply within a Region in Banknote Supply Chain

Yunxia Zhu, Assistant Professor, Rider University, 2083 Lawrenceville Rd, Lawrenceville, NJ, 08648, United States of America, yuzhu@rider.edu, Chelliah Sriskandarajah, Subodha Kumar, Sara Rodriguez-Sanchez

We study the problem faced by regional banks in managing the currency supply in banknote supply chain with distinct features due to security concerns. After deriving a polynomial-time strategy to guarantee an optimal solution for the special bin-packing problem faced in this study, we provide an MIP formulation for this supply planning problem. We also propose four polynomial-time algorithms for deriving either optimal or near-optimal solutions for the problem under four different settings.

■ SB31

Hilton- Union Sq 11

Online Reviews of Services: An Examination of Their Content, Structure and Impact

Sponsor: Service Science

Sponsored Session

Chair: Rebecca Hamilton, Associate Professor, University of Maryland, R.H. Smith School of Business, 3456 Van Munching Hall, College Park, MD, 20742, United States of America, rhamilto@rhsmith.umd.edu

1 - Online Reviews of Credence Services: Content, Credibility, and Usefulness

Shannon Lantzy, Doctoral Candidate, University of Maryland, 3330M Van Munching Hall, College Park, MD, 20904, United States of America, slantzy@rhsmith.umd.edu, Rebecca Hamilton, Katherine Stewart

We study the content, structure, and consumer perceptions of online reviews for credence services. We find credence reviews systematically differ from reviews of experience services and are more likely to contain unsupported claims. We experimentally examine consumer perceptions of reviews: consumers discount the credibility of credence claims of short, simple reviews but we expect more complex argument structure and inclusion of experience attributes in the review to attenuate this effect.

2 - Word-of-Mouth vs. Word of Health Inspectors: Evidence from Restaurant Reviews

Chenhui Guo, University of Arizona, 1130 E. Helen, Tucson, AZ, 85721, United States of America, chguo@email.arizona.edu, Paulo Goes, Mingfeng Lin

We study the effect of disclosing health inspection results on the word-of-mouth generated by consumers. Using data from a popular website for restaurant reviews around the time of a policy change, we exploit temporal and spatial variations to identify the effect on several important metrics of word-of-mouth.

3 - Dynamics of Social Tagging Networks: Insights for Retail Demand Forecast

P. K. Kannan, University of Maryland, Smith School of Business, College Park, MD, United States of America, PKannan@rhsmith.umd.edu, William Rand, Hyoryung Nam

Products and service experiences are related to ideas, concepts and beliefs, and as interest in those ideas, concepts and beliefs change so does consumer interest in those products/services. This presentation investigates whether the position of products on social tagging networks can predict sales dynamics in a retail context.

4 - Controlling for Self-Selection Bias in Customer Reviews

Dina Mayzlin, University of Southern California, 3660 Trousdale Parkway, ACC 306E, Los Angeles, CA, 90089-0443, United States of America, mayzlin@marshall.usc.edu, David Godes, Leif Brandes

Customers frequently use user online reviews as a valuable information resource before making a purchase. One critique of reviews as a source of information is the self-selection in the review process: consumers self-select into choosing whether to review a product, which suggests that reviews may be prone to the extremity bias. We propose a method to control for this bias.

■ SB32

Hilton- Union Sq 12

Service Science in the Emerging Markets

Sponsor: Service Science

Sponsored Session

Chair: Qiang Qiang, Penn State Univ., 30 E. Swedesford Rd., Malvern, PA, 19355, United States of America, qzq10@psu.edu

1 - Quantifying the Bullwhip Effect in Service Supply Chain Networks of the Emerging Markets

Xiaowei Zhao, Tongji University, Dept of Management Science & Engineering, 1239 Siping Road, Shanghai, 200092, China, zhaoxiaowei119@126.com, Jiantong Zhang

In this paper, we quantify the bullwhip effect in service supply chain networks of the Emerging Markets. Our model includes two of the factors commonly assumed to cause the bullwhip effect in services: time delays and work backlogs. Then we propose a relative strategy with the fuzzy robust control method to reduce the bullwhip effect. Finally, an example is provided to illustrate the effectiveness of the proposed method.

2 - Competition of Online Shopping Malls with Logistics Investment

Yihong Hu, Assistant Professor, Tongji University, Economics and Management School,, No 1239, Siping Road, Shanghai, China, fox2002cn@gmail.com

We studies the competition between the online shopping malls based on price and logistics delivery service. The competition model between online shopping malls is constructed. The existence of Nash equilibrium is proved and the properties in the equilibrium is provided. The market structure analysis disclose that the total cost coefficient determines the winners in the competition.

3 - Rail Transit Passenger Behavior Model and Simulation in Emergencies Based on Multi-Agent System

Haifeng Zhao, Tongji University, Room 611,Block A, Tongji Building, No1. Zhangwu Road, Yangpu Distirct, Shanghai, 200092, China, hfzhao@tongji.edu.cn, Yi Dong

With the increasing population, rail transit is facing more frequent emergencies. The model, based on Multi-Agent System, is developed to establish passenger route choice algorithm and to describe the behavior of passengers. Through simulation, it finds that the conformity behavior of passengers will be disadvantageous to the evacuation, and the direction from external environment can reduce the influence of conformity. The result will provide theoretical basis of making the evacuation plan.

4 - International Financial Networks with Socially Responsible Investing

Ke Ke, Associate Professor, Central Washington University, 2400 S. 240th St, POBox 13490, Des Moines, WA, 98198, United States of America, kekegrace@yahoo.com

Although the research on SRI has increased significantly, the majority of them are focused on qualitative or empirical study. This research will extend my earlier paper (Qiang, Ke and Hu (2013)) regarding the modeling of financial networks with SRI to incorporate globalization and exchange rate risk. To be more specific, a framework for a multitiered international financial network with SRI will be developed where both the fund sources and the intermediaries are multicriteria decision-makers.

5 - Research on Dynamic SERVQUAL Model Based on QFD

Lixin Cui, Beijing Institute of Technology, Beijing, China cuilixin@bit.edu.cn, Renhe Shi

Both conventional SERVQUAL model and the QFD method have their own limitations. In this article,to constitute the dynamic SERVQUAL model based on QFD,we add the 22 dimensions of SERVQUAL model to the HOQ matrix,as well as the time dimension. This model combines customer requirements of service quality with technical methods of service enterprise. With the support of multi-period data, we can forecast dynamic customer requirements more effectively by using the GM(1,1) model with boundary value modified,which will provide support for the service enterprise to make efficient decisions.

■ SB33

Hilton- Union Sq 13

Technology Adoption and Innovation Management as a Search Process

Cluster: New Product Development

Invited Session

Chair: Raul Chao, University of Virginia, 100 Darden Blvd, Charlottesville, VA, 22902, United States of America, chaor@darden.virginia.edu

1 - Centrality and Misalignments in Complex New Product Development Projects

Javad Nasiry, Assistant Professor, HKUST, LSK Building, HKUST, Hong Kong, Hong Kong - PRC, nasiry@ust.hk, Michael Kirley, Mohsen Jafari Songhori

There are two forms of misalignments between product and organizational structures in complex new product development projects: interaction and interface misalignments. In a model of product design as a search on a rugged landscape, we model misalignments as design teams searching on a "perceived" rather than "real" landscape. We then study the effects of component centrality and misalignments on the project performance and convergence characteristics.

2 - Impact of Sequence and Timing of Information Technologies Adoption on Hospital Performance

Luv Sharma, The Ohio State University, 600 Fisher Hall, Columbus, OH, 43210, United States of America, sharma.154@buckeyemail.osu.edu, Aravind Chandrasekaran

This paper looks at the sequence of adoption of Health Information Technologies for 3600 US hospitals to identify ideal sequences of adoption. Deviations from the ideal sequences in terms of the order of adoption and the timing between adoption of technologies is conducted and performance implications studied.

3 - Knowledge Transfer in Product Development Projects
Wenli Xiao, Assistant Professor, University of San Diego, 5998 Alcala Park, San Diego, CA, 92110, United States of America, wenlixiao@sandiego.edu, Cheryl Gaimon

We use a dynamic model to explore a manager's pursuit of a new product development (NPD) project and an existing product improvement (EPI) project. A key feature of our model is the characterization of the knowledge transfer process from the NPD project to the EPI project. We identity the optimal knowledge development strategies for both projects and the optimal strategy for knowledge transfer. Lastly, we provide results in how different parameters impact the manager's optimal decisions.

4 - On the Effectiveness of Patenting Strategies in Innovation Races
Fabian Sting, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, fsting@rsm.nl, Jurgen Mihm, Tan Wang

Which inventions should a company patent? We develop an integrative framework of patenting strategies and contingencies for innovation races. Based on technology landscape simulations we identify competitive dynamics as the most salient determinant of the firm's patenting strategy. Thus our research contributes to establishing a contingency theory of patenting strategies.

■ SB34

Hilton- Union Sq 14

Optimization and Modeling For Election Systems

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43210, United States of America, allen.515@osu.edu

1 - Convergent Algorithms for Satisfying Standards with Election System
Muer Yang, Assistant Professor, Opus College of Business, University of St. Thomas, 1000 LaSalle Ave, Minneapolis, MN, 55403, United States of America, yangmuer@stthomas.edu, Theodore Allen

We present methods for determining the minimum resources to meet service objectives using simulation both for individual systems (Straddling a Standard) and across multiple parallel systems (Service Constrained Minimax Optimization). We describe proofs of rigor and implications for President Obama's guarantee of less than 30 minutes of waiting time.

2 - Feasible Allocation thru Iterative Relaxations with Election Systems
Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43210, United States of America, allen.515@osu.edu, Muer Yang

We present an algorithm for minimizing the maximum waiting time across parallel systems. We describe the proof of its properties and its real world applicability in election systems. Also, results illustrate that dramatic reductions in computation times compared with greedy methods making the methods more usable.

3 - Methods for Estimating the Number of Deterred Voters in Elections
Shijie Huang, Performance Improvement Consultant, Carilion Clinic, P.O. Box 13367, Roanoke, VA, 24014, United States of America, skylovtata@gmail.com, Theodore Allen

This article proposes several methods for estimating the number of would be voters who are deterred from voting because of current or past waiting lines. The methods include linear regression, queuing-based imputation, and simulation-based imputation. We use data from recent elections in Florida and Ohio to illustrate and compare the alternative approaches.

4 - Sequential Kriging Optimization to Determine the Cost Effective Number of Early Voting Days
Sayak Roychowdhury, Graduate Research Associate, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, roychowdhury.6@osu.edu, Theodore Allen

We propose a simulation model of waiting lines, cost, and turnout as a function of the number of early voting days. Then, we describe results from optimizing this model using Sequential Kriging Optimization with objectives ranging from increasing turnout to reducing costs. We use data from real elections to illustrate.

■ SB35

Hilton- Union Sq 15

Routing for Public Needs

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Burcu Keskin, Associate Professor, University of Alabama, 300 Alston Hall, Tuscaloosa, Al, 35487, United States of America, bkeskin@cba.ua.edu

1 - Optimizing Itineraries in Public Transportation with Walks between Rides
Bram De Jonge, University of Groningen, P.O. Box 800, 9700 AV, Groningen, Netherlands, b.de.jonge@rug.nl, Ruud Teunter

We optimize itineraries in public transportation, where we allow travelers to alternate rides with walks. We derive theorems for identifying a small subset of all possible walks that need to be considered, and test the results in a real-life setting for bus transportation in a medium sized city. It turns out that (a) only one per cent of all possible walks needs to be considered, and (b) that allowing walks reduces the travel time in 6 per cent of all cases by more than 10 per cent on average.

2 - School Bus Routing with Stochastic Demand and Duration Constraints
Hernan Caceres, Ph.D. Student in IE, University at Buffalo, 342 Bell Hall, University at Buffalo, Buffalo, NY, 14260-2050, United States of America, hernanan@buffalo.edu, Qing He, Rajan Batta

We propose a model of the school bus routing problem responding to the overbooking policies applied at a real-world school district, where the probability of a student using the bus varies from 22% to 77%. Overbooking is modeled via chance constrained programming, and it aims to improve their capacity utilization. Additionally, the uncertainty of travel time is also considered. The district-problem is partitioned into each school and solved sequentially, using column generation for each one.

3 - OAR Lib: An Open Source Arc Routing Library
Oliver Lum, Graduate Student, University of Maryland, College Park, 11604 Parkedge Drive, Rockville, MD, 20852, United States of America, oliver@math.umd.edu, Bruce Golden, Carmine Cerrone, Edward Wasil

We present computational results for a new Open Source Arc Routing Library (OAR Lib). This Java library provides an extensible graph architecture and solvers for problems in the field of arc routing. This library will allow researchers to begin writing their own code quickly.

4 - An Improved Formulation for the Maximum Coverage Patrol Routing Problem
Ibrahim Capar, Graduate Research Assistant, ISM Dept. 300 Alston Hall, 361 Stadium Drive, Tuscaloosa, Al, 35487-0226, United States of America, icapar@cba.ua.edu, Paul Rubin, Burcu Keskin

The main goal of the patrol routing problem is to maximize the coverage of critical highway stretches while ensuring feasibility of routes. By using the structural properties of the solution, we formulate an improved MIP that can solve large instances to optimality within seconds, where methods in literature failed to find provably optimal solutions. We show an average increase in coverage of 20% for the randomly generated instances provided in literature, with a best case increase over 46%.

■ SB36

Hilton- Union Sq 16

Decomposition Techniques for Network Design

Sponsor: Telecommunications

Sponsored Session

Chair: Bernard Fortz, Professor, Université Libre de Bruxelles, GOM CP212, Bld du Triomphe, Brussels, 1050, Belgium, bernard.fortz@ulb.ac.be

Co-Chair: Dimitri Papadimitriou, Pr. Eng. Research, Bell Labs, Copernicuslaan 50, Antwerp, 2018, Belgium, dimitri.papadimitriou@alcatel-lucent.com

1 - Reliability-based Combined Network Design and Routing Optimization
Dimitri Papadimitriou, Pr.Eng.Research, Bell Labs, Copernicuslaan 50, Antwerp, 2018, Belgium, dimitri.papadimitriou@alcatel-lucent.com, Bernard Fortz

The combined network design and routing problem with time-dependent demands generalizes the fixed charge network design problem. This problem can be formulated as a multi-period mixed integer optimization problem. As

decomposition techniques overcome the computational limit to solve such problem, we extend its formulation to account for failure patterns affecting installed arcs over time. We analyze the formulation with different reliability functions to derive the best arc replacement strategy.

2 - Lagrangian Decomposition for the Two-Level FTTx Network Design Problem

Andreas Bley, University of Kassel, Institute for Mathematics, Heinrich-Plett-Str. 40, Kassel, 34132, Germany, andreas.bley@mathematik.uni-kassel.de, Olaf Maurer, Ivana Ljubic

We address the design of a passive optical telecommunication network, where clients are connected via an intermediate level of distribution points to some central offices in a tree-like fashion. We discuss a Lagrangian algorithm that decomposes the problem based on the cost structure and solves the subproblems using advanced MIP techniques. Our computational results for realistic instances show that this approach yields high quality solutions and bounds requiring only little computing time.

3 - A Computational Comparison of Approaches to Lagrangian Duals: The Case Study of FC-MMCF

Enrico Gorgone, Université Libre de Bruxelles, Bld du Triomphe, 1040, Belgium, egorgone@ulb.ac.be, Bernard Gendron, Antonio Frangioni

The focus of this work is to compare a large set of approaches for solving Lagrangian duals of combinatorial problems. In particular we compare different nonsmooth optimization methods like (incremental, deflected, projected) subgradient-type algorithms and (disaggregated, generalized) bundle-type algorithms. We use as a test set the multicommodity capacitated network design problem (FC-MMCF), a problem arising in many different applications such as logistics and transportation.

4 - Spanning Trees with Variable Degree Bounds

Pedro Moura, Univ of Lisbon, Centro de InvestigaÁ„o Operacional, Bloco C6 - Piso 4- Campo Grande, Lisboa, 1749-016, Portugal, pmmoura@fc.ul.pt, Amaro de Sousa, Luis Gouveia, Mario Ruthmair

We study a generalization of the Degree Constrained Minimum Spanning Tree problem where we may install one of several transmission systems (TS) in each edge. We discuss a particular case in the design of wireless mesh networks where the degree of the endnodes of each edge depends on the TS installed on it and on the length of the edge. We propose 3 different models and compare them and the corresponding LP relaxations from a theoretical perspective as well as from a computational point of view.

■ SB37

Hilton- Union Sq 17

Analyzing Social Networks and Social Media II

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Kang Zhao, Assistant Professor, University of Iowa, S224 PBB, Iowa City, IA, 52242, United States of America, kang-zhao@uiowa.edu

1 - Early Prediction of Movie Success – Social Network Perspective

Michael Lash, The University of Iowa, michael-lash@uiowa.edu, Kang Zhao

Recently, the movie industry has seen tremendous growth. . While many previous studies have focused on gross revenue, this research addresses profitability, an aspect that is more important to investors. Our prediction leverages characteristics of actors and their social networks, as such information is usually available in early stages of movie production, when investment decisions are made. Our model can determine movie success with decent accuracy early on in the production process.

2 - Efficient Respondents Selection for Biased Survey using Online Social Networks

Jiaofei Zhong, Assistant Professor, University of Central Missouri, 121 E Hunt Ave, #301, Warrensburg, MO, 64093, United States of America, fayzhong08@gmail.com, Minhyuk Lee, Deying Li, Yingshu Li, Alade Tokuta, Donghyun Kim

Online social networks provide rich sources of data for us to learn about our society, and online surveys are an essential tool for many applications. One important issue is to select a good respondent group so that the survey result is reliable. We investigate the use of online social network to form a biased survey respondent group that is useful for certain applications. We present a new optimization problem MIkCDSP, show its NP-hardness, and introduce a greedy approximation algorithm for it.

■ SB38

Hilton- Union Sq 18

Data-Driven Research in Healthcare

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Masha Shunko, Purdue University, 403 W. State Street, West Lafayette, IN, 47906, United States of America, mshunko@purdue.edu

1 - Evaluation of Inventory Technologies for Operating Rooms

Vera Tilson, Simon School, University of Rochester, Rochester, NY, United States of America, vera.tilson@simon.rochester.edu, Greg Dobson, Abraham Seidmann

After labor, supply chain costs are the second-largest expense for hospitals, constituting up to 40% of the total operating budget. According to a recent PWC study perioperative services account for approximately 61% of these costs. We examine the issue of supply and inventory planning in operating rooms, and evaluate the benefits of standardization and of using technologies such as bar codes and RFIDs.

2 - Ranking Healthcare

Ping H. Huang, Research Scientist, Regenstrief Center for Healthcare Engineering, Purdue University, West Lafayette, IN, 47906, United States of America, huang74@purdue.edu

Many initiatives call for the dissemination of transparent data based on the assumption that it will lead to cost-effective healthcare. As healthcare providers face large volumes of data, they require decision-making assistance to become informed decision-makers. We develop a ranking method that accounts for multiple criteria but avoids the bias of assigning weight for each criterion. Our illustrated examples include hospital rankings for patients as well as patient stratification for providers.

3 - Impact of Ambulance Diversion Ban on Emergency Departments' Length of Stay

Ahmad Ashkanani, Purdue University, Krannert School of Management, 403 W. State Street, West Lafayette, IN, 47907, United States of America, aashkana@purdue.edu, Masha Shunko, Ping H. Huang

Emergency department (ED) crowding poses a serious threat to the access and quality of health care in the US. Many EDs use ambulance diversion (AD) practices in an effort to alleviate ED crowding. The state of Massachusetts (MA) issued a statewide ban in 2009 ending the AD practice. We study the impact of the AD ban on ED length of stay using 2008 and 2009 ED data from MA.

4 - Managing Hospital Inpatient Bed Capacity through Partitioning Care into Focused Wings

Thomas Best, Doctoral Candidate, The University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, tbest@chicagobooth.edu, David Meltzer, Burhaneddin Sandikci, Donald Eisenstein

We provide an optimization framework to support a hospital administrator, who chooses between pooling inpatient demand and bed capacity, and forming specialized wings to focus on narrow ranges of care types. Specialized wings not only provide advantages from focused care, but also allow the protection of beds for high utility care types. Using data from an urban teaching hospital and a national database, we discuss our model's solutions and managerial insights.

■ SB39

Hilton- Union Sq 19

Decision-Making for Population Health Outcome Interventions

Sponsor: Health Applications

Sponsored Session

Chair: Monica Gentili, University of Salerno, Via Giovanni Paolo II n. 132 - 84084, Fisciano (SA), Italy, mgentili@unisa.it

1 - A Standard Acquisition Charge Model for a National Kidney Exchange Program

Andrew Schaefer, William Kepler Whiteford Professor, The University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, schaefer@pitt.edu, Amin Dehghanian

Kidney exchange is a rapidly growing approach to solve the shortage of kidneys for transplantation. A major challenge to establish a national kidney exchange program is the establishment of the proper incentives for transplant centers to participate. We develop a mathematical program that explores payment strategies and maximizes a social welfare criterion subject to individual rationality and incentive compatibility constraints of transplant centers.

2 - Diffusion of Information in Diabetes Care

John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Vishal Ahuja

We evaluate the changes in prescription patterns of an anti-diabetic medication during the time period when health warnings were issued by FDA related to drug. Using data on diabetic patients from the Department of Veterans Affairs, we identify the regional variation in the prescription patterns to study the diffusion of information and examine operational factors that promote physician learning.

3 - The Impact of Geographic Access on Severe Health Outcomes for Pediatric Asthma

Erin Garcia, Georgia Institute of Technology, Atlanta, GA, 30332, United States of America, egarcia3@gatech.edu, Nicoleta Serban, Julie Swann

Access to medical care and severe pediatric asthma outcomes vary with geography. We measure geographic access to primary and asthma specialist care using mathematical optimization models and estimate the association between outcomes and access in the presence of other factors using logistic regression. The model is used to project the reduction in severe outcomes with improvement in access. To gain maximum benefit interventions should be targeted to areas with the greatest potential improvement.

4 - Chemotherapy Capacity Planning

Leah Weber, Operations Research Scientist, BC Cancer Agency, 600 W 10th Ave, Vancouver, BC, V5Z 4E6, Canada, leah.weber@bccancer.bc.ca, Claire Ma, Antoine Sauré, Emma Liu, Martin Puterman

Chemotherapy treatment within Canada is in high demand and there are currently insufficient resources to meet demand in a timely manner, leading to long wait times for new patient appointments and, consequently, the potential for the patient's disease to progress further. In order to ensure demand for treatment is met in a timely manner, we are developing a long-term resource planning strategy for the BC Cancer Agency that will aid in matching staffing requirements with demand levels.

■ SB40

Hilton- Union Sq 20

Appointment Scheduling

Sponsor: Health Applications

Sponsored Session

Chair: Van-Anh Truong, Assistant Professor, Columbia University, 500 West 120th St, New York, NY, 10027, United States of America, vt2196@columbia.edu

1 - Optimal Advance Scheduling

Van-Anh Truong, Assistant Professor, Columbia University, 500 West 120th St, New York, NY, 10027, United States of America, vt2196@columbia.edu

The dynamic assignment of advance appointments has been considered to be especially challenging due to its high-dimensionality. For a canonical model with two patient classes, we derive an elegant characterization of an optimal policy and an efficient algorithm to compute the policy exactly. We introduce the property of successive refinability, which allows advance schedules to be easily computable and under which there is no cost to the system to making advance commitments to patients.

2 - Managing Customer Arrivals in Service Systems with Multiple Servers

Christos Zacharias, New York University, Stern School of Business, New York, NY, 10012, United States of America, czachari@stern.nyu.edu

We analyze a discrete multi-server queueing model for scheduling customer arrivals in service systems with parallel servers. Theoretical and heuristic guidelines are provided for the effective practice of appointment overbooking to offset no-shows. The benefits of resource-pooling are demonstrated in decreasing operational costs and increasing customer throughput.

3 - Managing Patient Admissions in a Neurology Ward

Saied Samiedaluie, Post-Doctoral Fellow, University of British Columbia, E204 - 4500 Oak Street, Vancouver, BC, V6H 3N1, Canada, samiedal@mail.ubc.ca, Beste Kucukyazici, Vedat Verter, Dan Zhang

We study patient admission policies in a neurology ward where there are multiple types of patients with different medical characteristics. We formulate this problem as an infinite-horizon average cost dynamic program and propose an efficient approximation scheme. The computational results from applying our model to a neurology ward show that dynamic policies generated by our approach can reduce the overall deterioration in patients' health status compared to several static policies.

■ SB41

Hilton- Union Sq 21

Healthcare Modeling for Efficient Policy Decisions

Sponsor: Health Applications

Sponsored Session

Chair: Sze-chuan Suen, Stanford University, 117 Encina Commons, Stanford, United States of America, ssuen@stanford.edu

1 - Cost-effectiveness of Oral PrEP as HIV Prevention for Injection Drug Users in the United States

Cora Bernard, PhD Student, Stanford University, 9074 Great Dome Ct, Fair Oaks, CA, 95628, United States of America, clb210@stanford.edu, Chris Weyant, Margaret Brandeau, Jeremy Goldhaber-Fiebert, Douglas K. Owens

The US Centers for Disease Control and Prevention recently recommended oral pre-exposure prophylaxis (PrEP) for HIV prevention among at-risk individuals in the US. We use a dynamic compartmental model combined with an economic model to assess the cost-effectiveness of PrEP in the US IDU population. We evaluate cost-effectiveness as function of level of risk behavior and adherence to PrEP.

2 - Cost Effectiveness of Sofosbuvir-based Treatment for Hepatitis C in U.S. Incarcerated Populations

Shan Liu, Assistant Professor, Industrial and Systems Engineering, University of Washington, UW Box 352650, Seattle, Wa, 98195-2650, United States of America, liushan@uw.edu, Daena Watcha, Mark Holodniy, Jeremy Goldhaber-Fiebert

The prevalence of chronic hepatitis C virus (HCV) infection is estimated at 12-35% among U.S. incarcerated populations, where we assessed the cost-effectiveness of newer sofosbuvir-based therapy. We developed a decision-analytic Markov model that included the natural history of chronic HCV and combinations of treatment options both in and out of prisons; and the possibility of reinfection. We found sofosbuvir-based therapy is cost-effective for long and short-term incarcerated individuals.

3 - Cost-effectiveness of Rapid Diagnostics and Care Systems Improvements for Tuberculosis in India

Sze-chuan Suen, Stanford University, 117 Encina Commons, Stanford, United States of America, ssuen@stanford.edu, Kimberly Babiarz, Eran Bendavid, Jeremy Goldhaber-Fiebert

We evaluated the cost-effectiveness of novel drug susceptibility testing technologies, private patient referrals to more effective public clinics (PPM), and combinations of these policies in India. Using a dynamic transmission microsimulation model, we found that rapid TB and drug susceptibility testing provide benefits at costs below 3-times India's per-capita GDP. The combination of PPM with rapid drug susceptibility testing provides benefits at costs below 1-time per-capita GDP.

4 - Cost-effectiveness of Multiple Sclerosis Disease-modifying Therapy: Accounting for Patient Risk

Allie Leeper, Stanford University, 475 Via Ortega, Stanford, United States of America, allie105@stanford.edu, Alexandra Goodyear, Douglas K. Owens, Jeremy Goldhaber-Fiebert

Objective: We assess cost-effectiveness of glatiramer acetate (GA) and dimethyl fumarate (DMF) for patients with multiple sclerosis using a microsimulation model to account for variation in patient risk for long-term disability. Results: At full prices, both drugs yield health benefits at high costs relative to no drug. For clinical cases where drug therapy is indicated, DMF costs $99,000 per QALY gained compared to GA. Both drugs yield better value for money for high-risk patients.

■ SB42

Hilton- Union Sq 22

Stochastic Models on Medical Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: F. Safa Erenay, University of Waterloo, 200 University Ave. CPH 4323, Waterloo, ON, N2L 3G1, Canada, ferenay@uwaterloo.ca

1 - Evaluate the Importance of Different Clostridium Difficile Sources in Hospital Setting by Agent Base

Biao Wang, PhD Candidate, University of Waterloo, 200 University Avenue, Waterloo, ON, Canada, b67wang@uwaterloo.ca, Kenneth McKay, William Ciccotelli

An agent based simulation of C. Difficile spread in a public hospital is developed using data from the hospital and literature. The simulation results suggest that the admission of asymptomatic patients in the ward could be the major source of hospital acquired C. difficile infection (CDIs). This observation is consistent with recent findings in the literature that diverse sources might exist for the hospital acquired CDI transmission.

2 - Optimal Design of the Annual Influenza Vaccine with Manufacturing Autonomy

Osman Ozaltin, Assistant Professor, North Carolina State University, Industrial and Systems Engineering, Raleigh, United States of America, oyozalti@ncsu.edu, Oleg Prokopyev, Andrew Schaefer

Seasonal influenza is a major public health concern, and the first line of defense is the flu shot. We propose a bilevel multi-stage stochastic mixed-integer program that maximizes societal benefit of the flu shot under autonomous profit maximizing manufacturers. Calibrated over publicly available data, our model returns the optimal flu shot composition and timing in a stochastic and dynamic environment. We derive analytical results, and perform extensive numerical experiments.

3 - Colonoscopy Surveillance for Metachronous Colorectal Cancer Prevention and Early Detection

F. Safa Erenay, University of Waterloo, 200 University Ave. CPH 4323, Waterloo, ON, N2L 3G1, Canada, ferenay@uwaterloo.ca, Oguzhan Alagoz, Adnan Said

Colorectal cancer (CRC) survivors have high risk of developing metachronous CRC (MCRC). We developed a discrete-event simulation model and compared the effectiveness of possible colonoscopy surveillance policies for MCRC prevention and early-diagnosis in a cost-utility analysis setting based on data from MAYO Clinic, Rochester. We derived the Pareto-efficient policies in the spectrums of MCRC risk, total cost, total quality adjusted life years, and expected number of required colonoscopies.

■ SB43

Hilton- Union Sq 23

Joint Session ICS/OPT: Global Optimization and Mixed-Integer Nonlinear Programming II

Sponsor: Computing Societ & Optimization

Sponsored Session

Chair: John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, On, K1S 5B6, Canada, chinneck@sce.carleton.ca

Co-Chair: Leo Liberti, IBM TJ Watson Research Center, Yorktown Heights, Yorktown Heights, PA, United States of America

1 - Multidimensional Piecewise Linear Approximation Strategies for Nonlinear Programs

Leon Lasdon, University of Texas, Austin, TX, United States of America, lasdon@utexas.edu, Anant Balakrishnan, Vivek Vasudeva

Piecewise linear approximation (PLA) solves NLP's by approximating the non-linear functions by piecewise linear interpolations over a grid, imposing adjacency conditions on the grid point weights, and solving the resulting MILP. This has been extended to nonseparable functions of several variables. We discuss features and computational experience with our implementation of PLA, including grid shapes, speeding up the MILP, and problem reformulations. The approach has promise in finding near-optimal solutions of nonconvex NLP's and MINLP's.

2 - Piecewise-linear Approximations for MIQCP and Global Optimization of Electrical Power Flow Problems

James Foster, Postdoctoral Research Associate, University of Wisconsin/WID, Wisconsin Institute for Discovery, 330 North Orchard Street, Madison, WI, 53715, United States of America, jfoster@discovery.wisc.edu, Natashia Boland, Hamish Waterer

We present a novel global optimization approach to solving nonconvex power flow optimization problems. We describe a systematic approach to constructing minimal-error piecewise-linear approximations of the two-dimensional paraboloid function using the framework of the Delaunay triangulation and majorization theory. This analysis is applied to the problem of creating disjunctive outer approximations of indefinite quadratic constraints using MIP models with a limited number of integer variables.

3 - Generating Multi-row Simplex Cuts on Higher Dimensional Spaces

Emre Yamangil, Graduate Assistant, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, emreyamangil@gmail.com, Endre Boros

We consider the problem of generating a lattice-free convex set to find a valid inequality that minimizes the sum of its coefficients for multi-row simplex cuts. We formulate this problem as a fixed-dimensional semi-infinite disjunctive program on higher dimensional spaces. We investigate equivalent simplifications of this problem for efficiency and conclude with a numerical study on MIPLIB that shows improvement at the root gap.

■ SB44

Hilton- Union Sq 24

Digital and Social Media

Sponsor: Information Systems

Sponsored Session

Chair: Jui Ramaprasad, McGill University, 1001 Sherbrooke West, Montreal, QC, H3A 1G5, Canada, jui.ramaprasad@mcgill.ca

1 - Peer Influence in Academic Performance

Pedro Ferreira, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, United States of America, pedrof@cmu.edu, Ryan Turner, Rodrigo Belo

We track the usage of the wi-fi network on a college campus by engineering students to define networks of friends – those students that log to the same access point at the same time for most of the academic year. Using a panel with 3 years of data, we show that friends' grades influence one's grades. This result is obtained using randomization to separate the effect of peer influence from homophily and from other potentially unobserved covariates that might lead to correlation in grades.

2 - Reducing Medical Bankruptcy through Crowdfunding: Evidence from GiveForward.com

Jason Chan, Stern School of Business, New York, NY, United States of America, jcc534@stern.nyu.edu, Gordon Burtch

This paper examines the potential of medical crowdfunding in reducing bankruptcy. Medical crowdfunding is a relatively recent phenomenon where patients reach out to their social network for monetary support towards medical causes. We combine proprietary fundraising data with bankruptcy filing records in our analyses and find that medical crowdfunding reduce the financial burden faced by individuals on the brink of bankruptcy. This relationship is robust to alternative model specifications.

3 - Value of Following Network and User Interest in Social Advertising Targeting

Hyelim Oh, McGill University, Montreal, Canada, hyelim.oh@mail.mcgill.ca, Animesh Animesh, Alain Pinsonneault

This study investigates how firms can improve the effectiveness of social advertising by leveraging the viral features of social media platforms and social media analytics. Specifically, we focus on individual-level content retransmission decisions and examine how dyadic properties between a sender and receiver on Twitter networks affect the likelihood of a receiver's retweet decisions. Our preliminary findings show that latent homophily predicts the likelihood of a receiver's retweet decision.

4 - An Empirical Investigation of the Role of Basic and Social Features in the use of Online Music Sites

Genevieve Bassellier, Associate Professor, McGill University, Desautels Faculty of Management, 1001 Sherbrooke St. W., Montreal, Qu, H3A 1G5, Canada, genevieve.bassellier@mcgill.ca, Zachary Krastel, Jui Ramaprasad

This study examines users' perceptions of online music site features and their impact on use. We focus on two types of features: basic site features, e.g. the size of the song catalog, and social features that enable interaction amongst users and artists. We examine the impact of these features on different types of use for different types of sites. Preliminary results support the notion that not all features are created equally, which has significant implications for the design of such sites.

5 - A Brief History of Stenting: Antecedents of Organizational Technology Adoption and Abandonment

Brad Greenwood, University of Maryland, United States of America, brad.n.greenwood@gmail.com, Ritu Agarwal, Rajshree Agarwal, Anand Gopal

We investigate how factors which influence organizational adoption of technology also influence the decision to abandon technology after its efficacy is questioned. Using a census of 1.4 million patients admitted to Florida hospitals, results indicate that pecuniary incentives will retard the abandonment of technology, if it can still be leveraged for economic gain. However, incentives to adhere to scientific norms dominate these economic motives (resulting in an accelerated abandonment).

■ SB45

Hilton- Union Sq 25

Behavioral Modeling in Business

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Tony Cui, Associate Professor of Marketing, University of Minnesota, 321 19th Ave S, Ste 3-150, Minneapolis, MN, 55455, United States of America, tcui@umn.edu

1 - Cognitive Hierarchy in Capacity Allocation Games

Yinghao Zhang, Assistant Professor, Salisbury University, Perdue Hall 333, 1101 Camden Avenue, Salisbury, MD, 21804, United States of America, YXZHANG@salisbury.edu, Tony Cui

We experimentally study the capacity allocation game with the proportional allocation rule. The orders made by the subjects are significantly different from the Nash equilibrium. The data also suggests heterogeneities among the subjects. We propose a behavioral model to explain the phenomenon based on the Cognitive Hierarchy (CH) theory, in which decision makers are cognitively heterogeneous. The model coincides with the experimental observations and fits the data quite well.

2 - A Model of Bounded Cognition in Forecasting with Implications for Operations Management

Jordan Tong, Assistant Professor of Operations and Information Management, University of Wisconsin-Madison, Wisconsin School of Business, Madison, WI, United States of America, jtong@bus.wisc.edu, Daniel Feiler

We leverage psychological micro-foundations to analytically model bounded cognition in three forecasting tasks critical to operations management: the single forecast, the mth arrival time forecast, and the l-time demand forecast. For each task, we derive the distribution of behavior and the biases due to bounded cognition. Finally, we focus on the model's application to the well-studied newsvendor problem, including structural estimations and out-of-sample tests using existing empirical data.

3 - Information Sharing, Advice or Delegation: What Leads to Higher Trust in a Distribution Channel?

Upender Subramanian, Assistant Professor of Marketing, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, upender@utdallas.edu, Ozalp Ozer, Yu Wang

Many retailers solicit support from manufacturers in the form of information about market conditions, or advice about retail decisions, or even request manufacturers to make decisions on their behalf. Often such support is not explicitly governed by contracts, raising concerns about manufacturer opportunism. Using analytical and behavioral methods, we show how and why — contrary to predictions from standard theory — one form of support leads to more trust and cooperation than others.

4 - Is it Really Dumb to be a Dumber? Competitive Analysis of Hierarchically Strategic Firms

Tony Cui, Associate Professor of Marketing, University of Minnesota, 321 19th Ave S, Ste 3-150, Minneapolis, MN, 55455, United States of America, tcui@umn.edu, Zuhui Xiao

Research has suggested firms may have different levels of strategic reasoning capabilities. Incorporating hierarchical strategic capabilities into a duopoly model, we find that a less strategic firm may benefit from its limited strategic capability when competing with a more strategic firm, although the strategic firm can respond specifically towards the less strategic firm's decisions but not vice versa. A lab experiment provides empirical supports for theoretical predictions.

■ SB46

Hilton- Lombard

MINLP

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Akshay Gupte, Assistant Professor, Clemson University, Martin O-321, Dept. of Math Sciences, Clemson, SC, United States of America, agupte@clemson.edu

1 - On the Equate-and-Relax Procedure for LPCCs

Jean-Philippe P Richard, University of Florida, 303 Weil Hall P.O. Box 116595, Gainesville, FL, 32611, United States of America, richard@ise.ufl.edu, Mohit Tawarmalani, Trang Nguyen

We study the problem of generating cuts for linear programs with linear complementarity constraints (LPCCs) from simplex tableaux of their LP relaxations. We show that the convex hull of a suitably defined single-complementarity corner relaxation can be derived through a constructive equate-and-relax procedure. This result also holds when side constraints are added and can be used to generate cuts for problems with multiple complementarity constraints using a generalization of split disjunctions

2 - Integer Quadratic Programming is in NP

Marco Molinaro, Georgia Tech, Ferst Drive, Atlanta, United States of America, marco.molinaro@isye.gatech.edu, Santanu Dey

We prove that Integer Quadratic Programming (IQP) is in NP. The decision version of IQP is the following problem: Given one quadratic inequality and a system of linear inequalities in n variables where all data is rational, decide whether there exists an integral vector that satisfies all these inequalities. We prove that if the system of inequalities is integer feasible, then there exists one integer feasible solution whose size is bounded by a polynomial function of the size of the instance.

3 - A Trust Region Method for Solving Grey-box MINLP

Claudia D'Ambrosio, CNRS & LIX, Ecole Polytechnique, Batiment A. Turing, Palaiseau CEDEX, 91128, France, dambrosio@lix.polytechnique.fr, Ky Vu, Andrew Conn, Claire Lizon, Leo Liberti

We aim at solving grey-box MINLP problems with binary variables, i.e., mixed integer nonlinear optimization problems where the objective function is the sum of smooth functions given in closed form and of a black-box. We propose a trust region method with adjoined local branching type constraints that define the trust region for the binary variables. Both theoretical aspects and computational results on applications like smart building design and oil reservoir engineering are discussed.

4 - New MIP and SDP Approaches to the Floor Layout Problem

Joseph Huchette, MIT Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, huchette@mit.edu, Juan Pablo Vielma, Santanu Dey

The floor layout problem is central to VLSI: given a rectangular floor, find the best configuration of N rectangular boxes on the floor. The boxes must have a certain area, but their widths and heights can be varied. We present new MILP formulations for the problem, offering nontrivial LP relaxation bounds. We investigate incorporating existing SDP formulations into the MILP solution process as a cut generator, and we present extensive computational results for our formulations and techniques.

■ SB47

Hilton- Mason A

Stochastic Optimization in Networks

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Yongjia Song, Virginia Commonwealth University, 1015 Floyd Ave, Richmond, VA, 23284, United States of America, yjsong.pku@gmail.com

1 - A Two-stage Ambiguous Stochastic Generalized Network Flow Model for Water Allocation

Güzin Bayraksan, Associate Professor, Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, bayraksan.1@osu.edu

We present a two-stage stochastic generalized network flow model for water allocation. The distributional ambiguity is modeled by considering all distributions that are sufficiently close to a nominal distribution with respect to a phi-divergence (e.g., Chi-sq. distance, Kullback-Leibler divergence, etc.). We integrate forecasts from different sources of uncertainty and examine the value of additional data.

2 - Sensor Deployment for Stochastic Traffic Congestion Observation

Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu, Zhili Zhou

Under random traffic flows, we deploy sensors to cover all congested arcs. We minimize congested arcs subject to a chance constraint on flow losses. We generalize the cut-based flow inequalities and prove that they are facets of the MIP reformulation. Computational studies use data in Singapore, and show the effectiveness of integrating sensor deployment with traffic congestion minimization.

3 - Chance-constrained Multi-terminal Network Design Problem

Yongjia Song, Virginia Commonwealth University, 1015 Floyd Ave, Richmond, VA, 23284, United States of America, yjsong.pku@gmail.com, Minjiao Zhang

We study a chance-constrained multi-terminal network design problem, which is a stochastic variant of Steiner tree problems. We study formulations using valid inequalities that require different separation efforts. We conduct a computational test to show their performance.

4 - Efficient Methods for Vulnerability Assessment in Uncertain Networks

Thang Dinh, Assistant Professor, Virginia Commonwealth University, 401 West Main Street, Room 4244, P.O. Box 843019, Richmond, VA, 23284, United States of America, tndinh@vcu.edu, My Thai

We aim to identify the most critical elements whose removal maximizes the disruptive effect in terms of connectivity. We show that computing expected connectivity in uncertain networks is intractable and propose an FPRAS to estimate the connectivity with an arbitrary accuracy. Further, we propose an efficient two-stage stochastic programming and efficient solving methods to identify critical elements.

■ SB48

Hilton- Mason B

Stochastic Programming - A Mix of Recent Results

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Ruediger Schultz, University of Duisburg-Essen, Faculty of Mathematics, Forsthausweg 2, Duisburg, D-47048, Germany, ruediger.schultz@uni-due.de

1 - Risk Averse Routing in Single-VRP with Simultaneous Delivery and Stochastic Pickup

Nadine Wollenberg, nadine.wollenberg@uni-due.de, Walter Rei, Michel Gendreau, Ruediger Schultz

The talk addresses risk averse routing decisions. A stochastic extension of the vehicle routing problem with simultaneous delivery and pickup is presented. Delivery quantities are fixed and units to be picked up are a priori unknown. For the single vehicle case, the stochastic model is formulated as a two-stage stochastic program with recourse and solved by means of the integer L-shaped method. Solutions of different stochastic mean-risk models are examined and compared to the risk neutral case.

2 - Sufficient Conditions for Metric Regularity and Stability of Stochastic Dominance Constraints

Matthias Claus, Universitat Duisburg-Essen, Forsthausweg 2, Duisburg, 47057, Germany, matthias.claus@uni-due.de, Ruediger Schultz

Minimizing a disutility function under first-order stochastic dominance constraints for random variables arising as optimal values of stochastic programs with linear recourse leads to an optimization problem with uncountably many chance constraints. Metric regularity of the contraint function is the key to stability of the solution set mapping subject to perturbations of the underlying probability measure. The talk is on verifiable sufficient conditions based on a local linear growth.

3 - Semidefinite Sochastic Programming in AC Power Flow

Tobias Wollenberg, University of Duisburg-Essen, Faculty of Mathematics, Forsthausweg 2, Duisburg, D-47048, Germany, tobias.wollenberg@googlemail.com

Considering the AC load flow problem under uncertainty of infeed from renewables and customers' power demand leads us to specific semidefinite stochastic programs. Basic structures of these models are studied and a decomposition algorithm for their solution is proposed.

4 - Stochastic Programming with PDE Constraints in Shape Optimization with Random Load

Ruediger Schultz, University of Duisburg-Essen, Faculty of Mathematics, Forsthausweg 2, Duisburg, D-47048, Germany, ruediger.schultz@uni-due.de

Shape optimization with linearized elasticity and random loading has attracted research in stochastic programming only fairly recently. Typical paradigms from stochastic programming, to be discussed in the talk, such as the recourse idea or mean-risk objectives as well as dominance constrained constraints have their counterparts in shape optimization under uncertainty.

■ SB49

Hilton- Powell A

Risk-averse Optimization in Networks

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Pavlo Krokhmal, Associate Professor, University of Iowa, 3131 Seamans Center, Iowa City, IA, 52242, United States of America, krokhmal@engineering.uiowa.edu

1 - Risk Averse Strategic Planning of HVDC Grids

Bo Sun, University of Iowa, 3131 Seamans Center, Iowa City, IA, 52242, United States of America, bo-sun-1@uiowa.edu, Yong Chen, Pavlo Krokhmal

We consider the problem of risk-averse strategic planning of high-voltage direct current (HVDC) grids, which offer significant advantages over traditional AC transmissions. We discuss the problem of long-term planning of HVDC grids that incorporate sources of renewable energy. Risks of power shortages are controlled using nonlinear higher-moment coherent risk (HMCR) measures. Solution methods for the resulting mixed-integer programming problems and computational case studies are presented.

2 - Two-stage Stochastic Maximum Clique Problem

Maciej Rysz, University of Iowa, 3131 Seamans Center, Iowa City, IA, 52242, United States of America, maciej-rysz@uiowa.edu, Pavlo Krokhmal, Eduardo Pasiliao

We consider the problem of determining the largest "robust" clique in a stochastic graph, where links between nodes may randomly fail or "appear". The "robustness" of a complete subgraph is defined as its repairability after observable random changes to the graph's topology. A two-stage stochastic programming model is formulated, and a graph-based branch-and-bound algorithm is proposed. Numerical experiments illustrate computational effectiveness of the proposed method.

3 - On Incremental Network Design under Uncertainty

Nathaniel Richmond, University of Iowa, 3131 Seamans Center, Iowa City, IA, 52242, United States of America, nathaniel-richmond@uiowa.edu, Pavlo Krokhmal, Dmytro Matsypura

We consider the incremental network design problem, where the goal is to improve an existing network by building new arcs, given that only one arc can be built at a time, the arc budget is limited, and at each time step the desired network characteristic (e.g., a shortest path between two nodes) is minimized. Previous studies have shown this problem to be NP-hard. A stochastic extension of the problem is presented, and the theoretical and computational properties of its solutions are discussed.

■ SB50

Hilton- Powell B

Network Design, Dynamics and Optimization

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Mario Ventresca, Assistant Professor, School of Industrial Engineering, Purdue University, 315 N. Grant St., West Lafayette, IN 47907, United States of America, mventresca@purdue.edu

1 - Competitive Equilibrium in Electricity Markets with Price Fluctuation Penalty

Ermin Wei, MIT, Cambridge, MA, United States of America erminwei@mit.edu, Azarakhsh Malekian, Asuman Ozdaglar

We develop a flexible model of competitive equilibrium in electricity markets involving heterogeneous users with shiftable demand. The resulting equilibrium prices and quantities may feature undesirably high price volatility over time. To control this, we introduce an explicit penalty term on the price fluctuation and provide a distributed market implementation thereof. We analyze the connection between consumer utility properties and the price fluctuation at equilibrium.

2 - Modeling Evolution of Social Networks with the Node Prominence Profile

Nitesh Chawla, Associate Professor, University of Notre Dame, 384 Nieuwland Science Hall, Notre Dame, IN, 46556, United States of America, nchawla@nd.edu

Both preferential attachment and triadic closure properties are important in defining the growth of a network. As the node's influence and relative position in the neighborhood increases, it impacts the local network structure. We use the concept of prominence, which captures trade-offs between preferential attachment and triadic closure. We develop a method for predicting prominence and network evolution, and demonstrate its effectiveness over multiple social networks.

3 - Distributional Robust Network Design Problems
Zhihao Chen, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48105, United States of America, czhihao@umich.edu, Siqian Shen

We investigate network design problems under uncertain demand; the true distribution is unknown but historical data is available. We use candidate distributions whose moments are close enough to the empirical moments and find the optimal solution under the worst-case distribution. We will compare the performance of the distributionally robust approach against a stochastic approach where the distribution is intelligently guessed, and also examine the effect of correlated demands on this approach.

4 - Detecting Cliques of Maximum and Minimum Centrality
Chrysafis Vogiatzis, University of Florida, chvogiat@ufl.edu

We consider the problem of finding the most and least "influential" or "influenceable" cliques in graphs based on three classical centrality measures: degree, closeness, and betweenness. In addition to standard betweenness,, we also consider its optimistic and pessimistic versions. We discuss their computational complexity and develop linear 0-1 programming formulations. Finally, we demonstrate the performance of the formulations, and provide some interesting insights based on the results.

■ SB51

Hilton- Sutter A

Optimization in Dynamics and Control

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Amir Ali Ahmadi, Princeton University, 329 Sherrerd Hall, Dept. of Operations Research & Fin. Eng., Princeton, NJ, 08540, United States of America, a_a_a@princeton.edu

1 - An Input/Output Approach to Predicting and Engineering Emergent Network Behavior
Murat Arcak, Professor, UC Berkeley, Cory Hall, Berkeley, United States of America, arcak@berkeley.edu

Analytical and computational tools for certifying the stability and performance of feedback systems are applicable only to moderate size problems. We will present a compositional approach that exploits input-output properties of the subsystems and their interconnection structure to analyze large-scale systems. We will present a large-scale optimization technique to select important local properties to certify global objectives.

2 - Optimal Sampling-Based Motion Planning under Differential Constraints
Marco Pavone, Professor, Stanford University, 496 Lomita Mall, Room 261, Stanford, CA, 94305, United States of America, pavone@stanford.edu, Edward Schmerling

We present a thorough theoretical framework to assess optimality guarantees of sampling-based algorithms for robot motion planning under differential constraints. Our analysis yields convergence rate bounds - a first in the field. We exploit this framework to design and analyze two novel sampling-based algorithms that are guaranteed to converge, as the number of samples increases, to an optimal solution. Our focus is on driftless control-affine and on linear affine dynamical models.

3 - Robust to Dynamics Optimization (RDO)
Amir Ali Ahmadi, Princeton University, 329 Sherrerd Hall, Dept. of Operations Research&Fin. Eng., Princeton, NJ, 08540, United States of America, a_a_a@princeton.edu, Oktay Gunluk

We introduce a new type of robust optimization problems that we call "robust to dynamics optimization" RDO. The input to an RDO problem is twofold: (i) a mathematical program (e.g., an LP, SDP, IP), and (ii) a dynamical system (e.g., a linear, nonlinear, discrete, or continuous dynamics). The objective is to maximize over the set of initial conditions that forever remain feasible. We initiate an algorithmic study of RDO and demonstrate tractability of some important cases.

■ SB52

Hilton- Sutter B

First-Order Methods for Huge-Scale Optimization

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Robert Freund, Professor, MIT, Sloan School of Management, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, rfreund@MIT.EDU

1 - Boosting in Regression: Computational Guarantees and Regularization via Subgradient Optimization
Paul Grigas, MIT Operations Research Center, E40-130, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, pgrigas@mit.edu, Rahul Mazumder, Robert Freund

We present a novel subgradient descent framework for interpreting boosting methods in linear regression that yields new convergence and computational guarantees. Our framework includes both the incremental forward stagewise regression algorithm and boosting methods for lasso. Our results draw on existing theory of first-order methods in convex optimization as well as new extensions of this theory in the setting of linear regression.

2 - An Optimal Stochastic Incremental Gradient Method for Convex Optimization
George Lan, Assistant Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, glan@ise.ufl.edu

We present a novel stochastic primal-dual incremental gradient method and show that it can achieve the optimal O(1/k^2) rate of convergence for deterministic smooth optimization. The cost per iteration for this algorithm is comparable to stochastic / incremental gradient methods. Our work thus provides a positive answer to the open question regarding whether there exists an optimal incremental gradient method for convex optimization.

3 - An Accelerated Randomized Coordinate Descent Method for Strongly Convex Composite Optimization
Qihang Lin, Assistant Professor, The University of Iowa, 21 East Market Street, PBB S380, Iowa City, IA, 52245, United States of America, qihang-lin@uiowa.edu, Lin Xiao, Zhaosong Lu

We propose an accelerated randomized block-coordinate descent method for minimizing the sum of a smooth convex function and a block-separable convex function. The algorithm is developed based on the technique of randomized estimate sequence. Compared to existing coordinate descent methods, our method guarantees a linear convergence rate when the problem is strongly convex and its complexity has a better dependence on the condition number of the problem.

4 - An Extended Frank-Wolfe Method, with Application to Low-Rank Matrix Completion
Robert Freund, Professor, MIT, Sloan School of Management, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, rfreund@MIT.EDU, Paul Grigas, Rahul Mazumder

We present an extension of the Frank-Wolfe method that is designed to induce near-optimal solutions on low-dimensional faces of the feasible region. In addition to computational guarantees for the method, we present computational results for large-scale low-rank matrix completion problems that demonstrate its usefulness in providing order-of-magnitude speed-up in computing low-rank near-optimal solutions.

■ SB53

Hilton- Taylor A

Systemic Risk

Cluster: Optimization in Finance

Invited Session

Chair: Ciamac Moallemi, Barbara and Meyer Feldberg Associate Professor of Business, Columbia Business School, 3022 Broadway, Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

Co-Chair: Garud Iyengar, Columbia University, S.W. Mudd 314, 500W 120th Street, New York, NY, 10027, United States of America, garud@ieor.columbia.edu

1 - Information Contagion in Financial Networks
Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris 418, New York, NY, 10027, United States of America, alirezat@columbia.edu, Jennifer La'O

We analyze how incomplete information about the viability of bank assets may affect the fragility of the financial system. We show that fluctuations in expectations can be amplified and lead to systemic crises. Fragility depends both on the topology of the network as well as the structure of higher-order beliefs. Our results have implications for regulatory policies such as mandatory disclosure policies and stress tests.

2 - Measuring and Allocating Systemic Risk
Patrick Cheridito, Princeton University, 204 Sherrerd Hall, Princeton, NJ, United States of America, dito@princeton.edu

This paper develops a framework for measuring, allocating and managing systemic risk. SystRisk, our measure of total systemic risk captures the a priori cost to society for providing tail-risk insurance to the financial system. Our allocation principle distributes the total systemic risk among individual institutions according to their size-shifted marginal contributions.

3 - A Structural Model for Asset-based Contagion and Systemic Risk
Chen Chen, ShanghaiTech University, Shanghai, Shanghai, China, cc3136@columbia.edu, Garud Iyengar, Ciamac Moallemi

We develop a structural model for the analysis of systemic risk in financial markets based on asset-based contagion. Specifically, we describe a mechanism of contagion where exogenous random shocks to agents in an economy force portfolio rebalancing. This creates an endogenous chain reaction as agents trade in reaction to price changes. Our approach allows us to quantify the effect of attributes such as leverage and portfolio diversity on asset-based contagion.

4 - Optimal Capital Requirements in Interbank Networks
Jong Soo Hong, PhD Student, Duke Univ Fuqua School of Business, 4225 Larchmont Rd 527, Durham, No, 27707, United States of America, jongsoo.hong@duke.edu, David Brown

We consider a network of banks, with connections representing interbank liabilities, and study the problem of optimally trading off between capital reserves and systemic risk. In a model without default costs, the problem may be formulated as a stochastic linear program. Default costs and fire sales externality make the problem much more challenging, and we discuss approximation methods based on dual approach. We demonstrate the methods on an example using data from a central bank.

■ SB54

Hilton- Taylor B

Financial Engineering & Risk Management

Sponsor: Financial Services Section

Sponsored Session

Chair: Martin Haugh, Columbia University, 500 West 120th Street, Room 332, New York, NY, 10027, United States of America, mh2078@columbia.edu

1 - Systemic Risk and Preventive Policies
Agostino Capponi, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, 21218, United States of America, acappon1@jhu.edu

We provide a data driven network study to assess the effect of preventive policies for mitigating systemic risk in multi-tiers interbanking networks. Using balance sheet data from the Federal Reserve Call Report as well as interest rates from the Board of Governors H15 release, we calibrate the rules followed by the agents. Capital-to-asset and reserve-to-deposit ratio policies impact the structure of the system, with systemic risk switching from being generated by tier 2 to tier 3 institutions.

2 - Large Deviations for Affine Diffusion Processes on the Canonical State Space
Wanmo Kang, Professor, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, wanmo.kang@kaist.edu, Chulmin Kang

We approach this problem in two different ways. In the first approach, we first prove the large deviation principle for finite dimensional distributions, and then use it to establish the sample path large deviation principle. The second approach exploits the exponential martingale method of Donati-Martin et al. for the squares of Ornstein-Uhlenbeck processes. We provide an application to importance sampling of affine diffusion models.

3 - Datebase Monte Carlo Metamodeling
Imry Rosenbaum, Northwestern University, Evanston, United States of America, ImryRosenbaum2016@u.northwestern.edu, Jeremy Staum

Simulation metamodeling creates computational efficiency in applications such as financial risk management. However, metamodels based on function approximation need to be validated, which uses up analysts' time. Database Monte Carlo (DBMC) has been used for variance reduction in simulation. We explore the application of DBMC to construct metamodels that do not require validation.

4 - Information Relaxation Bounds for Infinite Horizon Stochastic Dynamic Programs
David Brown, Duke University, 100 Fuqua Drive, Durham, United States of America, dbbrown@duke.edu

We study infinite horizon MDPs with discounted costs and develop a general approach for calculating performance bounds using information relaxations. We discuss ways to make the approach computationally manageable on problems with large state spaces and study the quality of the resulting bounds. We demonstrate the method on an application involving dynamic scheduling for a multiclass queue.

■ SB55

Hilton- Van Ness

Integer Nonlinear Programming and Applications – I

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Monique Guignard, Professor, University of Pennsylvania, OPIM Dept., the Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104-6340, United States of America, guignard_monique@yahoo.fr

1 - Multi-objective MINLP Optimization for the Aircraft Collision Avoidance Problem
F. Javier Martin-Campo, Universidad Complutense de Madrid, Department of Statistics and Operations, Office N227, Building 1, Pozuelo de Alarcon (Madrid), 28223, Spain, javier.martin.campo@ccee.ucm.es, Laureano Escudero, Antonio Alonso-Ayuso

The aircraft collision avoidance problem consists of providing a configuration for a set of aircraft flying in a certain air sector such that every conflict situation is avoided (being the violation of the safety distances to be kept in flight). To do so, three different maneuvers may be performed. Three different multi-objective methods have been applied to the proposed MINLP model. A broad computational experiment will be presented to compare the performance of the models and the methods.

2 - The Generalized Trace Ratio Optimization Problem
Said Hanafi, Professor, Universite de Valenceinnes, Valenciennes, France, Said.Hanafi@univ-valenciennes.fr, Yousef Saad, Raca Todosijevic, Mohammed Bellalij

Recently Ngo et al, 2012, show that the trace ratio optimization problem can be solved efficiently using the Lanczos procedure, a good initialization, and an approximation of an eigenvector computed by the Newton procedure. We propose a new Generalized Trace Ratio Optimization problem and a new formulation of the cell formation problem. We propose a hybrid approach using Singular Value Decomposition techniques to produce an initial feasible solution and heuristic to improve it.

3 - Evaluation and Analysis of CDAP Heuristics via Discrete Event Simulation
Frederick Abiprabowo, Graduate Student, University of Pennsylvania, frabi@wharton.upenn.edu

Although the bilinear 0-1 Crossdock Door Assignment Problem (CDAP) is proven to reduce operational costs, little is known regarding its effects on certain performance metrics, such as item cycle time. To evaluate CDAP's efficiency in a holistic crossdocking environment, we designed a discrete event simulation and used an adaptation of the CHH heuristic to solve CDAP. The performances of Static and Dynamic CDAP assignments compare favorably with the door assignments used by a commercial company.

4 - using Fractional Optimization to Accelerate Column Generation
Laurent Alfandari, ESSEC, 1 Avenue Bernard Hirsch, Cergy, France, alfandari@essec.fr

Column Generation (CG) is often efficient to solve the linear relaxation of large-size integer LPs. We diversify criteria to select the columns with a subproblem based on a ratio criterion. The subproblem is a non-linear 0-1 fractional optimization program, which is polynomial under some specified conditions. Mixing this criterion with the classic negative reduced cost criterion enabled to accelerate CG in the numerical experiments conducted.

■ SB56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - GameLab: from Classroom to Playground
Bernardo Pagnoncelli, Assistant Professor, Universidad Adolfo Ibañez, Diagonal las Torres 2640, Oficina 533-C, Santiago, RM, 7910000, Chile, bernardo.pagnoncelli@uai.cl

Our company sells games to be used in the classroom as a learning tool in Undergraduate, Graduate and MBA courses. In the 45-minute slot we plan to do a demonstration in which the participants will be invited to play one of our games. Participants can play the games using their personal computers, and we encourage all participants to join us. Prizes will be given to the winners of the games.

2 - JMP® Workshop: Interactive and Visual Data Analysis with JMP 11 Pro

Walter Teague, SAS Institute Inc., JMP Division, walter.teague@jmp.com

JMP Statistical Discovery Software is interactive and visual desktop software for Windows and Mac, with a complete array of integrated graphical and statistical procedures. We will demonstrate JMP tools for data analysis, visualization and exploration, including, Graph BuilderÆ, bubble plots, the data filter, and our popular mapping tools.. In addition to interactive techniques for Univariate and Bivariate analysis we will look at methods for Multivariate analysis including Clustering, Principal Components and Data Mining.

■ SB64

Parc- Cyril Magnin I

Applications of Approximate Queueing Analysis

Sponsor: Applied Probability Society

Sponsored Session

Chair: Ramandeep Randhawa, USC, Marshall School of Business, Los Angeles, United States of America, ramandeep.randhawa@marshall.usc.edu

Co-Chair: Achal Bassamboo, Northwestern University, 2001 Sheridan Rd., Evanston, IL, United States of America, a-bassamboo@kellogg.northwestern.edu

1 - Heavy-Traffic Limits for a Fork-Join Network in the Halfin-Whitt Regime

Guodong Pang, Penn State University, College of Engineering, University Park, PA, United States of America, gup3@engr.psu.edu, Hongyuan Lu

We study a fork-join network of stations with multiple servers and non-exchangeable synchronization under the FCFS discipline, where all service stations are in the Halfin-Whitt regime. Tasks are only synchronized if all the tasks associated with the same job are completed. We show FLLN and FCLT for the number of tasks in each waiting buffer for synchronization, jointly with the number of tasks in each parallel service station and the number of synchronized jobs.

2 - Virtual Allocation Policies for Many-Server Queues with Abandonment

Jiheng Zhang, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, jiheng@ust.hk, Zhenghua Long

We study a multiclass many-server system with generally distributed patience times. We establish fluid approximations and study the long-term behavior of the fluid model under a family of non-preemptive policies. The equilibrium state of the fluid model connects to a nonlinear program which helps to identify a lower bound of the long-run expected holding and abandonment cost, and design a policy to achieve such a lower bound when the patience time distributions have decreasing hazard rate.

3 - An Analysis of a Large-Scale Machine Repair Model

Petar Momcilovic, University of Florida, Weil Hall, Gainesville, FL, United States of America, momcilovic@ufl.edu, Amir Motaei

A machine repair model under general operating/repair distributions is considered in the Quality-and-Efficiency Driven asymptotic (QED) regime: both the number of machines and the number of repairmen are large, while the capacity and offered load relate via the square-root staffing rule. Process-level convergence of the number of broken machines is established — the limit is in terms of the corresponding tractable infinite-repairmen process, a stationary centered Gaussian process.

4 - Patience Time Based Scheduling in Multi-class Service Systems

Achal Bassamboo, Northwestern University, 2001 Sheridan Rd., Evanston, IL, United States of America, a-bassamboo@kellogg.northwestern.edu, Ramandeep Randhawa

We consider multiclass queueing systems in which customers have generally distributed patience times. We study optimal scheduling that utilizes the customers' patience distribution.

■ SB65

Parc- Cyril Magnin II

Systemic Financial Risk

Sponsor: Applied Probability Society

Sponsored Session

Chair: Kay Giesecke, Stanford University, Huang Engineering Center, Stanford, United States of America, giesecke@stanford.edu

1 - Interacting Particle Methods for Conditional Distributions

Tomoyuki Ichiba, University of California Santa Barbara, South Hall 5508, University of California, Santa Barbara, CA, 93106, United States of America, ichiba@pstat.ucsb.edu, Mike Ludkovski

We discuss importance sampling approaches to approximating conditional distribution of multidimensional Markov processes, given rare events, in order to compute conditional expectations of functionals of the processes under the worst-case scenarios of financial systems. Examples include Brownian motions with reflections, heavy tailed jump processes and diffusion processes of mean-field type. With the time-reversal of interacting particle system we improve the empirical importance sampling.

2 - Systemic Risk in the Repo Market

Alexander Shkolnik, UC Berkeley, Berkeley, CA, United States of America, ads2@stanford.edu

The repo (repurchase agreement) market is a crucial part of the US financial infrastructure. The complex inter-connectedness of financial institutions and the practice of rehypothecation, the re-use of repo collateral, amplify its inherent systemic risk. In contrast to static models in prior literature, we propose and analyze a dynamic model of a networked repo market. We illustrate the complex phenomena exhibited by the model and study its stability properties using the Lyapunov method.

3 - Modelling Financial Systemic Risk – Network Effect and Liquidity Effect

Nan Chen, The Chinese University of Hong Kong, 609 William Mong Engineering Building, Hong Kong, Hong Kong - PRC, wyu@se.cuhk.edu.hk, Xin Liu, David Yao

The goal of our study is to investigate how two channels of risk transmission, interbank liability network and market liquidity, interact to propagate individual defaults to a system-wide catastrophe. We formulate the model as an optimization problem with equilibrium constraints and derive the solution via a partition algorithm. The analysis and numerical experiments underscore the importance of the market liquidity in the formation of systemic risk.

■ SB66

Parc- Cyril Magnin III

QSR Student Introductions and Interactions

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Tirthankar Dasgupta, Associate Professor, Harvard University, 1 Oxford Street, 7th Floor, Harvard Statistics Department, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu

Co-Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, kbwang@tsinghua.edu.cn

1 - QSR Student Introductions and Interactions

Tirthankar Dasgupta, Associate Professor, Harvard University, 1 Oxford Street, 7th Floor, Harvard Statistics Department, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu, Kaibo Wang

In this session, interested QSR student members will introduce themselves and their research interests through short presentations. Also, a few senior QSR members will be invited to discuss/share their experiences with students and to give them some words of advice about their careers.

■ SB67

Parc- Balboa

Condition Monitoring and Degradation Modeling

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Liu Xiao, IBM Research, Singapore, Singapore, liuxiao@sg.ibm.com

Co-Chair: Nan Chen, Assistant Professor, National University of Singapore, 1 Engineering Drive 2, Singapore, Singapore, isecn@nus.edu.sg

1 - A Hierarchical Model for Lithium-Ion Battery Degradation Prediction

Xin Xu, ph.d Student, NUS, BLK E1-07-19,ISE,NUS, Singapore, Singapore, xuxin@nus.edu.sg, Nan Chen

This paper presents a new point of view to analyze the lithium-ion battery degradation by using the detailed discharging profiles to characterize the degradation process. A hierarchical model combining discharging process and degradation process is proposed based on this idea. With this model, the End-of-Discharging prediction and Remaining-Useful-Life prognostics can be realized in one framework.

2 - Imperfect Condition-based Maintenance under Performance-based Logistics

Yisha Xiang, Assistant Professor, Sun Yat-sen University, 135 W. Xingang Rd., Guangzhou, 57025, China, xiangysh@mail.sysu.edu.cn, David Coit

In this study, we consider a heterogeneous population, and allow for unit-to-unit heterogeneity in degradation paths within all subpopulations through the incorporation of random effects. We further propose a condition-based maintenance model under a profit-centric approach for the degradation process of our interest , and compare the optimal policies and costs/profits under the traditional cost-minimization and the new profit-centric approaches.

3 - Joint Mixed Effects Logistic Regression for Rescue Inhaler Usage Prediction in SAM Systems

Junbo Son, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, json5@wisc.edu, Patricia Brennan, Shiyu Zhou

To effectively manage the asthma as a chronic disease, a statistical model based on the everyday patient monitoring is crucial. Also, a significant individualization is desirable to provide a patient-level prediction for key health indicators such as the rescue inhaler usage. Taking advantages from smart asthma management (SAM) systems, we propose an individualized prognostic model that has a form of extended logistic regression. Its promising features are shown in both simulation and case study.

4 - Predictive Maintenance for Data Centre Cooling System

Liu Xiao, IBM Research, Singapore, Singapore, liuxiao@sg.ibm.com

A condition-based maintenance approach is proposed for data centre cooling system. The statistical model is developed based on the first law of thermodynamics. The method has been tested and validated using real data. Our case study shows that the model successfully generates the early warning signal 2 to 3 weeks before the cooling system failure.

■ SB68

Parc- Davidson

Reliability Evaluation and Maintenance Optimization

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu

1 - Reliability of Systems with Spatially Distributed Units

Elsayed Elsayed, Distinguished Professor, Rutgers University, Department of Industrial and Systems Eng, Rutgers University, Piscataway, NJ, 08854, United States of America, elsayed@rci.rutgers.edu, Dingguo Hua

The reliability of systems with spatially distributed units have emerged as an important topic in aerospace and military industries. In this paper, we investigate spatially distributed k-out-of-n pairs:G balanced systems with different requirements. Reliability and other metrics such as time to a specified failure are estimated.

2 - Performance Evaluation of Wind Turbines using Wind Power Curves

Hoon Hwangbo, Texas A&M University, 3131 TAMU, College Station, TX, 77845, United States of America, hhwangbo@tamu.edu, Andrew Johnson, Yu Ding

Performance of a wind turbine embodies a lot of internal and external variation. To control for external variation, we align different annual datasets with similar aerodynamic conditions. Then, we apply a method developed based on Convex Nonparametric Least Squares to provide two measures for evaluating internal change of a wind turbine. One measure is for efficiency and another is for variability; together they can account for the performance change of a wind turbine over time.

3 - Optimal Replacement in Partially-Observed Environments

Jeffrey Kharoufeh, Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, PA, 15261, United States of America, jkharouf@pitt.edu

We address the problem of optimally replacing a component that resides in an uncertain environment. Two models are formulated using a partially-observed Markov decision process framework. The first model ignores downtime costs, while the second includes this cost explicitly. For both models, it is shown that a threshold replacement policy is optimal with respect to the cumulative level of degradation. These thresholds depend on the decision maker's assessment of the environmental conditions.

4 - Reliability Assessment of Wind Turbine using Stochastic Simulations

Youngjun Choe, Ph.D. Candidate, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, yjchoe@umich.edu, Nan Chen, Eunshin Byon

As simulation models become more realistic, reliability evaluation remains challenging due to the high computational cost of each simulation replication. We provide computationally efficient methods for reliability evaluation using stochastic simulations that generate random outputs given a fixed input. A new sampling method has been devised and validated using aeroelastic simulators developed by the U.S. National Renewable Energy Laboratory.

■ SB69

Parc- Fillmore

Design and Optimization of Sustainable Supply Chains

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Fengqi You, Assistant Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, you.fengqi@gmail.com

1 - A Multistage Stochastic Optimization of the Supply Chains of Biofuels

Yongxi Huang, Assistant Professor, Clemson University, 314 Lowry Hall, Clemson University, Clemson, SC, United States of America, yxhuang@clemson.edu, Fei Xie

A multistage stochastic programming model is developed for a multi-year biofuel supply chain design and planning under time dynamics and uncertainty of feedstock supply. We then use block-separable property to transform the problem to an equivalent two-stage stochastic program. We decompose it into tractable subproblems using the nested decomposition method and generate maximal bender cuts in the iterative process to improve the rate of convergence. We present numerical implementations.

2 - Incorporating Sustainability Concepts into Hybrid Ethanol Supply Chain

Iddrisu Awudu, NDSU, 26 University Village, Fargo, ND, United States of America, Iddrisu.Awudu@my.ndsu.edu, Atif Osmani, Jun Zhang

We develop a framework for the modeling and analysis of a hybrid generation biofuel supply chain (HGBSC) with economic, social, and environmental sustainability concepts. A two-stage stochastic mixed integer linear programming (SMILP) approach is used with the Sample Average Approximation (SAA) algorithm. Analyses of the results conclude that incorporating sustainability concepts into the supply chain provide the HGBSC with visibility and managed expectations of profit realization.

3 - Optimizing Biomass Co-Firing Decisions in Coal Fired Power Plants

Hadi Karimi, Mississippi State University, PO Box 9542, Mississippi State, MS, 39762, United States of America, hadi.karimi.00@gmail.com

This paper provides an optimization model to aid with biomass co-firing decisions in coal fired power plants. Co-firing impacts plant's logistics-related costs, capital investments, plant efficiency, and tax credit collected. We develop a linear MIP model to capture the relationships that exists between biomass usage and the corresponding costs and savings due to production of renewable electricity. We test the impact of the model proposed on renewable electricity production using a case study.

4 - Life Cycle Optimization with Functional Unit for Sustainable Supply Chain Design and Operations

Fengqi You, Assistant Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, you.fengqi@gmail.com, Dajun Yue

We propose a life cycle optimization framework for the sustainable supply chain optimization considering the concept of "functional unit" under economic and environmental criteria. This modeling framework integrates LCA with multiobjective optimization and measures the system's performance based on a standard quantity of functional unit associated with final products. We also present tailored algorithms for efficiently solving the resulting mixed-integer linear fractional programming problems.

■ SB70

Parc- Hearst

Open Pit Mining and Logistics

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Alexandra M. Newman, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Open Pit Mine Production Scheduling with Stockpiling

Mojtaba Rezakhah, PhD Student, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, mrezakha@mymail.mines.edu, Alexandra M. Newman, Vitaliy Krasko

We present several ways of considering stockpiling in open pit mine production scheduling, including (i) individual stockpiles for each block, (ii) homogenously mixed stockpiles, and (iii) binned stockpiles with pessimistic grade estimates. These models are formulated for a currently operational mine and compared to results without stockpiling in order to assess the benefits of stockpiling and to analyze the relationship between milling capacity and stockpiling value.

2 - Production Scheduling for Open Pit Mine Planning: Comparing New and Traditional Approaches

Marcos Goycoolea, Associate Professor, Universidad Adolfo Ibanez, School of Business, Santiago, Chile, marcos.goycoolea@uai.cl, Eduardo Moreno, Daniel Espinoza, Orlando Rivera

Mathematical programming (MP) methods were first proposed for the open pit production scheduling in the late 60s. Despite this, only in the last years has MP been a viable option for solving this problem due to the tremendous size of real planning instances. Instead, mine planners have relied on a heuristic known as the Nested Pit (NP) method. In this talk we describe a new MP approach, and compare it on real instances to Whittle, a market-leading mine-planning software using the NP method.

3 - Optimization of the Immediate Term Execution Schedule in Open Pit Mining

Ryan Miles, Principal Advisor, AngloGold Ashanti, 6300 South Syracuse Way, Suite 500, Centennial, CO, 80111, United States of America, rmiles@anglogoldashanti.com

Operations research in the mining industry has historically sought to optimize an extraction schedule that maximizes net present value over the long run (years-decades). This formulation evaluates the optimal extraction sequence in the immediate term (0-30 day outlook) to support production and maintenance supervisorial decisions based on blasted rock inventory locations and the availability of critical heavy mining equipment (i.e. loaders, shovels, haul trucks, and mineral processing).

4 - Logistic System Analysis for the Mining Company LKAB

Mikael Rönnqvist, Professor, Université Laval, Département de Génie Mécanique Pavillon, 1065, avenue de la Médecine, Québec, QU, G1V 0A6, Canada, mikael.ronnqvist@gmc.ulaval.ca, Patrik Flisberg, Dick Carlsson

LKAB is a large iron ore mining company and a world-leader in pellet manufacturing. It produces more than 20 million tons and this is increasing considerably over the next years. An important part of its logistic is to use trains to transport material and products. This system has a number of bottlenecks that may be critical. We present OR models of the transportation ranging from strategic down to operational planning. We present a number of case studies and analysis of these.

■ SB71

Parc - Lombard

Auctions and Markets for Information

Cluster: Auctions

Invited Session

Chair: Dirk Bergemann, Yale University, 30, Hillhouse Avenue, Cowles Foundation, New Haven, Co, 06511, United States of America, dirk.bergemann@yale.edu

1 - Robustness and Multidimensional Mechanism Design

Gabriel Carroll, Stanford University, 579 Serra Mall, Stanford, CA, 94305, United States of America, gdc@stanford.edu

We consider a robust multidimensional screening problem. A monopolist sells several goods simultaneously to a buyer with additive valuation. The seller knows the marginal distribution of values for each good, but not their joint distribution. Any mechanism for selling the goods is evaluated by its worst-case expected revenue over all joint distributions consistent with the seller's knowledge. The main result is that it is optimal to simply post a price for each good separately.

2 - Selling Cookies

Dirk Bergemann, Yale University, 30, Hillhouse Avenue, Cowles Foundation, New Haven, Co, 06511, United States of America, dirk.bergemann@yale.edu, Alessandro Bonatti

We analyze data pricing and targeted advertising. Advertisers seek to tailor their spending to the value of each consumer. A monopolistic data provider sells cookies about individual consumers' preferences. We characterize the set of consumers targeted by the advertisers and the optimal monopoly price of cookies. The price of data decreases with the reach of the database and increases with the fragmentation of data sales. We characterize the optimal policy for selling information.

3 - Surveying and Selling: Belief and Surplus Extraction in Auctions

Benjamin Brooks, Princeton University, 001 Fisher Hall, Princeton, NJ, 08540, United States of America, babrooks@princeton.edu

I consider a seller who is highly uncertain about demand for the good he is selling. All the seller knows is that values are private and beliefs are derived from a common prior. The seller wants to guarantee himself as large a revenue-share of the efficient surplus as possible. This goal is achieved by running a modified second-price auction, in which the seller collects additional information in order to calibrate a reserve price.

4 - Reserve Prices in Internet Advertising Auctions: A Field Experiment

Michael Schwarz, Yahoo! Labs, Sunnyvale, CA, United States of America, mschwarz@yahoo-inc.com, Michael Ostrovsky

We present the results of a large field experiment on setting reserve prices in auctions for online advertisements, guided by the theory of optimal auction design suitably adapted to the sponsored search setting. Consistent with the theory, following the introduction of new reserve prices revenues in these auctions have increased substantially.

■ SB72

Parc- Stockton

Demand Response in Electricity Markets

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Mahdi Kefayati, The University of Texas at Austin, 2501 Speedway ENS 506A, Austin, TX, 78712, United States of America, kefayati@utexas.edu

Co-Chair: Ross Baldick, Professor, The University of Texas at Austin, 1 University Station TX, C0803, Department of Electrical & Computer Engg, Austin, TX, 78712, United States of America, baldick@ece.utexas.edu

1 - A Graph-theoretic Computational Method for Emerging Power Optimization Problems

Ramtin Madani, Columbia University, 120th St, New York, NY, 10027, United States of America, rm3122@columbia.edu, Javad Lavaei, Ghazal Fazelnia, Somayeh Sojoudi

We study a general power optimization using a convex relaxation named semidefinite programming (SDP). The existence of a rank-1 matrix solution to the SDP relaxation enables the recovery of a global solution of the original problem. We show that the SDP relaxation has a solution whose rank is upper bounded by a parameter, named the graph complexity of the network. This number will reduce to 2 after sparsification. The results of this talk will be demonstrated on Polish and New England systems.

2 - Capturing User Behavior in the Smart Grid: Prospect Theory Meets Energy Management

Walid Saad, Virginia Tech, Perry St, Blacksburg, VA, United States of America, saad.walid@gmail.com, Narayan Mandayam, H. Vincent Poor

Active customer participation is seen as an integral part of the emerging smart grid. However, despite the foreseen technological benefits of user-centric grid features such as demand-side management, to date, their widespread adoption in practice remains modest. To shed light on this challenge, we explore the potential of prospect theory, a Nobel-prize winning theory, as a decision-making framework that can help understand how risk and uncertainty can impact the decisions of smart grid users.

3 - Pricing Mechanisms for Control

Desmond Cai, California Institute of Technology, Pasadena, CA, United States of America, wccai@caltech.edu, John Ledyard, Adam Wierman, Steven Low

We propose a mechanism for a principal to purchase the right to control the amount of consumption by a group of agents. Such a mechanism could be applicable when the principal is more efficient at managing the consumption of the agents than the agents themselves. Our scheme has applications in demand-side management, where a utility company could manage the power consumption of its end-use customers in conjunction with wholesale prices, to reduce overall energy costs of its end-use customers.

4 - Optimal Simultaneous Energy Consumption and Regulation Provision under Real-time Stochastic Prices

Mahdi Kefayati, The University of Texas at Austin, 2501 Speedway ENS 506A, Austin, TX, 78712, United States of America, kefayati@utexas.edu, Ross Baldick

The power trajectory followed by flexible loads need not be bound to a specific trajectory. Therefore, such loads can respond to prices or ancillary services commands. We propose an optimal policy for simultaneous energy consumption and regulation provision under the assumption that regulation provision requires capacity reservation. We show that the optimal policy admits a piecewise linear form which can be computed efficiently.

■ SB73

Parc- Mission I

New Paradigms in Transmission Expansion Planning

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Enzo Sauma, Associate Professor, Pontificia Universidad Catolica de Chile, Santiago, Chile, esauma@ing.puc.cl

1 - Scalable Decomposition Algorithms for Solving Stochastic Transmission Investment Planning Problems

Francisco Munoz, Analytics, Sandia National Laboratories, 1700 Indian Plaza Dr NE APT 5, Albuquerque, United States of America, elpanchomunoz@gmail.com, Jean-Paul Watson

We describe a scalable decomposition algorithm to solve real-sized investment-planning models taking into account the uncertainties that result from the increasing penetration of renewable energy technologies, as well as from long-term market and regulatory conditions. An application of our algorithm is illustrated using a 240-bus network representation of the WECC. We discuss its performance when implemented in both the Red Mesa supercomputer and a commodity multi-core workstation.

2 - Robust Transmission and Generation Expansion Planning

David Pozo, Pontificia Universidad Catolica de Chile, Avendia Vicuna Mackenna #4860, Raíl Deves Hall, 3rd floor, Macul, Santiago, Chile, davidpozocamara@gmail.com, Enzo Sauma, Javier Contreras

We present a robust model for a market-based transmission and generation expansion. In a first stage, transmission expansion decisions are taken. Afterwards, the optimal generation expansion among all generation companies is taken and finally, the market equilibrium is at the third stage. The second and third stages depict an EPEC. Manifold equilibria are possible with different costs for the system. We solve a robust version considering the worst-case equilibria solution of the EPEC problem.

3 - Transmission Planning for Reducing Emissions

Masood Jabarnejad, PhD Student, Auburn University, 333 East Magnolia Ave. APT 44, Auburn, AL, 36830, United States of America, masood@auburn.edu, Jorge Valenzuela

Dynamic thermal rating enhances the capability of in-service transmission lines and transmission switching reduces the electricity generation cost by temporarily removing inefficient transmission lines out of service. In this presentation, we propose an optimization model to integrate both approaches to better utilize wind energy and therefore reduce emissions.

4 - Real Option Approach in Transmission Expansion Planning under Uncertainty

Alvin Henao-Perez, Universidad del Norte, Km 5 Via Antigua a Puerto Colombia, Barranquilla, Colombia, henaoa@uninorte.edu.co, Enzo Sauma

Transmission Expansion Planning (TEP) is full of uncertainties and often analyzed from a probabilistic-choice or robustness point of view, under reliability and economic criteria. Because of the transmission investment features, it is useful to analyze the value of adding flexibility in the TEP. This study estimates this value using a multinomial decision tree to handle uncertainties related with load growth and electricity generation expansion, under a maximization of economic welfare criterion.

■ SB74

Parc- Mission II

Mitigating Uncertainty in Power System Operations through Market Design and Computational Methods

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Anthony Papavasiliou, Assistant Professor, Catholic University of Louvain, Voie du Roman Pays 34, Office b.114, CORE, Louvain la Neuve, 1348, Belgium, anthony.papavasiliou@uclouvain.be

1 - Efficiency Losses of Zonal Network Management under Large-Scale Renewable Energy Integration

Anthony Papavasiliou, Assistant Professor, Catholic University of Louvain, Voie du Roman Pays 34, Office b.114, CORE, Louvain la Neuve, 1348, Belgium, anthony.papavasiliou@uclouvain.be

We quantify the efficiency losses of zonal market clearing followed by counter-trading due to unit commitment that ignores Kirchoff's laws and congestion within zones. We focus on how these inefficiencies are exacerbated by uncertainty in the presence of large-scale renewable energy integration. The market coupling model is compared to an ideal stochastic unit commitment benchmark. We present results for Central Western Europe (CWE).

2 - Look-Ahead Security Constrained Optimal Power Flow via Proximal Message Passing

Sambuddha Chakrabarti, Graduate Student, The University of Texas at Austin, 1 University Station C0803, Department of Electrical & Computer Engg, Austin, TX, 78712, United States of America, sambuddha.chakrabarti@gmail.com, Matt Kraning, Eric Chu, Ross Baldick, Stephen Boyd

We present here a fully decentralized algorithm, the Proximal Message Passing to solve the Look Ahead SCOPF where we represent the post contingency states and formulate a restoration scheme, limiting the post fault line temperature and line current rise to within safe values and ensuring system security with respect to the next set of contingencies through ramp rate constraints on generators. This method will enable us to implement a dynamic optimal transmission switching plan as well.

3 - Service Pricing and Multiplicity of Equilibria in Short Term Power Markets with Wind

Yves Smeers, Professor Emeritus, Université Catholique de Louvain, Ctr Operations Research & Econometrics, Voie du Roman Pays 34, L1.03.01, B-1348, Louvain-la-Neuve, B-1348, Belgium, yvessmeers@me.com, Sebastian Martin

We consider a two-settlement short-term power market of the European type (separation of the PX dealing with energy and TSO dealing with services). Wind is currently supported by different means, some of them being an improper pricing of the services that it implies. We show that this can lead to a multiplicity of equilibria, which can be interpreted as an unnecessary volatility introduced by the market design.

4 - A Mechanism Design Model for Firming Intermittened Renewable Generation with Curtailable Demand

Clay Campaigne, Dept of Industrial Engineering and Operations Research, University of California, Berkeley, Berkeley, CA, 94720, United States of America, clay.campaigne@gmail.com, Shmuel Oren

We characterize the one-period optimal policy, for an aggregator who owns a portfolio of stochastic renewable energy resources but must commit in day-ahead to a quantity of power with a linear penalty for shortfall from the commitment The aggregator can contract with retail customers for reductions from their baselines so as to hedge its supply. The counterfactual baselines are private information which are elicited in the contracting process.

■ SB75

Parc- Mission III

Simulation Modeling for Anaysis

Sponsor: Simulation

Sponsored Session

Chair: Lee Schruben, lees@berkeley.edu

1 - Capturing the Impact of Input Model Uncertainty in Stochastic Models and Analysis: Lessons Learned

Russell Barton, Pennsylvania State University, 210E Business Building, Pennsylvania, United States of America, rrb2@psu.edu, Wei Xie, Barry Nelson

Discrete event simulations are driven by input models fitted with finite data. This presentation will highlight the difficulties in characterizing the impact on output analysis for the general case, the progress that has been made in special cases, and the broader implications for many stochastic modeling and optimization settings.

2 - Optimal Selection of the Most Probable Multinomial Alternative

David Goldsman, Professor, Georgia Tech, Stewart School of Indust & Sys Engr, Atlanta, GA, 30332-0205, United States of America, Sman@isye.gatech.edu, Craig Tovey, Anton Kleywegt, Eric Tollefson

We present selection procedures based on linear and mixed-integer linear programs that find the multinomial cell having the highest probability. Our procedures are optimal in the sense that they minimize the number of observations taken to achieve a certain probability of correct selection.

3 - Vamp1re: A Single Criterion for Evaluating Confidence-Interval Procedures

Bruce Schmeiser, Emeritus Professor, Purdue University, School of Industrial Engineering, West Lafayette, United States of America, bruceschmeiser@gmail.com, Ying-chieh Yeh

Confidence-interval procedures are classically evaluated using actual coverage probability and expected half width. We argue for a single criterion, based on Schruben's coverage function when sample size is constant. We extend the criterion to procedures with stopping rules.

4 - Effective Simulation Warm-up for a Neonatal Intensive Care Unit

Emily Lada, SAS Institute, World Headquarters, SAS Campus Drive, Cary, NC, 27513, United States of America, Emily.Lada@sas.com, Anup Mokashi, James Wilson

In simulating a neonatal intensive care unit subject to constraints on the available computing budget for generating certain key responses, effective warm-up is required to compute accurate point and confidence-interval estimates of, for example, the expected number of admissions per year as well as the long-run average length of a patient's stay. Techniques for steady-state simulation analysis (N-Skart and SBatch) are adapted to this problem.

■ SB76

Parc- Embarcadero

Cloud Infrastructure Planning and Optimization

Sponsor: The Practice Track

Sponsored Session

Chair: Thomas Olavson, Google, 1300 Crittenden Lane, Mountain View, CA, 94306, United States of America, tolavson@google.com

1 - Machine Fleet Planning in an Internal Resource Economy

John Bossert, Sr Quantitative Analyst, Google, 1300 Crittenden Lane, Mountain View, CA, 94306, United States of America, bossert@google.com

Google recently began transforming its compute infrastructure allocation process from centralized planning to an internal resource economy under which each product area purchases capacity options. I describe several machine fleet planning problems arising within this environment, and then formulate as a dynamic bin-packing the problem of assigning capacity options sold against a datacenter campus to specific clusters within that campus.

2 - Improving the Efficiency of Resource Provisioning and Utilization in Cloud Computing

Chen Peng, Sr Quantitative Analyst, Google, 1300 Crittenden Lane, Mountain View, CA, 94306, United States of America, cpeng@google.com, Chao Ding

We provide an overview of various resource provisioning and efficiency problems encountered at Google in operating one of the largest cloud computing infrastructures in the world—-such as capacity provisioning ratios of different resource dimensions, impact of heterogeneous machine configurations, smart job scheduling by leveraging the statistical properties of workload, etc.

3 - Panel Discussion: Cloud Infrastructure Challenges and Opportunities

Moderator: Brian Eck, Quantitative Analyst, Google, Inc., 1300 Crittenden, Building CL3, Office 2S5, Mountain View, CA, 94043, brianeck@google.com, Panelists: Cathy Xia, Ilyas Iyoob, Thomas Olavson, Muntazir Mehdi

This panel will include representatives from industry and academia, to discuss topics in leveraging Operations Research techniques for managing Cloud Infrastructure.

■ SB77

Parc- Market Street

Stochastic Models in Health Care

Sponsor: Applied Probability Society

Sponsored Session

Chair: Nilay Argon, University of North Carolina, Department of Statistics and Operations, Chapel Hill, NC, 27599, United States of America, nilay@unc.edu

1 - Modeling the Effect of Nurse as a Transmitter on Hospital Acquired Infections

Lerzan Ormeci, Associate Professor, KoÁ University, Istanbul, Turkey, LORMECI@ku.edu.tr, Evrim Gunes, Onder Ergonul, Amin Khoshkenar

We analyze the role of nurse in hospital acquired infection dynamics in an intensive care unit. An analysis of a dataset reveals that the infection status of a patient is significantly influenced by her neighbors' infection status and length-of-stay. We develop a Markov chain model to represent the interactions between a nurse and patients, where factors such as nurse-to-patient ratio, nurse's hand-washing behavior, contact rate and probability of contamination during a contact are included.

2 - Optimal Allocation of Physician's Time when Patient Utility is Heterogeneous

Balaraman Rajan, Simon Business School, University of Rochester, CS 4-339 Carol Simon Hall, Rochester, NY, 14627, United States of America, balaraman.rajan@Simon.Rochester.edu, Tolga Tezcan, Abraham Seidmann

We analytically investigate the strategic decisions of a medical specialist who treats patients visiting from a significant distance. We find that a revenue maximizing specialist spends more time with the patients, partially to compensate for their travel ëcost', and thus sees fewer patients than a welfare maximizing one. We extend our model to investigate how telemedicine technology influences the specialist's decisions and his service level.

3 - Scheduling Series Patients in a Healthcare Facility

Siyun Yu, PhD Candidate, UNC Chapel Hill, BB26 Hanes Hall, UNC Chapel Hill, Chapel Hill, NC, 27599, United States of America, yusiyun@live.unc.edu, Vinayak Deshpande, Vidyadhar Kulkarni

Many healthcare patients, requiring services such as physical therapy, are considered as ëseries' patients, which means that they are scheduled for a series of appointments. They are classified according to the number, frequency and the duration of the sessions they need. We develop a multi-class queuing network model to determine the number of appointment slots for the new patients as well as the returning patients to either assure reasonable waiting times or minimize the total operating cost.

4 - Priority Assignment under Non-linear Cost Functions

Nilay Argon, University of North Carolina, Department of Statistics and Operations, Chapel Hill, NC, 27599, United States of America, nilay@unc.edu, Huiyin Ouyang, Serhan Ziya

Consider a queueing system with two types of customers, each incurring a non-linear cost depending on its type and waiting time in the queue. The controller has information only on the order of arrivals of customers and their types. For such a system, we identify sufficient conditions under which first-come-first-serve, last-come-first-serve, or priority policies are optimal. A numerical study compares these policies with more complex ones that use information on the waiting times.

■ SB79

Parc- Powell I

Decision Analysis and Behavioral Research

Sponsor: Decision Analysis

Sponsored Session

Chair: Detlof von Winterfeldt, Professor, University of Southern California, Dept of Industrial & Systems Engineering, Olin Hall of Engineering, Los Angeles, CA, 90089, United States of America, detlof@aol.com

1 - Improving the Practice of Decision Analysis with Prescriptive Behavioral Economics

Ralph Keeney, Professor Emeritus, Duke University, 401 Hilton-Lombard, #704, San Francisco, CA, 94111, United States of America, KeeneyR@aol.com

Behavioral economics focuses on the biases and errors of human decisions. Prescriptive behavioral economics involves experiments with decision-makers facing their own real decisions to improve the procedures and techniques for the process of decision-making and the use of decision analysis. The goal is higher quality decisions for individuals and groups.

2 - Behavioral Analytics: A Framework for Exploring Judgments and Choices in Large Data Sets

Gilberto Montibeller, London School of Economics, Houghton Street, London, United Kingdom, G.Montibeller@lse.ac.uk

The increasing availability of large data sets that store users' judgments and choices provides a fertile ground for Business Analytics. Behavioral Decision Research has much to offer to analytics, but its fragmented nature often prevents decision analysts to use its full power. In this paper we thus propose a framework to explore such data sets, Behavioral Analtyics, which can support behavioral data mining and behavioral data learning (joint work with I Durbach).

3 - Convergent Validation of a Methodology for Eliciting Trade-offs for Protected (sacred) Values

Richard John, Associate Professor, University of Southern California, RTH 310, University Park, Los Angeles, CA, 90089, United States of America, richardj@usc.edu, Heather Rosoff, Kenneth Nguyen

We describe a methodology for eliciting trade-offs in highly political contexts, involving potentially protected values. We apply this methodology to two different security contexts: Air Travel and Cyber Privacy. A decision problem is constructed, including an additive MAU model. The elicitation uses sequential binary choices to obtain weights based on indifference between pairs of alternatives. Convergent validation is reported comparing different sets of trade-offs and swing weights.

4 - Biases that Matter for Decision Analysis (and those that don't)

Detlof von Winterfeldt, Professor, University of Southern California, Dept of Industrial & Systems Engineering, Olin Hall of Engineering, Los Angeles, CA, 90089, United States of America, detlof@aol.com

A large number of biases in judgment and decision making have been discovered since the early 1970s. Some of these biases matter, because they affect the elicitation the inputs to a decision analysis. Others don't matter, either because they do not commonly occur in decision analysis or because they can easily be overcome.

■ SB80

Parc- Powell II

Decision Analysis in Integrated Care (Healthcare and Social Care)

Sponsor: Decision Analysis

Sponsored Session

Chair: Lea Deleris, IBM, Dublin Research Lab, Dublin, Ireland, lea.deleris@ie.ibm.com

1 - The Role of Decision-analytic Modeling in Early-stage Health-economic Assessments of Medical Devices

Jan Pietzsch, President & CEO, Wing Tech Inc., 228 Hamilton Ave., 3rd floor, Palo Alto, CA, 94025, United States of America, jpietzsch@wing-tech.com

Medical technology innovations can contribute to meaningful advances in patient care. At the same time, the financial burdens on healthcare systems continue to increase, requiring the demonstration of a clear clinical and economic value proposition. In this talk, we review the critical role of decision-analytic modeling can play in early-stage health-technology assessment, and illustrate opportunities and challenges based on the discussion of two recent medical device assessments.

2 - Clinical Trials for Pharmaceuticals: To Repeat, or Not to Repeat?

John Cavallaro, Technical Director, Portfolio & Asset Strategy, Bristol-Myers Squibb, P.O. Box 4000, Princeton, NJ, 08543, United States of America, john.cavallaro@bms.com, David Swank

Reports that early pharmaceutical clinical trial results are not very predictive of later success have led some to propose repeating successful early phase trials before proceeding. Using a decision analytic framework, we modeled the decision to repeat, continue, or abandon a clinical program as function of the trial costs, market value, and success probabilities. Our results show that only under very specific conditions is it optimal to repeat trials after early success.

3 - A Model for Vulnerability Indexes in Social Care

Lea Deleris, IBM, Dublin Research Lab, Dublin, Ireland lea.deleris@ie.ibm.com, Robert Shorten, Fabian Wirth, Shravan Sajja

We describe a model that we have developed to provide care workers with a multidimensional vulnerability dashboard to help them understand the current and upcoming problems of the citizens that they manage. Our model is built upon a Bayesian network representation of the factors affecting vulnerabilities and a Markov Chain model capturing the evolution over time. All vulnerabilities are measured with the same metric which means that it is possible to compare across categories and across persons.

4 - Improving Investment Decisions at Hospitals through System Dynamics and Decision Analysis

Christian Wernz, Virginia Tech, 205 Durham Hall, Blacksburg, 24061, United States of America, cwernz@vt.edu, Hazhir Rahmandad, Alba Rojas-Cordova, Arash Baghaei Lakeh, Hui Zhang, Anthony Slonim

Hospital executives have to make capital investment decisions that account for multiple stakeholders and organizational objectives, risk and limited budgets. Furthermore, the long-term, organization-wide effects of an investment are difficult to predict. In response, we have developed a decision support method that integrates system dynamics with the simple multi-attribute rating technique (SMART). We tested and validated our approach with hospital executives for the Da Vinci surgical robot.

■ SB81

Parc- Divisadero

The Role of Information in Dynamic Games

Cluster: Data and Information

Invited Session

Chair: Kostas Bimpikis, Assistant Professor, Stanford GSB, 655 Knight Way, Stanford, United States of America, kostasb@stanford.edu

1 - Learning Product Features from Consumer Reviews

Davide Crapis, Columbia Business School, 434 West 120th Street, New York, NY, United States of America, dcrapis16@gsb.columbia.edu, Alireza Tahbaz-Salehi, Costis Maglaras

In the context of learning from on-line reviews, we study a model in which a good is represented by an attribute vector and the respective quality vector is unknown. Consumers are heterogeneous with respect to their preferences for the various attributes. First, when consumers observe only one-dimensional reviews, they do not learn the product quality. Second, when reviews are multi-dimensional, we characterize how different assumptions on the population of consumers affect the learning outcome.

2 - Information Provision in Dynamic Innovation Tournaments

Kostas Bimpikis, Assistant Professor, Stanford GSB, 655 Knight Way, Stanford, United States of America, kostasb@stanford.edu, Mohamed Mostagir, Shayan Ehsani

Tournaments are suited for settings that feature a high degree of uncertainty. Participants learn about the underlying environment from their competitors' gradual progress. On the other hand, information about the status of competition may adversely affect effort provision from the laggards. Thus, the tournament's information provision mechanism is critical for its success. The paper suggests a number of design guidelines with the objective of maximizing the probability of reaching the end goal.

3 - Strategic Trading in Informationally Complex Environments

Nicolas Lambert, Assistant Professor of Economics, Stanford University, Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, nlambert@stanford.edu, Mikhail Panov, Michael Ostrovsky

We study trading behavior and properties of prices in informationally complex markets in the Kyle 85 model. We allow for arbitrary correlations among the random variables involved in the model: the value of the asset, the signals of strategic traders, the signals of the market maker, and the demand from noise traders. We characterize the unique linear equilibrium, illustrate its properties, and use this characterization to study the informational efficiency of prices as the market grows large.

4 - Network Resilience against Epidemic Spread

Kimon Drakopoulos, MIT, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, kimondr@mit.edu, John Tsitsiklis, Asuman Ozdaglar

We study the problem faced by a network defender when an epidemic is evolving on a known network. We assume that the network defender has full information on the state of the epidemic and can allocate curing rates to nodes under a budget constraint. The goal is to minimize the expected extinction time of the epidemic. We find necessary and sufficient conditions on the graph structure under which curing policies that achieve sublinear extinction time exist.

■ SB82

Parc- Haight

Choice Behavior in MCDM

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Hannele Wallenius, Professor, Aalto University, Otaniementie 17, Espoo, Finland, Hannele.Wallenius@Aalto.fi

1 - Pricing New Services using Utility Functions

Outi Somervuori, Aalto University, P.O. Box 11000, Aalto, 00076, Finland, outi.somervuori@aalto.fi, Merja Halme

Choice-based conjoint analysis is used to set prices of new services available for a trial period in an airport relaxation area. 300 passengers evaluated the services with different prices. The results allow to assess optimal prices for the different services and the value of different product profiles for the respondents. The study was ordered by the company managing Finnish airports. Its results will be compared with a study employing incentive-based conjoint analysis.

2 - Emotional-Motivational Responses Predicting Choices: A Neurophysiological Investigation

Jyrki Wallenius, Professor, Aalto University, P.O. Box 11000, Aalto, 00076, Finland, Jyrki.Wallenius@Aalto.fi, Outi Somervuori, Pekka Korhonen, Murat Köksalan, Niklas Ravaja

We examined how emotional attachment to a choice option predicts choices and mediates the endowment effect and the emotional-motivational responses to trade-off choices. The participants made win-win and trade-off choices between product packages in neurophysiological study. The results suggest that approach motivation and emotional attachment mediate the endowment effect. In addition, high trade-off difficulty was associated with increased withdrawal motivation and negatively valenced arousal.

3 - Linear Model Prediction for Cognitive Skill Subgroups in Multiple Criteria Decision Making

Tommi Pajala, Aalto University, Laaksolahdentie 49, Espoo, 02730, Finland, tommi.pajala@aalto.fi, Pekka Korhonen, Jyrki Wallenius

We predicted choices in a four-criteria pairwise MCDM problem with a linear value function model with the epsilon formulation (Korhonen et. al., 2012). We investigated whether the Cognitive Reflection Test score is related to the predictive power, but no effects were found. Most subjects were inconsistent with their importance of criteria, questioning the usefulness of eliciting judgments of importance. The model predicted 81,7 % of choices, outperforming comparison models.

4 - Difficulties in Making Rational and Consistent Choices

Pekka Korhonen, Professor, Aalto University, School of Business, Aalto, FI, 11000, Finland, Pekka.Korhonen@Aalto.fi, Niklas Ravaja, Outi Somervuori, Jyrki Wallenius

We present the results of an experiment with the aim to study, whether the choices of subjects are rational and consistent. If not, "why not"? The choice problems consists of 2-3 criteria and 3, 4, and 6 alternatives. Pilot study revealed that the subjects had difficulties in making rational and consistent choices. We will repeat the experiment with a larger group with an aim to look for explanations to findings. The study is based on the use of two sets of criteria: utilitarian and hedonistic.

■ SB83

Parc- Sutro

Doing Good with Good OR - Student Paper Competition

Cluster: Doing Good with Good OR – Student Paper Competition

Invited Session

Chair: Ruben Proano, Assistant Professor, Rochester Institute of Technology, Rochester, NY, United States of America, rpmeie@rit.edu

1 - Doing Good with Good OR - Student Paper Competition

Carri Chan, Columbia University Business School, 3022 Broadway, Uris 410, New York, NY, United States of America, cwchan@columbia.edu

Doing Good with Good OR - Student Paper Competition is held each year to identify and honor outstanding projects in the field of operations research and the management sciences conducted by a student or student group that have a significant societal impact.

2 - Optimizing Vaccine Allocation for Pandemic Influenza

Hsin-Chan Huang, The University of Texas at Austin, 204 E. Dean Keeton Street, Stop C2200 ET, Austin, TX, 78712-0292, United States of America, neo.huang@utexas.edu, Bismark Singh

With the Texas Department of State Health Services, we develop a web-based decision-support tool to optimize vaccine allocations during an influenza pandemic. Our allocation is proportionally fair for user-specified target populations. Using 2009 H1N1 data, we show how reserving a small percentage of doses can achieve fair coverage, while most vaccines are allocated based on healthcare provider requests.

3 - Global Supply Chain Optimization – United Nations World Food Program

Yuvraj Singh, Georgia Institute of Technology, Atlanta, GA, United States of America, yuvrajasr7@gmail.com, Lakshmi Gadepalli, Maria Ayers, Ashfaque Kachwala, Tahsin Munir, Gabriel Rodriguez, Cane Punma

The MCNF model arrived at an optimal solution under 5 minutes for WFP's largest operation. Doubling operation size resulted in a processing time of 13 minutes ensuring the capacity of the model. The optimal solution indicates potential savings of $34 million. Essentially, this model quantifies the value of a centralized decision-making process with proper visibility of every decision's impact.

4 - Optimizing Mobile Blood Collection: Application in Turkey
Feyza Sahinyazan, McGill University, Montreal, QC, Canada, feyza.sahinyazan@mail.mcgill.ca

Effective use of bloodmobiles is helpful in increasing the number of donors and donation frequencies. Since bloodmobiles can reach potential donors with limited time and means of transportation, they can attract more donors than fixed points. In our project, we propose a new cost efficient and easy-to-implement mobile blood collection system based on the practices of Turkish Red Crescent (TRC).

Sunday, 1:30pm - 3:00pm

■ SC01

Hilton- Golden Gate 6

MAS Tutorial Session. A Quick Peek at Predictive Analytics

Sponsor: Military Applications Society

Sponsored Session

Chair: Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@knology.net

1 - A Quick Peek at Predictive Analytics
Thomas Willemain, Sr VP, Smart Software, Inc., 4 Hill Road, Belmont, MA, 02478, United States of America, tomw@smartcorp.com

This tutorial will introduce a few key methodologies in the field of predictive analytics: extrapolative time series forecasting, regression and logistic regression, and tree models including random forests. The emphasis will be on matching methods to problems, understanding the inputs required by and outputs supplied by the methods, and perspectives on the strengths and weaknesses of the methods. Reprises presentation at MORS 82.

■ SC02

Hilton- Golden Gate 7

Organizational Issues in Technology Management

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Zhijian Cui, Assistant Professor of Operations and Technology Management, IE Business School, Calle de Maria de Molina, 12, Madrid, 28006, Spain, zhijian.cui@ie.edu

1 - Buyer and Supplier Coordination for Knowledge Outsourcing under Information Asymmetry
Jaesoek Lee, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Jaeseok.Lee@scheller.gatech.edu, Cheryl Gaimon

This paper examines coordination between a buyer and a supplier for knowledge outsourcing under information asymmetry. Optimal decisions include the buyer's levels of knowledge insourcing and outsourcing, and the supplier's price for knowledge. This paper shows that the buyer's absorptive capacity, the scope of the knowledge development project, and the information structure are key drivers of the optimal solutions and payoffs in equilibrium.

2 - Optimal Search for the Best Alternative: An Experimental Approach
Gulru Ozkan, Clemson University, Department of Management, 120B Sirrrine Hall, Clemson, SC, 29634, United States of America, gulruo@clemson.edu, Fred Switzer, David Hall, Jeremy Hutchison-Krupat

Using a behavioral approach, we examine the strategy of decision makers who search for the best alternative to develop into a new product. The impacts of facing a set of radical or incremental set of alternatives and the level of time-sensitivity on the evolution of decision makers' performances are analyzed.

3 - To Adapt or Disrupt? Performance Objectives as Drivers of Innovation Strategies
Fabian Sting, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, fsting@rsm.nl, Murat Tarakci

We use agent-based simulations to explain why and when firms opt for an adaptive or a disruptive innovation strategy. We propose that a firm prefers adapting to the landscape when its objectives are based on improving its performance, whereas a firm follows a disruptive innovation strategy if it prioritizes performance relative to competitors. We also find that a firm's innovation strategy choice is contingent on its competitors' orientations and on the market's receptivity to disruptions.

4 - Focused or Flexible Targets? How Organizational Design Influences the Definition of Success
Jeremy Kovach, Georgia Tech, 800 West Peachtree NW, Atlanta, GA, United States of America, Jeremy.Kovach@scheller.gatech.edu, Stelios Kavadias

We analyze how stakeholder metrics are used to define success and determine the implementation of a strategic initiative, given the organizational design. We recognize the dual role of performance metrics: they communicate the target outcomes (i.e., which outcomes are considered "successful"), and they incentivize the organizational impetus (i.e., stakeholder effort commitment). We find that the same initiative might admit different definitions of success in different organizational structures.

■ SC03

Hilton- Golden Gate 7

Business Model Innovation in Cleantech Markets

Cluster: Business Model Innovation

Invited Session

Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, United States of America, jguajardo@haas.berkeley.edu

1 - Business Models and System Performance: Empirical Evidence from the U.S. Solar Energy Market
Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, United States of America, jguajardo@haas.berkeley.edu

We empirically analyze the relationship between business models and system performance in the U.S. solar energy market, characterizing the drivers and mechanisms by which different business models affect system performance.

2 - Competition and Externalities in Green Technology Adoption
Charles Thraves, MIT, 70 Pacific Street APT 255B, Cambridge, United States of America, cthraves@mit.edu, Maxime Cohen, Georgia Perakis

We study competition among suppliers for green technologies with government subsidies to the consumers. We quantify who benefits from competition and when, as well as the impact of environmental externalities. The results differ depending on demand uncertainty and supplier asymmetry but also can be affected by the presence of externalities. We show that competition hurts suppliers and benefits the government but not always the consumers.

3 - Effects of Buyer Safeguards on Prices for New, Used, and Remanufactured Products
Necati Tereyagoglu, Assistant Professor of Operations Management, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Necati.Tereyagoglu@scheller.gatech.edu, Ramanath Subramanyam, Ravi Subramanian

Using detailed transaction-level data, we explore how seller- and product-specific attributes influence the seller decision to allow returns and how the presence of this safeguard influences prices paid for new, used, and remanufactured products. We find evidence that the effect of this safeguard varies across these product types. Our findings have implications for research on secondary markets and closed-loop supply chains.

4 - The Potential of Servicing as a Green Business Model
Vishal Agrawal, Georgetown University, 37th and O streets, Washington, D.C., United States of America, va64@georgetown.edu, Ioannis Bellos

In recent years, manufacturers in various industries have begun to orient their practices towards selling the use of the product as opposed to selling the product itself. We investigate the economic and environmental implications of the manufacturer's design and pricing decisions under different forms of servicizing business models.

■ SC04

Hilton- Continental 1

Strategic Decision Making in Manufacturing & Service Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Muge Yayla-Kullu, RPI Lally School of Management, 110 8th Street, Troy, NY, 12180, United States of America, YAYLAH@rpi.edu

1 - Optimal Design of Channel Effort

Haresh Gurnani, University of Miami, United States of America, haresh@miami.edu, Mike Wang, Sammi Yu Tang

Customers buying certain products may lack functional knowledge and need additional help after purchase. This entails an inconvenience cost for them and handling costs to the provider. The retailer (or manufacturer) can invest in pre-sales effort; customers still needing help may receive after sales support. We study the service channel design problem with different structures and show that the retailer would even be worse off if the manufacturer chooses to share the cost of service effort.

2 - The Effect of Targeted Coupons on Quality Choices, Pricing Decisions and Market Segmentation

Amit Eynan, Professor, University of Richmond, 1 Gateway Rd, Richmond, VA, 23173, United States of America, aeynan@richmond.edu, Benny Mantin

A manufacturer who faces customers with heterogeneous willingness to pay based on quality can segment the market by offering multiple products at different qualities and prices. Buyers will self-select the product that maximizes their utility. We investigate the effect of manufacturer's targeted marketing efforts in the form of coupons on his quality and price choices, the optimal product line and corresponding profit.

3 - Serving Heterogeneous Buyers through Price and Effort Differentiation

Guangwen Kong, Assistant Professor, University of Minnesota, 111Church Street SE, MINNEAPOLIS, MN, 55455, United States of America, gkong@umn.edu, Hao Zhang, Sampath Rajagopalan

We consider optimal pricing of outsourced services such as web design to two types of consumers with different valuations for service quality. Two different scenarios are considered with public and private quality where the service provider's effort is hidden. We compare and contrast different pricing schemes in terms of profits and quality offered to both types of consumers and identify the benefits and costs of hidden effort. We provide managerial guidelines for pricing of services.

4 - A Pricing Survey for Utility Estimation on Household Electricity Consumption

Osman Kazan, Assistant Professor, Tulane University, okazan@tulane.edu

Consumers' surveys are generated and carried out to estimate utility functions for electricity consumption in US households. The consumers are asked to schedule daily household activities in different pricing schemes: constant and dynamic. Utility of unit of electricity is estimated, and used in Time-of-Use electricity pricing models. Optimal pricing difference between peak and off-peak hours can be employed by the marketing departments of power utilities.

5 - National Culture and Service Quality

Muge Yayla-Kullu, RPI Lally School of Management, 110 8th Street, Troy, NY, 12180, United States of America, YAYLAH@rpi.edu, Praowpan Tansipong, Adelina Gnanlet, Christopher M. McDermott, Jeffrey F. Durgee

This is a large-scale theory-building study of the impact of national culture on service quality outcomes. Because of the interactive role employees play in service operations, their behaviors often affect the customer's experience directly. Employee behaviors are often a function of the culture in which they are born and raised. This paper examines how a nation's culture impact service operations through employees' actions and how these relationships change in different segments of a market.

■ SC05

Hilton- Continental 2

Innovation in the Supply Chain

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Cheryl Druehl, George Mason University, 4400 University Drive, Fairfax, United States of America, cdruehl@gmu.edu

1 - Predicting High-tech Innovation Failures: Empirical Analysis of Big Data on Medical Device Recalls

Ujjal Mukherjee, PhD Student, University of Minnesota, 1261 Gibbs Avenue, Saint Paul, MN, 55108, United States of America, mukh0067@umn.edu, Kingshuk Sinha

With increasing technological complexities of products, firms are becoming increasingly vulnerable to the risk of failure of technological innovations while in use in the marketplace. Hence, what is of significance is to be able to detect early signals of such failures, both internal and external to a firm. The central question that serves as the motivation for this paper is: Can user-level feedback related to episodic adverse events in the market predict product-level innovation failure?

2 - The Agency Model for Digital Goods

Yinliang (Ricky) Tan, Doctoral Student, University of Florida, 355A Stuzin Hall, PO Box 117169, Gainesville, Fl, 32611, United States of America, yinliang.tan@warrington.ufl.edu, Janice Carrillo

Recently, the agency model exploited by publishers in the e-book industry has been highlighted in the press as a result of the U.S. Department of Justice's (DOJ) lawsuit against Apple, Inc. We investigate the strategic impact of the agency model in comparison with the prevalent wholesale and fixed price models by formulating a dual channel model of distribution accommodating sales of both traditional and digital goods.

3 - Modularity, Mass Customization, & Innovation Performance: The Role of Structural Sophistication

Xenophon Koufteros, Jenna & Calvin R. Guest Professor in Business Administration, Texas A&M University, Mays Business School, INFO Department, College Station, TX, 77843-4217, United States of America, XKoufteros@mays.tamu.edu, Cornelia Droge, Shawnee Vickery, Roger Calantone

We investigate relationships among modularity, mass customization, and innovation performance and explore whether the structural sophistication of a product moderates these relationships.Product modularity is modeled as antecedent to process modularity; both are modeled as antecedent to mass customization, and all three are modeled as antecedent to innovation performance.The hypotheses are tested using structural equations modeling augmented by bootstrapping based on a sample of 109 companies.

4 - Innovation across the Supply Chain

Cheryl Druehl, George Mason University, 4400 University Drive, Fairfax, VA, United States of America, cdruehl@gmu.edu, Janice Carrillo, Juliana Hsuan

Innovation is an integral part of every firm's ongoing operations. Beyond product innovation, supply chain innovations offer a unique source of competitive advantage. We synthesize recent research on innovation in the supply chain, specifically, innovative supply chain processes such as collaborations with customers and suppliers to create new product and process innovations, open innovation, and globally distributed innovation. We conclude with potential areas for future research.

■ SC06

Hilton- Continental 3

Topics in Sustainable Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Chien-Ming Chen, Nanyang Business School, Nanyang Technological University, 50 Nanyang Ave., Singapore, 639798, Singapore, cmchen@ntu.edu.sg

1 - Supply Chain Strategies and Carbon Performance: The U.S. Manufacturing Sector

Chien-Ming Chen, Nanyang Business School, Nanyang Technological University, 50 Nanyang Ave., Singapore, 639798, Singapore, cmchen@ntu.edu.sg, Maria Montes-Sancho

We empirically test how operational capabilities and strategies can jointly influence environmental and market performances, and whether broadening the scope of environmental assessment to include the supply chain will alter the aforementioned relationship. We find that manufacturers pursuing a broadly defined lean strategy with high operational leanness and a parsimonious process structure tend to attain better direct and supply-chain carbon performances.

2 - Greenhouse Gas Reduction: Why Do Firms Differ?

Jason Nguyen, Carlson School of Managment, University of Minnesota, nguy1762@umn.edu, Karen Donohue, Rachna Shah

We use the CDP data set to empirically investigate the impact of firms' and industry characteristics on firms' choices of different strategies for reduction of greenhouse gas emissions.

3 - Investment in Environmental Process Improvement in Response to Regulation

Cheryl Gaimon, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Cheryl.Gaimon@scheller.gatech.edu, Markus Biehl, Ravi Subramanian

We analyze a firm's dynamic investment in environmental process improvement (EPI) to reduce waste and its toxicity in response to regulatory penalties and subsidies. The firm minimizes the costs incurred for investing in EPI (less subsidy), the production cost, and the penalty for waste and toxicity. We show that a firm's investment in EPI over time differs substantially in response to penalties versus subsidies and, thus, demonstrate the impact of regulatory choices on dynamic firm behavior.

4 - An Empirical Investigation of Firms' Waste Reduction Efforts under Changing Perceptions of Hazard

Wayne Fu, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, United States of America, Wayne.Fu@scheller.gatech.edu, Ravi Subramanian, Basak Kalkanci

Governments and NGOs provide public information on the potential hazards of industrial chemicals. However, there is limited research on the relationship between this information and firms' waste reduction efforts. We empirically investigate the relationship between changes in assessed hazards of chemicals and firms' waste reduction efforts for these chemicals. We also examine how differences in waste reduction efforts relate to chemical, firm, and market characteristics.

■ SC07

Hilton- Continental 4

From Data to Assessments and Decisions: Epi-Spline Technology

Cluster: Tutorials

Invited Session

Chair: Johannes Royset, Naval Post Graduate School, Monterey, CA 93943, United States of America, joroyset@nps.edu

Co-Chair: Ignacio Rios, Research Associate, Universidad de Chile, Department of Industrial Engeneering, Universidad de Chile, Santiago, Chile, ignacio.rios.u@gmail.com

1 - From Data to Assessments and Decisions: Epi-Spline Technology

Johannes Royset, Naval Postgraduate School, Monterey, CA 93943 United States of America, joroyset@nps.edu

Analysts in every field face the challenge of how to best use available data to estimate performance, quantify uncertainty, and predict the future. The data is almost never "just right," but rather scarce, excessive, corrupted, uncertain, and incomplete. External information derived from experiences, established "laws," and physical restrictions offer opportunities to remedy the situation and should be utilized. Applications in sustainable energy, natural resources, image reconstruction, financial planning, uncertainty quantification, and reliability engineering are rich with problems where decisions rely on data analysis under such circumstances. We address these problems within a framework that identifies a function that according to some criterion best represents the given data set and satisfies constraints derived from the data as well as external information. Epi-splines provide the linchpin that allows us to handle shape restrictions, information growth, and approximations.

■ SC09

Hilton- Continental 6

The Impact of Workload and System Factors on Patient Outcomes

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Anita Tucker, Harvard Business School, Morgan Hall, Soldiers Field, Boston, MA, 02163, United States of America, atucker@brandeis.edu

1 - Life is All about Timing: Differences in Treatment Quality for Trauma Patients

David Anderson, Assistant Professor, Baruch College, Zicklin School of Business, 1 Bernard Baruch Way, New York, NY, 10010, United States of America, david.anderson@baruch.cuny.edu, Guodong Gao, Bruce Golden

Using data from the National Trauma Data Bank, we find that patients arriving at the hospital overnight (6 PM – 6 AM) receive significantly lower quality care than those who arrive during the daytime. We find that the inferior care overnight is likely due to limited availability of high-quality resources, and not unobserved heterogeneity, disruptions in circadian rhythms, or delays in receiving treatment. This leads to higher mortality, surgical complication rates, and longer length of ICU stay.

2 - Empirical Analysis of Ambulance Diversion: Policy Change in Los Angeles County

Eric Park, Kellogg School of Management, Northwestern University, Evanston, IL, United States of America, eric-park@kellogg.northwestern.edu, Sarang Deo, Itai Gurvich

We study the effect of a policy change that was intended to reduce ambulance diversions in LA County, CA. We find that the new policy succeeded in its purpose of reducing the time emergency departments (EDs) spent on diversion but did not reduce the fraction of ambulances being diverted. A possible explanation for this outcome, identified by our empirical analysis, is a combination of operational process improvement EDs underwent in response to the policy change and neighboring ED effect.

3 - Decomposing the Effect of Workload on Patient Outcomes: An Empirical Analysis of a Maternity Unit

Michael Freeman, Judge Business School, University of Cambridge, Cambridge, CB2 1AG, United Kingdom, mef35@cam.ac.uk, Nicos Savva, Stefan Scholtes

In this paper, we use a detailed dataset from the delivery unit of a major teaching hospital to better understand how workload impacts quality. We consider two mechanisms: direct impact through deterioration in the quality of task execution and indirect through the choice of care pathway. Our results provide a better understanding of how workload affects quality in service settings.

4 - Reducing Hospital Readmissions by Integrating Empirical Prediction with Resource Optimization

Jon Stauffer, Indiana University, 1309 E. Tenth Street, Bloomington, United States of America, stauffer@indiana.edu, Jonathan Helm, Kurt Bretthauer, Adel Alaeddini, Ted Skolarus

17% of Medicare patients are readmitted within 30 days of discharge. Post-discharge monitoring is effective in reducing readmissions but is currently done ad-hoc. We develop a large scale optimization and decomposition approach for weakly-coupled network flow problems to design optimal post-discharge monitoring plans and allocate capacity for post-discharge patient visits.

■ SC10

Hilton- Continental 7

Supply Risk Management/Inventory Control

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Xin Chen, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, xinchen@illinois.edu

1 - Supply and Demand Functions in Inventory Models

Qi Feng, Professor, Purdue University, Krannert School of Management, West Lafayette, IN, 47907, United States of America, AnnabelleFeng@purdue.edu, George Shanthikumar

The existing inventory literature focuses on almost surely linear supply/ demand functions, which limits the applicability of the models. We provide a unified approach to analyze general supply / demand functions. By transforming the problem into one in a higher dimension, we show many of the seemingly highly (almost sure) nonlinear functions are linear in the stochastic sense. We derive properties of the profit function and optimal policy for a general class of random supply/ demand functions.

2 - Dual Sourcing under Supply Capacity Uncertainty

Zhan Pang, Lancaster University, Management School, Lancaster, LA1 4YX, United Kingdom, z.pang@lancaster.ac.uk, Xin Chen

We study the optimal policies of a periodic-review dual-sourcing inventory system with demand and supply capacity uncertainty. The replenishment lead times can be arbitrary. To perform the structural analysis for this problem, we develop a transformation technique and some new preservation properties of L-natural-convexity. We show that these properties can be readily applied to characterize the optimal policy. We further show that dual-index policies are optimal under certain conditions.

3 - Dynamic Inventory Management with Total Minimum Commitments and Two Supply Options

Xiting Gong, Assistant Professor, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, Hong Kong - PRC, xtgong@se.cuhk.edu.hk, Tong Wang, Sean Zhou

We study a dynamic inventory control problem for a firm who operates under a total minimum commitment (TMC) contract with two supply options. Under such a contract, the cumulative order quantity from either supply or from both supplies over a finite horizon must be at least as large as a given quantity. Using a decomposition technique and multimodularity, we characterize the firm's optimal inventory control policy under different TMC contracts.

4 - Managing Component Allocation for Assemble-to-Order (ATO) Manufacturing

Qiong Wang, Associate Professor, University of Illinois at Urbana-Champaign, 117 Transportation Buiilding, 104 South Mathews Avenue, Urbana, IL, 61801, United States of America, qwang04@illinois.edu, Martin I Reiman, Haohua Wan

We study the allocation policy of Reiman and Wang, which is asymptotically optimal in minimizing the long-run average cost of ATO inventory systems with identical lead times. We show asymptotic optimality of their policy extends to other problems, e.g., maximizing the discounted profit of ATO production/inventory systems. By allowing continuous review, the policy never stops serving high-value demands, but may withhold components from low-value ones, which we prove is sometimes necessary.

■ SC11

Hilton- Continental 8

Competition and Coordination in Supply Chains

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Robert Swinney, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27516, United States of America, robert.swinney@duke.edu

1 - Dynamic Bargaining in a Supply Chain with Asymmetric Demand Information

Lauren Lu, Associate Professor, University of North Carolina - Chapel Hill, Kenan-Flagler Business School, Chapel Hill, NC, 27599, United States of America, lauren_lu@unc.edu, Qi Feng, Guoming Lai

We analyze a dynamic bargaining game in which a seller and a buyer negotiate over quantity and payment to trade for a product. Both firms are impatient, and they make alternating offers until an agreement is reached. The buyer is privately informed about his type, which can be high or low: the high-type's demand is stochastically larger than the low-type's. We characterize the equilibrium and generate insights into how demand forecasting accuracy affects firm profitability.

2 - Cournot Competition in Networked Markets

Kostas Bimpikis, Assistant Professor, Stanford GSB, 655 Knight Way, Stanford, United States of America, kostasb@stanford.edu, Shayan Ehsani, Rahmi Ilkilic

We consider competition among firms in a networked environment. A bipartite graph determines which subset of markets a firm can supply to. We show that the resulting game has a unique equilibrium for any network. We identify a close connection between equilibrium quantities and supply paths in the underlying network. We proceed to study the impact of new entry and mergers on firms' profits and consumer welfare.

3 - Coordination of a Two-Level Supply Chain with Multiple Shipments by Inventory Subsidizing Contracts

Shi Chen, Assistant Professor, University of Washington, Foster School of Business, Foster School of Business, ISOM Department, Box 353226, Seattle, WA, 98195, United States of America, shichen@uw.edu, Hau Lee, Kamran Moinzadeh

Consider a supply chain involving a supplier-retailer relationship and assume that the supplier can stock and deliver the product in multiple shipments for one season. We derive the retailer's optimal order quantities driven by the end-season and within-season critical ratios. The optimal contract requires adjusting both the wholesale price and the retailer's effective inventory holding cost. The contract can be implemented by either a direct subsidizing scheme or a delayed payment scheme.

4 - Supply Chain Models with Preferred Retailer Privy to Supplier's Inventory Information

Hamed Mamani, Assistant Professor, University of Washington, Foster School of Business, ISOM Department, Seattle, WA, 98195, United States of America, hmamani@uw.edu, Kamran Moinzadeh, Apurva Jain

In a supply chain consisting of a supplier and several retailers, some of the retailers have preferred status, providing them with information about the supplier's inventory level. Preferred retailers, thus, can be proactive and inflate their orders when supply gets short. We study the dynamics of such supply chains as a Stackelberg game where retailers react after the supplier has fixed his strategy. We evaluate outcome of the resulting game with solution of the centralized problem.

■ SC12

Hilton- Continental 9

Sustainable Operations Management with Public Interest

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Nicholas C. Petruzzi, University of Illinois at Urbana-Champaign, 350 Wohlers Hall, 1206 S. 6th Street, Champaign, IL, 61820, United States of America, petruzzi@illinois.edu

Chair: Michael Lim, Assistant Professor, University of Illinois, Champaign, IL, 61822, United States of America, mlim@illinois.edu

1 - Productively using Waste as By-Product

Mustafa Tongarlak, Assistant Professor, Bogazici University, Department of Management, Bebek, Istanbul, Turkey, tongarlak@boun.edu.tr, Deishin Lee

Firms can often make productive use of their waste stream. In some cases, for example, profitable by-products may be created from the waste stream. We compare the profitability and social welfare of two scenarios: when the firm converts its excess product into by-product, and when it donates its excess product.

2 - The Economic Value of Market Information for Farmers in Developing Economies

Ying-Ju Chen, Berkeley- IEOR, 4121 Etcheverry Hall, Berkeley, United States of America, chen@ieor.berkeley.edu, Chris Tang

To alleviate poverty, various non-governmental organizations (NGOs) and for-profit companies have developed different ways to distribute information about market price, crop advisory and farming technique to farmers. Will information create economic value for farmers? We construct a stylized model in which farmers face an uncertain market price (demand) and must make production decisions before the market price is realized. We examine the interplay between private and public signals.

3 - Efficient Feed In Tariff Policies for Renewable Energy Technologies

Saed Alizamir, Yale School of Management, New Haven, CT, United States of Americasaed.alizamir@yale.edu, Peng Sun, Francis de Vericourt

Feed-in-tariff (FIT) policies aim at driving down the cost of renewable energies by fostering learning and accelerating the diffusion of green technologies. This paper provides insights and guidance into designing cost-efficient and socially-optimal FIT programs. We characterize the structure of the optimal policy for the social welfare objective as well as when the objective is achieving a capacity target at minimum cost. Our proposed policies are in contrast with the current practices of FIT.

4 - Municipal Groundwater Management: Optimal Allocation and Control of a Renewable Resource

Michael Lim, Assistant Professor, University of Illinois, Champaign, IL, 61822, United States of America, mlim@illinois.edu, Nicholas C. Petruzzi, Karthik Murali

Through a stylized dynamic optimization formulation, we study a municipality's problem of allocating renewable groundwater in the presence of water transfer opportunities through two prominent mechanisms. We establish and characterize dynamic threshold polices that govern the export/import decisions of a given municipality. We also address the increasing trend of privatization of water supply systems. Throughout, we assess the resulting allocation equilibria in the spirit of triple bottom line.

■ SC15

Hilton- Exec. Boardroom

Computational Issues and the Relationships Between Related Models

Cluster: Data Envelopment Analysis

Invited Session

Chair: Tim Anderson, tim.anderson@pdx.edu

1 - Parallel DEA in R

Tim Anderson, Portland State University, Portland, OR, United States of America, tim.anderson@pdx.edu, Tom Shott

This work builds upon past research to provide an open source R package for doing DEA in R. Computational results are provided.

2 - Technology Forecasting using DEA in the Presence of Infeasibility

Dong-Joon Lim, PSU/ETM, 625 SW Jackson St. Apt.975, Portland, OR, 97201, United States of America, tgno3.com@gmail.com

As a predictive use of DEA, Technology Forecasting using DEA (TFDEA) measures the rate of frontier shift by which the arrival of future technologies can be estimated. This study develops an extended TFDEA model that can handle infeasibility based on the modified super-efficiency model proposed by Cook, et al. The application of LCD technology forecasting shows the proposed approach makes a reasonable forecast for formerly infeasible targets as well as a consistent forecast for feasible targets.

3 - A Parallel DEA Implementation for Massive Data Sets

Tom Shott, Graduate Student, Portland State University, 4110 SE Hawthorne Blvd., #113, Portland, OR, 97214, United States of America, tshott@pdx.edu

Software enabling processing of massive data sets is presented. Running on a high-performance parallel cluster the software processes 10K's of DMU's with 20X speedup. The software uses preprocessing (early DMU classification including geometric techniques) and computational techniques (starting basis, preferred solution sets) for high performance analysis. The theoretical foundations, implementation tradeoffs and current performance of the software implementation in R are discussed.

4 - Dynamic Network Data Envelopment Analysis-DEA on Evacuation Performance

Kostas Triantis, Professor, ISE Department-Virginia Tech, 7054 Haycock Rd, Room 428, Falls Church, VA, 22043, United States of America, triantis@vt.edu, Oscar Herrera-Restrepo, Praveen Edara, Pamela Murray-Tuite, Joseph Trainor

This paper proposes a theoretical representation of a slacks-based dynamic network DEA approach for measuring evacuation performance when a ramp closure strategy is considered. It includes an integrated conceptual framework that incorporates stakeholder perspectives, evacuation-related systems and processes. The approach allows for the discovery of potential performance improvement actions that can inform the definition of future requirements of transportation evacuation strategy designs.

■ SC16

Hilton- Franciscan A

Operations and Finance Interface

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Saif Benjaafar, Distinguished McKnight University Professor Professor, University of Minnesota, 111 Church St SE, Minneapolis, MN, 55455, United States of America, saif@umn.edu

1 - Inventory Models with Tail Constraints

Rene Caldentey, Professor, New York University, 44 West Fourth Street, 8-77, New York, NY, 10012, United States of America, rcaldent@stern.nyu.edu

We propose a methodology for the optimal selection of inventory decisions for a company that faces tail risk constraints. We apply our methodology to some standard operations problems including the popular newsvendor model and a supply chain procurement/inventory problem.

2 - Inventory, Risk Shifting, and Trade Credit

Jiri Chod, Boston College, 140 Commonwealth Ave, Chestnut Hill, MA, 02459, United States of America, jiri.chod@bc.edu

We show that the use of trade credit prevents risk-seeking behavior often associated with debt financing. We consider a financially constrained retailer procuring inventory of two products under uncertain demand. With bank financing, the retailer overinvests in the riskier product where riskiness depends on salvage value, profit margin, mean demand, and demand volatility. A retailer relying on trade credit chooses the first-best inventory, for which he is rewarded by a lower cost of borrowing.

3 - On the Impact of Input Price Variability and Correlation in Stochastic Inventory Systems

David Chen, University of Minnesota, 111 Church Street, Minneapolis, MN, 55455, United States of America, chen2213@umn.edu, Saif Benjaafar, William Cooper

For inventory systems with stochastic demand and stochastic input prices, we show that higher input price variability in the sense of the convex order always leads to lower expected cost. We also find that expected cost is increasing in price correlation over time and decreasing in price correlation across components. We present numerical results that provide insights on how various parameters influence the effects of price variability and correlation.

■ SC17

Hilton- Franciscan B

Retail Operations

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Santiago Gallino, Tuck School of Business, 100 Tuck Hall, Hanover, NH 03755, United States of America, santiago.gallino@tuck.dartmouth.edu

1 - Detecting Stock-outs based on Transaction Data

Marcelo Olivares, Assoc. Professor, Columbia University, Broadway 3027, New York, NY, United States of America, molivares@columbia.edu

This work combines techniques from statistical process control and discrete choice models of demand to develop a real-time system to detect stock-outs in supermarket shelves. The method can be designed to attain a desirable level of false alarms, which is key to facilitate the adoption of the system by store employees. We tested our methodology by running a pilot study where actual shelf availability was monitored for several products with more than 4500 visual inspections.

2 - Intelligent Assortment Expansion for an Online Retailer

Youran Fu, Doctoral Candidate, The Wharton School, 532.4 Jon M. Huntsman Hall, 3730 Walnut St., Philadelphia, PA, 19104, United States of America, youranfu@wharton.upenn.edu, Marshall Fisher

We work with a Chinese e-retailer to develop optimal assortment expansion. The e-retailer believed they could just carry everything but many SKUs they added only became stale inventory. We view a SKU as a set of attributes, and apply both the multinomial logit model and the model developed by Fisher and Vaidyanathan (2012). With sales history data, the latter shows an overall better fit. It is implemented for the imported beer category, increasing the success rate of new SKUs from 24% to 83%.

3 - Size and Prepack Optimization to Minimize Lost Sales and Logistics Costs at an Apparel Retailer

Gurhan Kok, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, gurhan.kok@duke.edu, Yunus Emre Koç, Ozgur Sivrikaya

Pre-pack optimization is a common problem in fashion retailing. Retailers pack multiple sizes of the same product (style) into the same package to minimize warehouse costs. We develop a stochastic inventory model based evaluation system for determining the optimal package configurations and the procurement amount of each package type. Live controlled experiments demonstrate a 10% increase in gross margin after taking into account a 5% increase in sales and slight increase in logistics costs.

4 - Increasing Retail Sales via Improved Store Staffing: An Empirical Study with Implemented Results

Marshall Fisher, The Wharton School, University of Pennsylvania, 3730 Walnut Street, Room 542, Philadelphia, PA, 19104, United States of America, fisher@wharton.upenn.edu, Serguei Netessine, Santiago Gallino

We analyzed 30 months of a retailer's history on store-month sales and potential sales drivers to measure the impact of store selling staff level on revenue. We identified a third of the stores where our analysis indicated that increasing staffing would increase sales. The retailer confirmed this finding via a 16 store test which showed that a 10% increase in sales staff resulted in a 9.9% sales increase, and was highly profitable. The retailer is now implementing our finding in other stores.

■ SC18

Hilton- Franciscan C

Choice Models in Revenue Management and Pricing III

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Maarten Oosten, Senior Manager Advanced Analytics Optimization Services, SAS Institute, SAS Campus Drive, Cary, NC, 27513, United States of America, maarten.oosten@sas.com

Co-Chair: Matt Maxwell, SAS Institute Inc., 500 SAS Campus Dr, Cary, NC, 27513, United States of America, Matt.Maxwell@sas.com

1 - Estimation of Choice-Based Revenue Management Models

James Lemieux, Senior Research Statistician Developer, SAS Institute, 100 Sas Campus Dr, Cary, NC, 27617, United States of America, James.Lemieux@sas.com

Estimation of choice-based revenue management models is made difficult when non-purchasers are missing. Talluri and van Ryzin (2004) overcome this limitation by using an EM algorithm. Newman et al (2012) proposed an alternative based on marginalizing the parameters under the assumption that choice is multinomial logit. This paper discusses the technical difficulties in implementing these techniques and proposes an extension that improves the arrival rate estimate in certain circumstances.

2 - Assortment Planning under the Multinomial Logit Model with Totally Unimodular Constraint Structures

James Davis, jamesmariodavis@gmail.com, Guillermo Gallego, Huseyin Topaloglu

We consider constrained assortment optimization problems where product purchase probabilities are governed by the multinomial logit model and the constraint structure can be captured by a totally unimodular matrix. This is a general framework that captures a variety of capacity constraints and discrete pricing problems. We develop a linear program for these problems and use it to develop purely combinatorial algorithms and gain insight into the structure of optimal solutions.

3 - Customer Choice Model Optimization with Overlapping Consideration Sets

Matt Maxwell, SAS Institute Inc., 500 SAS Campus Dr,, Cary, NC, 27513, United States of America, Matt.Maxwell@sas.com

Customer Choice Model (CCM) based revenue management has become increasingly attractive due to recent market changes which weaken traditional demand model assumptions; however, there are still significant optimization challenges for revenue management given a CCM. In particular, optimization algorithms frequently become intractable when multiple market segments have overlapping consideration sets. We discuss heuristic methods used to overcome this difficulty and compare their performance.

4 - Launch Price Optimization for Pharmaceutical Products

Bahadir Aral, Sr Operations Research Specialist, SAS Institute, SAS Campus Drive, Cary, NC, 27513, United States of America, bahadir.aral@sas.com

Pharmaceutical companies face unprecedented pressure to stay profitable in a difficult global pricing environment that increasingly demands the ability to respond swiftly (and smartly) to changing government requirements. A myriad of price referencing rules complicate the already difficult business and mathematical challenges of achieving optimal launch sequences and prices across all markets. This presentation will describe challenges with the problem , a novel approach to the launch optimization problem, including management of the scheduling and pricing components simultaneously while allowing for extensive what-if analysis to identify the most appropriate course of actions.

■ SC19

Hilton- Franciscan D

Topics in Revenue and Capacity Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Dan Zhang, University of Colorado at Boulder, 419 UCB, Boulder, CO, 80309, United States of America, dan.zhang@colorado.edu

1 - Investing in a Shared Supplier in a Competitive Market: Stochastic Capacity Case

Anyan Qi, The University of Texas at Dallas, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, axq140430@utdallas.edu, Amitabh Sinha, Hyun-Soo Ahn

We consider what happens when two competing firms invest in a shared supplier's capacity under two common forms of restrictions: the investing firm has exclusive use of the invested capacity, or first priority in having the firm's order fulfilled. We model firms' investment and production decisions as a two-period game, characterize the equilibrium capacity investment outcomes, and analyze the impact of the spillover effect.

2 - Delivering Guaranteed Display Advertising under Reach and Frequency Requirements

Ali Hojjat, PhD Candidate, University of California Irvine, Paul Merage School of Business, SB 332, Irvine, CA, 92697, United States of America, hojjats@uci.edu, John Turner, Suleyman Cetintas, Jian Yang

We propose a new modeling framework for scheduling guaranteed display advertising in which advertisers demand a specific number of unique users (reach) that each see the ad campaign at least a certain number of times (frequency). We integrate a novel user-level approach into a common aggregate planning schema which allows us to construct a solution and at the same time account for smooth delivery of ads over time, diversity of ads seen by each user, and other desirable factors.

3 - Preorder-contingent Pricing vs Preorder-contingent Production in Advance Selling

Fuqiang Zhang, Washington University, Olin Business School, St. Louis, United States of America, fzhang22@wustl.edu, Mike Wei

Motivated by emerging industry practices, this paper studies the effectiveness of two new advance selling strategies when facing strategic consumers. We show that compared to the traditional advance selling strategy, preorder-contingent production can significantly improve firm profit, while preorder-contingent pricing does not yield much benefit.

4 - A Model of Consumer Loyalty Reward Programs

Dan Zhang, University of Colorado at Boulder, 419 UCB, Boulder, CO, 80309, United States of America, dan.zhang@colorado.edu, Yacheng Sun

Despite the prevalence of loyalty reward programs in the retail and service industries, there is an ongoing debate on whether and when such programs are profitable. We consider a monopolistic firm selling to forward-looking consumers who are heterogeneous in product valuations and purchase frequencies. For each purchase, a consumer earns a reward that expires after a fixed number of periods. We discuss managerial implications of the model.

■ SC20

Hilton- Yosemite A

Matching and Market Design

Cluster: Matching and Market Design (in honor of Al Roth)

Invited Session

Chair: Jacob Leshno, Columbia University, 3022 Broadway, Uris Hall, 406, New York, NY, 10027, United States of America, jleshno@columbia.edu

1 - Matching in Networks

Michael Ostrovsky, Associate Professor of Economics, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, ostrovsky@stanford.edu

In this talk, I will present results on the existence and properties of stable outcomes in trading networks.

2 - Matching with Peers in School Choice

Atila Abdulkadiroglu, Professor, Duke University, 213 Social Sciences Building, Durham, NC, 27708, United States of America, atila.abdulkadiroglu@duke.edu

We develop a theory for matching of students to schools with peers and study various matching mechanisms with field data.

3 - Endogenous Preferences and the Role of the Mechanism in School Choice

Estelle Cantillon, Senior Research Fellow, Université Libre de Bruxelles (ECARES), 50, av FD Roosevelt, CP 114, Brussels, 1050, Belgium, Estelle.Cantillon@ulb.ac.be

We consider a school choice model where preferences over schools are endogenous because students care about the quality of their peers. In such a setting, the mechanism affects the degree of preference polarization. We show how mechanisms can be designed to reduce polarization and improve the distribution of ranks of assigned schools in students' preferences. A policy change in the city of Ghent (Belgium) provides a test for the predictions of the theory.

4 - Evidence of Strategic Behavior in Hospital Claims Reporting

Hamsa Bastani, Stanford University, Stanford, Stanford, United States of America, hsridhar@stanford.edu, Mohsen Bayati, Stefanos Zenios, Joel Goh

We provide evidence from Medicare claims data that hospitals engage in upcoding behavior when reporting hospital-acquired infections that are no longer reimbursed by Medicare. In particular, we show that hospitals sometimes mark a hospital-acquired infection as present-on-admission, presumably in order to collect greater reimbursement.

■ SC21

Hilton- Union Sq 1

Traffic Flow Modeling and Management

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Nikola Markovic, University of Maryland, Civil & Environmental Engineering, College Park, MD, United States of America, nikola@umd.edu

1 - Integrated Methodology for Online Calibration of Real Time Simulation Based Dynamic Traffic Assignment

Hossein Hashemi, Southern Methodist University, 3101 Dyer St, Room 203, Dallas, TX, 75205, United States of America, shashemi@smu.edu, Khaled Abdelghany, Ala Alnawaiseh

We present a methodology for online calibration of real-time traffic network simulation models. The methodology integrates time-dependent demand estimation and traffic flow propagation adjustment. The performance of the methodology is examined using a real-world application in which a real-time traffic network state estimation model is implemented for the US 75 Corridor in Dallas, Texas.

2 - Evasive Flow Capture: Optimal Location of Weigh-in-Motion Stations, Tollbooths, and Security Checkpoints

Nikola Markovic, University of Maryland, Civil & Environmental Engineering, College Park, MD, United States of America, nikola@umd.edu, Ilya Ryzhov, Paul Schonfeld

The flow-capturing location-allocation problem (FCLAP) consists of locating facilities in order to maximize the number of flow-based customers that encounter at least one of these facilities along their predetermined travel paths. The FCLAP literature assumes that, if a facility is located on a predetermined path of a flow of customers, that flow is considered captured. However, existing models for the FCLAP do not consider targeted users who behave non-cooperatively by changing their travel paths to avoid fixed facilities (such as weigh-in-motion stations used to detect and fine overweight trucks). We propose, for the first time, the evasive flow capture problem (EFCP), analyze its structural properties, present modeling techniques for reducing computational cost, and show a case study based on a real-world transportation network.

■ SC22

Hilton- Union Sq 2

Optimization and Disaster Management

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Anuj Sharma, Assistant Professor, Iowa State University, Iowa, Ames, IA, 50011, United States of America, anujs@iastate.edu

1 - Characterization of Social Networks in Humanitarian Projects

Gloria Cecilia Urrea Castaño, PhD Student, University of Lugano, Via Giuseppe Buffi 13, Lugano, 6900, Switzerland, Sebastian Villa Betancur, Paulo Goncalves

When different organizations from distinct sectors are involved in humanitarian projects, complex relations arise creating unique structures. By analyzing 794 humanitarian projects and using exponential random graph models, we are able to (1) better understand the interactions among humanitarian actors and (2) identify the specific generative mechanisms and attributes that characterize the different structures emerging in humanitarian networks.

2 - Modeling the Dynamic Resource Allocation Problem for Large-Scale Transportation Network Evacuation

Xiaozheng He, NEXTRANS, 3000 Kent Ave, West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu, Hong Zheng, Srinivas Peeta

This study addresses the dynamic resource allocation problem for large-scale transportation network evacuation in two aspects. First, we adapt the spatial-queue model to describe evacuation traffic flow dynamics such that the problem size can be reduced significantly. Second, a decomposition scheme is developed to improve the computational efficiency for the problem.

3 - Resilience of Networked Infrastructure with Evolving Component Conditions

Reza Faturechi, Senior Systems Engineer, Optym, 505 SW 2nd Ave, Gainesville, Fl, 32601, United States of America, reza.faturechi@gmail.com, Eyal Levenberg, Elise Miller-Hooks

The problem of evaluating and maximizing the resilience of a networked infrastructure given component performance deterioration, along with improvements due to maintenance under given maintenance policies, is modeled as a stochastic optimization problem. The effects of capturing deterioration and maintenance in resilience quantification are assessed for a specific case study.

4 - Designing Blackout Resilient Traffic Network using Hybrid Power Generation

Anuj Sharma, Assistant Professor, Iowa State University, Iowa, Ames, IA, 50011, United States of America, anujs@iastate.edu, Mo Zhao

During power outages, traffic control signals and ITS devices are unable to assist in traffic management. This paper develops a design optimization model to find the trade-off between traffic network reliability and investment on emergency power. The effectiveness of hybrid emergency power using wind and solar energy is investigated.

■ SC23

Hilton- Union Sq 3

Rich Vehicle Routing Problems I

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Baoxiang Li, TUE, Eindhoven, Netherlands, b.li@tue.nl

1 - using SA to Solve the VRP Problem with Capacity and Time Constraints in Non-Euclidean Networks

Alejandro Garcia del Valle, Professor, University of Coruña, Dept Economic Analysis and Management Sc, Ferrol, C, 15403, Spain, agvalle@udc.es, Javier Faulin, Diego Crespo Pereira, Rosa Rios Prado

In this paper we first analyze the behavior of the Simulated Annealing based on the quality of solutions used as a starting point, then we implement this method to solve the problem of designing the delivery routes with capacity constraints and time windows with a maximum time in each route, for non-Euclidean dispersed networks. Finally we analyze and discuss the results of our research.

2 - Designing Split Pickup Collection Routes with Operational Constraints

Zhijie Dong, Cornell University, Ithaca, NY, United States of America, zd57@cornell.edu, Mark Turnquist

We develop an extension of the Split Delivery Vehicle Routing Problem (SDVRP) that includes constraints on the number of routes visiting any customer and the total number of customers receiving split service. These constraints are important for development of collection routes for inbound materials being shipped to a manufacturing plant. An effective heuristic solution method is developed for the extended problem formulation and application to logistics operations in the automotive industry is demonstrated.

3 - Improving Profitability of Vehicle Routing Problems through Advanced Analytics

Dauwe Vercamer, Universiteit Gent, Belgium Dauwe.Vercamer@UGent.be, Dirk Van den Poel, Michel Gendreau, Philippe Baecke

Based on a real case in door-to-door sales, the study assesses whether revenue predictions coming from transactional data can effectively be used to improve fleet schedules. To do this, two different customer selection models are compared. In the static model, customers are first chosen based on the revenue predictions and then routed through a VNS. The dynamic model uses the predictions in an orienteering problem. Initial results show that the dynamic approach is the most profitable.

4 - Hierarchical Optimization Modeling of Vehicle Routing Problem in Urban Supply Chains
Yiou Wang, Penn State, State College, PA, United States of America
Terry Friesz, Tao Yao, Hongcheng Liu, Ke Han

This research proposes a novel bi-level extension of vehicle routing problem (VRP) by formulating it into a Stackelberg game that takes into account the congestion as a result of freight activities among the background passenger traffic in urban freight planning. The model incorporates the VRP with static user equilibrium traffic assignment as a lower level. Numerical experiment on variant problem sizes show that the routing decisions from the bi-level formulation outperform decisions from the classical VRP formulation.

5 - An Adaptive Large Neighborhood Search Heuristic for the Share-a-Ride Problem
Baoxiang Li, TUE, Eindhoven, Netherlands, b.li@tue.nl,
Dmitry Krushinsky, Tom Van Woensel

The Share-a-Ride Problem (SARP) aims at minimizing the cost of serving a set of passengers and parcels using a set of homogeneous vehicles. We propose an Adaptive Large Neighborhood Search (ALNS) heuristic for the SARP. Furthermore, we study the problem of determining the time slack of the SARP scheduling. The solution approach is tested on three sets of realistic instances. The performance of our heuristic is benchmarked against an MIP solver and DARP test instances.

■ SC24

Hilton- Union Sq 4

Traffic and Emissions Modeling

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Xuesong Zhou, Associate Professor, Arizona State University, School of Sustainable Engineering and th, Tempe, AZ, United States of America, xzhou74@asu.edu

1 - Emission and Signal Optimization
Tao Yao, Penn State, State College, PA, United States of America
tyy1@engr.psu.edu, Y. Sun, Terry Friesz, K. Han

We propose a mathematical program wherein combining the dynamic user equilibrium, emission constraints and the decision variables that are the signal timing plans at all intersections.. The continuum signal model is an efficient and effective alternative of the so-called on-and-off signal models frequently employed in signal optimization problems.

2 - Traffic Signal Prediction for Engine Stop-start System
Jianfeng Zheng, University of Minnesota, Minneapolis, United States of America, zheng220@umn.edu, Henry X. Liu

Engine stop-start system, which shuts down and restarts an engine to reduce idling time when a vehicle stops, has become a common feature of vehicles nowadays. In this work, we propose a prediction model to predict vehicle stopping time at signalized intersections, aiming at better controlling engine stop-start system with traffic signal information. The feasibility and potential of the proposed method are demonstrated with a field example.

3 - System-optimal Traffic Routing Plans for Agents with Goals: Travel Time, Energy Cost and Emission Impacts
Jiangtao Liu, ASU, Tempe, AZ, United States of America
jliu215@asu.edu, Xuesong Zhou, Srinivas Peeta

Reducing energy consumption and pollutant emission from traffic systems is a practically important issue for urban network planners. Based on a set of queue and kinematic wave models, this talk will discuss a few analytical models for estimating the energy cost and emission impacts under different traffic states. Both non-linear and linear programming models are constructed to provide system-optimal routing plans for agents with various goals.

4 - Finding Green System Optimal Routing Policies through a Multi-Scale Dynamic Path Flow Assignment Model
Chung-Cheng Jas Lu, jasoncclu@gmail.com

This talk will discuss a problem of finding system optimal eco-routing or green routing flows that minimize total vehicular emission in a network. A mesoscopic dynamic network loading model that tightly links Newell's simplified kinematic wave and car-following models is proposed to facilitate an internally consistent dynamic traffic assignment for temporally cross-resolution and spatially multi-scale emission modeling.

■ SC25

Hilton- Union Sq 5

Flexible Transit and Ride-Share Systems

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Shadi Djavadian, Ryerson University, 350 Victoria Street, Toronto, Canada, shadi.djavadian@ryerson.ca

1 - Benefits of Recourse in the Stochastic Dial-A-Ride Problem
Neza Vodopivec, Graduate Assistant, University of Maryland, 1173 Glenn Martin Hall, University of Maryland, College Park, MD, 20742, United States of America, nvodopivec1@gmail.com,
Elise Miller-Hooks, Paul Schonfeld

DARP considers optimal schedules for door-to-door shared ride services. Few investigations incorporate the stochastic nature of real-world travel times, and none start from the premise that operators will wish to use means beyond their own fleets to minimize customer inconvenience. In this presentation, we investigate the handling of uncertain travel times by taxi and other recourse options.

2 - Agent Based Equilibrium Simulation Model to Evaluate Flexible Transit System Designs
Shadi Djavadian, Ryerson University, 350 Victoria Street, Toronto, Canada, shadi.djavadian@ryerson.ca, Jaeyoung Jung,
Joseph Y.J. Chow

We design and develop an agent based transportation simulation tool which evaluates the equilibrium demand for flexible transit service designs that cannot be determined analytically. Alternatives evaluated include different service types (fixed route, flex-schedule versus pure demand-responsive service) and dispatch algorithms. This work bridges the gap between service simulation models that ignore schedule-based demand interactions and activity-based models like MATSim that do not exhibit robust transport service simulation components. The simulation model is applied to two different settings in Ontario: London and Oakville, to demonstrate effectiveness.

3 - Minimum Number of Cars a City Needs in a Fully Coordinated Vehicle Sharing System
Monirehalsadat Mahmoudi, ASU, Tempe, AZ,
United States of America, mmahmou2@asu.edu, Xuesong Zhou

By introducing the concept of shared autonomous vehicles and ride sharing, we will address the following key questions: How many cars a city should use to support the overall transportation activity demand/desires, at different levels of coordination and pre-trip scheduling? How many parking lots and road infrastructure are required? We present a holistic optimization approach for synchronizing travel activity schedules, transportation services, and infrastructure on urban networks.

4 - Algorithms for Routing in Peer-to-peer Ride-share Systems
Neda Masoud, University of California, Irvine, CA,
United States of America, R. Jayakrishnan

The current ride-matching techniques in peer-to-peer ridesharing systems are rather preliminary and don't allow taking advantage of the full potential of the ridesharing systems. This paper formulates the multi-hop peer-to-peer ride-matching problem and proposes algorithms to solve the problem efficiently.

■ SC26

Hilton- Union Sq 6

Location Optimization I

Sponsor: Location Analysis

Sponsored Session

Chair: Alan Murray, Professor, Drexel University, Center for Spatial Analytics and Geocomp, College of Computing and Informatics, Philadelphia, PA, 19104, United States of America, amurray@drexel.edu

1 - Mitigating Urban Heat Island Effects through Strategic Park Siting
Yujia Zhang, ASU, ASU, Tempe, United States of America,
yzhan169@asu.edu, Kailai Wang, Alan Murray

The paper develops an approach for optimizing the cooling benefits of urban parks. A multi-objective spatial model is introduced accounting for area, shape and surrounding land cover of parks.

2 - Modeling Framework for Strategic Airline Network Design
Armin Lüer-Villagra, PhD Candidate, Pontificia Universidad Catolica de Chile, Department of Electrical Engineering, Av. Vicuña Mackenna 4860, Santiago, 7820436, Chile, arminluer@gmail.com, Guillermo Latorre-Níñez, Vladimir Marianov

We study the effect of different network policies in terms of strategic performance indicators on airlines. We formulate a location-network design problem, in which a company must locate their management and maintenance facilities in existing airports, together with deciding routes and the capacity allocation both on arcs (airplanes) and nodes (airports), minimizing costs, subject to an aggregated level of service constraint. The results suggest a strong impact of these policies.

3 - Spatial Strategy Development for Network Containment
Tony Grubesic, Professor, Drexel University, 3141 Chestnut St, Philadelphia, PA, 19104, United States of America, grubesic@drexel.edu, Alan Murray

This paper details location models to support containing, isolating and canalizing spatial flows to diminish the distribution of known and potential threats. Strategies for enhancing monitoring activities are discussed and public policy implications are discussed.

4 - Cournot-Stackelberg Games in Competitive Delocation
Diego Ruiz-Hernandez, Associate Professor, University College for Financial Studies, Serrano Anguita 9, Madrid, 28004, Spain, d.ruiz@cunef.edu, Javier Elizalde

During economic crises, the number of commercial facilities decreases. Many firms need to reduce their network minimizing the market share lost. We address the problem of facilities closing in a duopolistic market considering three ways of behaviour: myopic, Cournot and Stackelberg competition. We present a binary integer programming formulation, and provide an algorithm to find the non-cooperative solutions. The existence of Nash equilibrium is empirically tested.

■ SC27

Hilton- Union Sq 7

Roundtable Discussion on Bridging Data and Decisions I

Sponsor: Railway Applications

Sponsored Session

Chair: Marc Meketon, Vice President, Oliver Wyman, 1 University Square Drive, Suite 100, Princeton, NJ, 19002, United States of America, Marc.Meketon@oliverwyman.com

1 - Roundtable Discussion on Bridging Data and Decisions
Marc Meketon, Vice President, Oliver Wyman, 1 University Square Drive, Suite 100, Princeton, NJ, 19002, United States of America, Marc.Meketon@oliverwyman.com

The freight railway industry is awash in data in every corner of its business. From immediate operations that collect real-time information on locomotives, cars and even wheel bearings, the million+ commercial shipments per month, the tens of millions of duties performed in the yards, movement of almost a million containers and trailers, track analysis data, and so on. This roundtable will discuss how advanced techniques of data analysis and operations research are being used to make the best decisions from the data.

■ SC28

Hilton- Union Sq 8

Advanced Analytics: Applications to Solve Aviation System Level Problems

Sponsor: Aviation Applications

Sponsored Session

Chair: Philippe Bonnefoy, Lead Associate, Booz | Allen | Hamilton, 22 Batterymarch Street, Boston, MA, 02109, United States of America, bonnefoy_philippe@bah.com

1 - Game Theoretic Based Decision Analytics: Applications to the Aviation and Aerospace Markets
Philippe Bonnefoy, Lead Associate, Booz | Allen | Hamilton, 22 Batterymarch Street, Boston, MA, 02109, United States of America, bonnefoy_philippe@bah.com, Alice Fan, Gregory Raiffa

New game theoretic models that combine Bayesian Networks and Level-K solution concepts can help to better capture inherent uncertainties in the complex systems and (2) strategic interactions between decision makers. These models were applied to; (1) the aviation market by modeling and evaluating airlines' equipage of NextGen technology adoption under various policy scenarios and (2) the aerospace market to model the strategic interactions involving aircraft acquisitions.

2 - The Impact of Aircraft Design Reference Mission on Fuel Efficiency In The Air Transportation System
Brian Yutko, Post-Doctoral Associate, MIT, 9 Newbury Street, Somerville, MA, 02144, United States of America, byutko@mit.edu

There currently exists a large mismatch between commercial aircraft design capability (payload and range) and the way they are typically operated in the global system. This research proposes a new way of thinking holistically about the optimization of aircraft design capability, network structures, and operational techniques. Preliminary results indicate that there is a significant pool of potential fuel burn savings (~30-40%) that can be realized without new technology or fuels.

3 - Opportunities for Cruise Altitude and Speed Optimization in US Domestic Airline Operations
Luke Jensen, Research Assistant, MIT, 10 Landers St Apt 3, Somerville, MA, 02143, United States of America, ljensen@mit.edu

Operational strategies to reduce aircraft fuel consumption can mitigate costs and environmental impacts on a short time horizon. Most prior research has focused on lateral track optimization to achieve these benefits. This talk examines the system fuel burn reduction potential resulting from an alternative strategy, cruise speed and altitude optimization, in domestic US airline operations. Potential benefits, applications, and barriers to implementation are discussed.

4 - Encouraging Change in Air Traffic Control: A Game Theoretic Application
Nicole Adler, Hebrew University of Jerusalem, Mount Scopus, Jerusalem, 91905, Israel, msnic@huji.ac.il, Eran Hanany

Drawing on lessons from the airline and airport sectors, it would appear necessary to change both the market structure and regulatory environment of the air traffic control sector in order to achieve the goals of SESAR and NextGen. Using a network flow quadratic program within a congestion game, we analyse potential regulatory and ownership typologies in order to determine how to encourage the air traffic control sector to adopt the new technologies that have been developed over the last decade.

■ SC29

Hilton- Union Sq 9

"Just the Facts" Papers in Strategy

Cluster: Strategy Science

Invited Session

Chair: Myles Shaver, U of MN, 321-19th Ave S, Suite 3-365, Minneapolis, MN, 55455, United States of America, mshaver@umn.edu

1 - Marked for Life?: Temporary Mobility Constraints and Entrepreneurship Decisions by Foreign Graduates
Martin Ganco, Assistant Professor, University of Minnesota, 321 - 19th Avenue South, #3-365, Minneapolis, MN, 55455, United States of America, mganco@umn.edu

I study the effects of individuals facing a constraint when making initial employment decision post-graduation. I design a quasi-experiment by examining the effect of timing of green card that was not received through employment sponsorship in the context of foreign graduates of U.S. universities in science and engineering. I find that individuals who are more constrained are more likely to start a growth-oriented business and are less likely to enter a field not related to their degree.

2 - Geographic Proportional Representation of Female-Owned Businesses: Survival and Performance Outcomes
Michele Williams, Assistant Professor, Cornell University, 393 Ives Hall Faculty Building, Ithaca, NY, 14853, United States of America, mwilliams@cornell.edu, Arturs Kalnins

Analyzing survival duration of one million proprietorships and revenues of six thousand lodging proprietorships, we find a robust positive relationship between the proportional representation of female-owned proprietorships and both the survival duration and revenue performance of female-owned proprietorships, relative to male-owned proprietorships. We address endogeneity via instrumental variables.

3 - The Impact of Collusive Non-poaching Agreements, Mobility and Innovation
Ajay Bhaskarabhatla, Assistant Professor, Erasmus School of Economics, Burgemeester Oudlaan 50, PO Box 1738, Rotterdam, 3061XN, Netherlands, bhaskarabhatla@ese.eur.nl, Deepak Hegde

This study investigates the impact of secret bilateral agreements among select firms in Silicon Valley to not actively solicit each other's employees. Using US patent grant data during 1995-2009 and a differences-in-differences methodology, we find that inventor mobility declined among the colluding firms relative to others during the period of collusion. We also find that the individual inventor productivity and invention quality at the colluding firms declined during the period of collusion.

■ SC30

Hilton- Union Sq 10

Scheduling in Maritime Logistics

Cluster: Scheduling and Project Management

Invited Session

Chair: Xiangtong Qi, HKUST, Dept of IELM, HKUST, Hong Kong, Hong Kong - PRC, ieemqi@ust.hk

1 - Optimal Algorithm for the General Quay Crane Double-cycling Problem

Chung-Yee Lee, Professor, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, cylee@ust.hk, Ming Liu, Chengbin Chu

This paper studies quay crane double-cycling problem. We show that it can be formulated as a flow shop scheduling problem with series-parallel precedence constraints, thus allowing it to be solved polynomially. This also answers the optimal question regarding the computaitonal complexity of the problem.

2 - New Solution Methods for the Continuous Berth Allocation Problem

Zhou Xu, Hong Kong Polytechnic University, Hong Kong, Hong Kong - PRC, lgtzx@polyu.edu.hk, Chung-Yee Lee

Port operators today are struggling to enhance efficiency through better utilization of berth spaces. In this paper, we have developed novel solution methods for a continuous berth allocation problem, based on a new lower bound of the optimal solution, a new heuristics, and a new exact algorithm. Computational results show that compared with existing methods, our methods can solve more instances to optimal, and generate better near-optimal solutions and lower bounds.

3 - The Impact of Slow Ocean Steaming on Delivery Reliability and Fuel Consumption

Jiheng Zhang, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, jiheng@ust.hk, Chung-Yee Lee, Hau Lee

Slow steaming has become a widely adopted practice as a way to reduce bunker costs and carbon footprints. In this paper, we propose a model to quantify the relationship among shipping time, bunker cost and delivery reliability. Moreover, we verify our model and results via numerical experiments by using actual data from a large ocean carrier in Hong Kong. Our findings lead to a simple and implementable policy with a controlled cost and guaranteed delivery reliability.

4 - Disruption Recovery for Berth Allocation

Xiangtong Qi, HKUST, Dept of IELM, HKUST, Hong Kong, Hong Kong - PRC, ieemqi@ust.hk, An Zhang

We consider berth allocation after the terminal is disrupted with multiple waiting vessels. While the terminal has the objective of reducing the queue quickly, the container transshipment among the vessels should also be respected as much as possible. We treat and solve the problem as scheduling with soft precedence constraints. The work is supported by a grant from the Research Grants Council of the HKSAR T32-620/11.

■ SC31

Hilton- Union Sq 11

Delivering Services Over the Digital Media

Sponsor: Service Science

Sponsored Session

Chair: Tuck Siong Chung, Nanyang Tech. U., Nanyang Bus. School, Singapore, 639798, Singapore, ATSChung@ntu.edu.sg

1 - An Integrated Model of Online Rating Decision: Role of Pre-Purchase Expectation and Post-Purchase Experience

Tuck Siong Chung, Nanyang Tech. U., Nanyang Bus. School, Singapore, 639798, Singapore, ATSChung@ntu.edu.sg

The authors developed a three stage sequential decision model that links expectation disconfirmation with post consumption rating decisions in the online context. They empirically examine the proposed model in a controlled laboratory setting and find that disconfirmation plays an important role in rating behaviors. They show via a simulation study that the proposed model can successfully recreate a range of distributional and evolutionary characteristics of online rating environment that are commonly found in real life.

2 - Digital Brand Delight - Structure, Causes and Consequences of Brand Delight in a Digital Environment

Markus Lenkar, University of Koblenz-Landau, Institute for Management, Germany, markus.lenker@audi.de

The Digitization greatly changed the behavior of customers. Purchase decisions for a car are strongest influenced by the websites of a brand. To differentiate from competitor, brands have to create emotional relationships to their customers. Two empirical Studies in cooperation with a German premium car manufacturer identify influencing factors of website quality and online brand experiences on brand delight. Overall, this research Shows how Brands can attain brand delight in an online environment and clarifies its effects on consumer behavior.

3 - Combining Quantitative and Text Mining Approaches for Win Prediction of IT Outsourcing Bids

Hamid R. Motahari-Nezhad, IBM Almaden Research Center, 650 Harry Road, San Jose, United States of America, motahari@us.ibm.com, Daniel Greenia, Taiga Nakamura, Aly Megahed

Information technology service providers, as IBM, design and propose bids to potential clients in an effort to win high-valued outsourcing information technology contracts. Several project factors contribute to whether the deal is won or lost. In this work, we develop and combine quantitative and text analytics approaches that predict and prioritize the winning deals among a given list of on-going deals. We present a real-world case study that shows the practical impact of using our model.

■ SC32

Hilton- Union Sq 12

Accelerate Service Innovations with Data Mining and Machine Learning

Sponsor: Service Science

Sponsored Session

Chair: Mu Qiao, Research Staff Member, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, mqiao@us.ibm.com

1 - Team Recommendation for IT Strategic Outsourcing Services

Mu Qiao, Research Staff Member, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, mqiao@us.ibm.com, Daniel Greenia, Rama Akkiraju, Taiga Nakamura, Haibin Liu, Hamid R. Motahari-Nezhad, Stephen Dill

In IT strategic outsourcing services, it is critical to have competent deal teams to design competitive service solutions and respond to clients' request for proposals swiftly. We present a team recommendation framework for finding the best deal team for a given set of job roles using a machine learning approach. It takes into account diverse individual and team level features, and can accommodate various cost or feature functions. We show the recommendation results in a real business scenario.

2 - End-to-end Real-time Proactive Cloud Management Analytics

Rong Liu, IBM Research, 1101 Kitchawan Rd, Ossining, NY, 10598, United States of America, rliu@us.ibm.com, Jeaha Yang, Juhnyoung Lee

As the complexity of cloud computing increases and software components are deeply interconnected, it is challenging for customers to manager their applications on cloud to achieve true self-service. Here we propose an end-to-end approach that allows customers to actively monitor their systems on cloud. This approach aggregates and analyzes data/events from software stacks on cloud, proactively alert customers potential failures, and recommend actions to remedy failures of their applications.

3 - using Social Network Analysis to Improve the Incident Handling in IT Services

Zhe (Jay) Shan, University of Cincinnati, Cincinnati, Ohio zhe.shan@uc.edu, Rong Liu

In a complex IT environment, the diagnosis of application-level incidents is very difficult. Therefore, matching incident cases with appropriate SMEs is one of the key challenges in IT service industry. In this work, we propose to use the social network information mined from historical communication information among SMEs to improve the case dispatch system. This analysis can not only identify the expertise similarity and complementarity among SMEs, but also their collaboration patterns.

■ SC33

Hilton- Union Sq 13

Managing the Innovation Process for New Product Development

Cluster: New Product Development

Invited Session

Chair: Joel Wooten, University of South Carolina, Moore School of Business, Columbia, SC, United States of America, joel.wooten@moore.sc.edu

1 - Sequential Innovation by Startups

Karthik Ramachandran, Associate Professor, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu, Sreekumar Bhaskaran, Sinan Erzurumlu

Start-up firms often consider launching an immediately available product to generate funds for developing a more advanced, but risky, product. However, this release could have an adverse effect on the perception of the firm's future products. We model this trade-off and derive managerial insights on this novel problem

2 - Optimal Shapes of Innovation Pipelines

Joel Wooten, University of South Carolina, Moore School of Business, Columbia, SC, United States of America, joel.wooten@moore.sc.edu, Sriram Venkataraman

New product introductions often occur via R&D pipelines. We explore the optimal number of innovation options to pursue in this complex managerial process. A stylized game simulation of the pharma industry provides additional evidence for our problem.

3 - Innovation Lessons from the Field II

Tom Arnold, CEO, Gridium, San Francisco, CA, United States of America, tom@gridium.com

Serial entrepreneur (and current CEO of Gridium) Tom Arnold will discuss his managerial insights from starting and running three different energy and environmental start-ups.

4 - Innovation Lessons from the Field I

Erin Quist, COO, Wahwah Networks, San Francisco, CA, United States of America, erin@wahwahnetworks.com

Erin Quist (COO of Wahwah Networks) will share her experience managing innovation and product roll-outs at several different companies in the online media and advertising industry.

■ SC34

Hilton- Union Sq 14

Humanitarian Logistics and Development

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Begona Vitoriano, Associate Professor, Complutense University of Madrid, Faculty of Mathematical Sciences, Plaza de las Ciencias, 3, Madrid, 28040, Spain, bvitoriano@mat.ucm.es

1 - SEDD: Disaster Diagnostic and Evaluation System

J.Tinguaro Rodriguez, Complutense University of Madrid, Plaza de Ciencias 3, Madrid, 28040, Spain, jtrodrig@mat.ucm.es, Begona Vitoriano, Javier Montero

A decision support system to assess consequences of disasters with the very first available information is presented in this work. This DSS, refered as SEDD, is based on a rule-based learning model focused on interpretability. Moreover, among its main features, SEDD's methodology enables an expressive representation of uncertainty and knowledge of predicted consequences of disasters, as well as to include decision maker's attitude and requirements inside its learning and inference procedures.

2 - Integrating Real Time Data into Logistical Models: A Case Study from Typhoon Haiyan

Kezban Yagci Sokat, PhD Candidate, Nortwestern University, 2145 Sheridan Road, Room C210, Evanston, IL, 60208, United States of America, kezban.yagcisokat@u.northwestern.edu, Irina Dolinskaya, Karen Smilowitz, Jennifer Chan

We present a first-hand experience of collecting, analyzing and integrating real time data into logistical models. Using the recent Philippines Typhoon Haiyan as a case study, we analyze how dynamically emerging data can be collected, processed and used in humanitarian logistical decisions.

3 - Logistics for Rural Development: A Model for Photovoltaic Rural Electrification in Morocco

Begona Vitoriano, Associate Professor, Complutense University of Madrid, Faculty of Mathematical Sciences, Plaza de las Ciencias, 3, Madrid, 28040, Spain, bvitoriano@mat.ucm.es, Luis Miguel Carrasco, Luis Navarte, M. Teresa Ortuño, F. Javier Martin-Campo

Photovoltaic electrification for rural development has experienced a scale change in terms of size of the programmes developed, with thousands of solar home systems, and long operation and maintenance service periods. Planning and cost evaluation of maintenance operations is crucial for these decentralized systems. So far it has not been done properly, leading to poor performance of these services. A model for these purposes will be shown, applied to a real case on a province of Morocco.

■ SC35

Hilton- Union Sq 15

Public Health I

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, United States of America, chaitrag@umass.edu

1 - Global Health: Optimizing the Use of Scarce Resources

Eva Lee, Professor & Director, Georgia Institute of Technology, Ctr for OR in Medicine & Healthcare, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

This work is joint with Tanzania public health ministry and CDC. Public health in developing countries is often underfunded and has limited resources. The healthcare systems have to explore strategies that allow them to serve the largest population with regular needs such as pregnancy screening, childhood vaccination, HIV and TB tests. We describe a decision support system that helps to improve hospital throughput and maximize the population served.

2 - Factors Influencing Healthcare Disparities in Breast Cancer Patients: A Review

Diana Prieto, Western Michigan University, 4601 Campus Drive, Kalamazoo, MI, 49008, United States of America, diana.prieto@wmich.edu

In the United States, there is a large body of research about factors influencing healthcare disparities in breast cancer patients. We conducted a systematic review to determine the factors that have been rarely investigated, and to identify the relationships between factors and endpoints with respect to the different treatment and post-treatment options for breast cancer. We will also discuss the modeling frameworks that are currently used to investigate the factors.

3 - Modified Network Model to Estimate HIV Transmissions in the US

Stephanie Sansom, CDC, Atlanta, GA, United States of America sos9@cdc.gov, Chaitra Gopalappa, Paul Farnham

Individual-based network models can simulate interactions among individuals and are suitable for modeling infectious diseases such as HIV. However, fitting network models can require long computational times, which may make them unsuitable for simulating large populations. We present a modified network model designed to overcome this limitation. We apply the model to the US population to estimate annual HIV incidence and transmission rates.

4 - Dynamic Network Disease Modeling of the Synergistic Transmission of HIV and HSV2

Yao-Hsuan Chen, CDC, 1600 Clifton Rd, Atlanta, United States of America, xhj1@cdc.gov, Thomas Gift, Samuel Friedman, Joel Sokol

The purpose of the study was to test the hypothesis that contact dynamics and contact network structures are important to closely predict the spread of sexually transmitted diseases (STDs). Our work supported the hypothesis that considering the underlying contact dynamics as well as network structures was important for making optimal disease prevalence predictions. Our results also demonstrated the need to model the data sampling process when validating against real-world data.

■ SC36

Hilton- Union Sq 16

Telecommunications Best Paper Award

Sponsor: Telecommunications

Sponsored Session

Chair: Michael Bartolacci, Pennsylvania State Univesity, Berks, Reading, PA, 19610, United States of America, mbartolacc@aol.com

1 - GUB Covers and Power-Indexed Formulations for Wireless Network Design

Fabio D'Andreagiovanni,f.dandreagiovanni@gmail.com, Carlo Mannino, Antonio Sassano

We propose a pure 0-1 formulation for the wireless network design problem, i.e., the problem of configuring a set of transmitters to provide service coverage to a set of receivers. In contrast with classical mixed integer formulations, where power emissions are represented by continuous variables, we consider only a finite set of power values. This has two major advantages: it better fits the usual practice and eliminates the sources of numerical problems that heavily affect continuous models.

2 - The Two-level Diameter Constrained Spanning Tree Problem

Luis Gouveia, Professor, University of Lisbon, Centro de Investigacao Operacional, Bloco C6 - Piso 4- Campo Grande, Lisbon 1749-016, Portugal, legouveia@fc.ul.pt, Markus Leitner, Ivana Ljubic

We introduce the Two-Level Diameter Constrained Spanning Tree Problem (2-DMSTP). We first observe that any feasible solution to the 2-DMSTP can be viewed as a DMST that contains a diameter constrained Steiner tree. This observation allows us to prove graph theoretical properties related to the centers of each tree which are then exploited to develop mixed integer programming formulations, valid inequalities, and symmetry breaking constraints.

3 - Multipath Wireless Network Coding: An Augmented Potential Game

Vinod Ramaswamy, Texas A&M University, College Station TX 77843, United States of America, vonod83@tamu.edu, Natarajan Gautam, Vinith Reddy, Srinivas Shakkottai, Alex Sprintson

We consider wireless networks in which multiple paths are available between each source and destination. We allow each source to split traffic among all of its available paths, and we ask the question: How do we attain the lowest possible number of transmissions per unit time to support a given traffic matrix? Traffic bound in opposite directions over two wireless hops can utilize the "reverse carpooling" advantage of network coding in order to decrease the number of transmissions used. We call such coded hops "hyper-links." With the reverse carpooling technique, longer paths might be cheaper than shorter ones.

4 - Branch-and-price Algorithm for the Resilient Multi-level Hop-constrained Network Design

Fernanda S.H Souza, Federal University of Minas Gerais, Belo Horizonte 31270-010, Brazil, fernandasumikahojo@gmail.com, Michel Gendreau, Geraldo R. Mateus

In this work, we investigate the Resilient Multi-level Hop-constrained Network Design (RMHND) problem, which consists of designing hierarchical telecommunication networks, assuring resilience against random failures and maximum delay guarantees in the communication. Three mathematical formulations are proposed and algorithms based on the proposed formulations are evaluated.

■ SC37

Hilton- Union Sq 17

Methods and Models for Large Social Networks

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Bin Zhang, University of Arizona, McClelland Hall, Room 430, P.O. Box 210108, Tucson, AZ, 85721, United States of America, binzhang@arizona.edu

1 - Large-scale Social Identity Linkage via Heterogeneous Behavior Modeling

Siyuan Liu, Research Scientist, Carnegie Mellon University, Forbes Ave 5000, Pittsburgh, PA 15217-1011, United States of America, siyuan@cmu.edu, Shuhui Wang, Feida Zhu, Jinbo Zhang, Ramayya Krishnan

We study the problem of large-scale social identity linkage across different social media platforms. We propose HYDRA, a solution framework which consists of three key steps: (I) modeling heterogeneous behavior; (II) constructing structural consistency graph; and (III) learning the mapping function by multi-objective optimization. Extensive experiments demonstrate that HYDRA correctly identifies real user linkage across different platforms.

2 - Price Discounts and Peer Effects in Information Goods: A Randomized Experiment

Rodrigo Belo, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA 15217-1011, United States of America, rbelo@cmu.edu, Pedro Ferreira, Miguel Matos

We analyze the role of word-of-mouth (WoM) and its relationship with price promotions on a video-on-demand (VoD) platform of a major telecom operator. We design, implement and analyze the outcomes of a randomized experiment aimed at studying the effect of price discounts on movie sales. We find that promoted movies increased short-term sales at the expense of non-discounted titles. We also find that WoM generated by purchases in our experiment accounted ~50% of all WoM generated by consumers.

3 - The Evolution of Generative Architecture of an Open Ecosystem: A Case of WordPress

SungYong Um, Temple University, 1810 North 13th Street, Philadelphia, PA19122, United States of America, sungyong.um@temple.edu, Bin Zhang, Youngjin Yoo, Sunil Wattal

We study the evolutionary pattern of an open digital ecosystem. We use text mining techniques on the source code of WordPress plug-ins created from 2004 to 2012, and extract all Application Programming Interface (API) data used in these plug-ins. We observe that the plug-in network eventually evolves into a hierarchical structure, which is induced by the generative feature of digital elements.

■ SC38

Hilton- Union Sq 18

Systems Engineering and Public Health

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Saeideh Fallah-Fini, Assistant Professor, California State and Polytechnic University, Pomona, 3801 W. Temple Ave, Pomona, CA, 91768, United States of America, sfallahfini@csupomona.edu

1 - Dynamics of Obesity Interventions inside Organizations

Mohammad S. Jalali, Virginia Tech / MIT, 113 Harvard St, Apt 1, Cambridge, MA, 02139, United States of America, mj@vt.edu, Hazhir Rahmandad, Sally Bullock, Alice Ammerman

A large number of obesity interventions from upstream (policy) to downstream (individual) have been put forward to curb the obesity trend in the US but not all those interventions have been successful. In this study, we aim to understand how effectiveness of organizational level obesity interventions depends on dynamics of Adoption, Implementation, and Maintenance (AIM) of the interventions. Using a dynamic simulation model, we show how small changes in AIM can make a big difference in impact.

2 - An Agent-based Model to Assess the Role of the Food Environment on Body Mass Index in Children

Mehdi Jalalpour, Assistant Professor, Civil And Environmental Engineering, Cleveland State University, 1960 East 24th Street, Cleveland, OH, 44115, United States of America, M.Jalapour@csuohio.edu, Amii Kress, Thomas Glass

An agent-based model is proposed to assess the role of the food environment on body mass index (BMI). Children, ages 10-15 from 2 boroughs in Pennsylvania were used for validation. Spatial information was imported from GIS, and children data are from electronic health records. The model simulates food foraging outside the home, accounting for peer influences. The model is calibrated to BMI after 3 years.

3 - A Dynamic Model for Health Screening: Understanding Long Term Trends in Screening Mammography

Ozge Karanfil, PhD Candidate, Alfred P. Sloan School of Management, MIT, Sidney-Pacific NW 86-815, Cambridge, MA, United States of America, karanfil@mit.edu, John Sterman

In this study we develop the first explicit and integrated, broad boundary feedback theory around the dynamics of medical screening. The theory includes a decision theoretic core around costs and benefits including the fundamental tradeoff between sensitivity and specificity; and feedbacks that condition guidelines and the actual practice. To provide context we use the mammography case as a motivating example, but our model is generic and applicable to other contexts such as the PSA screening.

4 - Modeling the Potential Community-Wide Benefits of a Jail Based Screen-Treat Program for Chlamydia

Ozgur Araz, Assistant Professor, Department of Health Promotion, Social, & Behavioral Health, University of Nebraska Medical Center, Omaha, NE, 68198-4365, United States of America, ozgur.araz@unmc.edu, Brock Hanisch, Ruth Margalit

Sexually Transmitted Infections (STIs) remain a major health burden within the United States. The US jail population is disproportionately impacted by STIs and thus serves as a key point of access for screening and treatment for this transient and high-risk population. To aid in implementing an opt-out screen-and-treat policy at the Douglas County Jail we developed a systems model that incorporates the mathematical epidemiology of Chlamydia.

■ SC39

Hilton- Union Sq 19

Medical Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: Anahita Khojandi, University of Tennessee, Knoxville, TN, 37996, United States of America, khojandi@utk.edu

1 - Screening for Hepatocellular Carcinoma under Limited Resources: A POMDP Approach

Elliot Lee, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48105, United States of America, elliotdl@umich.edu, Mariel Lavieri, Michael Volk

We model the problem of allocating a limited screening capacity across a panel of patients at risk for developing hepatocellular carcinoma as a partially observable markov decision process. We seek to utilize biological information gathered sequentially over time to shift resources towards patients of higher risk. We present structural properties of this problem, and draw conclusions about more efficient screening behaviors.

2 - Valuing Paired Kidney Exchanges: A Stochastic Game Approach

Murat Kurt, Assistant Professor, University at Buffalo (SUNY), 309 Bell Hall, University at Buffalo(SUNY), Buffalo, NY, 14260-2050, United States of America, muratkur@buffalo.edu, Andrew Schaefer, Utku Unver, Mark Roberts

Paired kidney exchanges (PKE) help alleviate the disparity between the supply and demand of kidneys for transplantation. We formulate patients' transplant timing decisions in a prearranged PKE as a non-zero sum stochastic game and compute a socially optimal equilibrium using a mixed integer linear programming formulation of the resulting equilibrium constraints. We use clinical data to present computational results that illustrate how the exchanges can be valued using their timings.

3 - MDP Model for Asymptotic Intracranial Aneurysm Treatment Selection under Risk Aversion

Vera Tilson, Simon School, University of Rochester, Rochester, NY, United States of America, vera.tilson@simon.rochester.edu, David Tilson

We use a finite-horizon MDP model to find optimal treatment plans for patients diagnosed with asymptomatic intracranial aneurysm. We consider two distinct criteria: (a) maximizing the expected number of life years in good health, and (b) maximizing the expected utility for number of years in good health. Use of alternate patient-selected criteria leads to recommendations that vary from a previously published recommendations in several scenarios.

4 - Dynamic Abandon/Extract Decisions for Failed Cardiac Leads

Anahita Khojandi, University of Tennessee, Knoxville, TN, 37996, United States of America, khojandi@utk.edu, Lisa M. Maillart, Oleg Prokopyev, Mark Roberts, Samir Saba

When a cardiac lead fails, physicians implant a new lead and may opt to extract the failed lead and/or any previously abandoned leads. Because the risk of extraction increases in lead age, physicians may extract leads to reduce the future risk of mandatory extraction, due to either infection or limited space in the vein. We use SMDP models for various cardiac devices to obtain patient-specific, lifetime-maximizing extraction policies and compare their performance to that of several heuristics.

■ SC40

Hilton- Union Sq 20

Scheduling Problems in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Narges Hosseini, Postdoc, Mayo Clinic, 200 1st St. SW, Rochester, MN, 55901, United States of America, Hosseini.Narges@mayo.edu

1 - Elective Case Rescheduling on the Day of Surgery

Robert Allen, Clemson University, Clemson, SC, United States of America, rallen3@g.clemson.edu, Kevin Taaffe

Operating room (OR) rescheduling is the process of adjusting the surgery schedule when the current schedule is subjected to disruptions on the day of surgery. Of particular importance is when, and which rescheduling method should be used to update the scheduling and tracking systems. Discrete event simulation was used to simulate surgical cases in the OR and to test different rescheduling policies and case updating policies for their effectiveness.

2 - Scheduling Coordinated Respirology Lab-clinics to Maximize the Service Level under Stochastic Time

Farzad Zaerpour, University of Calgary, Haskayne School of Business, 118, 3420, 50th Street, NW, Calgary, AB, T3A 2E1, Canada, farzad.zaerpour@haskayne.ucalgary.ca, Diane Bischak, Mozart Menezes

In respirology outpatient clinics, a patient's lab tests must be completed just before the clinic appointment, but patients scheduled into a given clinic will require different amounts of testing time. We develop a MIP-based approach for assigning doctors to clinic slots so that the likelihood of a patient not completing testing in time for the clinic appointment is minimized. Using a pre-processing technique, we avoid the approach of simulation within optimization.

3 - An Algorithm for Advance Surgical Scheduling

Narges Hosseini, Postdoc, Mayo Clinic, 200 1st St SW, Rochester, MN, 55901, United States of America, Hosseini.Narges@mayo.edu, Kal Pasupathy, Jeanne Huddleston

Spine surgeries are common and highly profitable. Based on Mayo Clinic, we developed a model to effectively schedule these surgeries. That includes a predictive model to accurately forecast surgical durations, and an algorithm that presents multiple solutions to the scheduling problem that minimizes the overall cost while meeting additional constraints. Offering multiple solutions gives the flexibility for scheduling convenient times and that is highly important in patient centered institutions.

■ SC41

Hilton- Union Sq 21

Medical Decision Making: Research by Bonder Scholars

Sponsor: Health Applications

Sponsored Session

Chair: Pooyan Kazemian, PhD Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, pooyan@umich.edu

1 - Optimal Policies for Arteriovenous Fistula Creation for Patients on Hemodialysis

Reza Skandari, PhD Candidate, University of British Columbia, 2053 Main Mall, Vancouver, V6T-1Z2, Canada, reza.skandari@sauder.ubc.ca, Steven Shechter, Nadia Zalunardo

To deliver Hemodialysis (HD), patients need to have a vascular access. The gold standard for delivering HD is via Arteriovenous Fistula (AVF). Due to AVF creation failure, limited lifetime of a functional AVF, and limited places to create an AVF, patients may use an inferior access substitute called Central Venous Catheter (CVC). We characterize conditions under which the patient should or should not be referred for AVF creation, under total lifetime and quality adjusted lifetime metrics.

2 - Improving HIV Early Infant Diagnosis Supply Chains in Sub-Saharan Africa

Jonas Jonasson, London Business School, Regent's Park, London, Regent's P, United Kingdom, jjonasson.phd2010@london.edu, Jérémie Gallien, Sarang Deo

Most countries in sub-Saharan Africa experience delays in HIV early infant diagnosis (EID). We develop a two-part modeling framework to generate operational improvements in EID networks and evaluate their impact on public health. For the case of Mozambique, we estimate that the interventions of optimally re-assigning clinics to labs and optimally re-allocating diagnostic capacity would result in 11% and 22% shorter turnaround times and 4% and 7% more infants starting treatment, respectively.

3 - Optimal Strategy for Hepatocellular Carcinoma Surveillance in Hepatitis C Patients

Qiushi Chen, Georgia Institute of Technology, Atlanta, GA, United States of America, chenqiushi0812@gatech.edu, Jagpreet Chhatwal, Turgay Ayer

The practice guidelines recommend surveillance for HCC, the main type of liver cancer, in high-risk hepatitis C patients every 6-12 months. However, the optimal surveillance interval is controversial. We present a mixed-integer programming-based approach to evaluate the cost-effectiveness of routine and dynamic policies. We found that dynamic outperform routine policies.

4 - Dynamic Personalized Monitoring and Treatment Control of Chronic Diseases

Pooyan Kazemian, PhD Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, pooyan@umich.edu, Jonathan Helm, Joshua Stein, Mark Van Oyen, Mariel Lavieri

We develop an innovative modeling framework for chronic disease patients to help guide clinicians to quickly detect disease progression and adjust the treatment plan over time to limit disease progression. The model is able to (1) optimize the time interval between sequential monitoring tests; (2) specify the best set of tests to take during each patient's office visit; and (3) provide target values for the controllable disease risk factors. Glaucoma is discussed as a case study.

■ SC42

Hilton- Union Sq 22

Network Epidemics: Theory Advancements and Applications

Sponsor: Health Applications

Sponsored Session

Chair: Benjamin Armbruster, Northwestern University, 2145 Sheridan Rd., IEMS, Evanston, Il, 60208, United States of America, armbruster@northwestern.edu

1 - Theoretical Results for Disease Spread on Networks

Benjamin Armbruster, Northwestern University, 2145 Sheridan Rd., IEMS, Evanston, IL, 60208, United States of America, armbruster@northwestern.edu

There are few theorems in this area. I summarize existing results and present new theoretical results on (1) the role of heterogeneity; (2) the speed of spread on dynamic networks (a formula involving only the degree, infection rate, and relationship duration); (3) the optimal targeting of nodes and links to reduce spread; and (4) the convergence to mean-field models.

2 - A Model of Partnership Formation and Dissolution to Study HIV Transmission among Young MSM (YMSM)

Ekkehard Beck, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, ekkehardbeck2015@u.northwestern.edu, Benjamin Armbruster

We introduce a discrete-time agent-based network simulation model of HIV/STI transmission and partnership formation and dissolution among YMSM using ego-centric network data of an ongoing longitudinal cohort study in Chicago. Results show that network position, age mixing, and race assortative mixing significantly impact HIV spread among YMSM. Additionally, sexually transmitted infections account for 13.7% of all HIV infections with rectal STIs accounting for more than 2/3 of these infections.

3 - Epidemics of Hepatitis C among Drug Injectors – The Role of Network Dynamics

Alexander Gutfraind, Research Assistant Professor, University of Illinois at Chicago, 1603 W. Taylor Street, MC 923, Chicago, IL, 60612, United States of America, agutfraind.research@gmail.com, Basmattee Boodram

People who inject drugs (PWID) are the highest risk population for Hepatitis C virus (HCV) infections in the US. Using multiple datasets collected in Chicago we constructed and validated a detailed agent-based model for this epidemic. Using this model we found that network dynamics and disease dynamics contribute to the spread of HCV in different time scales.

■ SC43

Hilton- Union Sq 23

Software and Tools for Large-Scale Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Jonathan Eckstein, Professor, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, jeckstei@rci.rutgers.edu

1 - Scenario Generation from Forecasts

David Woodruff, UC Davis, One Shields Ave, Davis, CA, 95616, United States of America, dlwoodruff@ucdavis.edu

I will describe the work of a team of researchers that have created software to create scenarios based on point forecasts for input to large-scale stochastic programming problems. Experience with data for the stochastic unit commitment problem will be used to illustrate.

2 - Massively Parallel Branch-and-Bound with PEBBL

Jonathan Eckstein, Professor, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, jeckstei@rci.rutgers.edu, Cynthia Phillips, William Hart

PEBBL is an object-oriented C++ library and software framework for implementing serial and parallel branch-and-bound algorithms. This talk describes PEBBL and its application to a machine learning problem, using a problem-specific combinatorial bound. On a large inifiband cluster, the application exhibits essentially linear speedup through 6,144 processor cores on our most difficult problem instance.

3 - Mixed-Integer Lower Bounds for Progressive Hedging

Jean-Paul Watson, Distinguished Member of Technical Staff, Sandia National Laboratories, P.O. Box 5800, MS 1326, Albuquerque, NM, 87185-1326, United States of America, jwatson@sandia.gov, Jonathan Eckstein, David Woodruff

Nonconvexities and time limits may cause the progressive hedging (PH) algorithm to terminate in the mixed-integer case with a feasible solution, but no corresponding lower bound. We describe new methods to obtain lower bounds using both the information prices generated by PH and bundling methods. We additionally discuss experimental results and supporting open-source software implemenations.

4 - New Parallel Programming Languages for Optimization Research

John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, On, K1S 5B6, Canada, chinneck@sce.carleton.ca, Stephane Ernst

New optimization algorithms that do not take into account parallel execution are handicapped since multi-core machines are now everywhere, including on desktop PCs. For a recent project we searched for a programming language that has three characteristics: (i) easy to program, (ii) simple facilities for dealing with parallelism, and (iii) fast compilation and execution. Two free languages satisfied these criteria: Google's Go, and Julia. We assess these languages for optimization research.

■ SC44

Hilton- Union Sq 24

Service Operations and Information Systems

Sponsor: Information Systems

Sponsored Session

Chair: Subodha Kumar, Carol and G. David Van Houten, Jr. '71 Professor, Mays Business School, Texas A&M University, Wehner 301F - 4217 TAMU, College Station, TX, 77843, United States of America, skumar@mays.tamu.edu

1 - Network Effects in Healthcare Information Exchanges

Emre Demirezen, Assistant Professor, Binghamton University Suny, Binghamton University Suny, 4400 Vestal Parkway East, Binghamton, NY, 13902, United States of America, edemirezen@binghamton.edu, Subodha Kumar, Arun Sen

Based on our interactions with three different healthcare information exchange (HIE) providers based in US, we study two models with network effects. The first one deals with the start-up HIEs; whereas in the second model, we analyze established HIE providers that also offer value-added services. We present several results and insights for HIE providers, healthcare practitioners, and policy-makers.

2 - Opportunistic Data Sharing: Co-opetition between Personalizing and Non-personalizing Firms

Abhijeet Ghoshal, University of Illinois, 1206 S. Sixth St, 446, Champaign, Il, 64820, United States of America, abhi@illinois.edu, Subodha Kumar, Vijay Mookerjee

We present a co-opetition model where a personalizing firm and a non-personalizing firm compete for the same set of customers while sharing data when it is mutually beneficial to them. The customer balances her purchases from the two firms in order to maximize her surplus. We provide conditions when the non-personalizing firm shares its data with the personalizing firm and the latter uses the data. Several interesting managerial insights are also provided regarding the data sharing equilibrium.

3 - ConSequence: Managing Fading Ads during a User Visit

Zhen Sun, University of Texas at Dallas, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, zhen.sun@utdallas.edu, Milind Dawande, Vijay Mookerjee, Ganesh Janakiraman

A fad is an ad that disappears if the visitor does not click on it after a given length of time. The withdrawn ad could be replaced by another ad. The goal of this paper is to choose a sequence of ads to display, such that the expected revenue is maximized.

4 - Coordination under Competition

Cheng Nie, Ph.D. Student, University of Texas at Dallas, 800 West Campbell Road, MC 1.406E, Richardson, TX, 75080, United States of America, cheng.nie@utdallas.edu, Vijay Mookerjee, Milind Dawande

Information sharing between various locations of a multi-location firm always seems beneficial for the firm. However, the duopolistic competition between firms might render this intra-firm information sharing harmful. We build a model to show that ignorance is bliss when firms compete with each other. The main lesson we learn is that a local-level competition between firms will change to a fiercer global-level competition when intra-firm information sharing is allowed.

■ SC45

Hilton- Union Sq 25

Service Operations Management

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Mirko Kremer, Professor, Penn State University, 460 Business Building, University Park, PA, United States of America, muk22@smeal.psu.edu

Co-Chair: Masha Shunko, Purdue University, 403 W. State Street, West Lafayette, IN, 47906, United States of America, mshunko@purdue.edu

1 - Impact of Observational Learning in a Congested Multi-Server Environment

Chen Jin, Northwestern University, Apt. 29 No. 2544 Prairie Ave., Evanston, IL, 60201, United States of America, chenjin2011@u.northwestern.edu, Laurens Debo, Mirko Kremer, Seyed Iravani

We study customers'queue selection behavior and its impact in a congested multi-server system with quality variation among servers and information asymmetry among customers who make decision based on the queue allocation across all servers observed upon arrival and their own private information (possessed by informed customers only). We show due to the presence of informed customer, the average welfare of uninformed can be worse off in some cases and we also found evidence in the experiment.

2 - Strategic Capacity Management When Customers Have Boundedly Rational Expectations

Tingliang Huang, Assistant Professor, UCL, Department of MS&I, Gower Street, London, WC1E 6BT, United Kingdom, t.huang@ucl.ac.uk, Qian Liu

The existing capacity rationing literature typically assumes that customers are able to form rational expectations about a firm's fill rate. In contrast, in this paper we ask: would strategic capacity rationing be optimal when customers have boundedly rational expectations?

3 - How do Delay Announcements Impact Customer Behavior: Experimental Study

Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Achal Bassamboo, Mirko Kremer

Delay announcements are prevalent in service systems. This paper is among the first experimental work studying how customers react to explicit and realtime waiting time information on anticipated delays. In particular, we are interested in studying how such announcements impact customers' beliefs about the anticipated waiting times.

4 - Experimental Study on State-dependent Productivity of Non-discretionary Tasks

Hao Zhang, Tsinghua University, Shunde Building 519A, Beijing, 100084, China, statistics.zhang@gmail.com, Xiaobo Zhao, Qi-Ming He

We conduct a 2 x 2 crossover laboratory experiment to investigate the impact of queue-length on performance at individual level. It shows that under the setting of non-discretionary task, different treatments of queue-length lead to the same average service time. However, queue-length influences participants' dynamic service times: a jump effect occurs when queue-length changes from zero to a positive value.

■ SC46

Hilton- Lombard

Joint Session OPT/ENRE: Mixed-integer Robust Optimization Models and Applications in Electric Power Systems

Sponsor: Optimization/Integer and Discrete Optimization & Energy Natural Resources and the Environment

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

1 - Multistage Adaptive Mixed-Integer Optimization

Angelos Georghiou, Research Associate, ETH Zurich, Physikstrasse 3, ETL K 12, Zurich, CH-8092, Switzerland, angelosg@control.ee.ethz.ch, Dimitris Bertsimas, John Lygeros

In recent years, decision rules have been established as the preferred solution method for addressing the computationally demanding, multistage adaptive optimization problems. Despite their success, existing decision rules (a) are typically constrained by their a priori design and (b) do not incorporate in their modelling adaptive binary decisions. In this talk, we present a methodology for the near optimal design of continuous and binary decision rules using mixed-integer optimization.

2 - Dynamic Uncertainty Sets for Robust Unit Commitment and Economic Dispatch

Alvaro Lorca, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, alvarolorca@gatech.edu, Andy Sun

Power systems with a large penetration of renewable energy sources require innovative methods for dealing with the high uncertainty in their supply of electricity. In this talk we present adaptive robust optimization models for robust unit commitment and economic dispatch, using the concept of dynamic uncertainty sets for capturing the temporal and spatial correlations of uncertain parameters. We also discuss solution methods and present computational experiments.

3 - Adaptive Robust Optimization for Generation Maintenance via Sensor Based Condition Monitoring

Murat Yildirim, Geogia Tech, Atlanta, GA, United States of America murat@gatech.edu, Nagi Gabraeel, Andy Sun

We provide an adaptive robust optimization model to determine the optimal generation maintenance scheduling by leveraging sensor health monitoring data and considering network constrained unit commitment decisions. We develop solution algorithms and conduct computational experiments that demonstrate the advantages of our proposal over traditional approaches that use periodic and reliability based maintenance models.

4 - A Cutting Plane Method for Robust Mixed Integer Programming

Anna Danandeh, University of South Florida, 4202 E Fowler Ave, Tampa, Fl, United States of America, annadanandeh@mail.usf.edu, Bo Zeng

Robust optimization is one of the reliable methods to hedge against the uncertainty. However, solving this problem is computationally challenging. In this work, we intend to describe a polynomially solvable algorithm that strengthens cover inequalities via a robust lifting function and derives strong cuts valid for the convex hull of the robust knapsack set.

■ SC47

Hilton- Mason A

Computational Stochastic Dynamic Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Xi Chen, New York University, New York University, New York, United States of America, xichen1987@gmail.com

1 - Linear Coupling of Gradient and Mirror Descent: A Novel, Simple Interpretation of Nesterov's Accelerated Methodand Mirror Descent

Zeyuan Allen-Zhu, Massachusetts Institute of Technology, CSAIL, Cambridge, MA, United States of America, zeyuan@csail.mit.edu, Lorenzo Orecchia

Almost all first-order methods rely on two standard algorithmic steps: gradient-descent and mirror-descent steps. We observe that the convergence of the two steps are complimentary, and obtain a simple reinterpretation of Nesterov's accelerated gradient method by expressing it as a linear coupling of the two. This complementary view lets us design new first-order (deterministic and stochastic) methods in a conceptually easier way, and facilitates two recent breakthroughs in approximately solving packing and covering LPs in nearly-linear time. These breakthroughs heavily relies on the linear couplings of (full or stochastic) gradient and mirror descent steps.

2 - Stochastic Mixed Integer Programming with Log-exponential Convex Risk Measures

Pavlo Krokhmal, Associate Professor, University of Iowa, 3131 Seamans Center, Iowa City, IA, 52242, United States of America, krokhmal@engineering.uiowa.edu, Alexander Vinel

We consider stochastic nonlinear mixed integer programming problems that involve log-exponential convex risk measures. Two solution approaches are discussed, which include a branch-and-bound method that relies on polyhedral approximations of nonlinear log-exponential constraints, and a branch-and-cut that employs nonlinear lifted cuts. Numerical experiments on portfolio optimization problems are presented.

3 - Tradeoff between Storage and Transport in Merchant Energy Trading on a Network

Selvaprabu Nadarajah, Assistant Professor, University of Illinois at Chicago, Liautaud Graduate School of Business, selvan@uic.edu, Nicola Secomandi

Merchant energy trading across wholesale markets and time can be represented as a network where storage and transport assets compete for capacity. We model this competition as a Markov decision problem and leverage structural analysis to develop an ADP policy. We find that the tradeoff between storage and transport is difficult to manage, as sequential storage and transport trading is considerably suboptimal. Our ADP policy is instead near optimal and more efficient than a practice-based method.

4 - The Knowledge Gradient Policy using a Sparse Additive Belief Model

Yan Li, Princeton University, Sherrerd Hall, Charlton St., Princeton, NJ, 08544, United States of America, yanli@princeton.edu, Han Liu, Warren Powell

We propose a sequential learning policy for ranking and selection problems with high dimensional sparse belief functions. We derive a knowledge gradient policy for sparse linear model with group Lasso penalty and generalize it to the nonparametric additive model and functional ANOVA model. Theoretically, we provide the estimation error bounds. Empirical experiments show that the algorithm efficiently learns the correct sparsity structure and outperforms the knowledge gradient for a linear model.

■ SC48

Hilton- Mason B

Stochastic Integer Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Kibaek Kim, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL, 60439, United States of America, kibaekkim@mcs.anl.gov

1 - Cut Generation in Optimization Problems with Multivariate Risk Constraints

Simge Kucukyavuz, Associate Professor, The Ohio State University, 210 Baker Systems Building 1971 Neil Ave, Columbus, OH, 43210, United States of America, kucukyavuz.2@osu.edu, Nilay Noyan, Xiao Liu

We give alternative mixed-integer programming formulations and algorithms for cut generation problems arising in optimization under multivariate risk constraints. We give the complete linear description of a non-convex substructure common in these cut generation problems. We present computational results that show the effectiveness of our proposed models and methods.

2 - Polyhedral Study of Chance Constrained Program – Implications of Bilinear Representation

Bo Zeng, Assistant Professor, University of South Florida, 4202 E Fowler Ave, Tampa, FL, 33620, United States of America, Bzeng@usf.edu, Kai Huang, Ming Zhao

Based on the non-popular bilinear formulation, we derive strong formulations and polyhedral results for chance constrained program. Our work includes a convex hull description of a subset, a set of cutting planes and separation algorithms. Our results lead to a great computational improvement.

3 - A Computational Comparison of Algorithms for Solving Two-stage Stochastic Mixed-integer Programs

Yunwei Qi, Ohio State University, 766 Saratoga Ave, San Jose, CA, 95129, United States of America, qi.47@osu.edu

This presentation focuses on solving two-stage stochastic programs with general mixed integer decision variables in both stages. We compare different decomposition algorithms in which the first stage approximation is solved using a branch-and-bound tree with ancestral Benders' cuts and the second stage convexification uses branch and bound tree with multi-term disjunctive cuts or Gomory cuts to obtain approximations of the second stage mixed-integer programs.

4 - Two-stage Stochastic Programs with Mixed Binary Recourse Function

Kuo-Ling Huang, Northwestern University, 2145 Sheridan Rd, Evanston, IL, United States of America, jupiters1117@northwestern.edu, Kibaek Kim, Sanjay Mehrotra

We study two-stage stochastic programs with mixed binary recourse function. We present a Benders decomposition method with lift-and-project cuts in the second stage. A practical algorithm based on this method is implemented in a software package named iOptimize. Computational results are also given in this talk.

■ SC49

Hilton- Powell A

Connectivity and Cluster Detection in Networks

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Austin Buchanan, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, buchanan@tamu.edu

1 - Detecting Sybil Nodes in Social Networks: A Fractional Programming Approach

Chrysafis Vogiatzis, University of Florida, chvogiat@ufl.edu

As online social networks become bigger and more widespread, they also become more prone to Sybil attacks. In its most basic form, a perpetrator creates multiple identities and tries to form bonds with honest users in order to disperse information, affect elections, and intercept messages. We formulate the problem as a ratio problem, and derive its complexity. We conclude by proposing different approaches to tackling the problem, and showing some preliminary computational results.

2 - Uncovering the Effect of Dominant Attributes on Community Topology in Facebook Networks

Soundar Kumara, Allen E. Pearce/Allen M. Pearce Professor, The Pennsylvania State University, 222 Leonhard Building, Industrial Engineering, University Park, PA, 16802, United States of America, skumara@psu.edu, YI-SHAN SUNG

Community structure does not only point to structural patterns but also reflects functional associations. Since one node may contain multiple attributes, it is difficult to identify the dominant attributes, having definitive effects on community formation. We obtain communities using a clustering game and elaborate the process to identify the dominant attributes. We test our method on 100 Facebook networks to enable an integrating observation on how the offline lives infer online consequences.

3 - Finding a Maximum k-club using the k-clique Formulation and Lazy Cuts

Esmaeel Moradi, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078-5018, esmaeel@ostatemail.okstate.edu, Baski Balasundaram

A subgraph of diameter at most k is called a k-club, which includes clique as a special case when k equals 1 and is a relaxation when k is larger than 1. It can be used to model low-diameter clusters in graph based data mining applications and social network analysis. In this talk, we present a branch-and-cut algorithm for the maximum k-club problem using the k-clique formulation as a linear programming relaxation. In this algorithm, the constraints are applied in a lazy fashion.

4 - On Imposing Connectivity Constraints

Austin Buchanan, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, buchanan@tamu.edu, Yiming Wang, Sergiy Butenko

In many clustering and network design applications, one wants to impose connectivity constraints. To this end, we study the connected subgraph polytope—the convex hull of subsets of vertices that induce a connected subgraph. Extra emphasis is placed on special cases where the maximum weight connected subgraph problem is polytime solvable and admits a compact extended formulation.

■ SC50

Hilton- Powell B

Network Analysis

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Bahar Cavdar, PhD Candidate, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, baharca@gatech.edu

1 - A CIP Approach for the Computation Time-Limited Vehicle Loading and Routing Problem

Bahar Cavdar, PhD Candidate, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, baharca@gatech.edu, Joel Sokol

In large instances of vehicle loading and routing problems where cutoff times limit the time available for computing solutions, good heuristic methods are unable to run until completion. We demonstrate a computation-implementation parallelization (CIP) approach that generates improved solutions and allows companies to trade off the benefit across three dimensions: shorter routes, later cutoff times, and earlier dispatch times.

2 - Arc Routing to Restore Post-Disaster Road Network Connectivity

Sibel Salman, Associate Professor, Koc University, Rumelifeneri Yolu, Sariyer, Istanbul, Turkey, ssalman@ku.edu.tr, Vahid Akbari

We find coordinated routes for road clearing teams to repair damaged roads and restore the network connectivity in shortest time after a disaster. The multi-vehicle problem combines arc routing, network design and scheduling aspects. We propose an effective constructive heuristic algorithm that processes a relaxed mixed integer programming solution.

3 - Supply Chain Network and Firm Returns

Jing Wu, PhD Student, University of Chicago Booth School of Business, 5050 S Lake Shore Dr 3417S, Chicago, IL, 60615, United States of America, wujing@chicagobooth.edu, John Birge

This paper investigates the effects of supply chain connections on firm performance, as reflected in stock returns, at two interaction levels, first-order from directions and second-order from systemic exposures through the network.

4 - Supply Chain Network and Systematic Risk

Jing Wu, PhD Student, University of Chicago Booth School of Business, 5050 S Lake Shore Dr 3417S, Chicago, IL, 60615, United States of America, wujing@chicagobooth.edu, John Birge

We study the systematic risk at different positions of the supply chain network, and find that under the goal of profit maximization, both manufacturing firms and logistics firms have incentive to increase the number of connections to the upstream firms which results in lower risk for the manufacturing firms but higher risk for the logistics firms.

■ SC51

Hilton- Sutter A

Methods in Nonlinear Optimization

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Katya Scheinberg, Lehigh University, 200 West Packer Ave,, Bethelehem, PA, 18015, United States of America, katyas@lehigh.edu

1 - Alternating Linearization Methods for Quadratic Least-Square Problem

Xi Bai, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, xib210@lehigh.edu, Katya Scheinberg

Second-order least square problems have arisen widely in binary optimization, portfolio optimization, etc.. In this talk, we propose an alternating linearization framework to solve this set of problems which are potentially nonconvex. We show the effectiveness of our technique in terms of both theory and numerical experiments in the application of risk parity optimization in portfolio management.

2 - using Probabilistic Regression Models in Stochastic Derivative Free Optimization

Ruobing Chen, Ph.D. Candidate, Lehigh University, 200 West Packer Ave., Bethlehem, PA, 18015, United States of America, ruc310@lehigh.edu, Katya Scheinberg

We consider the use of probabilistic regression models in a classical trust region framework for optimization of a deterministic function, only having access to noise-corrupted function values. Contrasting to traditional requirements on the poisedness of sample sets, our models are constructed using random samples while providing sufficient quality of approximation with high probability. We discuss convergence proofs of proposed algorithm based on error bounds from machine learning literature.

3 - Convergence Rates of Line-Search and Trust Region Methods Based on Probabilistic Models

Katya Scheinberg, Lehigh University, 200 West Packer Ave,, Bethelehem, PA, 18015, United States of America, katyas@lehigh.edu, Coralia Cartis

We examine traditional unconstrained optimization methods such as line search and adaptive regularization methods with cubics and extend them to the case where the first or second order models are random and have random "quality". Under assumptions that the "quality" is sufficiently good with probability >1/2 we derive expected convergence rates for these methods for nonconvex, convex and strongly convex cases. We give a general unified framework and its analysis based on random processes.

■ SC52

Hilton- Sutter B

Optimization, Variational Inequality Problems, and Games: Uncertainty, Imperfect Information, and Distributed Computation

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Uday Shanbhag, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16803, United States of America, udaybag@engr.psu.edu

1 - Empirical Centroid Fictitious Play: Strong Convergence in a Distributed-Information Setting

Brian Swenson, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, United States of America, brianswe@andrew.cmu.edu, Soummya Kar, Jo„o Xavier

Empirical Centroid Fictitious Play (ECFP) is an adaptation of the well-known Fictitious Play (FP) algorithm that is well-suited to implementation in large games. However, a shortcoming of ECFP (and FP) is that learning occurs only in the weak sense of convergence in empirical beliefs —- players' period-by-period strategies do not necessarily converge to equilibrium. The paper presents a distributed-information implementation of ECFP that converges in the latter stronger sense.

2 - Variational Inequality Problems: Addressing Uncertainty and Imperfections in Information

Uma Ravat, University of Illinois at Urbana-Champaign, 1832 Orchard Place #c, Urbana, United States of America, ravat1@illinois.edu, Uday Shanbhag

We consider the solution of variational inequality problems complicated by uncertainty and imperfect information. We examine the role of learning and how it may be combined with solution techniques. Preliminary algorithmic and numerical results will be provided.

3 - On the Resolution of Misspecified Convex Optimization Problems

Hesamoddin Ahmadi, Student, Penn State University, 107 Holderman Hall, University Park, PA, 16802, United States of America, hza108@psu.edu

We consider a misspecified optimization problem that requires minimizing of a convex function f (x;q*) in x over set X where q* is an unknown vector but can be learnt by a distinct learning problem. We develop joint first-order schemes for computation and learning and provide rate statements.

■ SC53

Hilton- Taylor A

Data Driven Computational Finance

Cluster: Optimization in Finance

Invited Session

Chair: Gerry Tsoukalas, Wharton, Walnut Street, Philadelphia, PA, United States of America, gtsouk@wharton.upenn.edu

1 - Data Driven Portfolio Optimization

Victor DeMiguel, London Business School, London, England, United Kingdom, avmiguel@london.edu

To compute efficient mean-variance portfolios, an investor needs to estimate the mean and the covariance matrix of asset returns, but due to estimation error the resulting portfolios typically perform poorly out of sample. In this talk, we discuss several approaches proposed in the recent literature to overcome these difficulties, including robust optimization and estimation, shrinkage estimation, Bayesian estimation, and norm constraints.

2 - Money Management with Performance Fees

Daniel Mitchell, Assistant Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, Singapore, dan.mitchell@utexas.edu, Kumar Muthuraman, Sheridan Titman

Hedge fund contracts are generally characterized by a flat fee, a performance fee and what are know as high-water-mark provisions. This paper describes and characterizes these contract features and analyzes how they influence the hedge fund's risk choices. We model the hedge fund's portfolio choice as a stochastic control problem with hybrid discrete and continuous controls. We develop a computational method to solve this class of problems and prove its convergence.

3 - A Multiclass Queueing Model of Limit Order Book Dynamics

Hua Zheng, Columbia Business School, 3022 Broadway, Uris 4S, New York, NY, 10027, United States of America, hzheng14@gsb.columbia.edu, Costis Maglaras, Ciamac Moallemi

We formulate and solve a problem of limit and market order placement in a limit order book to optimally buy a block of shares over a short, predetermined time horizon. We use the structure of the optimal execution policy to propose a microstructure model of market impact, which we estimate using trade data and highlight its increased accuracy over "macro" market impact models.

■ SC54

Hilton- Taylor B

Financial Risks

Sponsor: Financial Services Section

Sponsored Session

Chair: Justin Sirignano, Stanford University, 3 Gibbs Court, Irvine, CA, 92617, United States of America, jasirign@stanford.edu

1 - Efficient Risk Analysis for Mortgage Pools and MBS

Justin Sirignano, Stanford University, 3 Gibbs Court, Irvine, CA, 92617, United States of America, jasirign@stanford.edu, Kay Giesecke

Typical mortgage pools of interest are very large and computationally expensive to simulate. We develop a dynamic law of large numbers and dynamic central limit theorem in order to tractably calculate pool loss and prepayment distributions for a broad class of models. Computational cost is often several orders of magnitude less than simulation of the actual pool with a similar level of accuracy.

2 - Robust Rare Event Analysis and Computations

Jose Blanchet, Associate Professor, Columbia University, Rm. 323, School of Engineering, 500 West 120th Street, New York, NY, 10027, United States of America, jose.blanchet@columbia.edu

We discuss a systematic approach which allows to broaden the applicability of optimal rare-event simulation algorithms which are often designed under somewhat restrictive assumptions. We discuss several examples, one of them is the problem of performing risk analysis of Gumbel copula models, exploiting strongly efficient algorithms for t-copula models.

3 - Dynamic Credit Swap Selection under Funding Costs

Agostino Capponi, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, 21218, United States of America, acappon1@jhu.edu

We develop a dynamic optimization framework to assess the impact of funding costs on credit swap investments. A default risky investor can purchase CDS upfronts, borrow at a rate depending on her credit quality, and invest in risk-free money market account. Contagion effects make the optimal strategy coupled with the value function. We show that the latter can be recovered as the solution of a nonlinear HJB equation whose coefficients admit singular growth.

■ SC55

Hilton- Van Ness

Global Optimization: Algorithms and Applications

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Veronica Piccialli, University of Rome Tor Vergata, via del Politecnico 1, Rome, Italy, piccialli@disp.uniroma2.it

1 - Embedding SpeeDP Algorithm within a Branch & Cut Method for Solving the Large Max Cut Instances

Laura Palagi, Associate Professor, Sapienza University of Rome, Via Ariosto 25, Roma, 00185, Italy, palagi@dis.uniroma1.it, Maryam Salami, Veronica Piccialli, Giovanni Rinaldi

We design an algorithm that provides solutions to Max-Cut along with a guaranteed optimality error. We consider embedding algorithm SpeeDP, a fast method for the solution of low-rank semidefinite programming relaxations of unconstrained {-1,1} quadratic problems, into a Brach&Cut method which uses a Lagrangian relaxation of the additional cut constraints. We run it on very large graphs to verify the effectiveness of SpeeDP with respect to standard SDP solver.

2 - A Feature Ranking Method for Nonlinear Regression

Veronica Piccialli, University of Rome Tor Vergata, via del Politecnico 1, Rome, Italy, piccialli@disp.uniroma2.it, Luca Bravi, Marco Sciandrone

Feature selection (FS) allows to identificate relevant features on big amount of data. By exploiting the concept of inversion of a neural network, we reformulate the FS problem as a global optimization problem involving smooth concave approximations of the zero-norm. The effectiveness of the proposed strategy is proved by an extensive experimentation on synthetic data and real world problems.

3 - Exploiting Nonlinear Structure in Global Optimization

Sven Leyffer, Dr., Argonne National Laboratory, 9700 South Cass Ave, Argonne, United States of America, leyffer@mcs.anl.gov

We present a new approach to generate tight and tractable convex relaxations of nonconvex functions based on exploiting group-partial separability. We demonstrate this approach in the context of two classes of powerful relaxation techniques: semi-definite relaxations and the reformulation-linearization technique. In both cases, we derive tight relaxations that can be solved orders of magnitude faster than traditional techniques that do not exploit the nonlinear structure.

■ SC56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Building AMPL Models into Your Applications

Robert Fourer, President, AMPL Optimization Inc, 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com, Victor Zverovich

AMPL is well known for making optimization models easy to develop and to debug, but you don't have to give up these advantages when embedding your model into a larger system and deploying it to users. We present and contrast two facilities for building models into your applications: AMPL scripting, which provides powerful programming constructs within the modeling language; and the new AMPL API, which permits access to AMPL objects and methods from popular general-purpose programming languages.

■ SC64

Parc- Cyril Magnin I

Data-driven Decisions in Healthcare

Sponsor: Applied Probability Society

Sponsored Session

Chair: Mohsen Bayati, Stanford Graduate School of Business, Stanford, CA, 94305, United States of America, bayati@gsb.stanford.edu

1 - using Uncertain Markov Chains to Assess Cost-effectiveness of Medical Innovations

Joel Goh, joelgoh@stanford.edu, Sundeep Singh, David Moore, Stefanos Zenios, Mohsen Bayati

A common problem with using Markov chains in medical cost-effectiveness studies is that estimates of the transition matrix of the chain may be imprecise. We present an optimization-based approach for assessing the effect of this imprecision and apply it to studying the cost-effectiveness of fecal immunochemical testing (FIT) as a screening modality for colorectal cancer. We show that despite the larger uncertainty, FIT is highly cost-effective relative to colonoscopy.

2 - The Big Data Newsvendor

Cynthia Rudin, MIT Sloan School of Management, 100 Main Street, Cambridge, MA, 02139, United States of America, rudin@mit.edu, Gah-Yi Vahn

We investigate the newsvendor problem when one has n observations of p features related to the demand as well as past demands. Both small (sparse) data (p/n = o(1)) and big data (p/n = O(1)) are considered. We solve the problem as a high dimensional nonparametric quantile regression problem and provide theoretical guarantees on predictive performance.

3 - Improving the Prediction of Emergency Department Waiting Times

Erjie Ang, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, erjieang@stanford.edu, Michael Aratow, Sarah Kwasnick, Mohsen Bayati, Erica Plambeck

Using data from San Mateo Medical Center, we develop an easy method to predict waiting time at the ED accurately. We further explore how to present wait time information to potential patients. Combining behavioral experiments, econometric and machine-learning methods, we develop a new objective function to determine the best wait time message to present to patients. We compare the performance of our objective to those generated by traditional accuracy based objective functions.

4 - Improving Hospital Queueing with Future Information

Kuang Xu, MIT, 77 Massachusetts Ave., Cambridge, United States of America, kuangxu@mit.edu, Carri Chan

With an increase in availability of patient data, new predictive models are being developed. This begs the questions: How can forecasts and predictions of the future be used to improve the efficiency and effectiveness of healthcare delivery? We examine a class of queueing models and admissions control problems in emergency departments. We show, both analytically and via simulations, that system efficiency can be substantially improved by the access to (limited) future information.

■ SC65

Parc- Cyril Magnin II

Case Competitions I

Sponsor: INFORM-ED

Sponsored Session

Chair: Palaniappa Krishnan, University of Delaware, Newark, DE, United States of America, baba@udel.edu

1 - Case Competition

Palaniappa Krishnan, University of Delaware, Newark, DE , United States of America, baba@udel.edu

INFORMed's Annual Cased Competition is an opportunity fir INFORMS Members to showcase their efforts in the classroom. Cases are often later published.

2 - Idiopathic Pulmonary Fibrosis Case

David Kopcso, Professor of Mathematics and Information Technology, Babson College, 1 College Drive, Wellesley, MA, United States of America, kopcso@babson.edu, Howard Simon, Annie Gao

InterMune Inc. is a developer of pharmaceutical products for the treatment of idiopathic pulmonary fibrosis (IPF), a lung disease. Pirfenidone, a non-steroid hormone, was a product at which InterMune had been looking closely as a promising new drug for IPF treatment. Marnac, Inc. held the rights to pirfenidone in the US while KDL GmbH held the European rights. InterMune needs to decide if it should license pirfenidone. The decisions can be viewed from Marnac's perspective which supplies an introduction to a simple two-alternative decision analysis. An expanded view of the decision process that needs to be followed for FDA approval offers potential hedging insights, such as offering a license to InterMune. Lastly, InterMune may or may not be interested in adopting the FDA approval risk by accepting the license offer from Marnac and KDL GmbH.

3 - Developing a Business Model to Improve Energy Sustainability of Existing Buildings

Baris Tan, Professor of Operations Management, Koç University, Rumelifeneri Yolu Sariyer, Istanbul, 34450, Turkey, btan@ku.edu.tr, Yahya Yavuz, Emre N. Otay, Emre Camlibel

The case study introduces the business model of Energy Saving Companies (ESCO) by using the setting of improving energy efficiency of existing buildings at a university campus. Identifying and investing in the right energy saving technologies within a given budget help the adoption of energy efficiency measures in existing buildings. A mathematical programming approach can be used to select the right energy efficiency measures among all the available ones to optimize financial or environmental benefits subject to budgetary and other logical constraints in single- and multi-period settings. In order to implement this approach, one should determine all the relevant energy efficiency measures for the campus and their expected cost, energy, and environmental benefits together with their investment costs. The case reports how these measures are identified by using engineering measurements and modeling, how a mathematical model is developed and used to select the energy efficiency measures within a budget to optimize environmental and financial objectives, and how the solution is used to develop a business model to offer investments in energy.

4 - Storage Assignment in a Unit-load Warehouse

Yun Fong Lim, Associate Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, yflim@smu.edu.sg, Marcus Ang

This case describes a challenge faced by YCH Group, a leading third-party logistics provider in Singapore. In 2012, the company had started an ambitious plan to construct a US$159 million logistics hub. With 1.5 million square feet of warehouse space and a million square feet of office space, it would house YCH Group's headquarter, as well as research, training, and warehousing facilities. To keep pace with their fast expansion, it was crucial for YCH to increase their profitability. A key area to boost their profit was to improve the efficiency of the storage and retrieval operations of their unit-load warehouse. To achieve this, one approach was to use mathematical modeling (linear programming). The case requires students to make valid assumptions before they can formulate a linear programming model to find an efficient storage assignment policy for the warehouse. The case then directs the students to compare the performance of this policy with other heuristic policies using historical data. This case reinforces the students' skills in data processing, mathematical modeling, and numerical computation. After completing the case, the students will be able to: (1) Forecast mean demands with the data. (2) Build an appropriate linear programming model for the storage assignment problem, and evaluate the model's solutions using the data. (3) Perform sensitivity analysis on the parameters. This case can be used in undergraduate and graduate classes to illustrate the effectiveness of different policies for storage assignment in a unit-load warehouse.

5 - VASTA Wireless – Push vs. Pull Distribution Strategies
Yao Zhao, Associate Professor, Rutgers University, 1 Washington Street, Newark, NJ, 07102, United States of America, yaozhao@andromeda.rutgers.edu

VASTA is one of the largest wireless services (voice and data) carriers in the United States, and is well known for its reliable national network and superior customer service. In the fiscal year of 2009-2010, VASTA suffered a significant inventory write-off due to the obsolescence of handsets. VASTA was carrying a huge amount of inventory (~$2 Billion) in its national distribution system with a majority held at 2000+ stores to satisfy consumer demand at stores. To address this challenge, the company is thinking to change the current "push" inventory strategy which pushes inventory to stores towards a "pull" strategy that pulls the inventory of handsets from stores to three distribution centers (DCs), and uses the stores only as showrooms. Customers visiting stores will have their favorite phones delivered to their homes overnight from the DCs free of charge. Although the pull strategy has been used in the furniture industry and consumer electronics (for instance, by Apple), it was never attempted by VASTA and other US wireless carriers by 2010.

6 - Advertising Analytics
U.K. Bhattacharya, Indian Institute of Management Indore, Rau, Pigdamber, Indore 453556, India, utpalb@iimidr.ac.in

The case "Advertising Analytics" introduces various key issues to connect large set of data in order to take appropriate advertising decisions. The motivation of the case is to decide the number of advertisements in various newspapers and optimal allocation of budget to the different media in order to maximize the reach to the target customers . Here the advertising media has been considered as various newspapers. Based on the popularity and number of circulation five important newspapers have been chosen for advertising purpose. The case setting is typical for dealing with both single criterion and multi-criteria decision making situations. Main focus of this case is to carry advertiser's messages to the target market in order to improve the quality and conversion ratio of the intake.

■ SC66

Parc- Cyril Magnin III

Data Fusion in Manufacturing and Biomedical Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall,, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

Co-Chair: Kamran Paynabar, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, 30327, United States of America, kamran.paynabar@isye.gatech.edu

1 - Statistical Metamodeling and Computer Experiments of Large-scale Cardiac Models
Dongping Du, University of South Florida, 4202 E Fowler Ave, ENG302, Tampa, FL. United States of America, dongpingdu@mail.usf.edu, Hui Yang

Cardiac voltage-gated sodium (Nav) channel plays significant roles in cardiac electrical signaling. Model of Nav channels involves greater levels of complexity. Traditional optimization methods have encountered many difficulties, even infeasible, for model calibration. We developed a new statistical metamodeling approach for computer experiments and optimization of Nav channels. The approach achieves superior performance for modeling the glycosylated and controlled kinetics of Nav channels.

2 - Classification of Additive Manufacturing (AM) Part Quality using Graph Laplacian Topology Modeling
Zhenyu Kong, Associate Professor, Virginia Tech, 1145 Perry Street, Blacksburg, VA, 24061, United States of America, zkong@vt.edu, Prahalad Rao

We present a graph Laplacian connectivity-based approach that can classify AM part quality in terms of dimensional integrity and surface roughness. Using empirical data we show that graph Laplacian topological invariants can unambiguously detect part quality deviations. Because the presented approach uses point cloud and image information obtained from non-contact scanners, it can significantly enhance the status quo of metrology in AM.

3 - Bayesian D-Optimal Design of Experiments with Quantitative and Qualitative Responses
Lulu Kang, Assistant Professor, Illinois Institute of Technology, 10 W 32nd Street, E1-208, Chicago, IL, 60616, United States of America, lkang2@iit.edu, Ran Jin, Xinwei Deng

Systems with quantitative and qualitative (QQ) responses are widely encountered in many applications. Experiments are conducted to study such systems. Classic experimental design methods are not suitable for such experiments. A Bayesian D-optimal design method is developed for quantitative and binary qualitative responses. Both noninformative and informative conjugate prior distributions are considered. Iterative point-exchange search algorithm is developed.

4 - An Efficient Emulator for Multivariate Gaussian Processes using a Pairwise Fitting Approach
Qiang Zhou, Assistant Professor, City University of Hong Kong, Kowloon, Hong Kong - PRC, q.zhou@cityu.edu.hk, Yongxiang Li

Multivariate Gaussian process may be used for modeling multiple response systems for information sharing, yet the computation can be prohibitive when there is a large number of response levels. In this work, we propose a computationally efficient multivariate GP model which permits a pairwise fitting scheme with great scalability.

■ SC67

Parc- Balboa

System Informatics and Control: Learning from Complex Data

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Arash Pourhabib, Assistant Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, arash.pourhabib@okstate.edu

1 - Weak Hierarchical Lasso: Efficient Algorithms and Applications
Jieping Ye, Associate Professor, Arizona State University, Tempe, AZ, 85287, United States of America, jieping.ye@asu.edu

We consider weak hierarchical Lasso, a sparse interaction regression model, which produces sparse and hierarchical structured estimator by exploiting the Lasso penalty and a set of hierarchical constraints. We show how to efficiently solve the challenging non-convex weak hierarchical Lasso formulation based on a key observation that the associated proximal operator admits a closed form solution. Finally, we present numerical experiments to demonstrate the efficacy of the proposed algorithm.

2 - Learning for Wireless Systems with Orientation-Aware Devices and Structured Antenna Patterns
Jean-Francois Chamberland, Associate Professor, Texas A&M University, 3128 TAMU, ECE Department, College Station, TX, 77843, United States of America, chmbrlnd@tamu.edu, Gregory Huff

Wireless communication systems employ link adaptation and scheduling to exploit the diversity afforded by fading channels in multi-user environments. The emergence of reconfigurable antenna systems, together with the wide availability of orientation information in smartphones, offers new ways to improve performance. The power of these new modalities can be harnessed through a machine-learning framework, which seeks to exploit past observations in predicting suitable modes of operation.

3 - Extracting Sparse Patterns from High-dimensional Data using Gaussian Mixture Models
Yang Zhao, Ph.D. Student, City University of Hong Kong, 83 Tat Chee Ave, Kowloon, Hong Kong - PRC, yangzhao9-c@my.cityu.edu.hk, Kwok Leung Tsui, Abhishek Shrivastava

Gaussian mixture model (GMM) is widely used for learning the latent structure in data. Though effective in many applications, GMMs show poor performance in high-dimensional setting. We propose regularized parameter estimation for learning the GMM. The regularization ensures a positive definite inverse covariance matrix and captures important correlation information between features. We demonstrate the performance of the estimate through various datasets.

4 - Embedded Synthetic Data Generation for Imbalanced Two-class Classification
Arash Pourhabib, Assistant Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, arash.pourhabib@okstate.edu, Yu Ding

We propose an algorithm for two-class classification problems when the number of training instances in one of the classes is so low that the conventional classification algorithms become ineffective in detecting the minority class. We present a modification of the kernel Fisher discriminant analysis in which synthetic data points are generated iteratively. The novelty of the proposed method is that synthetic data generation is embedded in the algorithm.

■ SC68

Parc- Davidson

Simulation Optimization and Sequential Sampling Rules

Sponsor: Simulation

Sponsored Session

Chair: Peter Frazier, Assistant Professor, Cornell University, 232 Rhodes Hall, Ithaca, NY, 14853, United States of America, pf98@cornell.edu

1 - New Methods for Choosing Parameters for Sampling Rules

Dashi Singham, Naval Postgraduate School, Mail Code: OR, Operations Research Dept, Monterey, United States of America, dsingham@nps.edu, Michael Atkinson

Sampling rules for simulation experiments depend on a number of parameters: desired precision and confidence in the output, underlying variance of data, and constraints on the number of samples. We analyze the relationships between these parameters by using a new measure of reliability for cumulative mean behavior that extends the traditional notions of coverage.

2 - Parallelized Bisection Method: Effectively using Asynchronous Information

Stephen Pallone, Cornell University, 290 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, snp32@cornell.edu, Peter Frazier, Shane Henderson

We consider a one-dimensional bisection method for finding the zero of a monotonic function, where the function can be evaluated asynchronously in a parallel computing environment. Using dynamic programming, we characterize the Bayes-optimal policy for sequentially choosing points at which to query the function. Our results provide insight on how evaluation times, risk preferences, and computational budget affect the trade-off between search space reduction and a desirable query distribution.

3 - Optimal Sampling Laws for Multi-objective Simulation Optimization on Finite Sets

Susan Hunter, Assistant Professor, Purdue University, School of Industrial Engineering, West Lafayette, IN, 47907, United States of America, susanhunter@purdue.edu, Guy Feldman, Raghu Pasupathy

Consider the context of selecting Pareto-optimal systems from a finite set of systems based on multiple stochastic objectives. We seek a characterization of the asymptotically optimal sample allocation that maximizes the rate of decay of the probability of misclassification, i.e., the probability a Pareto system is falsely estimated as non-Pareto, or a non-Pareto system is falsely estimated as Pareto. We discuss recent advances in solving this problem, including a solution for two objectives.

■ SC69

Parc- Fillmore

Land Use, Conservation and Sustainability

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Hayri Onal, Professor, University of Illinois, United States of America, h-onal@illinois.edu

1 - Designing a Dynamic Reserve Problem under Stochastic Uncertainties

Nahid Jafari, University of Georgia, Athens, GA, United States of America, nahid.jafari@uga.edu, Clinton Moore

Conservation agencies tasked with reserve design need a dynamic decision system that provides guidance for short-term decision opportunities while focusing on a long-term objective of assembling the best set of protected areas possible. We outline an approach that provides optimal actions that account for stochastic behaviors in future funding levels, land prices, and lands lost to conservation use, given land protection status, constraints, and objectives related to ecological value and cost.

2 - Landscape Sustainability and Optimum Management of Military Training Areas

Hayri Onal, Professor, University of Illinois, United States of America, h-onal@illinois.edu, Scott tweddale, Philip Woodford, James Westervelt

Training-induced land degradation, especially formation of gullies, reduces the ability of training lands to support the scheduled training activity in military installations and poses serious risk for the personnel and training equipment. We present a dynamic optimization/simulation model which determines the optimal timing, location and amount of land repairs for a given annual training schedule and budget constraints. Empirical results suggest that a preemptive repair schedule would be best.

3 - Optimal Harvest Schedules with Endogenous Road Maintenance Costs

Kai Ross, PhD. Student, University of Washington, Loew Hall 304, Seattle, WA, 98195, United States of America, mailkaiross@gmail.com, Weikko Jaross, Sandor Toth

Forest roads constitute the greatest financial and environmental cost to forestry. They degrade over time incurring extra costs and must be rebuilt to standard prior to timber haul. We propose an integer program that integrates road maintenance with harvest scheduling. The model captures both the road reconstruction costs that increase the longer a road is in disuse and the fixed cost savings that arise with the spatiotemporal coordination of harvests and road maintenance.

4 - An Optimisation Approach to Bushfire Fuel Management

Dmytro Matsypura, The University of Sydney, Sydney, Australia, dmytro.matsypura@sydney.edu.au, Oleg Prokopyev

Bushfires represent a real and continuing problem that has a major impact on people, wildlife and the environment. One way to reduce the severity of their effect is through fuel management. We propose a methodology to address the problem of optimal resource allocation for bushfire fuel management subject to landscape connectivity and stochastic fuel regeneration. In this work we draw inspiration from the literature on robust optimisation, network interdiction and critical element detection.

■ SC70

Parc- Hearst

Topics in Underground Mine Planning

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Alexandra M. Newman, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Moving Toward Holistic Mine Scheduling

Barry King, PhD Student, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, barking@mymail.mines.edu

Currently, open pit and underground mine production schedules are generated separately and then melded together a posteriori in a suboptimal fashion. We present a unified open pit and underground schedule that provides a holistic view of the entire deposit. Our primary focus is creating a generic underground mine formulation that pairs well with the standard open pit formulation.

2 - using an Open Pit Production Scheduling Algorithm on an Underground Mine Scheduling Model

Andrea Brickey, PhD Candidate, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, abrickey@mymail.mines.edu, Alexandra M. Newman

Open pit mine production scheduling has advanced since the 1960's, while its underground counterpart is still relegated primarily to manual scheduling methods. We present the application of an algorithm (Bienstock-Zuckerberg) that can be applied to precedence-constrained knapsack problems with the structure exhibited by open pit mine planning problems, to determine an underground production schedule with ventilation considerations, and compare the results with more traditional solution methods.

3 - Open Pit to Underground Transition Depth Determination through Production Scheduling Optimization

Kadri Dagdelen, Professor, Colorado School of Mines, Mining Engineering Department, 1600 Illinois Street, Golden, CO, 80401, United States of America, kdagdele@mines.edu, Ismail Traore

The transition depth from open pit to underground in a mining complex is a critical engineering problem with significant economic implications. This paper will present an iterative method based on mixed integer programing optimization of production scheduling of open pit and underground operations where net present value of production from combine operations are maximized at each iteration. The optimum depth is determined from a set of solutions corresponding the highest NPV.

4 - Underground Mine Access Design to Maximise the Net Present Value

Kashyapa Sirinanda, Graduate Student, University of Melbourne, Melbourne, Australia, kash.s@Student.unimelb.edu.au

We consider a modified Steiner tree problem in which the tree has construction costs associated with edges and values associated with nodes. The objective is to maximise the total discounted cash flows, or Net Present Value (NPV). An application of this problem occurs in underground mining. We propose an efficient iterative algorithm to optimally locate a single degree-3 Steiner point to maximise the NPV. This algorithm converges and the Steiner point is unique for realistic design parameters.

■ SC71

Parc - Lombard

Incentive Auctions

Cluster: Auctions

Invited Session

Chair: Robert Day, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, CT, United States of America, Bob.Day@business.uconn.edu

1 - The Use of Optimization in the Spectrum Incentive Auctions

Karla Hoffman, George Mason University, Fairfax, VA, United States of America, khoffman@gmu.edu, Rudy Sultana, Tony Coudert, Brian Smith

Optimization will be employed in a variety of ways in the upcoming FCC ncentive auction. It will used to determine the clearing target (i.e. the amount of spectrum to be acquired), to check whether a set of TV stations could be packed within a specific band of spectrum, to determine the final channel assignment for those TV broadcasters that remain on the air, and, possibly, to help set prices during the auction. A brief overview of the optimization problems will be presented.

2 - Feasibility Checking for Spectrum Reallocation

Kevin Leyton-Brown, Professor, University of British Columbia, 2366 Main Mall, Vancouver, BC, V6T1Z4, Canada, kevinlb@cs.ubc.ca, Alexandre Frechette

The FCC's upcoming incentive auction gives rise to a computational problem which is dubbed "feasibility checking": determining whether there exists a way of reassigning a given subset of television stations to different frequencies so that they can all broadcast in a reduced spectrum band without harmfully interfering with each other. This talk will describe recent efforts towards addressing this problem, and will emphasize both the methods used and the empirical performance achieved.

3 - Deferred-Acceptance Auctions and Radio Spectrum Reallocation

Paul Milgrom, Stanford University, 903 Cottrell Way, Stanford, CA, 94305, United States of America, pmilgrom@gmail.com, Ilya Segal

Deferred-acceptance auctions choose allocations by an iterative process of rejecting the least attractive bid. Any deferred acceptance auction with threshold pricing is weakly group strategy-proof, can be implemented using a clock auction, and leads to the same outcome as the complete-information Nash equilibrium of the corresponding paid-as-bid auction. A paid-as-bid auction with a non-bossy bid-selection rule is dominance solvable if and only if it is a deferred acceptance auction.

■ SC72

Parc- Stockton

Energy Storage for Grid Integration of Renewable Energy

Sponsor: Energy, Natural Resources & the Environment/ Energy

Sponsored Session

Chair: Audun Botterud, Energy Systems Engineer, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL, United States of America, abotterud@anl.gov

1 - Siting and Sizing of Distributed Battery Energy Storage

Hrvoje Pandzic, University of Zagreb Faculty of Electrical Engineering and Computing, Unska 3, Zagreb, Croatia, hrvoje.pandzic@ieee.org, Daniel Kirschen

A three-stage method to identify the optimal locations and capacities of distributed storage is proposed. In the first stage, the optimal storage locations are determined. In the second stage, storage units are installed at these locations and their optimal energy and power ratings are determined. In the final stage, the optimal operation of the storage is simulated to quantify the benefits that it would provide by reducing congestion.

2 - Grid Level Energy Storage for Integration of Renewable Energy

Audun Botterud, Energy Systems Engineer, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL, United States of America, abotterud@anl.gov, Prakash Thimmapuram, Emil Constantinescu, John Birge, Canan Uckun, Kevin Gallagher

We present initial results from a project where we are developing an analytical framework to evaluate the potential benefits of energy storage for grid integration of renewable energy. Numerical weather predictions are used to characterize the spatio-temporal characteristics of wind and solar resources. We formulate and solve operational decision problems for the grid system operator as well as for an energy storage owner, considering different storage technology solutions.

3 - Strategies for Mitigating the Reduction in Economic Value of Variable Generation at High Penetration

Andrew Mills, Staff Research Associate, Lawrence Berkeley National Laboratory, 1 Cyclotron Rd, MS90-R4000, Berkeley, CA, 94720, United States of America, admills@lbl.gov, Ryan Wiser

Previously, we quantified a decline in the marginal economic value of wind and PV with increasing penetration levels. We use the same model and data to evaluate options to stem the decline in value of these technologies. The largest increase in the value of wind comes from increased geographic diversity. The largest increase in the value of PV comes from assuming that low-cost bulk power storage is an investment option. Other attractive options include real-time pricing and technology diversity.

4 - Modeling Energy Storage as an Enabler of Ultra-low Carbon Power Systems

Jesse Jenkins, PhD Student, Engineering Systems Division / Research Assistant, MIT Energy Initiative, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room E40-369, Cambridge, MA, 02139-4307, United States of America, jessedj@mit.edu, Fernando de Sisternes

Reaching an ultra-low carbon electricity system will rely on an emissions free source of flexibility for power systems operations. Absent such a source, operational and economic constraints will limit the penetration of renewable electricity, nuclear power, or a combination thereof. We use a capacity expansion model with unit commitment constraints to explore the impact of storage on the optimal mix of low-carbon electricity sources in renewable, nuclear, or hybrid renewable-nuclear systems.

■ SC73

Parc- Mission I

Policy Analysis and Planning in Energy Sector

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Yihsu Chen, UC Merced, 5200 North Lake Road, Merced, CA, United States of America, ychen26@ucmerced.edu

1 - Cooperation in Regional Electricity Market Based on Tradable Green Certificate Offering

Yingjue Zhou, Oklahoma State University, Stillwater, OK, United States of America, yingjue.zhou@okstate.edu, Tieming Liu

We study the cooperation between green/black suppliers in regional electricity markets. The green supplier has random power shortage. To attract the black supplier to build response capacity and cover the shortage, the green supplier offers tradable green certificate to the black supplier. We find the cooperation model reaches the global optimum capacity. In a decentralized model without cooperation, the capacity investment is less than the global optimum.

2 - Selection of Climate Policies under Current Knowledge of Uncertainties

Massimo Tavoni, Fondazione Eni Enrico Mattei (FEEM), Corso Magenta 63, Milan, Lo, 20123, Italy, massimo.tavoni@feem.it, Valentina Bosetti, Laurent Drouet

In the present paper we use the best available knowledge to model the key risks and uncertainties affecting the cost of mitigating greenhouse gases emissions, the future change of climate and its economic impact on societies. We derive robust climate policies, in terms of carbon budgets, consistent with different preferences for dealing with these risks and uncertainties. Results indicate that different preferences can lead to significantly different carbon budgets.

3 - Multi-sector Model of Inter-temporal Permit Banking under Imperfect Competition

Makoto Tanaka, GRIPS, 7 Chome-22-1 Roppongi, Tokyo, Japan, mtanaka@grips.ac.jp, Yihsu Chen

This paper develops a multi-sector model of inter-temporal permit banking under imperfect competition. The permit price rises at a higher rate than the discount rate. Under a declining emissions cap system, the dominant firm has an incentive to suppress the permit prices when buying the permits in early periods, and then inflate the permit prices when selling them in later periods. Numerical results of the California case are broadly consistent with the analytical conclusion.

4 - Pollution Regulation and Market Structure

Francois Giraud-Carrier, Assistant Professor, University of Illinois Springfield, College of Business and Management, One University Plaza, UHB MS 4021, Springfield, IL, 62703, United States of America, fgira2@uis.edu, Krishnan Anand

We develop an integrated pollution-production model to study the interactions between strategic firms operating under pollution regulations and the regulator when markets are imperfect. Our model incorporates the firms' emissions, abatement technologies, the damage from pollution, and three popular regulatory mechanisms—Cap, Cap-and-Trade, and Tax. We analyze the effect of these mechanisms on firms, consumers and society, and derive important implications for the regulator.

■ SC74

Parc- Mission II

Strategic and Complementarity Models in Energy Markets

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Jalal Kazempour, Postdoctoral fellow, Johns Hopkins University, 3400 N Charles St. Mechanical Eng. Dep., Latrobe 223, Baltimore, MD, 21218, United States of America, skazemp1@jhu.edu

1 - Strategic Forward Trading and Technology

Heikki Peura, London Business School, Regent's Park, London, United Kingdom, hpeura@london.edu, Derek Bunn

Forward trading in electricity markets is usually driven by hedging motives, but may also result from strategic considerations. In increasingly technologically diverse markets, the flexibility and reliability of production technologies may influence not only spot prices but also the nature of forward trading. We develop a theoretical model to study the impact of these factors and their interactions on spot and forward market equilibria, with implications on both firm strategy and market design.

2 - The Value of Demand Response in Day-ahead and Real-time Markets: A Stochastic Equilibrium Model

Venkat Prava, PhD Student, Johns Hopkins University, 108 W 39TH ST APT 10, BALTIMORE, MD, 21210, United States of America, vprava1@jhu.edu, Ben Hobbs, Jalal Kazempour

We analyze the value of demand-side operational flexibility in a two-settlement wind-integrated electricity market (including day-ahead and real-time). To this end, a stochastic equilibrium model is characterized through a simultaneous clearing of day-ahead and real-time markets. Wind power uncertainty in each market is represented by a separate set of scenarios. The upward and downward demand responses are considered in both markets.

3 - Imperfect Demand-side Response to Wind Power Integration: A Complementarity Model

Ali Daraeepour, Duke University, A327 LSRC, Box 90328, Durham, NC, 27708, United States of America, a.daraeepour@duke.edu, Jalal Kazempour, Antonio J. Conejo, Dalia Patino-Echeverri

Demand-side behavior (strategic or competitive) affects clearing of wind-integrated electricity markets. We investigate this impact using a bilevel optimization model (as a complementarity approach) whose upper-level represents the expected utility maximization problem of a strategic consumer under wind-power production uncertainty and whose lower-level represents the clearing of day-ahead and real-time markets. We also explore the effects of wind power penetration and volatility levels.

4 - Modelling Strategic Interaction between Russia and Ukraine in Natural Gas Trade: Application of MPEC

Chi Kong Chyong, University of Cambridge, k.chyong@jbs.cam.ac.uk, Ben Hobbs

We formulate a mathematical problem with equilibrium constraints where Russia acts as a leader in both strategically investing in transportation capacity to ensure security of supply as well as supplying gas to Ukraine. Ukraine in turn is a follower and decides on investment in its transit capacity to serve Russian gas transit to Europe as well as investing in alternative routes to diversify away from Russian gas imports. We test the model with N-1 scenarios for Ukraine's major transit routes.

■ SC75

Parc- Mission III

Efficient Learning in Stochastic Optimization

Sponsor: Simulation

Sponsored Session

Chair: Ilya Ryzhov, Assistant Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, iryzhov@rhsmith.umd.edu

1 - Forgetful Bayes and Myopic Planning: Human Learning and Decision Making in a Bandit Setting

Shunan Zhang, University of California San Diego, s6zhang@mail.ucsd.edu, Angela Yu

We study how humans negotiate the tension between exploration and exploitation in a multi-armed bandit task. By comparing human behavior to a variety of models that vary in their representational and computational complexity, we found that subjects' choices are best captured by a "forgetful" Bayesian iterative learning model in combination with a partially myopic decision policy known as Knowledge Gradient, outperforming the optimal Bayesian learning and risk minimization and other heuristics.

2 - An Inverse Reinforcement Learning Model of Human Behavior in Social Media

Sanmay Das, Associate Professor, Washington University in St. Louis, sanmay@seas.wustl.edu, Allen Lavoie

How do humans change their behavior in response to feedback in social media? We introduce a model for how humans learn in response to different types of feedback, and validate our model on data from the social news website Reddit. Our model combines the behavioral reinforcement learning model of Erev and Roth with a Hierarchical Dirichlet Process model of preferences, and significantly outperforms all known baselines in predicting users' future behavior.

3 - Hierarchical Bandits with Infinitely Many Arms: Properties and Heuristics

Alessandro Arlotto, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, alessandro.arlotto@duke.edu, Noah Gans, Stephen E. Chick

We study hierarchical bandit models with a finite number of subpopulations and infinitely many arms in each subpopulation. The statistics of each subpopulation are unknown, and they are modeled as independent draws from some known hyperprior distribution. The statistics of each arm are also unknown, and modeled as independent draws from the subpopulation distribution to which the arm belongs. In this talk, we discuss properties of this model and propose sampling schemes that perform well.

4 - The Local Time Method for Targeting and Selection

Ilya Ryzhov, Assistant Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, iryzhov@rhsmith.umd.edu

We present the new targeting and selection (T&S) model, in which the goal is to find a simulation design that is maximally similar to a pre-specified target, a problem with applications in simulation validation and the design of competitive events. We also present a novel method for this problem based on the expected local time of a Brownian approximation. The method exhibits interesting parallels to value of information procedures for ranking and selection, but performs better in T&S.

■ SC76

Parc- Embarcadero

Community Service OR: Learn By Doing

Sponsor: The Practice Track

Sponsored Session

Chair: Tali Freed, Professor, Cal Poly State University, Industrial and Manufacturing Engineering, 1 Grand Avenue, San Luis Obispo, Ca, 93407, United States of America, tfreed@calpoly.edu

1 - Community Waste Management Optimization

Colyn Dickson, Student, Cal Poly State University, Industrial and Manufacturing Engineering, 1 Grand Avenue, San Luis Obispo, Ca, 93407, United States of America, cmdickso@calpoly.edu, Tali Freed

A cost minimization model for residential and commercial waste removal is presented. The model considers dumpster capacity constraints as well as pooling capacity of adjacent sub-communities. A case study of a university's waste management is discussed in detail.

2 - E-Waste Recycling Optimization
Roopak Mitra, United States of America, Mitra rmitra@calpoly.edu, Liang Li, Andrea Schmidt, Tali Freed

We propose a model for regional optimization of e-waste recycling. The existing drop off system utilized in many communities is modified to include optimization of pickup locations and vehicle scheduling. The goals include higher recycling rates of various types of e-waste, and minimal costs to the region and its residents.

3 - Integer Programming Formulation for Course Timetabling using Partially Aggregated Student Data
Jesse Bukenberger, jbukenbe@gmail.com, Tali Freed

We propose an integer programming formulation for the course timetabling problem that maximizes student enrollment in their desired courses. The formulation takes partially aggregated student data and quickly generates an optimal timetable; specific student enrollments are then generated from the timetable. The method is tested with local schools.

4 - Small-scale Dynamic Job Shop Scheduling
Heidi Richardson, California Polytechnic State University, San Luis Obispo, CA, United States of America, herichar@calpoly.edu, Lauryl Nakagawa, Tali Freed

This paper presents a heuristic scheduling algorithm created for dynamic work environments with multiple types of inputs and resources to address scheduling conflicts and tardiness. Better resource utilization is shown to increase throughput and customer satisfaction.

5 - Optimal Search Pattern for Difficult to Find Targets
Blake Currie, California Polytechnic State University, San Luis Obispo, CA, United States of Americabcurrie@calpoly.edu, Jessica Burke, Tali Freed

This paper focuses on optimization of search patterns based on the orienteering problem with resource dependent rewards. Target location probabilities are based on environmental conditions and last known location. Variable search times are allowed with upper limit on total time. Node probabilities decay exponentially as the area is searched.

■ SC77

Parc- Market Street

Joint Session Analytics/HAS: Topics of Healthcare Analytics I

Sponsor: Analytics & Healthcare

Sponsored Session

Chair: Issac Shams, University of Michigan-Ann Arbor, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, issacsh@umich.edu

1 - Phenotyping from Electronic Health Records using Tensor Factorization
Jimeng Sun, Associate Professor, School of Computational Science and Engineering, Georgia Tech, 266 Ferst Drive, Atlanta, GE, 30363, United States of America, jsun@cc.gatech.edu, Joydeep Ghosh, Joyce C. Ho

Limestone, a nonnegative tensor factorization method to derive phenotype candidates with no human supervision. We demonstrate the capability of Limestone on a cohort of 31k patient records. Our results show that using only 40 phenotypes, we can outperform the original 640 features to achieve AUC of 0.720. Moreover, in consultation with a medical expert, we confirmed 82% of the top 50 candidates are clinically meaningful.

2 - Does Healthcare Insurance Matter? Establishing Insurance Status as a Risk Factor for Trauma Mortality
Bruce Golden, Professor, University of Maryland - Robert H. Smith School of Business, University of Maryland - Robert H. Smith, College Park, MD, 20742, United States of America, BGolden@rhsmith.umd.edu, Hector Corrada Bravo, Shawn Mankad, Hisham Talukder

The identification of risk factors that affect the outcome of trauma patients has critical healthcare policy implications. We investigate the National Trauma Database, a collection of outcome records from over 100 trauma centers in the United States, to find that insurance status has a significant impact on survival outcomes when controlling for confounding variables. We utilize logistic regression and visualization techniques to identify potential explanations for these findings.

3 - Cost-effectiveness of HIT-facilitated Adoption of Collaborative Depression Care for Diabetes Patient
Shinyi Wu, Associate Professor, University of Southern California, 1150 S. Olive Avenue, Suite 1400, Los Angeles, CA, 90015, United States of America, shinyiwu@usc.edu, Haomiao Jin

Collaborative depression care is an evidence-based care model but providers find it difficult to implement among low-income minority diabetic patients. To support its adoption, an automated telephone assessment tethered with an enhanced disease management registry to task provider team was developed and tested in a three-group quasi-experimental trial with 1406 patients for 18 months. This study presents the propensity score adjusted regression results for cost-effectiveness of the intervention.

■ SC78

Parc- Mason

Panel Discussion: Promoting INFORMS International Activities

Sponsor: Analytics

Sponsored Session

Chair: Grace Lin, VP & Director General, Advanced Research Institute, Institute for Information Industry, Taipei, Taiwan, gracelin.ny@gmail.com

1 - Promoting INFORMS International Activities
Moderator: Grace Lin, VP & Director General, Advanced Research Institute, Institute for Information Industry, Taipei, Taiwan, gracelin.ny@gmail.com

Panel Members INFORMS International Activities Committee (IAC)Panelists: Professor Tamar Abdelmaguid from Egypt, Professor Fugee Tsung from Hong Kong, Professor Michel Gendreau, Represtative, IFORS, Professor Leonardo Santiago from Brazil, Professor Roman Slowinski from Poland, and Professor Jian Chen from China. In this session, Members of INFORMS International Activities are invited to share their views about ORMS including emerging trends and opportunities in their respective regions. Q&A will then be conducted to discuss potential INFORMS International activities such as meetings, certification, continuing education, and promoting emerging areas such as Big Data Analytics and Global ORMS.

■ SC79

Parc- Powell I

Joint Session DAS/SPPSN: Societal Applications of Decision Analysis

Sponsor: Decision Analysis & Public Programs, Service and Needs

Sponsored Session

Chair: Warner North, President and Principal Scientist, NorthWorks, Inc., 1715 Taylor Street, San Francisco, CA, 94133, United States of America, northworks@mindspring.com

1 - Informing Decisions in a Democratic Society
Warner North, President and Principal Scientist, NorthWorks, Inc., 1715 Taylor Street, San Francisco, CA, 94133, United States of America, northworks@mindspring.com

My nearly 50 years of career experience, including many projects for U.S. and other government agencies plus participation in numerous reports of the National Research Council, endorse normative decision analysis fused with deliberative dialogue as a process that provides insight on critical information and value assessments in support of decision making. While decision analysis methodology fits the need, leadership and dialogue process improvements may enable more success in application.

2 - Improving Public Policy Decisions in California
Stephen Barrager, Publisher, Baker Street Publishing, San Francisco, CA, 94123, United States of America, steve@bakerstreetpublishing.com

California policy makers and implementors face three challenges: (1) moving large groups of people toward mutual learning; (2) Integrating the inputs of stakeholders, scientists, and experts; and (3) Overcoming the shortcomings of bureaucracies. This presentations reviews some of the key reasons for the success of the California Marine Life Protection Act Initiative. The charge of this initiative was to design a network of marine protected areas the length of California.

3 - EPA's Uses of Risk Assessment in Setting Ambient Air Quality Standards

Anne Smith, Senior Vice President, NERA Economic Consulting, 1255 23rd St NW, Ste 600, Washington, DC, 20008, United States of America, Anne.Smith@NERA.com

US air quality standards must be set at levels USEPA determines are protective of public health with a margin of safety. USEPA must make this judgment in face of uncertainties about critical relevant considerations such as levels for effects thresholds, often even lacking knowledge of physiological mechanisms that might cause health effects of concern. USEPA's risk analysis methods are described, and areas where principles of decision analysis could be more effectively applied are identified.

4 - DA and Analytics-Based Policy Program Design Enabling Balanced Growth and Job Creation for Nationals

Mazen Skaf, Managing Director, Strategic Decisions Group, 745 Emerson St, Palo Alto, CA, 94301, United States of America, mskaf@sdg.com

We present a DA-based approach to designing an active labor market policy program. Since its launch in May 2011, the program has spurred a significant increase in the rate of job creation for nationals in an economy that had a historical over-reliance on foreign labor. As of January 2014, within 32 months following the launch, more than 700,000 net new jobs for nationals have been created.

■ SC80

Parc- Powell II

Ensembles and Big Data

Sponsor: Decision Analysis

Sponsored Session

Chair: Yael Grushka-Cockayne, Darden School of Business, 100 Darden Blvd, Charlottesville, United States of America, GrushkaY@darden.virginia.edu

1 - Induced Dependence Coefficient for Heavy-tailed Distributions in DM

Jose Luis Guerrero-Cusumano, Associate Professor, Georgetown University, 435 Hariri Builing, Business School, 37 and O street, NW, Washington, DC, 20016, United States of America, guerrerj@georgetown.edu

The detection of changes in the dependence structure of a multivariate process is essential in Data Mining given the large number of variables and its interactions. The multivariate mutual information T(X) and induced dependence coefficient are used as tools for supervised and unsupervised learning in Data Mining to summarize changes in the dependence of the multivariate process under the multivariate t family (Cauchy) distribution. Detection mechanisms in the dependence structure are developed

2 - An Ensemble of Ensembles

Alan Briggs, Elder Research Inc., VA, United States of America alan.briggs@dataminginglab.com

Data scientists are always looking for new problems to solve, going directly to the data in pursuit of knowledge and insight that hasn't always been available. Experience suggests that just as ensemble methods have increased performance of certain machine learning applications by blending multiple advanced analytic methodologies into a single approach, ensembling popular data science techniques with conventional metrics and heuristics can provide practical solutions to many difficult problems.

3 - Ensembling Overfit and Overconfident Forecasts

Yael Grushka-Cockayne, Darden School of Business, 100 Darden Blvd, Charlottesville, United States of America, GrushkaY@darden.virginia.edu, Casey Lichtendahl, Victor Richmond Jose

We study the effect of combining forecasts that are overfit to sample data. We introduce a model that relates base-rate neglect and overconfidence. We present theory that suggests a trimmed opinion pool will be effective in combining forecasts that are both overfit and overconfident. Using a popular machine learning algorithm that ensembles a large number of overfit regression models, we test this hypothesis empirically on several public data sets.

4 - Ensemble Methods in DoD Decision Analyses: Improving Accuracy through Combining Utility Models

Aaron Burciaga, Senior Manager, North America Inventory Analytics Lead, Accenture, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, adburciaga@gmail.com

No single method for developing Decision is perfect, however each can be useful, and even powerful when considered in aggregate. Ensemble methods in Decision Analysis provide aggregate strength, detail, and confidence in prescribed actions. We present how ensemble methods have been used to support strategic DoD initiatives, through a combination of State Trees, Decision Trees, Influence Diagrams, Dynamic Bayesian Networks, and the Analytic Hierarchy Process.

■ SC82

Parc- Haight

Business Location Analysis with MCDM

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Luiz Flavio Autran M. Gomes, Professor, Ibmec, Rua Professor Manuel Ferreira, 115,, Apt. 201, Gavea, Rio de Janeiro, RJ, 22451030, Brazil, autran@ibmecrj.br

1 - Retail Location Analysis: A Comparison between TODIM-FSE and the Choquet Integral

Luiz Flavio Autran M. Gomes, Professor, Ibmec, Rua Professor Manuel Ferreira, 115,, Apt. 201, Gavea, Rio de Janeiro, RJ, 22451030, Brazil, autran@ibmecrj.br, Maria Augusta S Machado, Renato Monte Araujo

This paper approaches the problem of locating a new store for a major retailer in the City of Rio de Janeiro, Brazil. A number of factors are considered by the company's decision makers and some of them are clearly interrelated. Therefore the problem has a multicriteria nature. It is solved by the TODIM-FSE method as well as by using the unipolar Choquet Integral. The two results are next compared and suggestions are provided for future studies.

2 - An Approximation Algorithm for the Bi-criteria p-median/p-dispersion Problem

Golbarg K. Tutunchi, PhD stdudent, North Carolina State University, 400 Daniels Hall College of Engineering, Industrial and Systems Engineering, Raleigh, NC, 27695-7906, United States of America, gkazemi@ncsu.edu, Yahya Fathi

We consider the p-median and the p-dispersion problems in the context of a bi-criteria location analysis. We discuss a mathematical programming approach to obtain a non-dominated solution with respect to these two objectives, and an e-approximation algorithm to obtain the corresponding efficient front. Through a computational experiment we demonstrate the effectiveness of this approach for relatively large instances of the problem.

■ SC83

Parc- Sutro

INFORMS Data Mining Best Student Paper Award

Sponsor: Data Mining

Sponsored Session

Chair: Onur Seref, Assistant Professor, Virginia Tech, Pamplin 1007, Blacksburg, VA, 24061, United States of America, seref@vt.edu

1 - Saddle Points and Accelerated Perceptron Algorithms

Adams Wei Yu, Graduate Student, Carnegie Mellon University, GHC 5508, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, weiyu@cs.cmu.edu

We consider the problem of finding a linear classifier or providing a near-infeasibility certificate if there is none. We bring a new perspective to addressing these two problems simultaneously in a single efficient process, by investigating a related Bilinear Saddle Point Problem(BSPP). We show that such a approach provides either a linear classifier or an ϵ-infeasibility certificate and that Mirror Prox can be used to achieve the best known convergence rate.

2 - Career Development Paths in Online Labor Markets

Marios Kokkodis, PhD Student, New York University, Room 8-180,, 44 W 4th New York, New York, NY, 10012, United States of America, mkokkodi@stern.nyu.edu

The workers' value in an online labor market resides in a combination of both observable (e.g., list of skills) and latent characteristics (e.g., true expertise on these skills). In this work, I propose a framework that (1) estimates the level of expertise of a given worker for a given skill (2) quantifies the value of each skill given the worker's level of expertise and (3) recommends additional skills based on the current skill set of the worker.

3 - Image Defect Detection with Smooth-Sparse Decomposition

Hao Yan, PhD Student, Georgia Institute of Technology, 755 Ferst Dr, NW, Atlanta, GA, 30332, United States of America, yanhao@gatech.edu, Jianjun Shi, Kamran Paynabar

Defect detection in noisy images is important in modern manufacturing system. Most of the existing approaches perform denosing and detection separately, which affects detection accuracy. In this paper, we develop a novel one-step methodology through a regularized least square optimization model together with a fast algorithm implementation for defect detection in noisy images under a smooth background. The accuracy and computational speed is evaluated using simulation study and case study.

4 - Finding Short Peptide Substrates using Bayesian Active Learning
Jialei Wang, PhD Student, Cornell University, Frank HT Rhodes Hall, 292, Ithaca, NY, 14853, United States of America, jw865@cornell.edu, Pu Yang, Peter Frazier, Nathan Gianneschi, Michael Burkart, Michael Gilson, Lorillee Tallorin, Nicholas Kosa

We consider a Bayesian active learning problem arising in biochemistry, in which we wish to find peptides with properties that support a number of innovations in medicine, biochemistry, and materials science. Such peptides are difficult to find, and expensive to experimentally verify. We present a machine learning method for choosing which peptides to test to find such peptides as quickly as possible. We prove theoretical bounds on its solution quality and demonstrate performance in simulation.

Sunday, 4:30pm - 6:00pm

■ SD01

Hilton- Golden Gate 6

Mathematical Modeling and Operations Research in Military Decision Making I

Sponsor: Military Applications Society

Sponsored Session

Chair: William Fox, Professor, Naval Postgraduate School, Department of Defense Analysis, Monterey, CA, 93943, United States of America, wpfox@nps.edu

1 - Mathematical Modeling of Terrorists for Decision Making
William Fox, Professor, Naval Postgraduate School, Department of Defense Analysis, Monterey, CA, 93943, United States of America, wpfox@nps.edu, Tiffany Crosby

We present two models of terrorists. Model 1 is an OML human targeting model than ranks terrorists based upon criteria. We provide some insights and sensitivity analysis. Model 2 describes an attempt to use a software package, CrimeStat, to predict terrorist event activity.

2 - Using Operational Patterns to Influence Attacker Decisions on a Transportation Network
Daniel Stimpson, Operations Research / Systems Analyst, Joint Improvised Explosive Device Defeat Organization, 115 Hunton Drive, Fredericksburg, VA, 22405, United States of America, stimpsonde@yahoo.com, Rajesh Ganesan

We introduce a Reinforcement Learning (RL) model for determining convoy and route clearance schedules to minimize attack costs on a network subject to IED ambushes. We assume dependence between attack probabilities and observed traffic patterns. RL algorithms offer opportunities for meaningful improvements by optimizing individual movements across the planning horizon, accounting for downstream interaction. Our approach is grounded in Boyd's observe, orient, decide, and act (OODA) loop.

3 - Using a Simulation Model to Test Policies for Managing a Fleet of Naval Combat Helicopters
David Marlow, Defence Science and Technology Organisation, Joint and Operations Analysis Division, Australia, domarlow@nps.edu

We present a discrete-event simulation model of a fleet of naval combat helicopters. The model represents helicopters moving between being embarked on ships to ashore and between various types of scheduled and unscheduled maintenance over their life. The fleet must always provide eight embarked aircraft and meet annual embarked and ashore flying hour requirements. Here we test the impact of various policies for managing multiple squadrons on the ability to meet these requirements.

■ SD02

Hilton- Golden Gate 7

Entrepreneurial Innovation Process (Discussant Session)

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Sinan Erzurumlu, Associate Professor, Babson College, 231 Forest St, Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Returns to Bargaining Power in the Market Process
Moren Levesque, Professor, York University, 4700 Keele Street, Toronto, ON, M3J1P3, Canada, MLevesque@schulich.yorku.ca, Mohammad Keyhani

This study investigates the role of bargaining power in the market process as described by the Kirznerian school of Austrian market process theory. We study market dynamics using computer simulations of coalition formation in a cooperative game in which players form new coalitions by discovering the opportunities afforded by the characteristic function. Counter-intuitively, we find that when all players have entrepreneurial discovery capability, the returns to bargaining power are not monotonic.

2 - Sequential Innovation by Start-ups: Balancing Survival and Profitability
Sinan Erzurumlu, Associate Professor, Babson College, 231 Forest St, Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu, Karthik Ramachandran, Sreekumar Bhaskaran

Start-up firms typically consider launching an immediately available first version of a product to generate funds for developing more advanced products. However, this release could have an adverse effect on the perception of the firm's future products. We characterize an optimal policy with cash thresholds to determine when the firm should launch the first version and whether it should continue development.

3 - What is Your Return on Time Invested?
Onesun Steve Yoo, Assistant Professor, University College London, Gower Street, London, United Kingdom, o.yoo@ucl.ac.uk, Charles Corbett, Guillaume Roels

For entrepreneurs, how they invest their time and money has immediate consequences as they are often the key resource of their business. We discuss frameworks for (i) discounting time and money and (ii) exchanging time and money, and introduce a two-by-two NPV-type framework linking current and future money and time. We use it to show that high-growth entrepreneurs should discount time less than money.

■ SD03

Hilton- Golden Gate 7

Innovating in the Mobile World using Analytics

Cluster: Business Model Innovation

Invited Session

Chair: Marcel Goic, Assistant Professor of Marketing, University of Chile, Republica 701, Santiago, Chile, magoic@gmail.com

1 - Analyzing Mobile Application Usage and Ad Response for Optimal Targeting
Liye Ma, Assistant Professor, University of Maryland, 3323 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, liyema@rhsmith.umd.edu, Baohong Sun

Research shows that 64% of mobile phone time is spent on applications, and mobile advertising is expected to quadruple in five years. We study three questions regarding these two activities: 1) how does mobile application usage vary across people and time? 2) how are mobile ad responses driven by time and context? 3) how should firms target mobile ads? We develop an integrated model of mobile application usage and ad response, and develop optimal targeting strategy by solving a DP problem.

2 - Firm Value of Product Innovation in the Service Ecosystem
Hyunwoo Park, Georgia Institute of Technology, 85 5th St NW, Atlanta, GA, 30308, United States of America, hwpark@gatech.edu, Rahul Basole

We examine the asymmetric impact of product innovation on the market value of manufacturers (e.g. device manufacturers) and service providers (e.g. mobile network operators) in the mobile service ecosystem. Our analysis is based on a comprehensive dataset comprising over 1,500 smartphones and considers the influence of product characteristics, the frequency and timing of product innovation, and the network structure of the service ecosystem. Theoretical and managerial implications are discussed.

3 - Real-time Decisions to Serve the Unbanked Poor in the Developing World: Examples from Mexico & India
Devendra Potnis, Assistant Professor, University of Tennessee at Knoxville, School of Information Sciences, Communications Bldg., Suite 451, Knoxville, TN, 37996, United States of America, dpotnis@utk.edu, Lakshmi Mohan

Formal financial service providers like banks and microfinance institutions deploy field agents with mobile devices for serving the 2.5 billion "unbanked" poor at their door step. We present the applications of Banco Azteca in Mexico and Equitas Microfinance in India for making real-time decisions using data sent by field agents on their mobile devices. The business value of these applications is lower financial risk and improved operational efficiency.

4 - Empirical Analysis of the Effectiveness of Mobile Channels
Marcel Goic, Assistant Professor of Marketing, University of Chile, Republica 701, Santiago, Chile, magoic@gmail.com, Jose Guajardo

The continuously growing use of mobile devices provides the opportunity to use this new channel to complement the value proposition that companies offer to their customer. However, the nature of costumer responses to these initiatives remains largely unexplored. We empirically investigate the drivers of effectiveness in managing a mobile transactional channel and how to use location-based information to interact with consumers.

■ SD04

Hilton- Continental 1

Empirical Research in Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Suresh Muthulingam, Assistant Professor, Cornell University, 401P Sage Hall, Ithaca, NY, 14853, United States of America, sm875@cornell.edu

1 - The Effects of National Culture on the Leakage of Proprietary Digital Assets
Brett Massimino, Cornell University, School of Hotel Administration, Ithaca, NY, 14850, United States of America, massimino.3@fisher.osu.edu, John Gray

In this study, we relate the cultural characteristics of parties in a product development chain to the propensity that the product under development will be leaked to unauthorized distribution channels. In our empirical analysis, we utilize longitudinal data covering the development of video game products from the years 2000 through 2010, as well as data detailing the illegal distribution activities of a major black-market distribution channel.

2 - Spillover of Quality Knowledge at Suppliers: an Empirical Investigation
Suresh Muthulingam, Assistant Professor, Cornell University, 401P Sage Hall, Ithaca, NY, 14853, United States of America, sm875@cornell.edu, Anupam Agrawal

We investigate whether quality knowledge developed by a buyer at its suppliers spills over and benefits other firms. We find that quality knowledge spills over: (i) At suppliers with low levels of operational complexity, (ii) When it is not embedded in technology, and (iii) When it is related to the output activities of a supplier. Further, the spilled-over quality knowledge depreciates faster than knowledge developed by undertaking quality improvement initiatives directly with suppliers.

3 - Critical and Complex Technological Capability Development: Longitudinal Study of a Surgical Robot
Kingshuk Sinha, Professor, Mosaic Company Professor of Corporate Responsibility, Carlson School of Management, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Shoubhik Sinha, Scott Bosch, Ujjal Mukherjee

We report the results of a longitudinal field study on the adoption and usage of a surgical robot. Specifically, we investigate doctors' learning, surgical team's learning and the impact of doctors' specialization and experience (general and specific) on capability development. The impact of doctor and team learning on the usage of the surgical robot is also analyzed. The empirical setting of the study is a large multi-specialty hospital.

■ SD05

Hilton- Continental 2

Supplier Responsibility Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Li Chen, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, li.chen@duke.edu

1 - Designing Supply Networks for Relational Sourcing
Elena Belavina, Assistant Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, United States of America, belavina@uchicago.edu, Karan Girotra

Socially responsible sourcing has become a necessity for many global firms and a competitive advantage for others. Sourcing strategies based on social responsibility now increasingly employ long-term commitments (relational sourcing). This study examines the role that supply network configuration plays in the efficacy of relational sourcing in ensuring socially responsible behavior across the supply network (compliance).

2 - Time to Come Clean? Disclosure and Inspection Policies under Random Environmental Violations
Sang Kim, Yale School of Management, 165 Whitney Ave, New Haven, CT, 06511, United States of America, sang.kim@yale.edu

We examine the interplay between a regulator's inspections and a firm's noncompliance disclosure in the setting where environmental violations occur randomly, by developing a model that combines reliability theory and law enforcement economics. Our analysis shows that a threat of increased penalty does not always lessen the need for costly inspections. We also find that there are situations where pre-announced periodic inspections are preferred to unannounced random inspections.

3 - Supplier Evasion of a Buyer's Audit: Implications for Motivating Compliance with Labor and Environment
Terry Taylor, Associate Professor, U.C. Berkeley, Haas School of Business, 2220 Piedmont Ave., Berkeley, CA, 94720, United States of America, taylor@haas.berkeley.edu, Erica Plambeck

Many brands have recently been tarnished by publicity of suppliers' labor and environmental violations, and have responded by increasing their auditing efforts. Suppliers seek to pass audits not only through efforts to comply with standards, but also through efforts to deceive auditors. We characterize when auditing backfires by increasing deception effort and reducing a supplier's effort to comply with labor and environmental standards.

4 - Mitigate Supplier Responsibility Risk in Emerging Economies: An Ethical Sourcing Framework
Li Chen, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, li.chen@duke.edu, Hau Lee

Sourcing from emerging economies may yield direct cost savings, but this practice often entails greater supplier responsibility risk. In this paper, we discuss the effectiveness of various contracting and certification mechanisms that aim to mitigate such risk.

■ SD06

Hilton- Continental 3

Strategic Supply Risk Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Yimin Wang, Arizona State University, Department of Supply Chain Management, Tempe, 85287, United States of America, Yimin_Wang@asu.edu

1 - To Remarket Now or Save for Warranty Claims
Cerag Pince, Kuehne Logistics University, Grosser Grasbrook 17, Hamburg, 20457, Germany, Cerag.Pince@the-klu.org, Beril Toktay, Mark Ferguson

Consumer returns constitute a substantial fraction of sales in the consumer electronics industry and often cannot be re-sold as new due to litigation concerns. Therefore, identifying the best joint pricing and disposition strategy is a challenging but important decision for consumer electronics OEMs. This paper investigates how an OEM should price new and refurbished products while allocating consumer returns between remarketing and warranty coverage options over the product's short life cycle.

2 - Worker Poaching in a Supply Chain: Enemy from Within?
Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Achal Bassamboo, Evan Barlow

Luring workers away from other firms (or poaching) has become a universal practice. Poaching between firms usually hurts firm profits through higher wages and higher worker turnover. We explore worker poaching between firms linked in a supply chain. We show that the supply chain relationship reverses some common conclusions from the labor economics literature. Furthermore, we show how and under what conditions worker poaching can, in fact, improve supply chain performance.

3 - Unsold versus Unbought Commitment: Minimum Total Commitment Contracts with Nonzero Setup Costs
Geoffrey Chua, Nanyang Technological University, Singapore, 639798, Singapore, geoffchua@pmail.ntu.edu.sg, Frank Youhua Chen, Xing Liu, Quan Yuan

We study a minimum total commitment where the buyer commits to purchase a minimum quantity of a single product from the supplier over the contract horizon. We consider non-stationary demand and per-unit cost, discount factor, and nonzero setup cost. Since existing method cannot solve this problem, we develop a new method based on a state transformation technique using unsold commitment instead of unbought commitment as state variable. We prove for the first time the optimality of a modified (s,S) policy. We also discuss some extensions to show the generality of our method's effectiveness.

4 - United We Stand, Divided We Fall: Strategic Supplier Alliances under Default Risk

Xiao Huang, Assistant Professor, Concordia University, 1455 de Maisonneuve Blvd W, Montreal, QC, H3G1M8, Canada, xiaoh@jmsb.concordia.ca, Tamer Boyaci, Mehmet Gumus, Saibal Ray, Dan Zhang

We study coalition formation among suppliers in a one downstream firm-n upstream suppliers framework. Each supplier faces an exogenous default risk and is endowed with certain risk-mitigating resources that can be shared within an alliance. We characterize the Coalition-proof stable alliance structure and stakeholders' equilibrium investment strategy and establish under what conditions will suppliers form large coalitions and when will they opt for only a few partners.

■ SD07

Hilton- Continental 4

Global Healthcare Operations

Cluster: Tutorials

Invited Session

Chair: Pinar Keskinocak, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, United States of America, pinar.keskinocak@isye.gatech.edu

Co-Chair: Julie Swann, Harold R. and Mary Anne Nash Associate Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, jswann@isye.gatech.edu

1 - Research in Public Health for Efficient, Effective, and Equitable Outcomes

Pinar Keskinocak, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, United States of America, pinar.keskinocak@isye.gatech.edu, Julie Swann, Turgay Ayer

Public health focuses on preventing disease, prolonging life, and promoting health in a population. In this tutorial, we discuss examples of work in several areas of public health including Access and Equity, Disease Screening, Chronic Diseases and Infectious Diseases. In each of these areas, we give a brief overview of challenging issues and related literature, give a specific example of a research topic, and point to potential future directions for research. We describe several trends that could impact future public health research including aging populations and an increase in electronic records. The tutorial is intended to introduce OR/MS researchers to the many opportunities for having a positive impact on specific populations and the society overall, through OR/MS research related to public health.

■ SD09

Hilton- Continental 6

Tackling Readmissions: From Policy to Practice

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Jonathan Helm, Indiana University, 1309 E. 10th St, Bloomington, IN, United States of America, helmj@indiana.edu

1 - Missed Opportunities in Preventing Readmissions: Redesigning Post-discharge Checkup Policies

Michael Hu, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, hum@mit.edu, Mariel Lavieri, Jonathan Helm, Kedi Wu, Ted Skolarus, Xiang Liu

Readmissions affect hundreds of thousands of patients annually, negatively impacting patients and tremendously burdening the healthcare system. Post-discharge checkups can reduce readmissions, but the methods behind designing effective checkup policies are poorly understood. Up to 67% of readmitted patients are readmitted before their first scheduled checkup. We examine the structure of optimal policies and develop policies that mitigate at least 32% more readmissions than current practice.

2 - Should Hospitals Keep Their Patients Longer? The Role of Inpatient Care in Reducing Readmissions

Song-Hee Kim, Yale School of Management, sk3116@columbia.edu, Carri Chan, Ann Bartel

Under the Affordable Care Act, hospitals with higher than expected 30-day readmission are being financially penalized. Using retrospective data on the over 6.6 million Medicare patients treated between 2008 and 2011, we develop an understanding of the potential impact of an inpatient intervention (keeping patients in the hospital for an extra day) versus providing outpatient interventions.

3 - Hospital Readmission Reduction Program: An Economic and Operational Analysis

Itai Gurvich, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu, Dennis Zhang, Jan Van Mieghem, Eric Park, Robert Young, Mark Williams

The Hospital Readmission Reduction Program is a new government policy that penalizes hospitals with excess readmissions. The policy benchmarks hospitals against similar peers and inherently introduces a game theoretic element to hospital decisions. We take an economic and operational (patient flow) view to map hospitals' characteristics to their readmission reduction decisions and quantify the effectiveness of the policy. We apply our model to data from hospitals in California.

4 - Reducing Readmissions through Scheduling and Staffing a Follow-up Organization

Jonathan Helm, Indiana University, 1309 E. 10th St, Bloomington, IN, United States of America, helmj@indiana.edu, Shanshan Hu, Sean Yu

Readmissions are an increasingly major problem for US healthcare organizations because of new reimbursement structures, government penalties and more. The medical literature has shown that following up with patients can have a major impact. We investigate scheduling and staffing rules for follow-ups to improve the effectiveness of follow-ups in a systematic way based on reallocating current medical staff time or contracting with an independent follow-up organization.

■ SD10

Hilton- Continental 7

Crowdsourcing

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Michael Wagner, University of Washington, Seattle, United States of America, mrwagner@uw.edu

1 - Managing Innovation in a Crowd

Mohamed Mostagir, University of Michigan, Ross School of Business, Ann Arbor, United States of America, mosta@umich.edu, Daron Acemoglu, Asuman Ozdaglar

A central problem in crowdsourcing innovation is that the difficulties of innovation tasks as well as the skills of crowdsourced labor are not known in advance. How can we then best match tasks to workers when we know neither the difficulties of the tasks nor the skills of the workers? We give a pricing mechanism for tasks that provides an incentive for workers to reveal their skills and that implements the optimal matching.

2 - Crowdsourcing Critical Fractiles from Overconfident Forecasters

Casey Lichtendahl, University of Virginia, 100 Darden Blvd, Charlottesville, United States of America, LichtendahlC@darden.virginia.edu, Yael Grushka-Cockayne

We present a model of overconfident forecasters and show how to optimally aggregate their critical fractiles into a consensus critical fractile for the newsvendor problem. We also introduce an incentive-compatible mechanism for eliciting critical fractiles that are well-calibrated. This mechanism provides a reward as a function of the consensus critical fractile.

3 - Mechanisms Design for Crowdsourcing: The Optimal Budget-Feasible Mechanism for Large Markets

Afshin Nikzad, Stanford University, 37 Angell Court, Stanford, Ca, 94305, United States of America, afshin.nikzad@gmail.com, Gagan Goel, Nima Anari

We consider a mechanism design problem in the context of large-scale crowdsourcing markets such as Amazon's Mechanical Turk: There is a requester who wants to hire workers to accomplish some tasks. Each worker gives some utility to the requester; each worker also has a minimum cost (only known to himself) that he needs to be paid for getting hired. We design a (provably optimal) direct revelation mechanism that picks the right set of workers to hire in order to maximize the requester's utility.

■ SD11

Hilton- Continental 8

Joint Session M&SOM Supply Chain/BOM: Pricing from the Practitioner's Perspective

Sponsor: Manufacturing & Service Operations & Behavioral Operations Management

Sponsored Session

Chair: Wedad Elmaghraby, Associate Professor, University of Maryland, wedad_elmaghraby@rhsmith.umd.edu

1 - Revenue-Maximizing Dynamic Tolling

Robert Phillips, Columbia University, rp2051@columbia.edu

Increasingly, new highway capacity is being built by private companies who have the authority to set tolls to maximize revenue. We present a dynamic toll-setting algorithm that seeks to maximize revenue based on current and anticipated traffic. We discuss the real-world challenges in implementing the approach considering technical limitations, issues of public acceptance, and regulatory consideration.

2 - Pricing Mediated by Humans: The Role of Sales Rep Discretion

Loren Williams, Chief Data Scientist, EY, 55 Ivan Allen Jr. Blvd, Suite 1000, Atlanta, GA, 30308, United States of America, loren.williams@ey.com

Many observers hold the belief that permitting front line B2B sales reps to have pricing discretion leads to over discounting, while at the same time many firms execute their pricing with such a policy. In this talk we examine reasons that we might expect sales reps to over discount, some survey results on the prevalence of the practice of granting pricing discretion and some reasons that might explain the patterns observed.

3 - The Emperor has no Clothes! Issues and Opportunities to Enhance the Human Agent Role in PRM

Vedat Akgun, Director, Operations Research, Revenue Analytics, 3100 Cumberland Blvd, Suite 1000, Atlanta, GA, 30339, United States of America, vakgun@revenueanalytics.com, Jon Higbie

At Revenue Analytics we have had a unique opportunity to observe many companies' current and future Pricing and Revenue Management processes. Based on our experience and research, we will share insights that challenge perceptions that persist in public domain research. We will also share some success stories on how companies have achieved extraordinary benefits by dealing directly with the role of the human agent in the process.

■ SD12

Hilton- Continental 9

Sustainability Impacts of Operational Choices in Energy Generation and Storage

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

1 - Combining Operations Management and Engineering Models to Manage and Value Electricity Storage

Yangfang Zhou, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, helenzhou@smu.edu.sg, Nicola Secomandi, Stephen Smith, Alan Scheller-Wolf, Jay Apt

The extant literature on the management and valuation of grid-level electricity storage facilities often ignores their physical characteristics and operating dynamics (such as energy-capacity degradation). We develop a stochastic optimization model and apply it to realistic data to study the importance of modeling these features when determining the storage operating policy and resulting valuation, focusing on three state-of-the-art grid-level electricity storage technologies.

2 - Operations and Investment of Energy Storage in the Presence of Transmission Losses

Owen Wu, Indiana University, owenwu@indiana.edu, Roman Kapuscinski, Santhosh Suresh

Due to transmission losses, the value of energy storage depends on the location of its investment. We consider the problem of sizing and siting storage facilities on a grid, to minimize investment and production costs. We model this problem as a trade-off between centralizing storage capacity, that increases aggregation, or localizing storage capacity, that brings it closer to the end consumer. We provide intuition on how changes in system parameters will affect this choice.

3 - Building and Replacing Battery Capacity for Energy Shifting

Shanshan Guo, Doctoral Student, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, guoshan@indiana.edu, Gil Souza, Shanshan Hu

Batteries may be used for energy shifting in the power system: storing electricity when the power supply is abundant and cheap, and releasing electricity when the supply is tight and more expensive. The batteries' effective (storage) capacity decays over time, and its deterioration speed is determined by the depth of discharge, which decreases in the battery capacity. This paper determines the optimal battery size and replacement time, as a function of energy shifting demands.

4 - Capacity Investment in Renewable Technology with Uncertain Yield

Shanshan Hu, Assistant Professor, Indiana University, Kelley School of Business, 1309 E. 10th St,, Bloomington, IN, 47405, United States of America, hush@indiana.edu, Wenbin Wang, Mark Ferguson, Gil Souza

Motivated by the penetration of renewable technologies, particularly in the energy sector, we study a firm's one-time strategic capacity investment in a portfolio of technologies that are used to meet stochastic demand. The renewable intermittency is modeled through stochastic capacity yield. We derive closed-form solutions for the optimal investment. Actual case studies demonstrate the effects of yield uncertainty and its correlation with demand.

■ SD15

Hilton- Exec. Boardroom

Stochastic Alternatives: SFA and StoNED

Cluster: Data Envelopment Analysis

Invited Session

Chair: Timo Kuosmanen, Aalto University, Finland, timo.kuosmanen@aalto.fi

1 - Modeling Joint Production under Noise: Axiomatic Nonparametric Approach

Timo Kuosmanen, Aalto University, Finland timo.kuosmanen@aalto.fi, Andrew Johnson, Chris Parmeter

Stochastic data generating process of joint production is introduced where all inputs and outputs correlate with inefficiency and noise. We show that directional distance functions (DDF) are identified by an appropriate specification of the direction vector. A consistent nonparametric estimator of DDF is developed, which satisfies the axioms of the production theory. DDF of Finnish electricity distribution firms is estimated.

2 - Intra-Firm Wage Bargaining, Hold-Up, and Over-Employment: A Test of the Stole-Zwiebel Model

Ronald Warren, Professor of Economics, University of Georgia, Department of Economics, Terry College of Business, Athens, GA, 30602, United States of America, warren@uga.edu, Yongseung Han, Arthur Snow

We test the Stole-Zwiebel model of intra-firm wage bargaining in the presence of the threat of employee hold-up, using panel data on savings banks in Korea. We find evidence of allocative inefficiency, in the form of over-employment of labor, and equality of the bargain-determined wage and the competitive wage, consistent with the key predictions of the model.

3 - A Multivariate Seminonparametric Bayesian Concave Regression Method to Estimate Stochastic Frontiers

Andrew Johnson, Texas A&M, 3131 TAMU, College Station, TX, United States of America, ajohnson@tamu.edu, Jose Luis Preciado Arreola

We estimate a production frontier using Multivariate Bayesian Convex Regression and several distributional assumptions for inefficiency combining Bayesian semi-parametric regression and parametric Bayesian inefficiency modeling. Only axiomatic restrictions are imposed on the production function. The concavity constraints are automatically satisfied by our regression method, while monotonicity is imposed through a rejection method. The method can be used in data sets with up to 3000 observations.

4 - Orthogonality Conditions for Identification of Joint Production Technologies Axiomatic

Chris Parmeter, University of Miami, 5250 University Drive, Miami, United States of America, cparmeter@bus.miami.edu

This paper sheds some new light on this issue from the perspective of the production theory. We introduce a stochastic data generating process of joint production where all inputs and outputs correlate with inefficiency and noise. We show that an appropriately specified direction vector can provide the orthogonality conditions required for identification of the directional distance functions.

■ SD16

Hilton- Franciscan A

Information, Risk Management, and Production Strategies

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Ying-Ju Chen, Berkeley- IEOR, 4121 Etcheverry Hall, Berkeley, United States of America, chen@ieor.berkeley.edu

1 - On the Supply Chain Finance Role of 3PL's Procurement Service
Gangshu Cai, Santa Clara University, OMIS Department, Santa Clara, CA, 95053, United States of America, gcai@scu.edu, Xiangfeng Chen, Jing-Sheng Song

Some third-party logistics (3PL) firms have taken the role of procurement for the retailers in addition to the traditional shipping service. Our analysis indicates that there exists a Pareto zone where all firms benefit from the procurement service compared with the traditional pure logistics service.

2 - Supply Diagnostic Incentives in New Product Launch
Mehmet Gumus, Associate Professor of Operations Management, McGill University, 1001 Sherbrooke Street West, Bronfman Building, Montreal, QC, H3A 1G5, Canada, mehmet.gumus@mcgill.ca, Mohammad Nikoofal

In launching new products, the newness of the production leads to unexpected reliability issues on supply side. The adverse effect of supply risk can be mitigated via test production. We explore how such a diagnostic technology investment may affect both incentive and information asymmetries across channel partners.

3 - A Bayesian Nonparametric Mixture Model for Logistics Disruption Risk Assessment
Yan Shang, PhD Candidate, Duke University, 845 Ivy Meadow Ln, Apt 3D, Durham, NC, 27707, United States of America, ys79@duke.edu, David Dunson, Jing-Sheng Song

We develop a Bayesian nonparametric (BNP) mixture model to estimate multi-stage logistics service delay distributions. These estimates allow us to separate recurrent and disruption risks, which helps to devise suitable hedging strategies. They can also be used to rank service supplier reliability, aiding supplier selection decisions. We apply this method to a one-year international air cargo dataset and use the results to make suggestions on airport cargo warehouse capacity planning.

4 - Nonlinear Pricing with Consumer Satiation
Hui Xiong, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, 430074, China, zsjxh@163.com, Ying-Ju Chen

In various scenarios, consumers may get satiated with the products, and the degree of satiation is directly associated with their prior experiences. We find that the ex ante quantity is first decreasing and then increasing in the satiation rate. Further, the two-stage information asymmetries may give rise to a rationale for the quantity upward distortion when the consumers' preferences are highly sensitive to the first-stage consumptions.

■ SD17

Hilton- Franciscan B

Customer Behavior and Call Center Management

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Philipp AfËche, Rotman School of Management; University of Toronto, 105 St.George Street, Toronto, Canada, Philipp.Afeche@Rotman.Utoronto.Ca

1 - Service Time Sensitivity to Load: Who is to ìBlameî?
Pnina Feldman, UC Berkeley, Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu, Galit Yom-Tov, Jun Li

The service operations literature typically assumes that firms control service times and that those are independent of the time customers spend waiting. Empirical evidence suggests otherwise. In fact, the time customers spend in line affects their expected service length. The reasons for that are many and involve agents and customers mechanisms for adaptations to load. Using call center data, we examine such correlations, and distinguish between customer and agent effects.

2 - Customer Learning in Call Centers
Seyed Emadi, Assistant Pofessor, Kenan-Flagler Business School, 300 Kenan Drive, Chapel Hill, NC, 27599, United States of America, Seyed_Emadi@kenan-flagler.unc.edu, Baris Ata, Jay Swaminathan

We investigate the impact of customers' repeat contacts on their abandonment behavior. We use a Bayesian learning framework to model customers' behavior and estimate their parameters from a call center data.

3 - Optimal Staffing under Endogenous Arrivals with Heterogeneous Customer Time-of-Service Preferences
Yang Li, Doctoral Student, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, Yang.Li10@rotman.utoronto.ca, Philipp AfËche

The service operations literature usually treats arrivals as exogenous processes. However, arrival processes may be endogenous in many settings. That is, customers may account for system congestion in choosing their time of service. We propose an equilibrium model that captures how rational customers with heterogeneous preferences decide their time-of-service. We also study the optimal staffing policies, taking into account customers' time-of-service choices.

4 - using Estimated Patience Levels to Optimally Schedule Customers
Ramandeep Randhawa, USC, Marshall School of Business, Los Angeles, CA, United States of America, ramandeep.randhawa@marshall.usc.edu, Achal Bassamboo

In M/M/N+G queueing systems, even though arriving customers appear identical, as they wait in the queue, an update can be formed on their willingness to wait. In this manner, as time progresses, customers become differentiated. We exploit this dimension of customer heterogeneity to construct scheduling policies that dynamically prioritize customers based on their time in the system in order to optimize any given system performance metric.

■ SD18

Hilton- Franciscan C

Choice Models in Revenue Management and Pricing IV

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Jeffrey McGill, Professor, Queen's University, Queen's School of Business, 143 Union Street, Kingston, ON, K7L3N6, Canada, jmcgill@business.queensu.ca

Co-Chair: Mikhail Nediak, Queen's University, Kingston, Ontario, Canada

1 - Pricing under the Nested Attraction Model
Tim Huh, Associate Professor, University of British Columbia, Sauder School of Business, Vancouver, BC, V6T 1Z2, Canada, tim.huh@sauder.ubc.ca, Hongmin Li

We develop a solution approach to the centralized pricing problem of a nested attraction model with a multi-stage tree structure. We identify conditions under which the optimal solution can be uniquely determined and characterize the optimal solution as a fixed-point of a single variable.

2 - Sequential Price Competition with Unknown Demand Functions
Yonatan Gur, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, United States of America, ygur@stanford.edu, Omar Besbes

In most dynamic pricing problems demand depends on prices selected by competitors. This, in conjunction with the uncertainty about the underlying demand leads to dynamic interactions among competitors. We study such interactions and appropriate equilibrium notions.

3 - Probabilistic Choice Models for Aggregate Pricing in RM markets
Srini Krishnamoorthy, Visiting Assistant Professor - Management Science, A.B. Freeman School of Business, Tulane University, New Orleans, LA, 70118, United States of America, Srinivas.Krishnamoorthy@tulane.edu

Standard game theoretic methods fail to explain aggregate pricing decisions of travel capacity providers that often appear to be economically irrational. We use probabilistic choice models to obtain more realistic predictions of provider behavior in competitive revenue management markets.

4 - Revenue Management under a Markov Chain Based Choice Model
Jacob Feldman, Cornell University, Ithaca, NY, United States of America, jbf232@cornell.edu, Huseyin Topaloglu

We study both static and dynamic assortment problems under a Markov chain based choice model. We provide a novel LP formulation for the static assortment optimization problem whose geometry allows us to develop efficient solution approaches for the network revenue management problem.

■ SD19

Hilton- Franciscan D

Integrating Pricing and Supply Chain Planning

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Mike Freimer, VP Science & Research, PROS, 101 Montgomery Street, Suite 400, San Francisco, CA, 94104, United States of America, mfreimer@pros.com

1 - Coordinating Pricing and Production Decisions for Commodity-Based Manufacturers

Mike Freimer, VP Science & Research, PROS, 101 Montgomery Street, Suite 400, San Francisco, CA, 94104, United States of America, mfreimer@pros.com

Price volatility has become increasingly dramatic in agricultural and other commodity industries, causing significant pain for manufacturers who suffer the effects of volatility on both upstream procurement and downstream sales. We present an optimization framework that allows manufacturers to react more quickly to changes in the marketplace, and to make coordinated pricing, production, inventory and procurement decisions.

2 - Demand-Driven Production Optimization for Commodity-Based Manufacturers

Evan Davidson, Senior Scientist, PROS, 101 Montgomery Street, Suite 400, San Francisco, CA, 94104, United States of America, edavidson@pros.com

In this talk, we round out the description of an optimization framework for commodity-based process manufacturers. We focus on the supply side of the problem, describing how procurement, production, and inventory planning can be coordinated with allocation and pricing to maximize overall profitability. We discuss how the procurement optimization problem can be viewed as the mirror image of the pricing problem.

3 - Supply Chain Analysis of Contract Farming

A. Serdar Simsek, Instructor/Researcher, Cornell ORIE, 282 Rhodes Hall, Ithaca, NY, United States of America, as2899@cornell.edu, Awi Federgruen

Contract farming sustains the operations of vulnerable farmers while better positioning the manufacturers to manage their supply risks. In this setting, a manufacturer who owns several production plants – each with a random demand for the crop – selects the set of farmers that minimizes her expected procurement and distribution costs before the growing season. We present two solution methods to this problem. We applied our model to a company contracting with hundreds of small farmers in India.

4 - Structural Results for a Capacity Sharing Problem

David McCaffrey, Senior Scientist, PROS, 3100 Main Street, Houston, TX, 77002, United States of America, dmccaffrey@pros.com, Darius Walczak

We consider a capacity sharing problem for a single leg airline reservation process with two compartments, business and economy, in which business reservations are accepted only into business, but economy reservations are accepted into either economy or business. We define the dynamic programming equation for this problem and show that the 2-dimensional value function is discretely sub-modular and concave in both variables. We present examples and consider generalizations to more compartments.

■ SD20

Hilton- Yosemite A

Matching Markets

Cluster: Matching and Market Design (in honor of Al Roth)

Invited Session

Chair: Yash Kanoria, Columbia Business School, 404 Uris Hall, New York, NY, 10027, United States of America, ykanoria@columbia.edu

1 - Stable Matching in Large Economies

Fuhito Kojima, Stanford University, 579 Serra Mall, Stanford, CA, 943055007, United States of America, fkojima@stanford.edu

Complementarities of preferences have been known to jeopardize stability of two-sided matching markets, yet they are a pervasive feature in many matching markets. In large markets, we demonstrate that if each firm's choice changes continuously as the set of available workers changes, then there exists a stable matching even if firm preferences exhibit complementarity. Building on this result, we show that there exists an approximately stable matching in any large finite economy.

2 - The Prior-Independence Approach

Inbal Talgam-Cohen, PhD Candidate, Stanford University, 86 Hulme Ct, Apt 108, Stanford, CA, 94305, United States of America, italgam@stanford.edu, Tim Roughgarden

The matching literature has recently begun to consider priors on agents' utilities. One of the barriers to adopting this potentially very fruitful approach is that priors add significant informational assumptions to the model. We survey a successful alternative approach from mechanism design called prior independence, which alleviates such assumptions while still reaping most benefits. We discuss both sampling-based methods and methods based on ensuring sufficient competition in the market.

3 - The Structure of the Core in Assignment Markets

Yash Kanoria, Columbia Business School, 404 Uris Hall, New York, NY, 10027, United States of America, ykanoria@columbia.edu, Daniela Saban, Jay Sethuraman

Assignment markets (Shapley & Shubik 1971) involve matching with transfers, as in labor markets and housing markets. We consider a two-sided assignment market with agent types and stochastic structure similar to models used in empirical studies. Each agent has a randomly drawn "productivity" associated with each type on the other side. We characterize how the structure of the core, i.e., the set of stable outcomes, is determined by market characteristics.

■ SD21

Hilton- Union Sq 1

Transportation and Routing under Uncertainty I

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Arthur Flajolet, MIT, Cambridge, MA, United States of America, flajolet@mit.edu

1 - Reliable Vehicle Routing Problems (RVRP) with Correlated Parameters

Carlos Felipe Ruiz, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, DC, 0000, Colombia, cf.ruiz1135@uniandes.edu.co, Andres Sarmiento, Raha Akhavan Tabatab, Andrés L. Medaglia, Jorge Mendoza

Reliable vehicle routing problems consist of designing time-dependable transportation routes of minimal expected cost over a network where travel and service times are represented by random variables. In this work we consider the case in which the random variables describing travel times may be correlated. We propose a flexible methodology that comprises a state-of-the-art routing engine and is able to effectively handle any travel and service time distribution and pairwise correlations.

2 - Handling Travel Time Uncertainty in City Logistics

Utku Can Kunter, Research Assistant, Middle East Technical University, ‹niversiteler mah. ODTU Kampüsü, Endüstri Mühendisligi Bölümü Oda No:325, Ankara, 06800, Turkey, kunter@metu.edu.tr, Cem Iyigün, Haldun Süral

City logistics aims to design freight distribution networks on a large scale. In this study, we consider the travel time uncertainty in 1-tier city logistics systems. We propose approaches to analyze the effect of travel time stochasticity on the location decisions of city distribution centers. We provide computational results to compare the performances of the proposed approaches with those of deterministic methods.

3 - Dynamic Technician Routing with Experience-based Service Times

Xi Chen, University of Iowa, IA, United States of America, xi-chen-3@uiowa.edu, Barrett Thomas, Michael Hewitt

We study a dynamic technician routing problem with experience-based service times. We use well-established models from the psychology community to model how gains in experience impact service times. We assume that the volume and location of customer requests are uncertain. We model the problem as a Markov decision process with the objective of minimizing the expected total makespan over a finite horizon. We also propose a number of approximate dynamic programming schemes and present results.

4 - Robust Adaptive Routing under Uncertainty

Arthur Flajolet, United States of America, flajolet@mit.edu, Patrick Jaillet, Sebastien Blandin

We consider an adaptive stochastic shortest path problem with independent random arc costs. Our contributions are two-fold. First, we extend a pre-existing dynamic programming formulation to a large class of objective functions. Second, in an attempt to mitigate the impact of scarce information on the arc costs, we develop a robust counterpart that relies on lower-order statistics as opposed to entire arc cost probability distributions for the nominal problem.

■ SD22

Hilton- Union Sq 2

Preparing for and Responding to Disaster with Tools of OR

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Martijn Mes, University of Twente, P.O. Box 217, Enschede, 7500 AE, Netherlands, m.r.k.mes@utwente.nl

1 - Empirical Study on People's Route Choice Behavior in Response to the Reopening of the I-35W Bridge

Sharon(Xuan) Di, University of Minnesota, 500 Pillsbury Dr. SE, Minneapolis, MN, 55455, United States of America, dixuan@umn.edu, Henry X. Liu, Shanjiang Zhu, David M. Levinson

Fewer people used the new I-35W Bridge after its reopening in 2008 in Minneapolis though it provided substantial time saving to commuters. The classical route choice model assumption that people always take the shortest path fails to capture the above anomalous phenomenon. This study proposes a boundedly rational route choice model to explain the observation and the parameter related to bounded rationality is estimated from a GPS study conducted before and after the reopening of the bridge.

2 - Objective Decision-Making Tools for Infrastructure Investments to Combat Impacts of Sea Level Rise

Ali Asadabadi, Graduate Research Assistant, University of Maryland, College Park, College Park, College Park, MD, 20742, United States of America, ali.asadabadi@gmail.com, Elise Miller-Hooks

Probabilistic projections of sea level rise and related intensified storm surges can affect coastal transportation infrastructure through temporary or permanent inundation. Mitigative and adaptive actions can be taken to combat these impacts. We will present optimization-based, decision-making techniques to aid in choosing among these options.

3 - Goal Programming Model for Integrated Relief Supply and Network Restoration-Hazus based Application

Kasin Ransikarbum, Clemson University, 103 Freeman Hall, Clemson, SC, 29634, United States of America, kransik@g.clemson.edu, Scott Mason

We present a goal programming model for integrated relief supply and network restoration operations. Our model provides fairness-based solutions for constrained capacity, budget, and resource problems. We analyze efficient frontiers between objectives and discuss compromise solutions when targets or goals are desired. Our results are illustrated with loss data in South Carolina generated from Hazus software to provide decision makers with candidate supply distribution and restoration plans.

4 - Integrated Tactical and Operational Planning of Police Helicopters

Martijn Mes, University of Twente, P.O. Box 217, Enschede, 7500 AE, Netherlands, m.r.k.mes@utwente.nl

We propose a tactical planning model to support various decisions regarding the use police helicopters, which include shift planning, standby time and the positioning of helicopters, while taking into operational decisions such as the starting times and optimal routes of surveillance flights. Decisions are based on historic data of high impact crimes. We also present a trade-off between maximizing the response time and an equitable distribution of helicopter capacity over the Netherlands.

■ SD23

Hilton- Union Sq 3

Rich Vehicle Routing Problems II

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Han Zou, University of Southern California, Los Angeles, CA, 90089, United States of America, hanzou@usc.edu

1 - A Multi-start Biased Method for the Vehicle Routing Problem with Backhauls and Environmental Impact

Javier Faulin, Professor, Public University of Navarre, Dept Statistics and OR, Campus Arrosadia, Pamplona, NA, 31006, Spain, javier.faulin@unavarra.es, Adrian Serrano, Javier Belloso, Angel Juan, Alejandro Garcia del Valle

We solve the Vehicle Routing Problem with Backhauls (VRPB) using a multi-start approach based on an adaptation of the SR-GWCS-CS method introduced by Juan et. al (2011). Later, the environmental impact associated with CO2 emissions was calculated using the Ubeda et al. (2012) methodology. Some classical benchmark instances for the VRPB were selected in order to compare the efficiency of our approach. Promising solutions have been obtained from our method implementation.

2 - An Adaptive Large Neighborhood Search Heuristic for the PDP with Fixed Scheduled Lines Services

Veaceslav Ghilas, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612 AZ, Netherlands, v.ghilas@tue.nl, Emrah Demir, Tom Van Woensel

The investigated problem concerns scheduling a set of vehicles to serve the freight requests such that a part of the journey can be carried out on fixed scheduled lines transportation service. We propose an Adaptive Large Neighborhood Search heuristic algorithm to solve the problem. Extensive computational results provide a clear understanding of the benefits of using fixed scheduled services as part of the freight's journeys.

3 - A Large Neighborhood Search Approach for the Truck and Trailer Routing Problem

Wentao Zhang, University of Southern California, Los Angeles, CA, United States of America, wentao@usc.edu

In the truck and trailer routing problem (TTRP), a fleet of trucks and trailers is used to serve a set of customers, some of which are only accessible by trucks, while the others are also accessible by a truck coupled with a trailer. A large neighborhood search heuristic is developed to solve the problem. Operators are designed to take care of the special constraint of TTRP. Our competitive numerical results indicate the effectiveness of this relatively simple approach.

4 - An Intelligent Look-ahead Framework for the Dynamic Vehicle Routing Problem

Han Zou, University of Southern California, Los Angeles, CA, 90089, United States of America, hanzou@usc.edu, Maged Dessouky

The problem concerns routing a fleet of capacitated vehicles in real time to fulfill both advanced and dynamic orders from a set of known customers. We develop an intelligent look-ahead framework that makes predictions based on historical information, instantly accepts or rejects dynamic orders, and constructs partial vehicle routes. Our approach has the potential to outperform both a priori routing and total dynamic dispatching schemes when the uncertainty level is moderate.

■ SD24

Hilton- Union Sq 4

Modeling of Emerging Sensor Technologies

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Pablo Durango-Cohen, Northwestern University, 2145 Asbury Avenue, Evanston, United States of America, pdc@northwestern.edu

1 - Analytics Approach to Support Health-monitoring and Management of Transportation Infrastructure

Pablo Durango-Cohen, Northwestern University, 2145 Asbury Avenue, Evanston, United States of America, pdc@northwestern.edu, Yikai Chen

Motivated by recent technological advances, we describe the development and validation of a statistical framework to support health-monitoring and management of transportation infrastructure. The framework consists of formulation of structural time-series models to explain, predict, and control for common-cause variation, and use of multivariate control charts to detect special-cause variation. We present several examples from an in-service bridge to validate the framework.

2 - Utilizing Mutiple Wireless Roadside Sensors At Intersections

David Kim, david.kim@orst.edu, Nadia Bathaee, SeJoon Park, Alireza Mohseni, David Porter

This research examines the estimation of vehicle time-distance trajectory through an intersection utilizing the data collection capabilities of multiple wireless roadside sensors that have been deployed along an intersection. Prior research with Bluetooth wireless roadside sensors show that signal strength data collected when data is obtained from a wireless device present in a vehicle can be used to estimate when the vehicle is close to passing a sensor. This capability is exploited through the development of portable Bluetooth wireless data collection units that communicate and synchronize time utilizing a Zigbee mesh network.

3 - Penetration Requirement of Mobile Sensing Data for Arterial Performance Measurement

Peng Hao, UC Riverside, Riverside, CA 92507, United States of America, haop@cert.ucr.edu, Xuegang (Jeff) Ban

This paper investigates the penetration requirement of mobile data to generate satisfactory performance measures for urban arterials. The results will help decision makers to assess the necessity and feasibility of mobile sensing at a given urban location or area.

4 - Real Time Freeway Traffic State Estimation and Prediction with a p-detector Based Approach in a Lagrangian Framework
Kerem Demirtas, Research Assistant, Arizona State University, Tempe, AZ, 85281, United States of America, kerem.demirtas@asu.edu, Zhuoyang Zhou, Pitu Mirchandani, Xuesong Zhou

Along with the recent technological developments, the availability of Lagrangian measurements become more widely used in real time traffic management applications. In this talk, we present a fast and novel approach to the freeway state estimation and prediction problem, that is based on a p-detector method in a Lagrangian sensing framework. Preliminary results show the accuracy of our proposed method.

■ SD25

Hilton- Union Sq 5

Advances in Routing and Scheduling Problems

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Hai Wang, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, wanghaimit@gmail.com

1 - Dynamic Hierarchical Modeling of Vehicle Routing Problem in Urban Supply Chains
Tao Yao, tyy1@engr.psu.edu, Terry Friesz, Yiou Wang, Ke Han, Hongcheng Liu

This research proposes a substantial extension of dynamic vehicle routing problem (VRP) formulation to a dynamic Stackelberg game model that takes into account the congestion as a result of freight activities among the background passenger traffic in urban freight planning. The model incorporates the dynamic VRP with dynamic traffic assignment problems by explicitly capturing their interplay on a network. We find that the routing decisions that explicitly consider congestions yields a significantly lower cost than the dynamic VRP solutions.

2 - Dynamic Vehicle Routing and Pricing with Look Ahead for Taxi Fleet
Hamid R. Sabarshad, Ryerson University, Toronto, ON, hsabarsh@ryerson.ca, Joseph Y.J. Chow

We propose a dynamic dial a ride and pricing problem with non-myopic policies for last mile transit, one with time-dependent non-homogeneous Poisson process for customer demands. Two policies are considered: customer-vehicle allocation, and dynamic fare pricing. The policy proposes a new fare structure which accounts for extra travel distance by anticipating the value of having the vehicle at the new location. The proposed model is compared against an "allocation only" queueing approach from Hyytia et al. (2012).

3 - Scheduling and Routing Operation of a Last Mile Transportation System
Hai Wang, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, wanghaimit@gmail.com

We describe a model that considers a last mile transportation system as a batch arrival, batch service, and multi-server queueing system. We present several methodologies to operate the system through near-optimal scheduling and routing decisions. Technically the model focus on "multi-server queue operation with flexible service combinations."

4 - Vehicle Routing with Flexible Delivery Locations
Daniel Gartner, Carnegie Mellon University, The H. John Heinz III College, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu, Alexander Düge, Markus Frey, Rainer Kolisch

We present a new extension of the vehicle routing problem (VRP): The VRP with flexible delivery locations (VRPFDL). In the VRPFDL, a job not only corresponds to exactly one location but has to be performed at one out of a set of possible locations. In order to solve the VRPFDL we present a Dantzig-Wolfe formulation which is solved by means of branch-and-price. The column generation's subproblem is treated as an elementary shortest path problem with resource constraints (ESSPRC).

■ SD26

Hilton- Union Sq 6

Location Optimization II

Sponsor: Location Analysis

Sponsored Session

Chair: Alan Murray, Professor, Drexel University, Center for Spatial Analytics and Geocomp, College of Computing and Informatics, Philadelphia, PA, 19104, United States of America, amurray@drexel.edu

1 - Exploiting Spatial Properties in Location Optimization
Alan Murray, Professor, Drexel University, Center for Spatial Analytics and Geocomp, College of Computing and Informatics, Philadelphia, PA, 19104, United States of America, amurray@drexel.edu

This paper details properties of space and spatial arrangement that can be relied upon to establish and solve a number of location models. Models are presented for which this is true, and application results are demonstrated.

2 - High Performance Computing to Optimize Spatial Coverage
Ran Wei, Oregon State University, 104 CEOAS Admin BLDG, Corvallis, OR, 97331, United States of America, rwei@coas.oregonstate.edu, Alan Murray

This paper addresses a continuous space problem focused on complete spatial coverage of continuously distributed demand. A new solution approach is developed through an iterative bounding scheme based on high performance computing techniques.

3 - Easy and Not so Easy Continuous Multifacility Location Problems
Justo Puerto, Universidad de Sevilla, Universidad de Sevilla, Sevilla, Spain, puerto@us.es, Victor Blanco

This talk presents a methodology for solving a class of continuous, multifacility location problems, in any dimension and l_p-norms: 1) by a new mixed integer second order cone programming formulation and 2) by a sequence of semidefinite programs that converges to the solution of the problem; each of these relaxed problems solvable in polynomial time. We apply dimensionality reductions of the problems by sparsity and symmetry to be able to solve larger problems.

4 - A Bi-objective Model for Designing Safe Walking Routes for School Children and its Applications
Ken-ichi Tanaka, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, Japan, ken1tnk@ae.keio.ac.jp, Yuichiro Miyamoto, Ryuhei Miyashiro

We consider the problem of designing safe walking routes from school to homes for school children. Children are thought to be safer when walking together in groups rather than alone. We propose a bi-objective model in which both the total distance walked alone and the total distance traveled by children are minimized. We apply the problem to road networks and analyze Pareto optimal solutions. We also apply heuristic methods to solve real-size instances.

■ SD27

Hilton- Union Sq 7

Roundtable Discussion on Bridging Data and Decisions II

Sponsor: Railway Applications

Sponsored Session

Chair: Marc Meketon, Vice President, Oliver Wyman, 1 University Square Drive, Suite 100, Princeton, NJ, 19002, United States of America, Marc.Meketon@oliverwyman.com

1 - Roundtable Discussion on Bridging Data and Decisions
Marc Meketon, Vice President, Oliver Wyman, 1 University Square Drive, Suite 100, Princeton, NJ, 19002, United States of America, Marc.Meketon@oliverwyman.com

The freight railway industry is awash in data in every corner of its business. From immediate operations that collect real-time information on locomotives, cars and even wheel bearings, the million+ commercial shipments per month, the tens of millions of duties performed in the yards, movement of almost a million containers and trailers, track analysis data, and so on. This roundtable will discuss how advanced techniques of data analysis and operations research are being used to make the best decisions from the data.

■ SD28

Hilton- Union Sq 8

AAS Dissertation Prize Finalists

Sponsor: Aviation Applications

Sponsored Session

Chair: Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

1 - AAS Dissertation Prize Finalists

Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

This session will feature finalists for the Aviation Applications dissertation prize. The Aviation Applications dissertation prize winner will be announced in the business meeting at INFORMS.

2 - The Airline Container Loading Problem with Pickup and Delivery

Virginie Lurkin, PhD Student, Université de Liège, Rue Louvrex 14, Liège, 4000, Belgium, vlurkin@ulg.ac.be, Michael Schyns

We look into the problem of optimizing the loading of a set of containers into cargo aircraft serving multiple airports. Due to the pickup and delivery operations, this problem is simultaneously a weight and balance problem and a sequencing problem. Our objective is to minimize fuel and handling operations costs. We resort to a mixed integer linear program. We show that our approach yields better solutions than traditional manual planning, which results in substantial cost savings.

3 - Wind Models and Stochastic Programming Algorithms for En Route Trajectory Prediction and Control

Clayton Tino, Resource Management Architect, Virtustream, Inc., 6 Concourse Pkwy NE #1930, Atlanta, GA, 30328, United States of America, clayton.tino@gmail.com

There is a need for a fuel-optimal required time of arrival (RTA) mode for aircraft flight management systems capable of enabling controlled time of arrival functionality in the presence of wind speed forecast uncertainty. A computationally tractable, two-stage stochastic algorithm utilizing a data-driven, location-specific wind forecast uncertainty model to generate forecast uncertainty scenarios is examined.

■ SD29

Hilton- Union Sq 9

New Directions in Understanding Buyer-Supplier Relations

Cluster: Strategy Science

Invited Session

Chair: Todd Zenger, Washington University, St. Louis, Missouri, United States of America, zenger@wustl.edu

1 - Discovering Value in Buyer-supplier Relationships

Olivier Chatain, HEC Paris, France, chatain@wharton.upenn.edu, Peter Zemsky

Relevant information about how much value can be created in a buyer-supplier relationship is often difficult to evaluate before exchange takes place. For instance, in professional services, the fit between buyers and suppliers can be hard to assess ex ante. We use a formal model to explore the implications of the lack of ex ante observability of bilateral value creation on the process of value discovery. We explore how the cost of resolving the uncertainty about value creation potential is magnified or minimized due to conflicts about the distribution of value.

2 - Contracts and Trust: Foundations and Emerging Directions

Laura Poppo, University of Kansas, lpoppo@ku.edu

Cooperative strategy has emerged as a paradigm for examining interfirm exchanges, with trust and contracts as focal concepts. After reviewing the significant work which has explored these facets, I will explore three under-researched and emerging areas: 1) different bases of trust; 2) asymmetric trust; and 3) the emergence of cooperation.

3 - The Fragility of Trust in Interorganizational Relationships

Bart S. Vanneste, University College London, United Kingdom, b.vanneste@ucl.ac.uk, Onesun Steve Yoo

We investigate under which conditions interorganizational trust is fragile (i.e., easily lost). We propose a generalized trust game, which has the well-known trust game as a special case. Using a formal model, we show that whether interorganizational trust is fragile depends on situation characteristics: value (creation vs. capture), risk (scope for failure vs. opportunism), task (difficulty vs. temptation), and fragility of trustworthiness (competence vs. benevolence).

4 - Creating and Capturing Value in Repeated Exchange Relations: Managing a Second Paradox of Embeddedness

Daniel Elfenbein, Washington University, elfenbein@wustl.edu, Todd Zenger

Prior studies reveal a strong relationship between repeated exchange and value in exchange relations, suggesting buyers may focus exchange to maximize relationship value. However, by distributing exchange, buyers may position themselves to capture more of the value created. We label this dilemma the second paradox of embeddedness, distinguishing it from Uzzi's (1997) paradox driven by technological uncertainty. Using data on the procurement activities of a large, diversified manufacturing company, we then test for supplier and buyer behavior consistent with this paradox.

5 - Buyer-supplier Relations: Exploring the Contractual Micro-foundations

Tomasz Obloj, HEC Paris, tobloj@gmail.com

The design and ensuing effectiveness of the buyer-supplier relationships interact in an important way with internal contractual structures and individual characteristics of organizational members. Yet, much remains to be understood about the micro-foundations of productive relationships. Unpacking these interactions, I study two sources of behavioral heterogeneity across and within firms: social comparison costs and transactional integrity of economic actors. I then discuss the broader implications of the behavioral micro-foundations for productive relationships.

■ SD30

Hilton- Union Sq 10

Supply Chain and Scheduling

Cluster: Scheduling and Project Management

Invited Session

Chair: Zhi-Long Chen, Professor, University of Maryland, R.H. Smith School of Business, College Park, MD, 20742, United States of America, ZChen@rhsmith.umd.edu

1 - Supply Chain Scheduling in Steel-making and Hot Rolling Operations

Lixin Tang, Chair Professor, Northeastern University, 3-11 Wenhua Road, Heping District, Shenyang, 110004, China, lixintang@mail.neu.edu.cn, Hongzhi Luo

We study a supply chain scheduling problem in steel-making and hot rolling operations. In steel making, orders with similar steel grades are grouped into charges, which are produced as a batch in oxygen converters. In hot rolling, slabs are chosen and produced in a serial of capacitated turns. We propose a column-generation-based algorithm for this problem with additional cuts. We test our algorithm on randomly generated data, and show the effectiveness of the proposed algorithm.

2 - Managing Engineering Design for Competitive Sourcing in Closed-Loop Supply Chains

Nagesh Murthy, Associate Professor, University of Oregon, Lundquist College of Business, Eugene, OR, 97403, United States of America, nmurthy@uoregon.edu, Tolga Aydinliyim

Using a game theoretical framework, we study the joint design and procurement decisions of a manufacturer who chooses between integral or modular design alternatives, and the pricing decisions made by its suppliers. The integral design requires more raw materials per pound of final product and prevents yield loss due to final joining. However, the modular design is simpler, resulting in a more competitive supplier base and allows the suppliers to rely less on reverse material flows.

3 - Integrated Production and Two-stage Delivery Scheduling

Feng Li, Northeastern University, Shenyang, China, fengli055@gmail.com, Zhi-Long Chen, Lixin Tang

We study several integrated production and two-stage delivery scheduling problems that arise in practical make-to-order settings in several industries. In these problems, make-to-order products are first processed in a plant, then delivered from the plant to a pool point, and finally delivered from the pool point to customer sites. We propose algorithms and analyze their performance theoretically and computationally.

■ SD31

Hilton- Union Sq 11

Theory Development, Measurement and Testing in Service Science

Sponsor: Service Science

Sponsored Session

Chair: Aleda Roth, Professor, Clemson University, 100 Sirrine Hall, Clemson, SC, United States of America, aroth@clemson.edu

1 - Innovative Experimental Approaches for Behavioral Service Research

Liana Victorino, Assistant Professor, University of Victoria, Peter B. Gustavson School of Business, PO Box 1700 STN CSC, Victoria, BC, V8W 2Y2, Canada, lianav@uvic.ca, Mike Dixon, Rohit Verma

From observation to participation to co-production to co-creation, service operations require customer engagement. Therefore to investigate behavioral issues for service design, researchers must leverage innovative methodologies such as video experiments or illustrated written scenarios. We review examples and offer suggestions for newer applications of experimental approaches for service research.

2 - Success and Failure of Technology-based Innovations in Service Encounters

Min Kyung Lee, Student, Clemson University, 100 Sirrine Hall, Clemson, SC, 29634-1305, United States of America, minl@g.clemson.edu, Mike Dixon, Rohit Verma, Aleda Roth

Technology-based innovations are introduced to increase efficiency and enhance service delivery. However, not every technology is successful for service industry. We present customer usage and preference of technology-based innovations in the US restaurant industry to demonstrate the success or failure of technology-based innovations.

3 - Managerial and Employees' Perceptions of Improvisation in Service Settings: A Multigroup Analysis

Enrico Secchi, Assistant Professor, University of Victoria, Gustavson School of Business, PO Box 1700 STNCSC, Victoria, BC, V8W2Y2, Canada, esecchi@uvic.ca, Aleda Roth, Rohit Verma

This paper tests a model of antecedents and consequences of Service Improvisation Competence-the ability of service delivery employees to promptly deviate from established processes when needed-across samples of hotel managers and employees. We find a mismatch between service design choices and their realization in the service encounter.

4 - Efficiency Analysis of U.S. and Indian Banks: Theory and Evidence

Sriram Venkataraman, Assistant Professor, University of South Carolina, Department of Management Science, Moore School of Business, Columbia, SC, 29208, United States of America, sriram.venkataraman@moore.sc.edu, Aleda Roth, Paul Wilson

By integrating diffusion theory from marketing literature and path dependency theory from economics into service operations, we compare and contrast the efficiency of U.S. and Indian banks. We find that Indian banks have caught up to U.S. banks in terms of efficiency after the entry of foreign banks into India.

■ SD32

Hilton- Union Sq 12

Data Science in Online Retailing

Sponsor: Service Science

Sponsored Session

Chair: Zhiwei (Tony) Qin, Data Scientist, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, tqin@walmartlabs.com

1 - Mixtures of Multivariate Dynamic Linear Models for Demand Forecasting in the Long-Tail Environments

Shubankar Ray, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, SRay@walmartlabs.com, Abhay Jha

We model multivariate time series via dynamic regressions of cross-sectionally correlated sales (from similar products) on structural multivariate Gaussian processes. Bayesian machinery is used to continuously ensemble/learn infinitely many dynamic regressions with new incoming sales; and effectively predict future sales for a variety of retail product categories in long-tail environments.

2 - Product Clustering through Low-rank Matrix Factorization with Side Information

Arnau Puig, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, APuig@walmartlabs.com

We present new matrix factorization techniques that find a representation of products on a lower dimensional space which enhances their clustering into frequently purchased groups. The novelty of our approach resides in the combination of various sources of data to estimate the low dimensional latent factors: an incomplete matrix of customer orders data for each product, and a complete matrix of semantic features that contains item attributes obtained from our catalog.

3 - Real-Time and Scalable Anomaly Detection using Parallel Regression

Derek Farren, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, derek@walmartlabs.com

In this paper we propose Sherlock, a scalable real-time Anomaly Detector that has been tested in large production systems. This Anomaly Detector was developed in order to accurately detect anomalies in massive data streams that can not be monitored with traditional Anomaly Detection solutions because of to the big processing needs required by such streams. We show Sherlock's efficacy and speed by comparing it against other popular Anomaly Detection solutions.

4 - Trend Spotting through Word Clouds: The Effects of Online Product Reviews on Product Sales

Hsuanwei Chen, Assistant Professor, San Jose State University, One Washington Square, San Jose, CA, 95192, United States of America, hsuanwei.chen@sjsu.edu

I will investigate the effects of online product reviews on product sales, particularly from an information visualization perspective. I will conduct a trend spotting analysis on product reviews through word cloud visualizations. The word clouds are used to identify the opinions and sentiments expressed by consumers. I will then examine the relationship between the evolutions of word clouds and product popularity trends (e.g., product sales).

■ SD33

Hilton- Union Sq 13

Incentives and Organizational Issues In New Product Development

Cluster: New Product Development

Invited Session

Chair: Nicos Savva, London Business School, Regentís Park, London, NW1 4SA, United Kingdom, nsavva@london.edu

Co-Chair: Niyazi Taneri, SUTD, 20 Dover Drive, Singapore, Singapore, niyazitaneri@sutd.edu.sg

1 - Resource Allocation Decisions under Imperfect Evaluation and Organizational Dynamics

Nektarios Oraiopoulos, University of Cambridge, Judge Business School, Trumpington Street, Cambridge, CB2 1AG, United Kingdom, n.oraiopoulos@jbs.cam.ac.uk, Jochen Schlapp, Vincent Mak

Every product portfolio manager is challenged by the limited information that she has available when allocating resources across multiple products. Her task is further complicated when this information is obtained from self-interested managers who might have an incentive to be overly optimistic about their own products. Our work studies how balancing individual and shared incentives can mitigate such inefficiencies and improve the product selection process.

2 - How Communication and Incentives Transform a Strategic Plan into Action

Jeremy Hutchison-Krupat, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, KrupatJ@darden.virginia.edu

We study the incentive and communication decisions that senior leadership makes to transform a strategic plan into actions. We embed a game of strategic information transmission in a principal agent framework to study senior leadership's incentive and communication decisions. We provide a characterization of senior leadership's communication and we contrast the results that are driven by an initiative's characteristics as opposed to those that are driven by the structure of the organization.

3 - Too Successful to Innovate? Dynamic Entrepreneurial Reputation and Venture Capital

Noam Shamir, Tel Aviv University, Tel Aviv, Israel, nshamir@post.tau.ac.il, David Zvilichovsky

This research integrates entrepreneurial experience, success, reputation and venture financing into a dynamic model which explores the execution of innovative projects under asymmetric information. We are interested in exploring the tension between the desire of the entrepreneur to exploit the current project opportunity and her understanding that the success or failure in this current project also impacts her future reputation.

4 - Licensing Contracts: Control Rights and Options

Niyazi Taneri, SUTD, 20 Dover Drive, Singapore, Singapore, niyazitaneri@sutd.edu.sg, Bert De Reyck, Pascale Crama

We investigate the impact of control rights, options, payment terms and timing decisions on R&D collaborations. Our study reveals a counterintuitive result; the innovator may, under certain conditions, prefer to grant launch control rights or buy-out options to the marketer despite the fact that both terms restrict its downstream actions. Studying renegotiation and postponed contracting we demonstrate that contract timing can also have a significant influence on the outcome of collaborative R&D.

■ SD34

Hilton- Union Sq 14

Humanitarian Operations Management Applications

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Alfonso Pedraza-Martinez, Assistant Professor, Kelley School of Business, Indiana University, 1309 E 10th Street, Kelley School of Business, IU, Bloomington, In, 47405, United States of America, alpedraz@indiana.edu

1 - Post-Disaster Information Dissemination in Online Social Networks

Eunae Yoo, Arizona State University, PO Box 874706, Tempe, AZ, 85287, United States of America, eunae.yoo@asu.edu, Mahyar Eftekhar, Elliot Rabinovich

Humanitarian organizations utilize social media platforms to collect local and instantaneous data. While this helps resolve post-disaster informational needs, data may be inaccurate. We integrate Network Theory and Information Cascades Theory to explore how information disseminates in online social networks and what network structures affect correction time. Our study contributes by analyzing misinformation propagation and by shedding light on the reliability of social media data.

2 - Service Agreements in Vehicle Leasing Programs: Turning Perception Gaps into Opportunities

Nathan Kunz, Research Fellow, INSEAD, Bd de Constance, Fontainebleau, 77305, France, nathan.kunz@insead.edu, Luk Van Wassenhove

Fleet leasing models in the humanitarian sector have led to significant savings for relief organizations. However, the adoption of this model is inhibited by biased perception from field offices. Through a case study we demonstrate how service agreements and performance measurement can facilitate the acceptance of fleet leasing models and lead to higher efficiency. Our findings are also relevant to other areas in humanitarian logistics similarly affected by perception gaps.

3 - Funding-Strategy Competition in Humanitarian Operations

Arian Aflaki, Duke University, Durham, NC, United States of America, arian.aflaki@duke.edu, Alfonso Pedraza-Martinez

Humanitarian organizations (HOs) follow the general practice of earmarking their funds to specific programs. Extant literature has shown that this practice negatively affects operational performance. To understand HOs' behavior, we use an analytical model that captures the effect of earmarking on operational performance, fundraising effort, and donor preferences. We find that no-earmarking could be a dominant strategy under monopoly; however, competition forces HOs to ask for earmarked funds.

4 - Measuring Humanitarian Response Capacity

Jason Acimovic, The Pennsylvania State University, 462 Business Building, University Park, PA, 16802, United States of America, jaa26@smeal.psu.edu, Jarrod Goentzel

Humanitarian aid organizations may manage several supply depots around the world used to help respond to disasters. They must decide how much to store and how to distribute inventory. We develop a metric based on a stochastic linear program that measures the capacity to respond to a disaster, and the quality of the inventory distribution.

■ SD35

Hilton- Union Sq 15

Decisions in a Nonprofit Supply Chain I

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Gemma Berenguer, Purdue University, 403 W. State St., West Lafayette, IN, 47906, United States of America, gemmabf@purdue.edu

1 - The Nonprofit Newsvendor's Procurement Problem

Gemma Berenguer, Purdue University, 403 W. State St., West Lafayette, IN, 47906, United States of America, gemmabf@purdue.edu, George Shanthikumar

The standard decision-making policies developed to efficiently run operations by for-profit organizations are not always efficient when run by nonprofit organizations. This talk focuses on the analysis of the newsvendor problem in a nonprofit context. Several scenarios are analyzed including the newsvendor problem that incorporates the external influence of the government through the use of subsidies.

2 - Dynamic Programming to Reduce Food Waste at Campus Dining Services

Esma Birisci, PhD Student, University Of Missouri, 217 W Broadway Apt C31, Columbia, United States of America, esmabirisci@mail.missouri.edu, Ronald McGarvey

In this study we propose a dynamic programming equation for minimizing food wastage in a stochastic inventory model at the University of Missouri. The aim is to reduce food wastage over multi-period horizon by taking into account uncertain demand. Mainly, focusing on how food production and ordering decision can reduce storage losses and over preparation loses. Because of uncertainty of demand, we use robust optimization to make decision on quantity of order for Campus Dining Services.

3 - Dynamic Facility Location and the Value of Inventory Mobility in Disaster Relief

Amber Richter, PhD Candidate, University of California, Berkeley, 4141 Etcheverry Hall, Berkeley, CA, 94720, United States of America, amberr@berkeley.edu, Zuo-Jun Max Shen

This research examines dynamic inventory relocation for responding to disasters over time. We model the problem using dynamic programming (DP) and find analytical and numerical results regarding optimal movement policies and the value of inventory mobility over traditional warehouse pre-positioning. We develop a heuristic which, on average, solves large instances of the problem within 0.5 percent of optimality in less than 1 percent of the time taken by an exact backward DP algorithm.

4 - Foreclosure Operations and Strategy Design for Community-based Organizations

Michael Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu, Senay Solak, David Turcotte, Jeffrey Keisler

The foreclosure crisis in the U.S. has resulted in immense economic and social losses for individuals and neighborhoods. The scale of the problem and the financial and technical limitations of not-for-profit responding organizations require novel methods for community stabilization and revitalization. We discuss neighborhood-based decision modeling responses that support housing acquisition and redevelopment as well as alternative land uses, depending on the likelihood of continued local decline.

■ SD36

Hilton- Union Sq 16

Wireless Mobility Modeling

Sponsor: Telecommunications

Sponsored Session

Chair: David Shallcross, Applied Communication Sciences, 150 Mount AIry Road, Basking Ridge, NJ, 07920, United States of America, dshallcross@appcomsci.com

1 - Hadal Zone Networks Modeling

Michael Bartolacci, Pennsylvania State Univesity, Berks, Reading, PA, 19610, United States of America, mbartolacc@aol.com

There has been recent interest in the exploration of the hadal zones of the world's oceans, the parts of the oceans that are below 6,000 meters deep. Recent interest in such explorations have brought to light the need for networks that can support the use of undersea technologies. Model such hybrid networks represents a challenge from several points of view: propagation of signals through the deep ocean, power conservation, heterogeneous hybrid nature of network devices, and other factors.

2 - Distributed Location of Wireless Mobile Relay Nodes
David Shallcross, Applied Communication Sciences, 150 Mount AIry Road, Basking Ridge, NJ, 07920, United States of America, dshallcross@appcomsci.com, Eric Van Den Berg

Client nodes distributed over an area may require relay nodes to enable communication. We consider mobile relay nodes, such as unmanned aerial vehicles, that may travel to position. We investigated variations of a simple distributed algorithm to minimize link lengths, and improve capacity. This is related to the Euclidean Steiner tree problem. We have both theoretical results and experimental results.

3 - Optimal Sensor Deployment to Increase the Security of the Maximal Breach Path
Necati Aras, Bogazici University, Bebek, Istanbul, Turkey, arasn@boun.edu.tr, Kuban Altinel, Ezgi Karabulut

We focus on an application of wireless sensor networks for border surveillance. It is a bilevel optimization problem involving two players. The defender is the leader of the Stackelberg game and wants to determine the best sensor locations in order to maximize the security in the area. The intruder, who is the follower, is capable of destroying some of the sensors to identify the maximal breach path. For the solution of the model we propose three heuristics based on Tabu search.

■ SD37

Hilton- Union Sq 17

Social Intelligence: Learning, Aggregation and Applications

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Ankur Mani, Massachusetts Institute of Tech, 20 Ames Street #385, Cambridge, MA, 02139, United States of America, amani@MIT.EDU

1 - Homophily in Voter Networks
Peter Krafft, Massachusetts Institute of Tech, 20 Ames Street #385, Cambridge, MA, 02139, United States of America, pkrafft@mit.edu, Ankur Mani, Alex Pentland, Joshua Tenenbaum

In this work we study the effect of network homophily on voting outcomes in multicandidate elections. We observe that homophily among rational voters affects this type of election by shifting the distribution of votes away from center candidates, which may lead to non-central candidates winning more often.

2 - Point of View and Manipulation on Wikipedia
Sanmay Das, Associate Professor, Washington University in St. Louis, sanmay@seas.wustl.edu, Allen Lavoie, Malik Magdon-Ismail

We describe new machine learning techniques for automatic classification of points of view and detection of possible manipulation on Wikipedia, and show how these techniques can be used to study social processes. In particular, we discuss applications to understanding administrator promotion elections as well as the evolution of Wikipedia pages in terms of which points of view are represented.

3 - Airplanes Aloft as a Sensor Network for Wind Forecasting
Debadeepta Dey, United States of America, debadeep@cs.cmu.edu, Ashish Kapoor

We explore the feasibility of using commercial aircraft as sensors for observing weather phenomena at a continental scale. We focus on the problem of wind forecasting and explore the use of machine learning and inference methods to harness air and ground speeds reported by aircraft at different locations and altitudes. We validate the learned predictive model with a field study where we release an instrumented high-altitude balloon and compare the predicted trajectory with the sensed winds.

■ SD38

Hilton- Union Sq 18

Healthcare Analytics

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Dept. SGMH-4113, 800 N State College Blvd, Fullerton, CA, 92831, United States of America, smitra@fullerton.edu

1 - Studying Consumer Behavior for Adopting Social and Mobile Media for Health Management via Analytics
Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Dept. SGMH-4113, 800 N State College Blvd, Fullerton, CA, 92831, United States of America, smitra@fullerton.edu, Rema Padman

Advances in technology and increased availability of large amounts of data in the recent decade has made it possible to use extensive analytical methods for effective decision-making, particularly in the healthcare industry. Based on a member survey of a large health plan, we identify factors (demographic, clinical and technological) that are significantly associated with member interest in adopting social and mobile media for obtaining health information from the health plan via analytics.

2 - On Learning and Visualizing Practice-based Clinical Pathways for Chronic Kidney Disease
Yiye Zhang, Carnegie Mellon University, 532 Tyrella Ave, Apt 56, Mountain View, CA, 94043, United States of America, yiyez@andrew.cmu.edu, Larry Wasserman, Rema Padman

This study analyzes the treatment data of chronic kidney disease (CKD) patients. We use hierarchical clustering based on longest common subsequence distance to discover patient subgroups, and represent each subgroup's clinical pathway as 2nd-order Markov chains to learn practice-based clinical pathways. Further, we model treatments as hidden states, and laboratory data as observations in the context of hidden Markov model, to decode the most likely sequence of treatments given laboratory data.

3 - Impact of Individual and Organizational Usage Experience on eVisit Service Efficiency
Changmi Jung, changmi@andrew.cmu.edu, Ateev Mehrotra, Rema Padman, Linda Argote

In this study, we aim to understand how the service efficiency is linked to individual and organizational usage experience. We address our questions by using physicians' evaluation time associated with eVisits in primary care practices affiliated with a major academic medical center. Results demonstrate that there is evidence of individual learning with moderating effect from physicians' system expertise, and complementing effect from organizational experiences on physician service efficiency.

4 - Evaluating m-Health Services for User Engagement and Health Promotion: A Randomized Field Experiment
Yi-chin Lin, Carnegie Mellon University, 4800 Forbes Ave HBH 3011, Pittsburgh, PA, 15213, United States of America, yichinl@andrew.cmu.edu, Vibhanshu Abhishek, Julie Downs, Rema Padman

Mobile technologies have the potential to engage patients and change their healthy behaviors, yet little evidence has been documented. Drawing on theoretical frameworks, this study proposes novel mobile-enabled interventions to improve healthy eating behaviors. The effects of interventions are examined via a randomized field experiment. Analysis of objective usage and subjective survey data provide strategic insights that can be generalized to other healthy behaviors.

■ SD39

Hilton- Union Sq 19

Joint Session HAS/Analytics/CPMS: Practicing OR/OM in Healthcare Providers - A Panel

Sponsor: Health Applications, Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Alexander Gutfraind, Research Assistant Professor, University of Illinois at Chicago, 1603 W. Taylor Street, MC 923, Chicago, IL, 60612, United States of America, agutfraind.research@gmail.com

1 - Panel on Implementation of Operations Research/Operations Management in Healthcare
Alexander Gutfraind, Research Assistant Professor, University of Illinois at Chicago, 1603 W. Taylor Street, MC 923, Chicago, IL, 60612, United States of America, agutfraind.research@gmail.com, Tarun Mohan Lal

Leading healthcare organizations like the Mayo Clinic, Geisinger Health System, and Cincinnati Children's Hospital have benefited from utilizing OR/OM and present approaches from idea generation to implementation. The panel will share examples that have benefited their organization, highlight tools and applied technologies, as well as present challenges and successes that can be translated for both academics and practitioners.

2 - Bridging the Gap between Theory & Application at Geisinger Health System
Christopher Strömblad, Senior Modeler - Operations Research, Geisinger Health System, 100 N. Academy Ave, Danville, PA, 17822, United States of America, chris.stromblad@gmail.com

This will be an integrated part of the above panel discussion with OR/OM practitioners in leading healthcare organizations.

3 - using Analytics to Improve Quality at Cincinnati Children's Hospital

Denise White, PhD, Director, QI Analytics, Cincinnati Children's Hospital, 3333 Burnet Avenue, Cincinnati, OH, United States of America, DeniseL.White@cchmc.org

This will be an integrated part of the above panel discussion with OR/OM practitioners in leading healthcare organizations.

■ SD40

Hilton- Union Sq 20

Public Health Applications

Sponsor: Health Applications

Sponsored Session

Chair: Margaret Brandeau, Professor, Stanford University, MS&E Department, Stanford, CA, 94305, United States of America, brandeau@stanford.edu

1 - Cost-effectiveness of Cardiac Resynchronization Therapy Defibrillator in Mild Heart Failure

Allison Pitt, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, alpitt@stanford.edu, Christopher Woo, Erika Strandberg, Jeremy Goldhaber-Fiebert, Mark Hlatky, Michelle Schmiegelow, Douglas K. Owens

Objective: We develop a decision analytic Markov model to estimate the cost-effectiveness of cardiac resynchronization therapy (CRT) in addition to an implantable cardioverter-defibrillator (ICD), compared with ICD alone, in patients with left ventricular systolic dysfunction, prolonged intraventricular conduction, and mild heart failure. Results: CRT plus ICD increased life expectancy and QALYs compared with ICD at a cost of $70,000 per QALY gained.

2 - Optimal Screening Strategies for Cervical Cancer

Esma Gel, Associate Professor, Arizona State University, 699 S Mill Ave, BYENG 318, Tempe, AZ, 85281, United States of America, Esma.Gel@asu.edu, Raha Akhavan Tabatab, Isabel Namen Leon

The recent use of the human papillomavirus DNA (HPV) test has motivated questions on how the test should be used in conjunction with traditional cervical cancer screening methods such as pap smear. We propose a POMDP model to suggest optimal policies for cervical cancer screening and prevention. For a case study, we use data from a practice in Colombia as well as specificity/sensitivity results from the medical literature to provide guidelines on optimal screening strategies for cervical cancer.

3 - Planning for HIV Screening, Testing and Care at the Veterans Health Administration

Sandeep Rath, PhD Student, UCLA Anderson, B513 Gold Hall, 110 Westwood Plaza, Los Angeles, CA, 90024, United States of America, sandeep.rath.2015@anderson.ucla.edu, Sarang Deo, Kumar Rajaram

CDC has recommended a routine screening policy for HIV. We modeled a QALY maximizing nonlinear mixed integer program incorporating system dynamics and disease progression and found that routine screening may not be always feasible. We applied this model to the Greater Los Angeles station of the Veterans Health Administration and used it to develop and evaluate managerially relevant policies within existent capacity and budgetary constraints to improve upon the current screening policy.

4 - Expansion of the National Salt Reduction Initiative: Requirements for Reducing Cardiovascular Disease

Sung Eun Choi, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, sungeunc@stanford.edu, Sanjay Basu, Margaret Brandeau

A number of public health programs, including National Salt Reduction Initiative, are increasingly seeking to mitigate upstream causes of high cardiovascular disease mortality in the United States by reducing dietary sodium intake. Individuals have different degrees of benefit from sodium reduction, given their demographic characteristics, such as age, race, and income. A microsimulation model was developed to investigate these complexities affecting national efforts to reduce dietary sodium.

■ SD41

Hilton- Union Sq 21

Decision Modeling for Disease Prevention Considering Imperfect Screening

Sponsor: Health Applications

Sponsored Session

Chair: Mahboubeh Madadi, PhD Candidate, University of Arkansas, 4117 Bell Engineering Center 1 Universit, Fayetteville, AR, 72701, United States of America, mmadadi@email.uark.edu

1 - A Simulation-based Cost-effectiveness Study on Age and Gender-specific CRC Screening Strategies

Nan Kong, Assistant Professor, Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, 47907, United States of America, nkong@purdue.edu, Carolina Vivas Valencia, Robert Klein, Thomas Imperiale

Current colorectal cancer (CRC) screening guidelines do not tailor recommendations to patients of different risks. However, there is new evidence that polyps form earlier and progress faster in men. We extend the Vanderbilt-NC State CRC simulation model and update model parameters based on recent evidence. Model-based cost-effectiveness analyses are conducted for distinct age- and gender-specific subpopulations. Our results quantify the benefits of starting screening earlier in men than women.

2 - Considering Heterogeneity of Provider Implementation of Screening Policies in Simulation models

Irene Vidyanti, Los Angeles Department of Public Health, 3530 Wilshire Boulevard, Los Angeles, CA, 90010, United States of America, irenevidyanti@gmail.com, Shinyi Wu

Imperfect screening requires a targeted approach and cooperation from providers to implement evidence-based policies. Implementation at the provider level and provider's heterogeneity of implementation then becomes an important issue in accurately assessing cost-benefit of screening. We use the case of Diabetic Retinopathy screening to compare a simulation model that takes into account heterogeneity of provider implementation with one that does not to show differences in precision of estimates.

3 - Analyzing the Effects of Different Models of Screening Choice in Colorectal Cancer Outcomes

Maria Mayorga, Associate Professor, North Carolina State University, 111 Lampe Dr., Raleigh, NC, 27695, United States of America, memayorg@ncsu.edu, Rachel Townsley, David Cornejo, Kristen Hassmiller Lich

Modality and compliance choice decisions substantially affect the health outcomes in colorectal cancer screening programs. We have created a dynamic simulation model that evaluates the effects of individual choice of screening modality and compliance on health outcomes. We experiment with different frameworks for defining these choice decisions. We find that the embedded assumptions of these choice frameworks lead to different results.

4 - A Nonlinear Programming Model to Optimize Screening Policies Considering Patients' Adherence

Mahboubeh Madadi, PhD Candidate, University of Arkansas, 4117 Bell Engineering Center 1 Universit, Fayetteville, Ar, 72701, United States of America, mmadadi@email.uark.edu, Shengfan Zhang, Edward Pohl

Patients' imperfect adherence is one of the issues that physicians encounter when recommending their patients undergo screening tests such as mammography. In this study, a nonlinear optimization model is developed to extract a screening guideline that minimizes the risk of a disease getting clinical while taking into account uncertainty in patient adherence behavior. Some numerical examples with application to screening mammography tests are solved using a heuristic method.

■ SD42

Hilton- Union Sq 22

Healthcare Operations

Sponsor: Health Applications

Sponsored Session

Chair: Mehmet Erkan Ceyhan, Operations Research Manager, Lahey Hospital & Medical Center, 41 Mall Road, Burlingto n, United States of America

1 - Anesthesiologist and Nurse Anesthetist Assignment

Ayten Turkcan, Northeastern University, Mechanical and Industrial Engineering, Boston, MA, 02115, United States of America, a.turkcan@neu.edu, Mehmet Erkan Ceyhan, Sina Aghsaei

We worked with the Surgery Department at Lahey Hospital and Medical Center to develop an optimization based decision support tool to solve anesthesiologist and nurse anesthetist (CRNA) assignment problem. We proposed integer programming models that consider working hours, skill levels, surgery durations, and difficulty of surgeries to assign anesthesiologists and CRNAs to operating rooms on the day of the surgery with the objective of balancing workload.

2 - Simulation of Chemotherapy Patient Flow in an Oncology Clinic

Bohui Liang, Northeastern University, Mechanical and Industrial Engineering, Boston, MA, 02115, United States of America, liang.boh@husky.neu.edu, Ayten Turkcan, Mehmet Erkan Ceyhan

We worked with the Hematology and Oncology Clinic at Lahey Hospital and Medical Center to improve patient flow and appointment scheduling for chemotherapy patients. We developed a discrete event simulation model to evaluate the operational performance in the clinic and to identify initiatives for improvement in process flow, scheduling and staffing. We proposed a mathematical programming model to generate balanced appointment schedules for oncologist visit and chemotherapy treatment.

3 - Stochastic Appointment Sequencing and Scheduling with Heterogeneous Service Times and No-show Rates

Onur Arslan, Teaching Assistant, Northeastern University, 360 Huntington Avenue, Boston, MA, 02115, United States of America, arslan.o@husky.neu.edu, Ayten Turkcan

We solve appointment sequencing and scheduling problem in a primary care setting where multiple patients with heterogeneous service time distributions and no-show probabilities are considered. We propose a two-stage stochastic programming model that minimizes waiting time, idle time, and overtime cost. We present the properties of an optimal solution for special cases, and provide comparative results for different service time distributions, uncertainty levels, and cost coefficients.

■ SD43

Hilton- Union Sq 23

Sparse Optimization: Theory and Applications

Sponsor: Computing Society

Sponsored Session

Chair: Dongdong Ge, Shanghai University of Finance and Economics, 777 Guoding Road, Shanghai, China, dongdong@gmail.com

1 - A Linear Time Algorithm for Bridge Regression Problem

Dongdong Ge, Shanghai University of Finance and Economics, 777 Guoding Road, Shanghai, China, dongdong@gmail.com

In this paper we consider a class of non-Lipschitz and non-convex minimization problems which generalize the L2-Lp minimization problem. We propose an iterative algorithm that decides the next iteration based on the local convexity/concavity/sparsity of its current position. We show that our algorithm finds a nearly KKT point within linear time iterations.

2 - New Analysis on Sparse Solutions to Random Standard Quadratic Optimization Problems and Extensions

Xin Chen, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, xinchen@illinois.edu, Jiming Peng

The standard quadratic optimization problem (StQP) refers to the problem of minimizing a quadratic form over the standard simplex. Such a problem arises from numerous applications and is known to be NP-hard. In this talk, we present an analysis for random StQPs combining probability inequalities derived from both the first-order and second-order optimality conditions to quantify the sparsity of optimal solutions, significantly improving our previous results.

3 - A Fast First Order Algorithm for Linear Constrained L2-Lp Problem

Rongchuan He, City University of Hong Kong, AC1-G7722, Tat Chee Ave 83, Kowloon, 852, Hong Kong - PRC, rongchuhe2@gmail.com

We propose a fast first order algorithm for solving linear constrained L2-Lp problem, which is shown to have the worst complexity O(\epsilon^-2) to reach an ϵ-KKT point. Further more, we use several techniques, such as lower bound cut, noise de-blurring and so on, to improve the speed of the algorithm and the quality of the solution. Numerical results on several applications demonstrate the efficiency of our algorithm.

4 - SOCP Formulation for Singly Constrained QCQP

Rujun Jiang, Student, CUHK, Department of Seem,CUHK,HK, Hong Kong, Hong Kong - PRC, rjjiang@se.cuhk.edu.hk, Duan Li

We investigate a general class of singly constrained QCQP. Applying simultaneous block diagonalization, we obtain a congruent canonical form for both symmetric matrices in the objective function and in the constraint. We derive necessary conditions for the solvability of QCQP. For all solvable QCQP problems, we can transform them into their corresponding SOCP formulation. Compared to the state-of-the-art in formulating QCQP as SDP, our SOCP formulation delivers a much faster solution algorithm.

■ SD44

Hilton- Union Sq 24

Social Media and Virtual Worlds

Sponsor: Information Systems

Sponsored Session

Chair: Sunil Wattal, Temple Univ, 1810 N 13 Street, Philadelphia, PA, 19122, United States of America, swattal@temple.edu

1 - Anonymity and Information Revelation in Online Crowdfunding

Sunil Wattal, Temple Univ, 1810 N 13 Street, Philadelphia, PA, 19122, United States of America, swattal@temple.edu, Gordon Burtch, Anindya Ghose

Most online crowdfunding platforms maintain a public record of transactions while providing users with transaction-level information controls, which enable them to conceal their identity or contribution amount. In this study, we explore the impact of these information control mechanisms on crowdfunder behavior, acknowledging possible positive (e.g., comfort) and negative (e.g., privacy priming) impacts. We also discuss the implications of our findings for the design of online platforms.

2 - Through the Looking Glass: The Relationship between Real World and Virtual World Behavior

Michael Frutiger, PhD Candidate, GT Scheller College of Business, 800 West Peachtree Street, Atlanta, GA, 30308, United States of America, mike.frutiger@scheller.gatech.edu, Eric Overby, D. J. Wu

Online services increasingly support complex individual expression by providing rich environments that are substantially abstracted from real-world experiences. While real-world meaning is often inferred from user online behavior (and vice versa), there is a limited understanding of how these are related. Using a combination of survey and archival data, this study contributes to a foundational understanding of the relationship between an individual's real world and virtual world behavior.

3 - Impact of Platform Integration on Consumer Demand in Complementary Markets

Zhuoxin Allen Li, PhD Student, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78703, United States of America, zhuoxin.li@phd.mccombs.utexas.edu, Ashish Agarwal

Platform owners often seek for complementary innovations from third-party providers (third-party contents), while at the same time providing their own applications to consumers (first-party contents). Using the Facebook platform as an example, we study the impact of Facebook's acquisition and tighter integration of Instagram on consumer demand for Instagram and other photo-sharing applications provided by third-party developers.

■ SD45

Hilton- Union Sq 25

INFORMS BOM Best Working Paper Award Finalist Presentations

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Brent Moritz, Assistant Professor, Penn State University, 469 Business Building, University Park, PA, 16802, United States of America, bmoritz@psu.edu

1 - INFORMS BOM Section Best Working Paper Award

Brent Moritz, Assistant Professor, Penn State University, 469 Business Building, University Park, PA, 16802, United States of America, bmoritz@psu.edu

The three finalists from the 2014 best working paper competition will be presenting their papers.

■ SD46

Hilton- Lombard

New Developments on MINLP and MIQCP

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Daniel Bienstock, Columbia University, 500 W. 120th Street, New York, NY, United States of America, dano@columbia.edu

1 - A Two-Variable Analysis of the Two-Trust-Region Subproblem

Boshi Yang, University of Iowa, Department of Mathematics, 14 MacLean Hall, Iowa City, IA, 52242, United States of America, boshi-yang@uiowa.edu, Samuel Burer

The two trust-region subproblem (TTRS) minimizes a general quadratic function over the intersection of two ellipsoids. For this problem, a general semidefinite-programming (SDP) relaxation admits a gap. In this paper, for the special case of TTRS with two variables, we fully characterize the remaining valid inequalities to close the gap. We also discuss computational issues and generalizations to the case of an arbitrary number of variables.

2 - Branch-and-Cut for Integer Programs with Complementarity Constraints

Ismael de Farias, Texas Tech, Department of Industrial Engineering, Lubbock, TX, United States of America, ismael.de-farias@ttu.edu

We give new inequalities valid for the complementarity-constrained optimization problem (CCOP), and in particular for CCOPs that are mixed-integer. We then present an extensive computational study where we discuss the effectiveness of different formulations for CCOP and the dramatic reduction in computational time, over some professional optimization solvers, that results from using the inequalities, particularly when the variables are constrained to be integers.

3 - Extended Formulations for Conic Quadratic Mixed Integer Programming

Juan Pablo Vielma, Assistant Professor, Massachusetts Institute of Technology, E62-561, 77 Massachusetts Ave, Cambridge, MA, 02142, United States of America, jvielma@mit.edu

An extended formulation for Mixed Integer Programming (MIP) is a formulation that uses a number of auxiliary variables in addition to the original or natural variables of a MIP. Extended formulations for linear MIP have been extensively used to construct small, but strong formulations for a wide range of problems. In this talk we consider the use of extended formulations in quadratic MIP and show how they can be used to improve the performance of branch-and-cut algorithms.

4 - Progress on Solving Quadratically Constrained Optimization Problems

Daniel Bienstock, Columbia University, 500 W. 120th Street, New York, NY, United States of America, dano@columbia.edu

We present results and survey older results on solving optimization problems subject to multiple quadratic constraints, starting with the classical CDT (Celis Dennis Tapia) problem (minimizing a general quadratic subject to two ellipsoidal constraints).

■ SD47

Hilton- Mason A

Computations and Applications of Stochastic/Robust Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu

1 - Stochastic Inventory Systems with Service Level Constraints: Structures and Approximations

Yuchen Jiang, University of Michigan, G815 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, ycjiang@umich.edu, Cong Shi, Siqian Shen

We study multiperiod stochastic inventory systems with probabilistic service level guarantees for restricting stockout probabilities. We prove that base-stock policies are optimal in the backlogging model and partially characterize optimal policies in the lost-sales model with positive lead time. We also propose an efficient approximation algorithm that admits a worst-case performance guarantee of 2 for the backlogging model and give an effective heuristic policy for the lost-sales model.

2 - A New Method for Solving Large-scale Multi-stage Stochastic Integer Programs

Osman Ozaltin, Assistant Professor, North Carolina State University, Industrial and Systems Engineering, Raleigh, United States of America, oyozalti@ncsu.edu, Burhaneddin Sandikci

Many large-scale multi-stage stochastic integer programs are among the most computationally challenging optimization problems. We propose a new solution method based on scenario decomposition, which is inherently parallelizable. Computational experiments demonstrate that the proposed method scales nicely with problem size and produces high quality solutions to practical instances within a reasonable time.

3 - Appointment Scheduling in Two-stage Stochastic Service Systems

Qingxia Kong, Assistant Professor, Universidad Adolfo Ibañez, Av. Diagonal Las Torres 2700, 531C, Penalolen, Santiago, Chile, q.kong@uai.cl, Chung-Piaw Teo, Zhichao Zheng

We study the design of healthcare appointment system when the patients need to go through two stages of service with stochastic duration. The problem is motivated by a case from en eye clinic where the patients have to take some tests (e.g., visual acuity test, dilation, etc.) before the consultation with the doctor. We use a network flow model to capture the dynamics of the system and develop a co-positive program to solve the appointment scheduling problem.

4 - Solution of Moment Robust Optimization using a New Cutting Surface Algorithm

Sanjay Mehrotra, Professor, Northwestern University, 2145 Sheridan Rd, Industrial Engineering & Mgmt. Sciences, Evanston, IL, 60208, United States of America, mehrotra@northwestern.edu

A central cutting surface method for semiinfinite convex problem, and its use to develop an algorithm for distributional robust optimization is presented. The uncertainty set consists of distributions with bounds on generalized moments of any arbitrary order. Results showing improvements over cutting plane approaches are presented. Computational experience and theoretical results on this moment robust optimization framework will also be presented.

■ SD48

Hilton- Mason B

Applications of Stochastic Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Kai Huang, Dr., McMaster University, 1280 Main St. W, Hamilton, On, L8S 4L8, Canada, khuang@mcmaster.ca

1 - Total Power Optimization of Multiple Wind Turbines

Shengyuan Chen, Assistant Professor, York University, 4700 keele street, Toronto, Canada, chensy@mathstat.yorku.ca, Yousef Akhavan, Dong Liang

Though the optimal operating point of a single wind turbine is known, the optimal operation of multiple wind turbines of a wind farm is a less explored area. We model the problem as a PDE-constrained optimization.

2 - Inventory Management Based on Target-Oriented Robust Optimization

Yun Fong Lim, Associate Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, yflim@smu.edu.sg, Chen Wang

We propose a target-oriented robust optimization approach to solve a multi-product, multi-period inventory management problem subject to ordering capacity constraints. By tuning a cost target, we can achieve a balance between expected cost and the associated cost variance. Our approach significantly outperforms traditional methods based on dynamic or stochastic programming if inaccurate demand distributions are used. We apply our approach to two case studies from different industries.

3 - Resource Planning under Uncertainty

Haitao Li, Associate Professor, College of Business Administration, 229 ESH, One University Blvd, St. Louis, MO, 63121-4400, United States of America, lihait@umsl.edu, Carlos Valencia, Cipriano Santos, Sergio Perez, Ivan Perez, Marcos Vargas

Service enterprises face various uncertainties of project win probability and attrition in their daily operations. We have extended our existing deterministic resource planning (RP) model, developed at HP, to a stochastic one for explicitly handling uncertainties. Various efficient algorithms are developed to solve large-size problems with up to thousands of resources and jobs. Comprehensive computational study has shown significant benefit of our methodology for real world applications.

■ SD49

Hilton- Powell A

Optimal Allocation of Scarce Infrastructure Capacity: Lessons from Different Network Industries

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Mort Webster, Associate Professor, Penn State, 123 Hosler Bldg, State College, PA, 16802, United States of America, mort@MIT.EDU

1 - Design of Capacity Pricing and Capacity Allocation Mechanisms in Shared Railway Systems

Maria Teresa Pena Alcaraz, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-246, Cambridge, Ma, 02139, United States of America, maitepa@MIT.EDU, Joseph Sussman, Mort Webster, Andres Ramos Galan, Jose A. Gomez-Ibanez

The use of shared railway systems enables high utilization of rail infrastructure. High utilization translates into efficiency gains for railways where infrastructure is often expensive and scarce. However, shared use requires the design of capacity pricing and allocation mechanisms to coordinate the infrastructure manager and the train operators (which trains access the system, when and at what price). This research analyzes how the design of these mechanisms impacts the system performance

2 - Design of a Capacity Allocation Mechanism for Airport Congestion Mitigation

Alexandre Jacquillat, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-246, Cambridge, MA, 02139, United States of America, alexjacq@mit.edu, Amedeo Odoni, Mort Webster

We design a mechanism for allocating airport capacity to competing airlines to mitigate congestion. We consider airlines' preferred flight schedules and airport capacity estimates. We develop a flight rescheduling approach to meet efficiency (minimizing scheduling changes), equity (balancing fairly changes across airlines) and reliability (reducing delays) objectives. It integrates an Integer Programming scheduling model, a Dynamic Programming operational model and a queuing model of congestion.

3 - Allocating and Planning Transmission in Competitive Power Markets

Jonathan Ho, Johns Hopkins University, 313 Ames Hall, Baltimore, MD, United States of America, jho19@jhu.edu, Ben Hobbs, Pearl Donohoo-Vallett, Francisco Munoz, Ozge Ozdemir

Electric transmission planning and allocation is radically changing due to restructuring, which has separated generation and transmission ownership, and the increasing importance of small-scale (distributed) generation and remote large-scale renewable power sources. Transmission planning must consider long-run uncertainties and the response of generation siting and operating decisions, implying a important role for stochastic, multi-level optimization. We provide computational examples.

4 - A Case for Virtualizing the Electric Utility in Cloud Data Centers

Bhuvan Urgaonkar, Associate Professor, Pennsylvania State University, 338D IST Building, State College, PA, 16802, United States of America, bhuvan@cse.psu.edu

Several shortcomings arise from the big gap that exists between the pricing interfaces exposed by electric utilities to clouds and by clouds to their tenants. To overcome these, we propose the idea of a virtual electric utility that cloud providers should expose to individual tenants. We discuss initial ideas for pricing design and cost-effective control in such environments.

■ SD50

Hilton- Powell B

Network Design with Hubs I

Cluster: Network Design

Invited Session

Chair: Hans-Jurgen Sebastian, Professor, RWTH Aachen University, Kackertstrafle 7B, Aachen, NR, D-52062, Germany, sebastian@or.rwth-aachen.de

1 - Modeling Hub Location and Network Design with Fixed and Variable Costs

James Campbell, campbell@umsl.edu, Ricardo Saraiva de Camargo, Gilberto de Miranda Jr., Morton O'Kelly

Many hub location models adopt restrictive assumptions on the topology, path lengths or cost structure. We present a new hub location and network design model with fixed and variable costs for all arcs that allows direct O-D arcs and incomplete hub networks. Results document a wide range of different types of optimal hub networks that emerge based on the relative cost pressures.

2 - Consolidation of Residual Volumes in a Parcel Service Provider's Long-haul Transportation Network

Martin Baumung, RWTH Aachen University, Kackertstr. 7, Aachen, 52072, Germany, baumung@or.rwth-aachen.de, Halil Ibrahim Guenduez

We consider the direct long-haul transportation network of a parcel service provider where transports are carried out using swap bodies. Our focus is on residual volumes, which are not enough to fill a swap body, and investigate how consolidation using hubs can lead to cost reduction through better capacity utilization. We developed a corresponding model minimizing total costs consisting of transportation costs for the swap bodies and costs for the additional sorting required in the hubs.

3 - Planning Tank Wash Activities for Dispatch Optimization in Bulk Transport Operations

Ted Gifford, Distinguished Member of Technical Staff, Schneider National Inc., 3101 Packerland Dr., Green Bay, WI, 54313, United States of America, giffordt@schneider.com

Over-the-road transportation of liquid bulk chemicals are significantly complicated by requirements to wash and prep tanker trailers between shipments. These washes occur at a limited number of facilities distributed across the service region. We consider these facilities as de facto hubs in a network and describe methods to provide minimum cost solutions for assigning tankers to wash facilities and optimal matching of drivers and tanker trailers to shipments.

■ SD51

Hilton- Sutter A

Recent Advances in Numerical Aspects for Nonlinear Programming

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Andreas Waechter, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, andreas.waechter@northwestern.edu

1 - JuMP: Nonlinear Modeling with Exact Hessians in Julia

Miles Lubin, MIT Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, mlubin@MIT.EDU, Iain Dunning, Joseph Huchette

We describe the recent advances for nonlinear programming in JuMP, a solver-independent easy-to-use open-source algebraic modeling language built on top of the Julia programming language. This includes a reimagined implementation of Automatic Differentiation (AD) techniques for computing exact sparse Hessian matrices which takes advantage of Julia's advanced technical features like just-in-time compilation and metaprogramming. We present performance comparisons with AMPL.

2 - A Derivative-free Method for Solving Nonlinear Problems with Deterministic Noise

Andreas Waechter, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, andreas.waechter@northwestern.edu, Irina Dolinskaya, Alvaro Maggiar

We present a derivative-free algorithm for problems with deterministic noise. In contrast to previously proposed methods, we do not assume a stochastic objective function whose value is determined as the expected value of a random variable. Instead, the algorithm optimized a modified objective function that is smoothed using a Gaussian kernel. The method is based on an approximation of the modified objective function that is based on random sampling.

3 - Experiments with Linear and Nonlinear Optimization using Quad Precision

Ding Ma, Stanford University, Dept of MS&E, Huang Engineering Center, Stanford, CA, 94305, United States of America, dingma@stanford.edu, Michael Saunders

For challenging numerical problems, Kahan has said that "default evaluation in Quad is the humane option". We describe experiments on multiscale linear and nonlinear optimization problems using a Quad implementation of MINOS.

■ SD52

Hilton- Sutter B

Advances in Binary Quadratic Programming

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Nathan Krislock, Northern Illinois University, Department of Mathematical Sciences, DeKalb, IL, 60115-2888, United States of America, krislock@math.niu.edu

1 - Quadratization of Pseudo-Boolean Functions

Endre Boros, Distinguished Professor, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, endre.boros@rutgers.edu, Martin Anthony, Yves Crama, Aritanan Gruber

Representing high degree binary optimization problems as equivalent quadratic optimization is an idea introduced originally by Rosenberg in 1975. Such a transformation allows the derivation of persistencies, leading to simplifications in the problem. The price we pay is the higher number of variables. In this research we provide new quadratization algorithms, and tight lower and upper bounds for the number of additional variables.

2 - Separating Hierarchical Cuts to Strengthen Semidefinite Relaxations of Max-Cut Problems

Elspeth Adams, Polytechnique Montreal, Montreal, Canada, elspeth.adams@polymtl.ca, Miguel Anjos, Franz Rendl, Angelika Wiegele

The max-cut problem can be closely approximated using the basic semidefinite relaxation. This relaxation can be further improved by adding valid inequalities. We propose projection polytopes as a new way to improve the relaxation. We further discuss the problem of identifying promising projection polytopes to add to the relaxation. Theoretical and computational results will be presented.

3 - Some Experiences with Solving Semidefinite Programming Relaxations in Computational Biology

Alexander Engau, Assistant Professor, University of Colorado Denver, 1250 14th Street, Denver, CO, 80202, United States of America, aengau@alumni.clemson.edu

We present two recent integer programming models in molecular biology and study practical reformulations to compute solutions to some of these problems. In extension of previously tested linearization techniques, we formulate a class of corresponding semidefinite relaxations and discuss practical rounding strategies to find good feasible approximate solutions. Our computational results highlight the possible advantages and remaining challenges of this approach especially on large-scale problems.

4 - BiqCrunch: A Semidefinite-based Solver for Binary Quadratic Problems

Nathan Krislock, Northern Illinois University, Department of Mathematical Sciences, DeKalb, IL, 60115-2888, United States of America, krislock@math.niu.edu, Jérome Malick, Frédéric Roupin

BiqCrunch is a branch-and-bound solver for finding exact solutions of any 0-1 quadratic problem, such as Max-Cut, Max-k-cluster, and Max-independent set. The bounds are based on a regularized semidefinite relaxation and are efficiently computable using eigenvalue decomposition and a quasi-Newton optimization method. The resulting semidefinite bounding procedure gives us a competitive branch-and-bound algorithm for solving many binary quadratic problems to optimality.

■ SD53

Hilton- Taylor A

Robust and Data-Driven Portfolio Optimization

Cluster: Optimization in Finance

Invited Session

Chair: Daniel Kuhn, EPFL, EPFL CDM MTEI RAO, Station 5, Lausanne, 1015, Switzerland, daniel.kuhn@epfl.ch

1 - Tracking-Error Models for Multiple Benchmarks: Theory and Empirical Performance

Zhichao Zheng, Assistant Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, danielzheng@smu.edu.sg, Yunchao Xu, Karthik Natarajan, Chung-Piaw Teo

We propose a new multiple-benchmark tracking-error model for portfolio selection. We construct a strategy to track the highest return from a set of benchmarks, by minimizing a quadratic loss function. This portfolio strategy retains features of the linear combination rule, with weights determined by the probability that each benchmark portfolio attains the highest return among all the benchmark portfolios. We develop the theory and describe several applications of this new approach.

2 - Portfolio Optimization with Ambiguous Correlation and Stochastic Volatilities

Chi Seng Pun, The Chinese University of Hong Kong, Rm2202, PGH2, CUHK, Shatin, N.T., Hong Kong, Hong Kong - PRC, cspun@cuhk.edu.hk, Hoi Ying Wong, Jean-Pierre Fouque

In a continuous-time economy, we investigate the asset location problem among a risk-free asset and two risky assets with an ambiguous correlation between the two risky assets. We formulate the robust portfolio selection as the utility maximization problem over the worst-case scenario with respect the possible choice of correlation. We solve the problem under the Black-Scholes model using theory of G-Brownian motions. We then extend the problem to stochastic volatility models.

3 - Robustifying Convex Risk Measures for Linear Portfolios: A Non-Parametric Approach

David Wozabal, Technische Universitat München, Arcisstrafle 21, Munich, 80333, Germany, david.wozabal@tum.de

We introduce a framework for robustifying convex risk measures. The robustified risk measures are defined as the worst case portfolio risk over neighborhoods of a reference probability measure. It is shown that the optimization problem of finding the worst-case risk can be solved in closed form. The resulting robust risk measures are computationally tractable and a numerical study shows that in most cases they perform significantly better out-of-sample than their non-robust variants.

4 - Robust Growth-Optimal Portfolios

Daniel Kuhn, EPFL, EPFL CDM MTEI RAO, Station 5, Lausanne, 1015, Switzerland, daniel.kuhn@epfl.ch

The log-optimal portfolio is known to outperform any other portfolio in the long run if stock returns are i.i.d. and follow a known distribution. In this talk, we establish similar guarantees for finite investment horizons where the distribution of stock returns is ambiguous. By focusing on fixed-mix portfolios, we exploit temporal symmetries to formulate the emerging distributionally robust optimization problems as tractable conic programs whose sizes are independent of the investment horizon.

■ SD54

Hilton- Taylor B

Financial Services Section Student Paper Competition

Sponsor: Financial Services Section

Sponsored Session

Chair: Jim Bander, National Manager, Decision Science, Toyota Financial Services, Chandler, AZ, 85226, United States of America, jim.bander@gmail.com

1 - Risk Analysis and Hedging of Parisian Options

Dong-Young Lim, Ph.D. Student, KAIST, 291 Daehak-ro, Yuseong-gu, Industrial and Systems Engineering,KAIST, Daejeon, Ch, 305-701, Korea, Republic of, ldy1848@kaist.ac.kr, Kyoung-Kuk Kim

A Parisian option is a variant of barrier options. We study its greeks via Laplace transform and conduct risk analysis, showing that theta is important to understand the behavior of a Parisian option and how it can make dynamic hedging fail. As an alternative, we propose a quasi-static hedging strategy by decomposing a Parisian option into other contingent claims which are statically hedged. Numerical comparisons of dynamic and static hedging are reported.

2 - Employee Stock Option Valuation with Job Termination Risk and Jumps in Stock Price

Haohua Wan, PhD Student, UIUC, Room 14 Transportation Bldg, 104 S. Mathews Ave, Urbana, IL, 61801, United States of America, hwan3@illinois.edu, Tim Leung

This paper studies an Employee stock options (ESOs) valuation framework that accounts for job termination risk and jumps in stock price under general Levy dynamics, which shows that the optimal exercise boundary and ESO cost can be determined by solving an inhomogeneous partial integro-dierential variational inequality (PIDVI).

3 - Equilibrium Asset Pricing with Rational and Irrational Investors

Jing Guo, Columbia University, 500 W 122nd Street, Apt. 1E, New York, NY, 10027, United States of America, jg3222@columbia.edu, Xuedong He

We study a multi-period asset pricing problem with rational investors having recursive utility preferences and irrational investors having additional CPT utility of gains and losses. In the logarithmic utility case, we derive the unique equilibrium analytically, propose a stock performance measure that determines the irrational investors' stock holding and show the market dominance of the rational investors in the long run. In the general case, we develop an algorithm to compute the equilibrium.

4 - Optimal Mean Reversion Trading with Transaction Cost and Stop-Loss Exit

Xin Li, Columbia University, 500 West 120th Street, New York, United States of America, xl2206@columbia.edu, Tim Leung

Motivated by the industry practice of pairs trading, we study an optimal double stopping problem to analyze the timing to start and subsequently liquidate the position subject to transaction costs and stop-loss constraint. We apply a probabilistic methodology and derive the optimal price intervals for entry and exit.

5 - Robust Investment Management with Uncertainty in Fund Manager Asset Allocation

Yang Dong, Senior Analyst, J.P. Morgan, 330 E. 46th street, Apt 2A, New York, NY, 10017, United States of America, woshidongyang@gmail.com, Aurelie Thiele

In this paper, we propose a robust framework that takes into account the uncertainty stemming from the fund managers' allocation in the context of portfolio management. We assume that only bounds on the fund managers' holdings are available. Numerical experiments suggest that our robust model provides better protection against risk than the nominal model when the fund managers' allocations are not known precisely.

■ SD55

Hilton- Van Ness

Meta-control Techniques for Non-convex Optimization

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Zelda Zabinsky, Professor, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, zelda@u.washington.edu

1 - Solving Global Optimization Problems Via Stochastic Inclusion Sets

Wolf Kohn, Professor and Chief Scientist, University of Washington, Industrial and Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, wolfk@u.washington.edu, Zelda Zabinsky, Yanfang Shen

We present a feedback controller based on mean field theory that operates on domains defined by rules that represent physical principles, requirements and sensory data. The controller learns and adapts to changing environmental conditions by building a model that is dynamically tuned using data. Our approach captures multiple objectives and uncertainties by propagating sets of points towards a set of non-dominated (Pareto) solutions using a dynamic set inclusion approach and turnpike theory.

2 - A Stochastic Meta-control Bang-bang Solver for a Large Binary Integer Program

Pengbo Zhang, Ph.D. Student, University of Washington, Industrial and Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, pbzhang@u.washington.edu, Wolf Kohn, Zelda Zabinsky

We develop a discrete stochastic meta-control algorithm that provides a good approximation to large-scale binary integer programs with low polynomial time complexity. The key idea is to balance the feasibility problem and optimizing the objective function. We define two coupled linear quadratic tracking problems, and iteratively solve them in sequence to improve the feasibility and optimality measures with respect to the original binary integer problem.

3 - A Fast Marching Algorithm with I-frames for Parameter Estimation in the Cloud for Demand Forecasting

Philip Placek, Ph.D. Student, University of Washington, Industrial and Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, pcplacek@gmail.com, Wolf Kohn, Zelda Zabinsky

We develop a methodology for solving parameter estimation problems in a cloud environment for demand forecasting. The classic approach is to solve a nonlinear least squares optimization problem. Our method divides the optimization into a two-step process, the I-frame optimization and the incremental optimization. The incremental optimization connects the I-frame solutions at discrete points in the state space to approximate the solution of the original problem.

■ SD56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Online Games to Teach Operations and Supply Chain Management

Sam Wood, Responsive Learning Technologies, wood@responsive.net

Learn about online competitive exercises that are used in Operations Management courses and Supply Chain Management courses to teach topics like capacity management, lead time management, inventory control, supply chain design and logistics. These games are typically used as graded assignments.

2 - Provalis Research - How to Analyze Big Text Data with Text Analytics Tools

Normand Peladeau, President & CEO, Provalis Research, 2997 Ave Cedar, Montreal, QC, H3Y 1Y8, Canada, npeladeau@provalisresearch.com

Provalis Research will showcase its integrated collection of text analytics software. QDA Miner is an easy-to-use qualitative and mixed methods software that meets the needs of researchers performing qualitative data analysis and would like to code more quickly and more consistently larger amounts of documents. It offers high level computer assistance for qualitative coding with innovative text search tools that help users speed up the coding process as well as advanced statistical and visualization tools. Users with even bigger text data can also take advantage of WordStat. This add-on module to QDA Miner can be used to analyze huge amounts of unstructured information, quickly extract themes, find trends over time, and automatically identify patterns and references to specific concepts using categorization dictionaries.

■ SD64

Parc- Cyril Magnin I

Scaling Limits of Stochastic Networks

Sponsor: Applied Probability Society

Sponsored Session

Chair: Kavita Ramanan, Professor, Brown University, 182 George St, Providence, RI, 02912, United States of America, kavita_ramanan@brown.edu

1 - A Decentralized Variant of a Limited Flexibility System

John Tsitsiklis, Massachusetts Institute of Technology, Cambridge, Ma, 02139, United States of America, jnt@mit.edu, Kuang Xu

We consider a multiserver system with a limited degree of flexibility, whereby a fraction p of the total available service rate resides at a flexible server that serves jobs from a longest queue. For large systems, The resulting delay is known to be very favorable. We show the same for a "push" policy that diverts jobs to the flexible server whenever a corresponding local queue exceeds a suitable threshold, and for a broad class of interarrival and service time distributions.

2 - Ticket Queue with Impatient Customers: Optimal Ticket-based Staffing Policies

Li Xiao, National University of Singapore, BIZ 2 Building,Basement B2-03, 1 Business Link, NUS Business School, singapore, Singapore, lixiao@nus.edu.sg, Hanqin Zhang, Susan Xu, David Yao

For ticket queues with impatient customers, we use Markov chain analysis and fractional programming to optimize the ticket-based staffing policy so as to minimize the combined delay, abandonment and operating costs. We also develop a random-walk/Brownian motion based approximation approach, and show its asymptotic optimality.

3 - Diffusion Limits for Shortest Remaining Processing Time Queues under Nonstandard Spatial Scaling

Amber Puha, Professor, California State University San Marcos, Department of Mathematics, 333 S. Twin Oaks Valley Road, San Marcos, CA, 92058, United States of America, apuha@csusm.edu

We develop a heavy traffic diffusion limit theorem under nonstandard spatial scaling for the queue length process in a GI/GI/1 shortest remaining processing time queue. For processing time distributions with unbounded support, standard diffusion scaling yields an identically zero limit. For a natural class of rapidly varying processing time distributions that includes Weibull distributions, we specify an alternative spatial scaling that produces a nonzero limit.

4 - Fluid Limits of a Randomized Load Balancing Model

Mohammadreza Aghajani, Brown University, Mohammadreza_Aghajani@brown.edu, Kavita Ramanan

We introduce a general framework for studying a class of randomized load balancing models in a system with a large number of servers that have generally distributed service times and use a first-come-first serve policy within each queue. Under fairly general conditions, we use an interacting measure-valued process representation to establish fluid limits in these models, and discuss the insights that the fluid limit provides into the performance of the system.

■ SD65

Parc- Cyril Magnin II

Case Competitions II

Sponsor: INFORM-ED

Sponsored Session

Chair: Palaniappa Krishnan, University of Delaware, Newark, DE, United States of America\, baba@udel.edu

1 - Case Competition

Palaniappa Krishnan, University of Delaware, Newark, DE , United States of America, baba@udel.edu

INFORMed's Annual Cased Competition is an opportunity fir INFORMS Members to showcase their efforts in the classroom. Cases are often later published.

2 - Case Study: using Regression to Improve Parole Board Decisions

Wendy Swenson-Roth, Associate Professor, Georgia State University, 6230 Forest Park Dr, Signal Mountain, TN, 37377, United States of America, wroth@gsu.edu

In this case, students are guided in the process of developing a regression model for a parole board to predict recidivism of inmates coming up for parole. The case is based off of an article from the Wall Street Journal, increasing the credibility of the assignment and with the additional goal of exposure to outside sources of business information. (A copy of the article is included at the end of the document for reference.) Students are exposed to steps of the entire decision making process instead of just focusing on tool usage. This allows for a broader discussion of the implementation of regression. Students may be intimidated when asked to collect their own data. Enhanced discussion of the process as part of this case helps better prepare students to address data collection issues in future assignments.

3 - Growing Pains Case

Mina Hadianniasar, PhD Student, University of Arkansas, Fayetteville, AR, United States of America, mhadiann@uark.edu, Ashlea Milburn

This is a case study of transportation and distribution services in undergraduate and graduate level transportation logistics or optimization courses. More specifically, this case is appropriate for use in any course that emphasizes on modeling, solving and interpreting the outputs of mixed integer programs by using various heuristics related to vehicle routing problem (VRP). This problem is faced by a real transportation company, where the company names and details have been changed to protect privacy. The major problem considered in this case study is estimating the annual freight transportation miles of Northeastern Home Goods (NHG) which is a retail chain offering contemporary home furnishings for bargain prices; if a single DC in Wilmington is used under the current service schedule. Designing a set of feasible and minimum-distance routes to serve all customers of NHG and determining the minimum number of drivers and vehicles required for this feasible set are some other aims of this case. This case study is designed to improve students' skills on modeling, finding set of feasible solutions using various heuristics and interpreting the outputs of mixed-integer programs. During this case study which is based on a real problem, students will learn how to model and analyze real data set and interpret the outputs and solutions, in order to make appropriate decisions leading to increasing their confidence and preparation for confronting and managing real-life problems. Moreover, this case study helps the students improve their skills to interpret results on a complex problem and understand that large unsolvable problems can be divided into smaller more manageable problems.

4 - Contracting for LTL Services at Hankey Industries

Matthew J. Drake, Duquesne University, Pittsburgh, PA, United States of America, drake987@duq.edu

Michael Barth, logistics manager at Hankey Industries, has received contract quotes from four less-than-truckload (LTL) carriers to supply its outbound transportation services for the next 18 months. Michael must analyze the quotes and determine which quote or combination of quotes to select to minimize the total monthly transportation costs. This case fills a void in the existing library of educational materials by focusing on the LTL industry, especially the intricacies of pricing for LTL services. Very few, if any, published cases give students the opportunity to perform contract analysis in the LTL industry. This is an important part of many transportation analyst positions in third-party logistics (3PL) providers, an industry that has recently lamented the lack of available talent graduating from university programs. The case is appropriate for any undergraduate or graduate course that includes coverage of transportation services. The first part of the case requires that students determine the cost to ship to each customer location using various contract options; students at any level should be able to complete this task. Once all of the costs are determined, the students must then develop and solve a binary integer program that determines the best combination of contracts to select; this part may only be appropriate for graduate and advanced undergraduate students.

5 - Material Handling Improvement in Warehouses by Parts Clustering

Mohammad Moshref-Javadi, Purdue University, 315 N. Grant St., Purdue University, West Lafayette, In, 47907, United States of America, moshref@purdue.edu, Mark Lehto

In this study, several methods and algorithms were used to form part families and determine the locations of parts in the layout. The applied clustering methods are based on statistical tools. These methods help researchers and practitioners to become familiar with new applications of statistical methods. In addition, this approach is a new method in order picking problem and hopefully can trigger more extensions and improvements of the techniques in facilities design problems. This case study also teaches students four different layout design algorithms and the best method among them to be applied. The results, algorithms, and techniques utilized in this case study can be helpful to both students and researchers to become familiar with new methods, as well as practitioners to optimize facilities for performance improvement.

■ SD66

Parc- Cyril Magnin III

Recent Advances in Experimental Designs

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Moein Saleh, Research Associate, Arizona State University, 699 S. Mill Ave., Tempe, AZ, 85281, United States of America, Moein.Saleh@asu.edu

1 - A Clustering-based Coordinate Exchange Algorithm for Finding G-optimal Experimental Designs

Moein Saleh, Research Associate, Arizona State University, 699 S. Mill Ave., Tempe, AZ, 85281, United States of America, Moein.Saleh@asu.edu

In experimental designs, the G optimality criterion minimizes the maximum prediction variance over the entire experimental design region. In this presentation, a hybrid of a clustering-based point exchange algorithm and a coordinate exchange algorithm is developed for obtaining G-optimal experimental designs for line

2 - Adding Realism to Choosing and Constructing Optimal Designed Experiments

Christine Anderson-Cook, Research Scientist, Los Alamos National Laboratory, PO Box 1663 MS F600, Los Alamos, NM, 87545, United States of America, c-and-cook@lanl.gov, Lu Lu

As computational power improves, statisticians can choose designs increasingly tailored to study experimental goals. Recent optimal designs allow more flexibility, but usually consider only one criterion. The Pareto Front approach adapts to different # of criteria, eliminates non-contenders based on user-specified criteria, and provides tools to select a design which best matches user needs. Examples illustrate choosing from a catalog of designs and constructing designs using a search algorithm.

3 - Projection Properties of Three-Level Fractional Factorial Designs under the Linear-Quadratic System

Arman Sabbaghi, Assistant Professor of Statistics, Purdue University, Department of Statistics, 150 N. University Street, West Lafayette, IN, 47907, United States of America, sabbaghi@purdue.edu

The linear-quadratic (LQ) system is important in applications because it yields partially aliased and interpretable interaction contrasts for quantitative factors. Projection properties of fractional factorial designs are evident from their indicator functions. By means of a new algebraic operation for calculation of indicator function coefficients, new insights and connections are obtained for different projection properties of three-level designs under the LQ system.

4 - Iterative Sparsity Search for Modeling Brand Correlation and Computer Experiments with Mixed Factors

Qiong Zhang, UW-Madison, 9406 West Brightway Circle, Madison, WI, 53705, United States of America, zhangqiong1985@gmail.com

We propose a statistical approach to estimating covariance structures of multiple brands with similar products in grocery stores. This approach models the sales performances of multiple brands in multiple markets using a multivariate spatial processes and develops an iterative sparsity search algorithm to estimate the model parameters. The effectiveness of the method is illustrated by examples from a consumer packaged goods database. Interestingly, the method is also applicable to computer experiments with quantitative factors and a large number of qualitative levels.

■ SD67

Parc- Balboa

Data Mining in Medical Decision Making and Bioinformatics Applications

Sponsor: Data Mining

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, 30327, United States of America, kamran.paynabar@isye.gatech.edu

1 - Modeling Outcomes of Cancer Screening

Alex Tsodikov, Professor of Biostatistics, University of Michigan, 1415 Washington Heights, Ann Arbor, MI, 48109, United States of America, tsodikov@umich.edu

Analysis of cancer data in the presence of screening is challenging because the phenotype observed at diagnosis and survival thereafter vary with cancer screening even in the absence of treatment benefit. In order to develop a foundation for decision making in the dynamic situation, we provide a statistical modeling approach and synthesize prostate cancer data from a variety of sources.

2 - Integrating Biological and Statistical Models for Predicting Complications in Radiation Therapy

Jing Li, Associate Professor, Arizona State University, jing.li.8@asu.edu, Xiaonan Liu

Intensity-modulated radiation therapy is a modern technique for treatment of aggressive cancers. Biological models exist for linking complications with radiation dose. While these models offer great biological insight, they do not consider individual patient difference. We propose an integrated approach that combines biological mechanisms and patient-specific data, to achieve better prediction and potentially individualized treatment.

3 - Aggregation of Statistical Findings, Case Study: BMR Estimation Models, White Males 8-18 Years Old

Mohammad S. Jalali, Virginia Tech / MIT, 113 Harvard St, Apt 1, Cambridge, MA, 02139, United States of America, mj@vt.edu, Hazhir Rahmandad, Kamran Paynabar

In this study, we present a general method to aggregate empirical statistical findings from prior studies. We present our method with a case study in obesity research where the literature provides over 100 equations to estimate Basal Metabolic Rate (BMR) as a function of different attributes (age, height, etc). There is currently no method that combines these equations into a more reliable one. Using our method, we aggregate BMR estimation models for a subpopulation (white males 8-18 years old).

4 - Measurement Error Isolation in Longitudinal MRI Data Analysis

Chitta Ranjan, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, United States of America, nk.chitta.ranjan@gatech.edu

MRI is common in hospitals for diagnosis, disease staging etc. Typically a patient undergoes MRI scanning in long intervals due to its harmful effects on health. This results into un-replicated longitudinal data and, owing to complexity of the procedure, with inherent measurement error. If this error is high then any inference is difficult to make. In this work we aim to measure and isolate the measurement error from the modeling error for better inferences using Bayesian mixed effect modeling.

■ SD68

Parc- Davidson

Interfaces Between Simulation and Optimization

Sponsor: Simulation

Sponsored Session

Chair: Tito Homem-de-Mello, Professor, Universidad Adolfo Ibañez, School of Business, Diagonal las Torres 2640, Santiago, Chile, tito.hmello@uai.cl

1 - Random Search vs Sample-average Approximation

Peter Glynn, Stanford University, Huang Engineering Center 357, Stanford, CA, 94305, United States of America, glynn@stanford.edu

We discuss and contrast random search algorithms with sample-average approximations (SAA). We show that the complexity of random search depends upon the problem instance in a fundamentally different way than does SAA, and note that random search can be implemented in such a way that its complexity is close to that obtained in the setting of deterministic function evaluations.

2 - Chance-constrained Problems and Rare Events: An Importance Sampling Approach

Tito Homem-de-Mello, Professor, Universidad Adolfo Ibañez, School of Business, Diagonal las Torres 2640, Santiago, Chile, tito.hmello@uai.cl, Javiera Barrera, Eduardo Moreno, Bernardo Pagnoncelli, Gianpiero Canessa

We study chance-constrained problems where the constraints involve the probability of a rare event. In this context, existing sampling-based algorithms require an impractical number of samples. Using a Sample Average Approximation approach combined with importance sampling techniques, we show how variance can be uniformly reduced so the problem can be solved with much fewer samples. We apply our methodology to a telecommunications problem and present numerical results to illustrate the ideas.

3 - Derivative-Free Optimization of Noisy Functions using a Trust Region Framework

Stephen Billups, Associate Professor, University of Colorado Denver, Dept of Math. and Stat. Sciences, CB 170, PO Box 173364, Denver, CO, 80217-3364, United States of America, Stephen.Billups@ucdenver.edu

Modern derivative-free trust region algorithms efficiently find local optima of functions where only function values (not derivatives) can be calculated. This makes them attractive for optimizing functions evaluated by computer simulations. However, noise or uncertainty, which is typically present in such function evaluations can pose significant problems for such algorithms. This talk describes a derivative-free trust region algorithm designed to robustly and efficiently handle such noise.

4 - Sequential Detection of Convexity from Noisy Function Evaluations

Nanjing Jian, PhD Student, Cornell University, School of ORIE, Rhodes Hall, Ithaca, NY, 14850, United States of America, nj227@cornell.edu, Susan Hunter, Shane Henderson

Given simulation estimates of function values at a finite set of points, we want to detect convexity or non-convexity of the true function on those points. We review a frequentist hypothesis test and introduce a sequential Bayesian test. The Bayesian test works for both independent sampling and CRN, and allows unknown variance, iteratively updating a posterior on the true function values. We approximate the probability that the function is convex based on the posterior using Monte Carlo.

■ SD69

Parc- Fillmore

Sustainable and Responsible Supply Chain Management

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Jose Cruz, Associate Professor, School of Business, University of Connecticut, Storrs, CT, United States of America, Jose.Cruz@business.uconn.edu

1 - Corporate Social Responsibility and Performance in the Supply Chain Network

Trisha Anderson, Texas Wesleyan University, Fort Worth, TX, United States of America, trdanderson@txwes.edu, Zugang Liu

We study the level of corporate social responsibility (CSR) and performance over a period of seven years (2003-2009) to compare the relationship between activities, across time, and with different size firms for various industries identified by the Standard Industrial Classification codes. We explain and validate a dynamic panel regression model that is used in the supply chain network model.

2 - The Impact of Customer Satisfaction Function on Sustainable Remanufacturing of Commercial Returns

Farhad Azadivar, Professor, University of Massachusetts Dartmouth, 285 Old Westport Road, North Dartmouth, MA, 02747, United States of America, fazadivar@umassd.edu, Ardavan Ardeshirilajimi

Commercial returns are products returned by customers within a relatively short period after purchase due to perceived deficiencies. The environmental costs of disposal and wasted material have made remanufacturing almost a necessity. Common assumption has so far been that all customers have the same perception of deficiency. In this report an alternative is presented by considering the role of a customer satisfaction function in targeting the product quality and remanufacturing policies.

3 - How Coopetition Have Effect on Green Product Development?

Maryam Hafezi, Wilfrid Laurier University, 1207-125 Lincoln Road, Waterloo, ON, N2J 2N9, Canada, hafe1390@mylaurier.ca, Xuan Zhao

In this research, we use game-theoretic approach to see how competition affects the price, quantity and quality of green products. By considering three innovation strategies – independent innovation, investment sharing, and innovation sharing strategy – we try to help manufacturers know how much to cooperate and how much to compete.

4 - Economic Sustainability of Closed Loop Supply Chains: A Holistic Decision and Policy Analysis

Jose Cruz, Associate Professor, School of Business, University of Connecticut, Storrs, CT, United States of America, Jose.Cruz@business.uconn.edu, Sudip Bhattacharjee

This paper develops an end-to-end model of a closed-loop supply chain (CLSC), and analyzes the economic viability of participants in this chain. We model the lifecycle of consumer electronics good and implement a system dynamic (SD) model to examine the complex interactions among different components. Our results highlight the product and marketing strategies that create profitable streams for all stakeholders in the chain for the closed-loop to be economically and environmentally sustainable.

■ SD70

Parc- Hearst

Analytics in the Petrochemical/Petroleum Industry

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Margery Connor, Chevron, 6001 Bollinger Canyon Road, San Ramon, United States of America, mhco@chevron.com

1 - O&G Value of Information of Appraisal Well with Continuous Distributions

Brian Putt, OC Manager, Chevron, 6001 Bollinger Canyon, San Ramon, CA, 94588, United States of America, brianputt@chevron.com

Traditional Value of Information requires Bayesian conditional probability assessments that are used in a decision tree with discrete outcomes. New modeling techniques enable the VOI analysis to consider continuous distribution. This presentation will contrast various VOI analyses techniques using an oil and gas upstream example and will introduce SIPmath to facilitate the probabilistic arithmetic of the VOI distributions using Excel only.

2 - R&D Roadmap for Aviation Biofuels: New Use for Decision Analysis Methods

Elizabeth Connelly, Graduate Research Assistant, University of Virginia, 151 Engineers Way, Charlottesville, VA, 22904, United States of America, ec5vc@virginia.edu, Lisa Colosi, James Lambert, Andres Clarens

Replacing petroleum-based jet fuel with renewable jet fuel addresses concerns related to environmental sustainability, price volatility, long-term supply, and national security. Multi-criteria decision analysis integrated with scenario analysis can be used to develop an R&D roadmap for promoting an aviation biofuel industry. Stakeholder preferences and uncertainties from emergent conditions are considered to produce a robust prioritization of R&D initiatives applicable to diverse groups.

3 - Rational Decision Making Model for Risk Assessment of Offshore Drilling

Maryam Tabibzadeh, University of Southern California, 1157 W., 30th St., Los Angeles, CA, United States of America, m.tabibzadeh@gmail.com

This paper introduces a rational decision making model, using the signal detection theory as a foundation, for risk assessment of misinterpreting a negative pressure test (NPT), as the primary means to ascertain well integrity during offshore drilling. This model proposes a structured framework to the practitioners of oil and gas industry for the interpretation of conducted NPTs and the analysis of involved decision making biases. This framework can be used in analyzing all high-risk operations.

■ SD71

Parc - Lombard

Panel Discussion: Government Auctions of Spectrum Licenses

Cluster: Auctions

Invited Session

Chair: Karla Hoffman, George Mason University, Fairfax, VA, United States of America, khoffman@gmu.edu

1 - Panel Discussion: Government Auctions of Spectrum Licenses

Moderator: Karla Hoffman, George Mason University, Fairfax, VA, United States of America, khoffman@gmu.edu, Panelists: Melissa Dunford, Brett Tarnutzer, Evan Kwerel

In 2015, the FCC will hold the first-ever "incentive auction" whereby the government buys back spectrum from TV broadcasters and then sells that spectrum for flexible wireless use. This panel will provide a historical view of all aspects of the auction from conceptualization, to auction design and finally testing and implementation. The panel will discuss how the agency interacted with Congress, OMB, the industry and the public. OR aspects of the problem will be presented.

■ SD72

Parc- Stockton

KINFORMS

Sponsor: KINFORMS (Korea Chapter)

Sponsored Session

Chair: Chang Won Lee, Professor, Hanyang University Business School, 222 Wangshimni-ro, Seoul, KR, 133-791, Korea, Republic of, leecw@hanyang.ac.kr

1 - Identifying the Impacts on the Social Enterprises Development in Cambodian Tourism Industry

Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonseidae-gil, Wonju, 220-710, Korea, Republic of, sungyongchoi@gmail.com, Sonita Eng

This research focuses on the work of identifying the impacts on the Social Enterprises (SEs) development in Cambodian tourism industry. In this exploratory work, we verify the four key factors, which are legal framework, financing, ownership, and social capital. The study wishes to find out both positive and negative impacts that are influencing current state of these SEs by analyzing its strengths, weaknesses, opportunities and threats (SWOT).

2 - Supply Chain Success Factors and Performance: Trust, Involvement and Partnership Perspectives

Chang Won Lee, Professor, Hanyang University Business School, 222 Wangshimni-ro, Seoul, KR, 133-791, Korea, Republic of, leecw@hanyang.ac.kr, Sang Hyung Ahn

The study is to present the relationship between supply chain success factors and supply chain performance in terms of trust, involvement and partnership perspectives. The research model is developed and empirically tested by Korean manufacturers. The results shows significant implications of trust, involvement and partnership in exploring supply chain success factors affecting supply chain performances in Korea business settings.

3 - Price Competition or Uncertainty Reduction? An Investigation of Green Car Technology

Byung Cho Kim, Associate Professor, Korea University Business School, Hyundai Motor Hall, KUBS, Anam-dong, Seongbuk-gu, Seoul, 136-701, Korea, Republic of, bkim@korea.ac.kr, Hosun Rhim, Hongsuk Yang

This paper examines the strategic choice of the green vehicle manufacturers under competition, between price competition and uncertainty reduction. Grounded on a stylized model for platform and two-sided market, we find profit- and welfare-maximizing levels of prices and uncertainty reduction effort, and investigate how the scope of network externality and cost differential influence the manufacturer's and the social planner's strategic choices.

4 - A Study on Emergency Logistics Problem after Massive Natural Disaster

Sumin Han, Ph.D candidate, Seoul National University, 39-317, Dept. of Industrial Engineering,, Seoul National University, Shillim-don, seoul, 151-744, Korea, Republic of, hans8501@mailab.snu.ac.kr, Youngwoo Kim, Gyusun Hwang, Sangyun Choe, Jinwoo Park

The occurrences of massive disasters increase in the 2000s. To minimize the damages due to disasters, studies on emergency logistics have received a wide attention. It is a logistics problem with uncertain information. So in these studies, it is important to include measures from advanced ICT and optimization tools. We suggest a solution that evolves with the information content of the situation beginning from uncertainty. Finally a simulation study supports the validity of our approach.

5 - Use of Noncental Composite Designs for Sequential Assembly

JH Byun, Professor, Gteongsang National University, 501 Jinju-daero, Jijju, Gyeongnam, Jinju, 660-701, Korea, Republic of, jbyun@gnu.ac.kr

In this paper we propose a non-overlapping noncentral composite design (NNCD) that can be used effectively when the data analysis result of the first factorial design shows synergistic interaction effects. We present design matrices and experimental points for NNCDs with two and three factors, in which the first factorial design is assembled with the second factorial design sharing one design point. A simple method for estimating linear, interaction, and quadratic coefficients is also given.

6 - Sequential Capacity Allocation under Order Manipulation

Kun Soo Park, Assistant Professor, KAIST College of Business, 85 Hoegi-ro, Donegaemun,, Seoul, Korea, Republic of, kunsoo@business.kaist.ac.kr, Bosung Kim, Seyed Iravani

We consider an allocation of a supplier's capacity that is made sequentially. In particular, we analyze how the ordering strategy of manufacturers change if they are allowed to manipulate their orders from their actual needs.

7 - A Rectified LAD for Numerical Data

Cui Guo, Shantou University Business School, No.243, Daxue Road, Shantou, China, cguo@stu.edu.cn, Hong Seo Ryoo

LAD presents some limitations when analyzing numerical data, owing to a difference in structural properties of originally 0-1 data and binarized 0-1 data. This paper illustrates these limitations and develops a way to rectify the general LAD framework to more accurately analyze numerical data.

■ SD73

Parc- Mission I

ENRE Awards Session

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Miguel Anjos, Professor and Canada Research Chair, Polytechnique Montreal, C.P. 6079, Succ. Centre-ville, Montreal, QC, Canada, miguel-f.anjos@polymtl.ca

1 - ENRE Young Researcher Prize 2014

To Be Announced

This award is given annually to one or more young researcher(s) for an outstanding paper on the application of OR/MS to an important problem in energy, natural resources and/or the environment. The Prize serves as an esteemed recognition of promising colleagues who are at the beginning of their academic or industrial career.

2 - ENRE Best Student Paper Award 2014

To Be Announced

This award is given annually to the best paper dealing with Energy, Environmental, or Natural Resource issues by a student author who is presenting at the INFORMS Annual Meeting.

3 - ENRE Best Publication Award 2014 in Natural Resources

To Be Announced

This award is given annually to the best refereed journal article in the area of Natural Resources published within the two calendar years prior to the year in which the award is given.

4 - ENRE Best Publication Award 2014 in Energy

To Be Announced

This award is given annually to the best refereed journal article in the area of Energy published within the two calendar years prior to the year in which the award is given.

5 - ENRE Best Publication Award 2014 in Environment and Sustainability

To Be Announced

This award is given annually to the best refereed journal article in the area of Environment and Sustainability published within the two calendar years prior to the year in which the award is given.

■ SD74

Parc- Mission II

Analytics Case Studies

Sponsor: The Practice Track

Sponsored Session

Chair: Chris Fry, Managing Director, Strategic Management Solutions, PO Box 5721, Redwood City, CA, 94065, United States of America, chris@strategicmgmtsolutions.com

1 - Inventory Allocation in an eCommerce Fulfillment Network

Jagtej Bewli, Group Product Manager, WalmartLabs, 850 Cherry Avenue, San Bruno, CA, 94066, United States of America, jbewli@walmartlabs.com, Mohan Akella

eCommerce Inventory allocation poses new and interesting challenges in the areas of OR and Machine learning. Unlike physical retail, demand in an ecommerce network can be fulfilled from any node, which changes the concept of "In Stock" and the "Demand' at a node. In this talk, we will discuss the challenges of this structure as well as enhancements to demand forecast and network flow models that are needed to optimize ecommerce fulfillment operations.

2 - Spare Parts Inventory Management for Google's Data Centers

John Khawam, Operations Strategy Lead, Google Inc., 1600 Amphitheatre Parkway, Mountain View, CA, 94043, United States of America, johnkhawam@google.com

Our goal is to forecast and set inventory levels for spare parts that serve Google's Data Centers throughout the world. Server uptime is critical to Google, and spare parts are often the last defense in preventing down machines.

3 - NASA's SACE Analytic Software Demonstrates Hybrid Artificial Intelligence – Operations Research Serving Critical Space Station Operations

John Chachere, Sargeant, NASA Ames Research Center, Mountain View, CA, United States of America, john.chachere@gmail.com

NASA's Solar Array Constraints Engine (SACE) demonstrates hybrid artificial intelligence – operations research analytics serving critical operations. The SACE software has helped the International Space Station (ISS) flight controllers safely and effectively operate ISS solar arrays. Flight controllers must position the arrays to collect adequate power for life and experiments on the station, yet avoid numerous hazards, including thruster firings, environmental contamination, communications interference, and extra-vehicular activities. Within minutes, violating these constraints could result in catastrophic failure of ISS (loss of $100B station, a global partnership, and astronaut heroes). Analytically, SACE linear programming prioritizes the diverse constraints while knowledge-engineered constraint propagation optimizes across time. SACE has provided the Mission Control Center with awareness of operational constraints that are in danger of being violated either at the current time or in the immediate future, and given them the ability to plan solar array activities for periods of weeks into the future.

■ SD75

Parc- Mission III

Simulation Methods for Risk Analysis and Finance

Sponsor: Simulation

Sponsored Session

Chair: Marvin Nakayama, Professor, New Jersey Institute of Technology, Computer Science Department, 218 Central Avenue, Newark, NJ, 07102, United States of America, marvin@njit.edu

1 - Simulation of Tempered Stable Levy Bridges and its Applications

Kyoung-Kuk Kim, Associate Professor, Korean Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Industrial and Systems Engineering,KAIST, Daejeon, Ch, 305-701, Korea, Republic of, catenoid@kaist.ac.kr

We consider tempered stable Levy subordinators and develop a bridge sampling method, i.e. sample paths conditioned on the end points. An approximate conditional PDF is derived using the double saddle-point approximation. The acceptance-rejection algorithm is then proposed using the known gamma and inverse Gaussian bridges as its proposals depending on a stable index. The method is applied to financial options under subordinated Brownian motion models and finite variation CGMY processes.

2 - A Sequential Procedure for Estimating Steady-State Quantiles

James Wilson, North Carolina State University, Dept.of Industrial & Systems Engineering, 111 Lampe Drive, Daniels Hall, Raleigh, NC, 27695, United States of America, jwilson@ncsu.edu, Anup Mokashi, Christos Alexopoulos, Kai-Wen Tien, David Goldsman

We formulate a fully sequential procedure yielding improved point and confidence-interval (CI) estimators for a steady-state quantile that incorporate effective methods to eliminate initialization bias in the point estimator and to adjust the CI half-length for the effects of skewness and correlation in the underlying simulation-generated process. We summarize the results of an experimental performance evaluation of the procedure.

3 - Stratified Estimators for Quantiles

Raghu Pasupathy, Associate Professor, Purdue University, Dept. of Statistics, West Lafayette, United States of America, pasupath@vt.edu, Soumyadip Ghosh

We consider quantile estimation in the context of streaming data.We present a new estimator obtained by adaptively stratifying incoming data, with the strata becoming progressively finer around the desired quantile. We find that the resulting reduction in storage is often dramatic, with negligible deterioration in estimator convergence rate. The method, while demonstrated for quantile estimation, seems to be applicable more widely.

4 - Confidence Intervals for a Quantile When Applying Latin Hypercube Sampling

Marvin Nakayama, Professor, New Jersey Institute of Technology, Computer Science Department, 218 Central Avenue, Newark, NJ, 07102, United States of America, marvin@njit.edu, Hui Dong

We develop confidence intervals (CIs) for a quantile when applying replicated Latin hypercube sampling (LHS). LHS reduces variance by stratifying inputs on all dimensions simultaneously. We use batching and sectioning to build asymptotically valid CIs. Similar to batching, sectioning CIs replace the batching estimator with the overall estimator. We establish the validity of the sectioning CI by first proving that a LHS quantile estimator satisfies a Bahadur representation.

■ SD76

Parc- Embarcadero

Innovations in Supply-Chain Operations

Sponsor: The Practice Track

Sponsored Session

Chair: Sam Eldersveld, Principle Research Scientist, Amazon, 333 Boren Ave. N., Seattle, WA, 98109, United States of America, sam.eldersveld@comcast.net

1 - Multimodel Inference as the Basis for Improved Supply-chain Planning

Sam Eldersveld, Principle Research Scientist, Amazon, 333 Boren Ave. N., Seattle, WA, 98109, United States of America, sam.eldersveld@comcast.net

Optimizing suppl-chain performance depends on good supply-chain planning; Future predictions of exogenous operational factors are crucial to meet this end. Multiple predictive models are available to help explain historical data and often no one model may be "perfect" over any time horizon. We present strategies for making better predictions from an a priori set of models based on information-theoretic and Bayesian criteria. The theory and application in supply chain settings will be presented.

2 - Large Scale Multi-item Order Optimization

Andrea Qualizza, Sr. Research Scientist, Amazon, Seattle, United States of America, qualizza@amazon.com

Near real-time multi-item order planning problems are computationally challenging since they entangle a number of nested NP-hard problems. In this talk we present an approach based on Generalized Networks that trades off some of the complexity of the nested problems and is able to get solutions in useful time for tens of millions of multi-orders simultaneously. Several business constraints, like for example load balancing across warehouses, are readily embedded in the model.

3 - Network Solutions and Shipment Optimization at Starbucks

Stephen Stoyan, Manager, Advanced Analytics, Starbucks Coffee Company, 2401 Utah Ave. S., Seattle, WA, 98134, United States of America, stoyan@mie.utoronto.ca

The supply chain network at Starbucks Coffee Company is facing new complexities on how products are shipped, stored, and distributed in the network. The advanced analytics team at Starbucks has developed a set of tools that optimizes the network, consolidates shipments, and tackles new challenges faced in the supply chain. We present the set algorithms that has already lead to millions of dollars in savings and growing.

4 - Hybrid Metaheuristics and Large Neighborhoods for the Clustered Vehicle Routing Problem

Thibaut Vidal, LIDS — Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 32-D566, Cambridge, MA, 02139, United States of America, vidalt@mit.edu, Anand Subramanian, Maria Battarra, Günes Erdogan

A vehicle routing problem with cluster constraints is studied, in which deliveries within a cluster must be serviced consecutively by the same vehicle. Postal services can include such features when considering zip code restrictions. Our newly-proposed hybrid metaheuristics generate very high quality solutions in about five minutes on a single CPU, for instances with up to 1200 service locations.

■ SD77

Parc- Market Street

Joint Session Analytics/CPMS: Panel Discussion: Making the Connection Between Analytics and OR

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Don Kleinmuntz, Professor of the Practice of Business Analytics, University of Notre Dame, 452 W Huron St, Chicago, Il, 60654, United States of America, don@kleinmuntzassociates.com

1 - Making the Connection between Analytics and OR

Don Kleinmuntz, Professor of the Practice of Business Analytics, University of Notre Dame, 452 W Huron St, Chicago, Il, 60654, United States of America, don@kleinmuntzassociates.com, Glenn Wegryn, Jack Levis, Anne Robinson

Analytics and related topics like Big Data continue to attract tremendous attention in the business community. This panel, consisting of accomplished industry executives at the intersection of OR and Analytics, will address the implications for the OR profession and how INFORMS is responding to this opportunity. Questions, comments, and discussion from the audience are actively encouraged.

■ SD78

Parc- Mason

Predictive Analytics Models and Methods

Sponsor: Analytics

Sponsored Session

Chair: Michael N. Katehakis, mnk@rutgers.edu

1 - Adaptive Task Assignment Policies for Multi-channel Call Centers
Ger Koole, VU, De Boelelaan 1105, Amsterdam, Netherlands, ger.koole@vu.nl, Benjamin Legros, Oualid Jouini

In many situations scheduling policies depend on the parameters of the system. However, often we have at best unreliable estimates of these parameters. In this paper we propose a policy for task assignment in call centers that automatically adapts itself to changes in the parameters without estimating these parameters but by changing the policy on the basis of changes in the objective value.

2 - On Single Payout Multi-armed Bandits and the Secretary Problem
Wesley Cowan, Rutgers University, Dept. of Mathematics, Piscataway, NJ, United States of America, cwcowan@math.rutgers.edu, Michael N. Katehakis

In this talk we present several extensions to the theory of the multi -armed bandit problem that are made possible by a new model of single payout bandits. We discuss applications to biding in auctions and extensions of the secretary problem.

3 - Multi-agent Coordination in Team Search Problems under a Bayesian Framework
Peter Beling, Associate Professor, University of Virginia, 151 Engineer's Way, Charlottesville, VA, 22904, United States of America, pb3a@virginia.edu, Yijia Zhao, Stephan D. Patek

We consider a decentralized path-planning problem for team Bayesian search. Each agent must formulate and solve a decentralized planning problem to compute its future actions. This planning problem is formulated as a partially observed Markov decision problem whose objective function is evaluated based on the assumption that all agents will use the same mixed strategy policy. We propose three dynamic programming heuristics for this planning problem.

4 - Predicting Inventory Status from Sales Transactions Data
Garrett van Ryzin, Columbia University, 412 Uris Hall, Columbia University, New York, NY, 10027, gjv1@columbia.edu, Juan Chaneton, Margaret Pierson

We use Monte Carlo Markov Chain (MCMC) methods to develop predictions of inventory status using only sales transactions data. Our predictions are shown to be effective at identifying out-of-stock status on both simulated and field tests and perform well relative to more naïve predictors. Such predictions are useful in a variety of supply chain applications and for detecting phantom stock-outs.

■ SD79

Parc- Powell I

Applications of Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Mazen Skaf, Managing Director, Strategic Decisions Group, 745 Emerson St, Palo Alto, CA, 94301, United States of America, mskaf@sdg.com

1 - Decision Quality: A Cultural Change Effort
James Driscoll, Director of Decision Quality, Intel Corporation, 2200 Mission College Blvd, Santa Clara, CA, United States of America, james.r.driscoll@intel.com

Discussion of the adoption of Decision Quality at a large, multi-national technology leader. History and evolution of the effort and what we've learned along the way. Emphasis will be on the cultural changes that are required to embed and derive value from DQ/applied decision theory. Note: this presentation will NOT cover details regarding applications of DQ to internal and/or non-public business strategies.

2 - Decision Analysis in Life and Business: Differences and Similarities
Larry Neal, Manager, Decision Analysis Consulting, Chevron, 6001 Bollinger Cyn. Rd., San Ramon, CA, 94583-2324, United States of America, larryneal@chevron.com

On the occasion of using decision analysis for a personal medical situation, the author compares and contrasts the experience with applying decision analysis professionally in the workplace. The author draws conclusions from the experience and offers suggestions for better serving the layperson in a difficult or ambiguous decision making situation.

3 - Process and System for Optimizing the Allocation of Energy Resources in an Energy-Rich State
Mazen Skaf, Managing Director, Strategic Decisions Group, 745 Emerson St, Palo Alto, CA, 94301, United States of America, mskaf@sdg.com

We present a DA-based process and system for optimizing the allocation of hydrocarbon resources and other energy resources across proposed uses taking into account: i) uncertainty in future supply and demand, ii) various economic, social, and environmental value measures, and iii) existing commitments. The methodology has been successfully applied over the past four years to support decision-making on resource allocation as well as to guide investments on the supply side.

4 - Reducing Risk and Improving Incentives to Entrepreneurs and Backers
Sam Bodily, John Tyler Professor, Darden School, UVA, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, BodilyS@Darden.virginia.edu

Incentive-compatible mechanisms are identified, risk analysis models are developed, and insights are obtained about how backers' funding (e.g. equity capital, incentive gifts, insurance, revenue contracts, and derivative swaps) can provide proper incentives and reduce risk to the entrepreneur, at least cost to the backers. Attention is given to avoiding problems of moral hazard. Certainty equivalents for financing alternatives are derived.

■ SD80

Parc- Powell II

Real Option Applications

Sponsor: Decision Analysis

Sponsored Session

Chair: Luiz Brandão, Associate Professor, PUC Rio, Rua Marques de Sao Vicente 225, Rio de Janeiro, RJ, 22450-900, Brazil, brandao@iag.puc-rio.br

1 - A Symmetrical Binomial Lattice Approach for Modeling Generic One Factor Markov Continuous Processes
Carlos Bastian-Pinto, Assistant Professor, IBMEC RJ, Rio de Janeiro, RJ, Brazil, carbastian@gmail.com

The mathematical complexity associated with real options derives from the need for a probabilistic solution for the optimal decision. Binomial lattices such as that of Cox et al are robust, precise and intuitively appealing for option valuation. We propose a Symmetrical Binomial Lattice equivalent to the Cox et al when modeling GBM, but which can be utilized for a wide variety of other stochastic processes that have the Markov property. We demonstrate its applicability with several examples.

2 - Switching Options in Nitrogen Fertilizer Plants
Luiz Ozorio, Assistant Professor, IBMEC RJ, Rio de Janeiro, RJ, Brazil, lmozorio@ibmecrj.br, Carlos Bastian-Pinto, Luiz Brandão, Rafael Branco

Fertilizers are extremely important to agricultural production due to the productivity improvements in cropping that it allows. This article uses the Real Options Theory to evaluate the switch-output option, ammonia or urea, in a nitrogen fertilizer plant. The Monte Carlo simulation was used to define the value of the option and it was assumed that the prices of natural gas (input), ammonia and urea follow MRM as stochastic process. The results show that the option of the investor is valuable.

3 - Stochastic Price Process Calibration Methods and Their Impact on Real Option Values and Strategies
Reidar Bratvold, Professor, University of Stavanger, Kjell Arholmsgate 41, Stavanger, 4036, Norway, reidar.bratvold@uis.no, Philip Thomas

Stochastic commodity price models play a central role when evaluating energy investment opportunities. Despite this, there has been little systematic evaluation of the effects of choosing different calibration methods and time horizons to determine state variables and parameters of such models. We present sensitivity analysis results of the impact the choice of calibration method and time horizon on real option values and strategies.

4 - Is the Rio – Sao Paulo High Speed Rail Project Feasible? A Real Options Analysis
Luiz Brandão, Associate Professor, PUC Rio, Rua Marques de São Vicente 225, Rio de Janeiro, RJ, 22450-900, Brazil, brandao@iag.puc-rio.br, Leandro Monteiro, Leonardo Lima

We analyze the 18 billion dollar Rio–Sao Paulo High Speed Railway project under the Real Options approach considering a PPP risk sharing scheme where the government offers demand insurance in the form of a minimum traffic guarantee (MTG). As MTGs can generate significant long term liabilities for the government, we propose liability caps and the use of CVaR to determine the optimal combination of MTG and cap level which maximizes the returns and minimizes the risk for the government.

■ SD81

Parc- Divisadero

Optimization and Modeling in Radiation Therapy Treatment Planning

Sponsor: Data Mining

Sponsored Session

Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, 500 West First Street, 420H Woolf Hall, UT Arlington, Arlington, TX, 76019, United States of America, shouyiw@uta.edu

1 - A New Optimization Approach for Multi-objective Radiotherapy Treatment Planning

Wenhua Cao, Research Assistant Professor, University of Houston, E206 Engineering Building 2, Houston, TX, 77204, United States of America, wcao@central.uh.edu, Laleh Kardar, Gino Lim

Designing treatment plans for radiotherapy often involves combining multiple objectives into a single objective function by taking a linear combination of multiple objectives. However, it is challenging to set the proper weights for those objectives. Here we introduce a sub-gradient optimization algorithm to find objective weights which can capture clinically relevant trade-offs. We test the algorithm on real patient data to show that the optimized weights outperform the ones used in the clinic.

2 - A Novel Approach for Real-Time Prediction of Semi-periodic and Nonstationary Time Series

Kin Ming Kam, The University of Texas at Arlington, Arlington, TX, 76019, United States of America, kinming.kam@mavs.uta.edu, Shouyi Wang

To suppress side effects of radiotherapy, system latency of device is needed to be compensated in order to accurately trace the respiratory motion. A novel method is developed by using adaptive orthogonal polynomials to precisely model the respiratory motion. Effective pattern recognition is then done by using the coefficients of OPs. The method can also be applied on other kinds of semi-periodic time series. Comparison with the latest methods will be presented to show the advancement.

3 - A Critical Evaluation of Worst Case Optimization Methods for Robust Proton Therapy Planning

Rasmus Bokrantz, RaySearch Laboratories, Sveavagen 25, Stockholm, 111 34, Sweden, rasmus.bokrantz@raysearchlabs.com, Albin Fredriksson

We analyze three optimization formulations for robust proton therapy treatment planning. The formulations range from protecting against the worst case error to protecting against the worst case error for each patient geometry volume element considered independently. We discuss the formulations' advantages and disadvantages based on their performance on clinical cases.

4 - A Scenario-based Generalization of Margins in Radiation Therapy Treatment Plan Optimization

Albin Fredriksson, RaySearch Laboratories, Sveavagen 25, Stockholm, Sweden, albin.fredriksson@raysearchlabs.com, Rasmus Bokrantz

We propose an optimization formulation using multiple scenarios to handle the effects of errors in radiation therapy treatment planning. This formulation coincides with margin-based planning if the implicit assumptions made when the margins are delineated are valid, but also generalizes to more difficult situations where these assumptions do not hold.

■ SD82

Parc- Haight

Bilevel Optimization: Algorithms and Applications

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Pekka Malo, Assistant Professor, Aalto University School of Business, P.O. Box 11000, Helsinki, Finland, pekka.malo@aalto.fi

1 - A Bilevel Optimization Approach to Automated Parameter Tuning

Peng Xu, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, 00100, Finland, peng.xu@aalto.fi

In this paper, we propose that the parameter tuning problem is inherently a bilevel programming problem. Based on this insight, we introduce an evolutionary bilevel algorithm for parameter tuning. A few commonly used optimization algorithms (Differential Evolution and Nelder-Mead) have been chosen as test cases, whose parameters are tuned on a number of standard test problems. The bilevel approach is found to quickly converge towards the region of efficient parameters.

2 - Multiobjective Bilevel Optimization under Decision Uncertainty

Pekka Malo, Assistant Professor, Aalto University School of Business, P.O. Box 11000, Helsinki, Finland, pekka.malo@aalto.fi, Kalyanmoy Deb, Pekka Korhonen, Jyrki Wallenius, Ankur Sinha

Bilevel optimization problems are characterized by a hierarchical leader-follower structure, where the leader desires to optimize her own strategy taking the response of the follower into account. Such problems are often encountered in strategic product design, homeland security applications, and economics. In this paper, we focus our attention on the development of a flexible evolutionary algorithm for solving multi-criterion bilevel problems with lower level (follower) decision uncertainty.

3 - Multi-objective Stackelberg Game between a Regulating Authority and a Mining Company

Oskar Ahlgren, Aalto University, Runebergingkatu 22-24, Helsinki, 00100, Finland, oskar.ahlgren@aalto.fi

I present a bilevel programming problem in the form of a Stackelberg game with multiple objectives at the upper level and a single objective at the lower level. The leader is the regulating authority, which tries to maximize the total tax revenue over multiple periods while trying to minimize the environmental damages. The follower is a mining company that is trying to maximize its total profit.

■ SD83

Parc- Sutro

Machine Learning, Data Mining, and Statistics I

Sponsor: Data Mining

Sponsored Session

Chair: Cynthia Rudin, MIT Sloan School of Management, 100 Main Street, Cambridge, MA, 02139, United States of America, rudin@mit.edu

1 - Predicting Power Failures in Electrical Grids

Seyda Ertekin, MIT, 100 Main Street E62 Building, Cambridge, MA, 02139, United States of America, seyda@mit.edu, Cynthia Rudin, Tyler McCormick

We present a new statistical model for predicting discrete events continuously in time, called Reactive Point Processes (RPP's). RPP's are a natural fit for many domains where time-series data are available, and their development was motivated by the important problem of predicting serious events (fires, explosions, power failures) in the underground electrical grid of New York City (NYC). The RPP model can also provide a cost/benefit analysis of different proactive maintenance programs.

2 - Statistical Methods for Ambulance Fleet Management

Dawn Woodard, Assistant Professor, School of ORIE, Cornell University, 206 Rhodes Hall, Ithaca, NY, 14850, United States of America, woodard@cornell.edu, Shane Henderson, David Matteson, Bradford Westgate

We address a problem arising in the management of ambulance fleets: predicting the distribution of ambulance driving time on an arbitrary route in a road network. We use a computationally efficient procedure to train a statistical model using GPS data from ambulance trips; challenges include the large size of the network and the lack of trips in the data that follow the route of interest. We demonstrate the accuracy of our methods using data from Toronto Emergency Medical Services.

3 - A Simple Frequency based Rule Classification Algorithm

Chun-An Chou, SUNY Binghamton, 4400 Vestal Pkwy, Binghamton, NY, United States of America, cachou@binghamton.edu, Anas Hourani

Associative classification has been increasingly applied to personalized medicine. Conventional approaches generate a large number of rules for classification of diagnostic outcomes. However, a simple rule, instead of various rules, is more desirable while accurate classification remains. In this work, we propose a new simple rule classification algorithm. A simple rule for individual patients is generated based on the class frequency.

Monday, 8:00am - 9:30am

■ MA01

Hilton- Golden Gate 6

Advances in Military Healthcare Operations Research

Sponsor: Military Applications Society

Sponsored Session

Chair: Nathaniel Bastian, PhD Student & NSF Graduate Research Fellow, Pennsylvania State University, 355 Leonhard Building, University Park, 16802, United States of America, ndbastian@psu.edu

1 - Optimizing U.S. Army Medical Department Workforce Planning Decisions using Goal Programming

Nathaniel Bastian, PhD Student & NSF Graduate Research Fellow, Pennsylvania State University, 355 Leonhard Building, University Park, 16802, United States of America, ndbastian@psu.edu, Lawrence Fulton, Pat McMurry, Paul Griffin

The U.S. Army Medical Department manages its officers over 30 years, so determining the appropriate number of hires and promotions for each medical specialty is complex. We proffer mixed-integer linear weighted goal programming models to optimize workforce planning, using simulation to verify and validate the results. Our models allow for better transparency of personnel for senior decision-makers and human resource planners, while effectively projecting the required manpower structure.

2 - Fuzzy Resource Allocation in Health Systems

Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy 411, San Marcos, TX, 78666, United States of America, tahirekin@gmail.com, Paul Griffin, Ozan Kocadagli, Nathaniel Bastian, Lawrence Fulton

The efficient use of system resources in health systems is crucial due to increasing demand despite increasing costs. Large health systems generally have fixed inputs to be allocated to branches that have particular target output levels. We propose a fuzzy resource allocation optimization model and illustrate it using real-world data from an U.S. Army hospital network. We discuss the implications of using a fuzzy decision making model that can deal with various risk preferences.

3 - Dispatching and Locating Military Aeromedical Evacuation Assets with Security Escort Assets

Benjamin Grannan, Virginia Commonwealth University, 1015 Floyd Ave, Richmond, VA, 23225, United States of America, grannanbc@mymail.vcu.edu, Laura McLay

In military medical systems, some aeromedical evacuation assets are weaponized and capable of flying solo. Other evacuation assets must fly in tandem with a security escort asset. Unavailable assets translate into delay of medical treatment for casualties. This paper introduces a MIP model that examines the locating and dispatching decisions for two types of aeromedical evacuation assets and security escort assets. The objective is to minimize the service time of the most urgent casualties

4 - The Future of Small Navy Ship Sickbays and Army Aeromedical Evacuation Aircraft

Nolan Roggenkamp, Captain / Student, U.S. Army, 11005 Moran Road, Monterey, CA, 93940, United States of America, ndroggen@nps.edu, Temi Ayeni

The purpose of this study is to explore the current configuration of Sickbays on small Navy surface combatant ships and the Army's Aeromedical Evacuation Aircraft. We will conduct a current capability based analysis that qualitatively identifies the employment of medical technology, equipment, and consumables on these two respective platforms. The results will be used as a baseline to determine the most effective means of utilizing advanced medical technologies in the future.

■ MA02

Hilton- Golden Gate 7

Growth Oriented Innovation in Entrepreneurial and Ecosystem Settings

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Sinan Erzurumlu, Associate Professor, Babson College, 231 Forest St, Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Governance Structure and Growth of High-Technology Startup

Jizhen Li, Associate Professor, Tsinghua University, School of Economics and Management, Room 541, Weilun Building, Beijing, 100084, China, lijizhen@gmail.com, Yueheng Wang, Can Huang

The governance structure of high-technology startups would influence their early-stage growth. In particular, whether the owner of technology is a majority shareholder or holds a high-level management position may affect the firm's performance. Our research finds that the high-technology startups with technologist-dominant governance structure grow slower than the capitalist-dominant ventures.

2 - Relationships under Stress: The Effects of Business Cycles on Industry-university Systems

Julio Pertuze, Assistant Professor, Pontificia Universidad Catolica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, RM, 7660259, Chile, jpertuze@ing.puc.cl

While universities have been portrayed as "engines of growth," little attention has been given to their role in periods of economic downturn. This paper analyzes the coevolution of industry-university relationships in the forest products sector. We found that universities act as "knowledge buffers" for cyclical industries, helping firms to regain lost capabilities and allowing corporate technologies time to mature despite changes in firm strategy. Policy and managerial implications are discussed

3 - The Role of Network Structure in Entrepreneurial Action

Sunny S. Yang, Senior Lecturer, University of Essex, Essex Business School, Essex, United Kingdom, sunnyy@essex.ac.uk, Emma Y. Liu, Yanto Chandra

We study the spread of entrepreneurial actions in a dynamic, networked system where each individual embedded decides to act entrepreneurially in each period. We develop a graph-theoretic model and simulate it to characterize system behaviors by investigating the combined impact of network structures and other contextual factors including external shock. Our analysis suggests that the change in network structures significantly impacts the number of individuals taking entrepreneurial actions.

4 - Innovation and Risk in Product Development: Empirical Testing of 3D Printers on KickStarter.com

Chao-Yang Song, Post-Doctoral Research Fellow, Singapore University of Technology and Design, 20 Dover Dr, Singapore, 138682, Singapore, chaoyang_song@sutd.edu.sg, Kevin Otto, Jianxi Luo, Katja Holtta-Otto

A new method is explored to explain market adoption of new products from innovation and risk perspectives. Based on the Real-Win-Worth framework, 26 questionnaires are developed to assess the all 3D printer projects to date from KickStarter.com. Key innovation or risk indicators and their correlations that explain crowd-funding success are identified via a PLS regression analysis. The results provide implications to crowd-funding strategy and risk management of early-stage innovation projects.

5 - Product Innovation and Platform Strategy: Technological Evolution in the Smartphone Industry

Hyunwoo Park, Georgia Institute of Technology, 85 5th St NW, Atlanta, GA, 30308, United States of America, hwpark@gatech.edu, Rahul Basole

Our study is based on the technological evolution of smartphones including physical characteristics, performance characteristics, and features over the past decade. Our longitudinal analysis of a dataset consisting of 1,169 smartphones by 79 device manufacturers and 12 different platforms highlights the significant transformational changes that have occurred. We propose an index to measure innovativeness of a smartphone upon which we test hypotheses on product family and platform strategy.

■ MA03

Hilton- Golden Gate 7

Social Networks, Personal Information, and Open Innovation

Sponsor: eBusiness

Sponsored Session

Chair: Idris Adjerid, University of Notre Dame, 358 Mendoza College of Business, Notre Dame, United States of America, iadjerid@nd.edu

1 - LIKE Economy: An Empirical Estimation

Rajiv Garg, McCombs School of Business, University of Texas, Austin, TX, United States of America, RajivGarg@mccombs.utexas.edu

Monetization of social interactions and influence is one of the key challenges facing researchers and practitioners alike. Users are often given incentives to "like" products and vendors on social media sites under the assumption that likes are valuable, the crux of the matter lies in the question: How much is a "like" worth to a seller? We address this question by empirically estimating the economic value of Facebook LIKE.

2 - Visceral Targeting - using Personal Information for ÚHidden Persuasion
Sonam Samat, Carnegie Mellon University, 5530 Howe Street, Apt 2, Pittsburgh, PA, 15232, United States of America, sonamsamat@gmail.com, Alessandro Acquisti, Eyal Pe'er, Ralph Gross

Online behavioral advertising has helped marketers target products to individuals based on their personal information. Marketers are constantly looking for ways to collect more information about customers. We investigate whether morphing individuals' facial images, which are collected from their social network profiles, making them unrecognizable yet subconsciously familiar, and using the resulting face composite to solicit personal information, can influence disclosure behavior.

3 - Baring Out with Iron Hands: Can Disclosing Make Us Harsher?
Laura Brandimarte, Carnegie Mellon University, Hamburg Hall 2107E, 4800 Forbes Avenue, Pittsburgh, United States of America, lbrandim@andrew.cmu.edu, Alessandro Acquisti, Francesca Gino

Two studies investigate how the act of disclosing sensitive information affects individuals' judgments of others who made similar disclosures. Study 1 uses information from social networks and finds that participants who shared online information about their questionable behaviors judged others who did the same more harshly, as compared to participants who did not share such information. Study 2 uses an online experiment to test for the causal role of disclosure, and confirms the result.

4 - Innovative or Practical? An Empirical Study of Idea Selection in an Open Innovation Funnel
Ajit Sharma, Ross School of Business, 701 Tappan Street, Ann Arbor, United States of America, asharmaz@umich.edu, Yan Huang

The digitization of innovation is increasingly manifest in a wide variety of open innovation archetypes. Arguably, the critical skill in open innovation is selection rather than generation of ideas. We empirically investigate idea-screening choices at the stage gates of an open innovation funnel for a large private bank. We find support for a desire to be radical in the early stage gates which is superseded by concerns of feasibility and execution in later stages closer to implementation.

■ MA04

Hilton- Continental 1

Empirical Research in Operations / Supply Chain

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Anupam Agrawal, UIUC, 363 Wohlers Hall, Champaign, Il, 61821-6255, United States of America, anupam@illinois.edu

1 - Organization Structure, Sourcing Quality, and Spillover
Anupam Agrawal, UIUC, 363 Wohlers Hall, Champaign, Il, 61821-6255, United States of America, anupam@illinois.edu

We detail a very interesting real life experiment, wherein a firm had two different organization structures in its two plants, and these different structures enabled differential improvement in the quality of sourced components. We also study spillover between these two plants.

2 - Differential Risks of Innovation Failures: New Products vs. New Versions of Existing Products
Kingshuk Sinha, Professor, Mosaic Company Professor of Corporate Responsibility, Carlson School of Management, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Ujjal Mukherjee

We investigate the underpinnings of two types of failures of technological innovation-in-use: (i) new products and (ii) new versions of existing products. The empirical context of the study is medical device recalls. We analyze two types of recalls: PMA and 510K. The results suggest differential risk of failure for a medical device firm across the two types of recalls. Implications of the study results are discussed.

3 - Competencies for Contingent Talent Supply Chain Intermediaries
Sriram Narayanan, Associate Professor, Michigan State University, N357 College of Business Building, 632 Bouge Street, East Lansing, Mi, 48824, United States of America, narayanan@broad.msu.edu, Hakan Yildiz, David Closs

Contingent talent supply chain management (CT-SCM) is a proactive approach to effectively meeting changing workforce needs of companies. Our research focuses on identifying key competencies of a managed service provider in orchestrating a CT-SCM. We use case based approach and substantiate our analysis with archival data where applicable.

4 - Firm and Regulator Timeliness in the Medical Device Product Recall Process
Rachna Shah, Associate Professor, UMN, United States of America, shahx024@umn.edu, George Ball

We investigate the attributes of medical device recalls that impact firm and regulator recall timeliness. Utilizing a unique dataset containing multiple time-stamps for ten years of medical device recalls, we find that more serious recalls lead to slower response times from both firms and regulators. Contrary to our expectations, we then discover that taking more time to open and close a recall may create more opportunities for learning and prevent future quality problems which lead to recalls.

■ MA05

Hilton- Continental 2

Session

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Alp Muharremoglu, Associate Professor, University of Texas at Dallas, Richardson, TX, United States of America, alp@utdallas.edu

1 - Optimality of (s,S) Policies in EOQ Models with General Cost Structures
Sandun Perera, PhD Candidate, Naveen Jindal School of Management, The University of Texas at Dallas, 800 West Campbell Rd., Richardson, TX, 75080, United States of America, sandun.perera@utdallas.edu, Ganesh Janakiraman, Shun-Chen Niu

The EOQ model is at the heart of supply chain optimization. We prove the existence of an optimal policy of the (s,S) type in the EOQ model under minimal assumptions on the ordering/procurement and holding/backorder costs. This result holds whenever an optimal solution exists for the problem of minimizing the long-run average cost within the class of (s,S) policies. Our proof is constructive and elementary, i.e., it is based on first principles that do not rely on advanced mathematical machinery.

2 - Optimal Storage Profile in a Semi-automated Order Fulfillment System
Rong Yuan, PhD Candidate, MIT, 235 Albany St, Cambridge, MA, 02139, United States of America, rongyuan@mit.edu, Stephen Graves

In this paper we examine the operation of a semi-automated fulfillment center, in which the storage pods do the traveling rather than the operators. The primary decision we consider is on what pod to store each unit of inventory. The objective is to minimize the expected number of pods required to satisfy a set of randomly-generated orders. We model this problem as a mixed-integer problem with non-linear objective function.

3 - Generalized Price-Only Contracts
Lifei Sheng, University of British Columbia, 2053 Main Mall, Vancouver, BC, Canada, Fay.Sheng@sauder.ubc.ca, Mahesh Nagarajan, Tim Huh

We consider a two-stage decentralized supply chain using a generalized price-only contract, wherein a supplier sequentially and dynamically offers a retailer n different wholesale prices. We show structural properties of how the profits of the supplier and the retailer change as n becomes large. Our analysis has some important implications for the role of strategic inventory and Coase's conjecture.

■ MA06

Hilton- Continental 3

Information in Supply-Chains

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Noam Shamir, Tel Aviv University, Tel Aviv, Israel, nshamir@post.tau.ac.il

1 - Information Sharing in a Supply Chain with a Trade Association under a Wholesale Price Contract
Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Noam Shamir

Studying the incentives of a group of retailers, organized as a trade association, to exchange forecast information, we compare between two industry policies: exclusionary and non-exclusionary information sharing. Although non-exclusionary policy has been advocated to promote information sharing, we show the opposite can happen and explain the reason.

2 - Cartel Formation through Strategic Information Leakage in a Distribution Channel
Noam Shamir, Tel Aviv University, Tel Aviv, Israel, nshamir@post.tau.ac.il

A group of retailers attempt to establish a cartel. In order to reduce the risk of the cartel's exposure, the retailers coordinate their strategies by sharing information with their manufacturer. Although the manufacturer is not part of the cartel, he is willing to assist the retailers in such a scheme.

3 - Bargaining in Supply Chains with a Single Pivotal Agent
Dror Hermel, Ariel University, Ariel University, Ariel, Israel, drorhe@ariel.ac.il, Daniel Granot, Mahesh Nagarajan

We study a setting where a single pivotal player negotiates with several non-pivotal players. We provide a bargaining framework to derive allocations of profit, using Nash bargaining principles. We identify inherent outside options, and use these to generate an endogenous disagreement outcome. When the non-pivotal players are not allowed to communicate, our solution coincides with the Nash-Nash solution, and it coincides with the Shapley value, when the non-pivotal players can communicate.

4 - The Third Party Logistics Coordinator Mechanism for Transshipments in Decentralized Systems
Yale T. Herer, Technion - Israel Institute of Technology, Faculty of Industrial Engineering, Haifa, 32000, Israel, yale@technion.ac.il, Avinoam Tzimerman

We investigate a multi-retailer single period stochastic lotsizing problem. In our decentralized system the retailers are independent, doing what is in their own best interest. We add transshipments to this constellation by introducing a third party whom we call 3PLC, which stands for Third Party Logistics Coordinator. We develop a coordination mechanism involving 3PLC with without the retailers disclosing their private information (costs and demand parameters) to the other retailers.

■ MA07

Hilton- Continental 4

From OR to OM: Observations on the Emergence of a Discipline

Cluster: Tutorials

Invited Session

Chair: John Buzacott, York University, Schulich School of Business, Toronto, ON, Canada, jbuzacott@schulich.yorku.ca

1 - From OR to OM: Observations on the Emergence of a Discipline
John Buzacott, York University, Schulich School of Business, Toronto, ON, Canada, jbuzacott@schulich.yorku.ca

This tutorial is based on the author's experience 50 years ago in applying OR in industry. It describes some of the problems and issues encountered, almost all of which were then new. There were no textbooks about how to use OR to understand production and inventory control. However, as awareness of the problems increased, approaches were developed using OR that industry found helpful. Eventually consultants, software developers and academics working with managers created a body of knowledge which was the basis of a new discipline, Operations Management.

■ MA08

Hilton- Continental 5

Applications of Little's Law

Cluster: Applications of Little's Law

Invited Session

Chair: John Little, MIT Sloan School, E62-534, 100 Main St., Cambridge, MA, 02142, United States of America, jlittle@mit.edu

1 - Generalized Little's Law-Asset Picking System to Model an Investment Portfolio: a Working Prototype
ML Ceprini, MIT Sloan School, E62-534; 100 Main St, Cambridge, MA, 02142, mceprini@mit.edu, John Little

Decision rules create an Asset Picking System (APS) structure that, combined with Little's Law (LL), Generalized Little's Law (GLL) and its corollaries, generates the GLL-APS model, a financial engineering tool bridging operations research and finance. The model selects type and number of shares for each investment. Changes can be accepted/rejected by the customer. GLL-APS customizes portfolios for clients. Now it is a working prototype, later, an assessed and calibrated model.

2 - Formula for Profit Increase Based on Little's Law
Michael George, 3605 Beverly Drive, Dallas, TX, 75205, mike@entropy2718.com, Dinesh Rajan

We derive a formula that will allow an executive to predict the profit increase created by an investment in Operations Management methods such as Lean and Six Sigma. The decomposition of Little's Law results in the Entropy and waste in a manufacturing process, which is then minimized. The accuracy of the resulting Formula for Profit Increase is confirmed by case studies. Shannon's Information Theory thus becomes a new approach to optimization in OM applications.

3 - Use of Little's Law For the Diagnosis and Realization of Hidden Profits and Undiscovered Risks
John F. Carrier, MIT, 247 Gray Street, Arlington, MA, 02476, United States of America, jfcarrie@mit.edu

We demonstrate how Little's Law may be used to detect and quantify the "hidden factories" within any system. We show its application to a large logistics project (deepwater O&G), and how it "cut through the Big Data problem" to find $20M/yr in savings. We also show how a mid-sized US manufacturer used its principles to survive the economic downturn of 2008-9, and how a start-up company used it to develop a system to serve its key customers while remaining loyal to its sustainability goals.

4 - Analysis of Biological Aging
John Little, MIT Sloan School, E62-534, 100 Main St., Cambridge, MA, 02142, United States of America, jlittle@mit.edu

Mitnitski, Song and Rockwood (2013) in an article on biological aging apply Little's Law in the following form: (the average number of biological deficits present in an individual) equals (the rate of environmental stresses) times (the average recovery time). Average deficits accumulate with age and average environmental stresses stay relatively constant. So Little's Law tells us that average recovery time increases with age. The usefulness of this simple formula is demonstrated with data.

■ MA09

Hilton- Continental 6

Healthcare Operations

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Robert Batt, Asst. Professor, UW-Madison, 975 University Ave., Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

1 - Planning Regional Hospital Bed Capacity to Ensure Appropriate Access to Inpatient Care
Thomas Best, Doctoral Candidate, The University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, tbest@chicagobooth.edu, Burhaneddin Sandikci, Donald Eisenstein, Varun Gupta

We consider a public board that oversees hospital bed capacities across a geographic region. The board aims to avoid excess bed capacities and also to reduce delays of inpatient admissions. To achieve its mission, the board sets bed capacity targets and evaluates proposed capacity changes against these targets. We develop a model to predict the delays from proposed bed capacities. We apply our model to regional inpatient data, and discuss its predictions and their implications for the board.

2 - using Matching to Examine Early Warning Systems for ICU Admissions
Wenqi Hu, Columbia University Business School, 3022 Broadway, Uris 4V, New York, NY, 10027, United States of America, whu17@gsb.columbia.edu, Jose Zubizarreta, Carri Chan

Unplanned transfers of patients from the ward to the Intensive Care Unit (ICU) occur due to rapid deterioration and can increase patients' mortality. This work is an empirical study of the potential benefits of preventive ICU admission based on a new warning system. In estimating the effect of endogenous admission decisions, we use a near-far matching method to improve the strength of the instrumental variable and find that preventative admission can potentially improve patient outcomes.

3 - SURGE: Smoothing Usage of Resources is Good for Emergencies
Alex Mills, Indiana University, Operations & Decision Technologies Dept, Kelley School of Business, Bloomington, IN, 47405, United States of America, millsaf@indiana.edu, Jonathan Helm, Yu Wang

Following a mass-casualty incident (MCI), a hospital faces a surge in demand. We study management tools to create surge capacity to meet this demand. We show that a hospital's best strategy to improve its surge response is not through immediate actions after the MCI, but through proactive long-term demand planning. In particular, discharging patients early sacrifices long-term recovery for short-term responsiveness, while workload smoothing improves the response in both short and long-term.

4 - The Disposition Decision: Handoffs and End-of-Shift Effects in an Emergency Department

Robert Batt, Asst. Professor, UW-Madison, 975 University Ave., Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu, Diwas KC, Brian Patterson, Bradley Staats

We examine what factors impact the probability of a patient being handed-off to a new doctor at the end of a shift versus being dispositioned by the current doctor. We also look at the effect of hand-offs on operational variables such as length of stay and revisit rate.

■ MA10

Hilton- Continental 7

Stochastic Models for Service Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Vasiliki Kostami, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, vkostami@london.edu

1 - Design and Operations of Service Systems with Unknown Customer Types

Mihalis Markakis, Assistant Professor, Universitat Pompeu Fabra, Ramon Trias Fargas, 25-27, Barcelona, Spain, mihalis.markakis@upf.edu, Kostas Bimpikis

Motivated by call centers and healthcare facilities, we consider a queueing system with two customer types and two server pools, where only a probabilistic prior for the types of customers is known upon their arrival. For given staffing levels we determine the stability region of the system and propose a simple threshold scheduling policy that is maximally stable, evaluating its delay performance through simulations. Finally, we look into the problem of optimally staffing the system.

2 - Prioritization of Customers with Hidden Types in a Service System

Zhankun Sun, Statistics and Operations Research UNC at Chapel Hill Hanes Hall, CB, szk@unc.edu, Nilay Argon, Serhan Ziya

We consider a service system with a single server and two types of customers. Each customer incurs a linear holding cost that depends on its type. The server can choose to investigate and classify a customer, serve one of the already classified customers, or serve one of the unclassified customers without investigation. We provide a characterization for the server's optimal actions.

3 - Competition and the Operational Performance of Hospitals: The Role of the Hospitals' Objective

Dimitrios Andritsos, HEC Paris, 1 Rue de la Liberation, Jouy-en-Josas, France, andritsos@hec.fr, Sam Aflaki

We examine the effect of a hospital's objective (i.e., non profit vs. for profit) in hospital markets for elective care. Using queueing models and game-theoretic analysis we compare the equilibrium behavior of three market structures: i) no competition ii) competition between non-profit hospitals and iii) competition between non-profit and for-profit hospitals.

4 - Managing the Customer Mix and Crowding via Pricing and Capacity Allocation

Vasiliki Kostami, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, vkostami@london.edu, Dimitris Kostamis, Serhan Ziya

We study the pricing and capacity allocation problem of a service provider who serves two distinct customer classes with utilities that depend on how many customers are in the system as well as who these customers are. We study the system when the provider can price discriminate and when she is restricted by a single price. We extend our analysis to the case where class interaction is prevented by allocating capacity segments to the two customer classes.

■ MA11

Hilton- Continental 8

Pricing and Contracts in Supply Chains

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Fernando Bernstein, Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, fernando.bernstein@duke.edu

1 - Sell Directly or Indirectly? Channel Structure and Dynamic Pricing with Strategic Customers

Sean Zhou, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, Hong Kong - PRC, zhoux@baf.cuhk.edu.hk, Jiye Xue, Qianbo Yin

We consider a dual-channel supply chain where a manufacturer sells a seasonal product to strategic consumers through both an independent retailer and its direct channel over a finite selling season. During each period, the manufacturer and the retailer sequentially set the wholesale and retail prices. We derive the unique sub-game perfect Nash equilibrium of this dynamic game and study how channel structure affects dynamic pricing strategies.

2 - Optimal Long-Term Supply Contracts with Asymmetric Demand Information

Ilan Lobel, Assistant Professor, NYU Stern School of Business, 44 W 4th St, New York, NY, 10012-1126, United States of America, ilobel@stern.nyu.edu, Wenqiang Xiao

We study the design of optimal dynamic long-term supply contracts between a manufacturer and a retailer. We show the simple structure of optimal long-term contracts both for the case of backlogging and the case of lost sales.

3 - Chasing Demand: Learning and Earning in a Changing Environment

Bora Keskin, The University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, bora.keskin@chicagobooth.edu, Assaf Zeevi

We consider a price-setting firm facing an unknown demand model that can change over time. We show that the firm can achieve a substantially better revenue performance in demand environments that change in "bursts" than it would in a demand environment that changes "smoothly." We also extend our analysis to the case of rapidly changing demand settings, and obtain a range of results that quantify the net effect of the volatility in the demand environment on the revenue performance.

4 - A Simple Heuristic for Joint Inventory and Pricing Problems with Lead Time

Yang Li, California State University, Sacramento, CA, United States of America, yang.li@csus.edu, Fernando Bernstein, Kevin Shang

We study a joint inventory and pricing problem in a single-stage system with positive lead time. This problem is, in general, intractable due to its computational complexity. We develop a simple heuristic that resolves this issue. The heuristic first generates a pricing policy which depends on the initial inventory level. We then transform the joint problem into a standard inventory problem. This heuristic enables us to explore the impact of lead time on the joint decision.

■ MA12

Hilton- Continental 9

Pricing and Regulation Issues in Sustainable Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Gal Raz, Associate Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, razg@darden.virginia.edu

1 - Optimal Pricing for New and Remanufactured Products

James Abbey, Texas A&M University, 4217, College Station, TX, 77843, United States of America, jabbey@mays.tamu.edu, Joe Blackburn, Dan Guide

When considering remanufactured products, do consumers follow the typical principle of 'cheaper is better' or do other rules apply? Additionally, do consumer markets for remanufactured products demonstrate homogeneous, price-taking behavior? This research provides insights into these and other questions through triangulation of empirical investigations and tightly coupled economic modeling.

2 - The Economical and Environmental Impact of Take Back Legislations in presence of Secondary Markets

Shumail Mazahir, PhD Candidate, HEC, Jouy en Josas, 78350, France, shumail.mazahir@hec.edu

We analyze the economical and environmental impact of various take back schemes in presence of secondary markets. We look at the cases (a) secondary market with remanufactured product (b) new and remanufactured products for both markets.We analyze the environmental and economical impacts on primary and secondary markets in presence of various combination of take back laws and provide conditions where one scheme can outperform the other.

3 - Economic and Environmental Assessment of Remanufacturing in a Competitive Setting

Gal Raz, Associate Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, razg@darden.virginia.edu, Anton Ovchinnikov, Vered Blass

This paper provides data-driven assessment of economic and environmental aspects of remanufacturing under competition. We study a product-line competition where one firm is selling new products and the other new and refurbished products. We use analytical and behavioral models to examine the impact of remanufacturing on the firms' competition.

4 - Competing on Toxicity: The Impact of Supplier Prices & Reg on Mfgs Substance Replacement Strategies

Tim Kraft, Assistant Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, KraftT@darden.virginia.edu, Gal Raz

We examine how competition impacts manufacturers' decisions to replace a substance of concern. We find that if manufacturers face a cost tradeoff between the substance's expected regulatory risk and the supplier price for the replacement substance, then a high-end manufacturer can use his brand to control the market. Conversely, opportunities may exist for manufacturers to collaborate to replace a substance, even when the shared cost to replace is greater than the sum of their individual costs.

■ MA14

Imperial B

Air Traffic Control: Safe and Sound?

Sponsor: Aviation Applications

Sponsored Session

Chair: David Chin, FAAFederal Aviation Administration, 800 Independence Avenue, SW, Washington, DC, 20591, United States of America, david.chin@faa.gov

1 - Computer Simulation Model to Study Current and Future Oceanic Operations

Antonio Trani, Virginia Tech, Blacksburg, VA, United States of America, vuela@vt.edu, Tao Li, Aswin Gunnam

This presentation describes the development of a North Atlantic Simulation Model (NATSAM III) to investigate the effects of changes to operational policies and strategies in oceanic airspace. We discuss the methodology, different components of the model, validation and a case study of the benefits of North Atlantic Data Link Mandates.

2 - Reducing Scheduled Block Times through Departure Sequencing

Mark Hansen, University of California, Berkeley, 114 McLaughlin Hall, Berkeley, CA, 94720, United States of America, mhansen@ce.berkeley.edu, Lu Hao

In previous work we have found a relationship between scheduled block times and the distribution of realized times, by phase of flight. Here, we consider how departure sequencing might be used to change the taxi-out time distribution and therefore reduce scheduled block times.

3 - World Airline Safety: Better than Ever?

Arnold Barnett, Professor, MIT, E62-568, MIT, Cambridge, MA, 02139, United States of America, abarnett@mit.edu

Moving beyond the (often ghastly) headlines about plane crashes and disappearances, we investigate statistically both the absolute mortality risks that air travelers face and cross-national disparities in risk levels. The answer to the titled question is: yes and no.

4 - Is There a Business Case for North Atlantic Data Link Mandate?

Aswin Gunnam, Research Analyst, GRA Incorporated, 1250 Maryland Avenue SW, Washington, DC, 20024, United States of America, aswin.ctr.gunnam@faa.gov, Arnold Barnett, Thea Graham

ICAO is has introduced GPS & satellite based Data Link technology over the North Atlantic oceanic airspace which would reduce the safety risks, but also would require huge investments. We present a cost-benefit analysis by estimating the risk levels with and without the Data Link and translating the resultant reduction in risk in NAT into economic consequences.

■ MA15

Hilton- Exec. Boardroom

Applications in Electricity Networks and Natural Disasters

Cluster: Data Envelopment Analysis

Invited Session

Chair: Jaap Bos, Maastricht University, Maastricht,The Netherlands, j.bos@maastrichtuniversity.nl

1 - Institutions and the Impact of Natural Disasters

Jaap Bos, j.bos@maastrichtuniversity.nl, Mark Sanders, Martien Lamers

We investigate the impact of natural disasters events using stochastic frontier analysis, separating efficient government responses to disasters from inefficient ones that have high human and economic costs. We find that the inefficiencies are not related to variables such as disaster intensity and regional geography, but instead have to turn to indicators of institutional quality and economic activity to explain them.

2 - StoNED Versus Two-stage DEA for Regulation of Electricity Networks

Mette Bjørndal, Norwegian School of Economics, NHH, Helleveien 30, Bergen, Norway, Mette.Bjorndal@nhh.no, Endre Bjørndal

We compare StoNED to the present method used by the Norwegian regulator. We see that the estimation of distributional parameters under StoNED has a strong effect on the best-practice frontier, while the average-practice frontier is more robust to noise in the data. The efficiency scores are calibrated by the regulator in order to ensure that companies with average efficiency earn the regulatory rate of return, and we discuss how this calibration can be related to the average-practice frontier.

3 - Compensating for Exogenous Cost Drivers in the Regulation of Electricity Networks

Endre Bjørndal, Norwegian School of Economics, NHH, Helleveien 30, Bergen, Norway, Endre.Bjorndal@nhh.no, Mette Bjørndal, Astrid Cullmann, Maria Nieswand

The present yardstick model used by the Norwegian regulator compensates, via two-stage DEA efficiency analysis, for a number of environmental factors. These factors are correlated with measured efficiency and company size. We compare conditional nonpararametric methods to current benchmarking model, and we discuss whether the choice of method affects the revenue caps of companies in a systematic manner.

4 - Stepwise DEA in Benchmarking of the Brazilian Distribution Electricity Companies

Ana Lúcia Lopes, Professor, Universidade Federal de Minas Gerais, Rua Rio de Janeiro, 2754 apto. 601, Belo Horizonte, MG, 30160042, Brazil, analopes.ufmg@gmail.com, Marcelo Azevedo, Sergio Fiuza

Data Envelopment Analysis(DEA) has been used by regulators to measure the efficient operational costs in transmission and distribution energy sector. This paper explores the Stepwise DEA methodology to identify variables that should be used in the evaluation of the Brazilian distribution energy companies. The results points out to the inclusion of number of transformers, rural and urban network as outputs in a model that uses OPEX as input and energy, consumers and network length as outputs.

■ MA16

Hilton- Franciscan A

Operations and Finance

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Arun Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, A.Chockalingam@tue.nl

1 - Managing Inventory for Entrepreneurial Firms with Trade Credit and Payment Defaults

Kevin Shang, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, kevin.shang@duke.edu, Wei Luo

This paper considers an entrepreneurial firm that periodically orders inventory to satisfy non-decreasing demand in a finite horizon. The firm provides trade credit to its customer while receiving it from its supplier. A default penalty cost is incurred for unfulfilled payments. We prove the optimal and near-optimal policies under different trade credit periods and assess the value of considering financial flows when making the inventory decision.

2 - The Financial Holding Cost of Inventory
Lei Xie, Associate professor, Shanghai University of Finance and Economics, Yangpu district, Guoding Road 777, Shanghai, China, xie.lei@mail.shufe.edu.cn, S. Alex Yang, Fehmi Tanrisever, Xiaoying Liang

We study a joint financing and inventory management model that characterizes firms' inventory policy under certain financial market imperfections and relate this model to the traditional inventory models.

3 - The Entrepreneurial Newsvendor: Managing Market Frictions through Process Investment
Fehmi Tanrisever, Bilkent University, Main Campus MA Building, Ankara, Turkey, tanrisever@bilkent.edu.tr, Sinan Erzurumlu, Nitin Joglekar, Moren Levesque

We show that the preemptive investment decision can be employed as an operational hedge to mitigate capital market frictions and create value by enhancing the firm's financing options and production volume. The fiscal value created by mitigating frictions is in addition to the traditional benefits of process investment. We derive conditions when such a preemptive investment is the optimal for the entrepreneur in the presence of capital market frictions.

4 - Short-term Financing with Reverse Factoring
Arun Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, A.Chockalingam@tue.nl, Matthew Reindorp, Fehmi Tanrisever

According to pecking order theory, firms resort to external sources to finance their operations when internal funds are limited. Firms may obtain short-term loans directly from banks or they may receive loans in the form of reverse factoring through the aid of other supply chain partners. We examine the trade-off between dynamically switching between traditional bank loans and reverse factoring as the risk-free rate of interest and customer demand fluctuate over time.

■ MA17

Hilton- Franciscan B

Empirical Research in Service Operations

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, United States of America, jguajardo@haas.berkeley.edu

1 - Impact of Delay Announcements in Call Centers: An Empirical Approach
Seyed Emadi, Assistant Pofessor, Kenan-Flagler Business School, 300 Kenan Drive, Chapel Hill, NC, 27599, United States of America, Seyed_Emadi@kenan-flagler.unc.edu, Baris Ata, Che-Lin Su, Zeynep Aksin

We undertake an empirical study of the impact of delay announcements on callers' abandonment behavior and the performance of a call center with two priority classes. We develop a methodological framework to find the new system equilibrium and analyze the impact on the system performance when there is a change in the call center operations, e.g. a new delay announcement rule or a new service discipline is introduced.

2 - Profitability Implications of Selling the Right Set of Information
Chris Parker, Penn State University, Business building, State College, PA, 16802, United States of America, chris.parker@psu.edu, Kamalini Ramdas, Nicos Savva

Farmers in India can receive daily price information via a text message subscription service in their choice of up to three markets out of a large selection of markets. We model the farmers' decision process and use structural estimation to understand these dynamics. We use counterfactual analysis to determine the impact of different managerial decisions on service penetration and profitability as well as farmer profitability.

3 - The Impact of Team Presence on Worker Productivity
Tom Tan, Cox Business School, Southern Methodist University, 6212 Bishop Blvd, Dallas, United States of America, ttan@mail.cox.smu.edu, Serguei Netessine

We examine how the presence of other coworkers affects individual workers' performance. Our study offers an approach for capturing the experience in a fluid team and highlights the need to understand the external impact of heterogeneous skills on other coworkers. In addition, our findings provide insights into how team composition can optimize worker productivity to achieve higher sales.

4 - Disentangling Production Smoothing from the Bullwhip Effect
Robert Bray, Assistant Professor, Kellogg School of Management, 830 Hinman Ave., 2S, Evanston, IL, 60202, United States of America, robertlbray@gmail.com, Haim Mendelson

Historically, production smoothing and the bullwhip effect have shared a common measure: the difference between production variability and demand variability. This metric confounds the two effects, however, suggesting that firms that exhibit the bullwhip effect cannot smooth production. We develop new production smoothing measures that are robust to the bullwhip effect. We derive these measures from a structural econometric production scheduling model, based on demand signal processing.

■ MA18

Hilton- Franciscan C

Choice Models in Revenue Management and Pricing V

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Huseyin Topaloglu, Cornell University, 223 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, ht88@cornell.edu

1 - A Market Discovery Algorithm to Estimate a General Class of Non-parametric Choice Models
Gustavo Vulcano, New York University, 44 West Fourth St, Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu, Garrett van Ryzin

We develop a column generation algorithm to estimate rank-based customer preferences for a set of substitutable products using only sales transactions and product availability data. The problem we address is how to jointly estimate the arrival rate of consumers and the pmf of the rank-based choice model under a maximum likelihood criterion. Numerical experiments confirm the potential of our proposal.

2 - A Dynamic Model of Shopping and Consumption
John Semple, SMU, Cox School, Dallas, United States of America, jsemple@mail.cox.smu.edu, Edward Fox, Laura Norman

We combine standard random utility theory with dynamic programming to determine how one should consume a set of products in order to maximize the utility of the entire set. Both the optimal policy and the optimal expected value function are closed-form and intuitively appealing. Our model can be used to design the optimal set of any size for a particular consumer based solely on their marginal preferences for products in a larger assortment.

3 - Solving Large-Scale Network Revenue Problems: An Aggregation Perspective
Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

Using compact approximate linear programs (ALPs) resulting from functional approximations to the network revenue management problem as a starting point, we propose aggregation schemes to solve the resulting problems. Computational results illustrate the potential of our approach.

4 - Revenue Upper Bound under Mixture of Logits
Huseyin Topaloglu, Cornell University, 223 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, ht88@cornell.edu, Jacob Feldman

We consider assortment optimization problems when customers choose according to a mixture of multinomial logit models. The problem of finding the revenue-maximizing assortment is NP-hard. We develop an efficient approach to obtain good upper bounds on the optimal expected revenue.

■ MA19

Hilton- Franciscan D

Operations and Marketing Interface

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St George Street, Toronto, ON, Canada, Ming.Hu@rotman.utoronto.ca

1 - Risk-aversion and Contracting in Managed Print Services

Jie Ning, Case Western Reserve University, 11119 Bellflower Rd, Cleveland, Oh, 44106, United States of America, jxn174@case.edu, John Handley, Volodymyr Babich, Jussi Keppo

Managed print service is an IT infrastructural service that provides comprehensive management over institutional customers' printer fleets. We develop a model on the service provider's optimal contracts under asymmetric information. Applying our model to a proprietary data set from Xerox, we estimate the structural parameters and report that the service provider is better modeled to be risk-averse rather than risk-neutral. We show that this result is robust to different model specifications.

2 - Newsvendor Mergers

Xin Wang, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, xinwang1@andrew.cmu.edu, Soo-Haeng Cho

We examine the effects of a merger between two price-setting newsvendors on the firms' prices, inventories and expected profits in an oligopolistic market. Existing literature studies mergers under deterministic demand, and predicts that cost savings always cause prices to drop. However, we find that under uncertain demand, cost savings from inventory pooling always cause prices to rise, and that marginal cost reduction induces firms to lower their prices only when it is substantial.

3 - Dynamic Pricing with Reference Price Effects under Heterogeneous Customer Arrivals

Zizhuo Wang, University of Minnesota, 111 Church St SE, Minneapolis, United States of America, zwang@umn.edu

We consider a seller facing heterogeneous arriving customers with reference price effect. We illustrate a new form of price discrimination opportunity, where the seller's optimal pricing strategy is cyclic even when customers are loss-neutral and have identical demand functions. This result differs from those in prior studies where the optimal price paths are shown to be asymptotically constant and is unique due to the interaction between heterogeneous arrivals and reference price effects.

4 - Less for More: Product Line Design under Social Influence

Jiahua Wu, Jiahua.Wu09@Rotman.Utoronto.Ca, Ming Hu

We consider a monopolistic firm selling multiple substitutable products to a stream of sequential arrivals whose purchase decisions can be influenced by earlier purchases. The products are horizontally differentiated on a Hotelling circle. We show that social influence increases product substitutability. In anticipation of this, the firm would reduce product variety in its product line.

■ MA20

Hilton – Yosemite A

Pricing & Revenue Management Convergence

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Hai Chu, Director, Decision Science, Walt Disney Parks & Resorts, 1375 E Buena Vista Dr., Lake Buena Vista FL 32836, United States of America, Hai.D.Chu@disney.com

Co- Chair: Cara Dienes,Walt Disney Parks & Resorts U.S., P.O. Box 10000, Lake Buena Vista FL 32830-9600, United States of America, Cara.J.Dienes@disney.com

1 - Optimization Challenges with a Customer Choice Model

Matt Maxwell, SAS Institute Inc., 500 SAS Campus Dr, Cary NC 27513, United States of America, Matt.Maxwell@sas.com

Traditional revenue management techniques centered on an independent demand model (IDM) where each demand is only interested in a single product. Recent market changes have weakened the legitimacy of the IDM model and prompted increased interest in customer choice models (CCM) where potential customers select from all available products based upon their preferences. We highlight some challenges that arise when using a CCM as compared to an IDM in revenue optimization.

2 - The Evolution of Revenue Management Systems

Frederick Zahrn, Walt Disney Parks & Resorts U.S., P.O. Box 10000, Lake Buena Vista FL 32830-9600, United States of America, Frederick.C.Zahrn@disney.com, Cara Dienes

Revenue Management (RM) systems in the travel industry have focused on availability control rather than dynamic pricing functionality, and they have tended to pay limited attention to customer choice behavior such as buy-down. This presentation explores a framework for understanding current and future RM systems that incorporate choice models or dynamic pricing functionality. While we focus on resort hotel applications, the framework is intended to be relevant beyond this context.

3 - Upgrades and Upsells: Hilton vs Hert

Guillermo Gallego, The Liu Family Professor, Columbia University, New York NY 10027, United States of America, gmg2@columbia.edu

We consider a revenue management problem with two popular upsell models that resemble the practice by Hilton and Hertz. Under the Hilton model, customers may be offered a conditional discount for an upgrade at booking. Under the Hertz model, customers may be offered an upgrade at a discounted price if profitable to Hertz. We compare the profitability of these models and against other variants.

4 - Lower Bounds on the Effectiveness of Dynamic Pricing under Limited Learning

Wang Chi Cheung, Graduate Student, Massachusetts Institute of Technology, 77 Massachusetts Ave, E40-149, Cambridge MA 02139, United States of America, wangchi@mit.edu, David Simchi-Levi

Motivated by flash-sales in the online retail environment, we consider an online dynamic pricing problem with limited price experimentation, when the underlying demand curve is unknown. We provide a tight lower bound on the seller's regret, which matches the regret upper bound by Simchi-Levi et al. (2013). Through the analysis, we identify the structure of an optimal pricing strategy, and illustrate a learning-earning trade-off by quantifying the loss in revenue under insufficient learning.

■ MA21

Hilton- Union Sq 1

Transportation and Routing under Uncertainty II

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Leila Hajibabai, University of Illinois at Urbana–Champaign, Urbana, IL, United States of America, hajibab1@illinois.edu

1 - Approximate Dynamic Programming for Last Mile Problem with Stochastic Demand

Shih-Fen Cheng, sfcheng@smu.edu.sg, Lucas Agussurja, Hoong Chuin Lau

We look at the problem of arranging rides for stochastically arriving passengers from a hub to their final destinations with limited number of vehicles. We propose a two-level approach: at the upper level, the strategic decision of assignment and dispatch in each period is made, and it is formulated as a MDP. The value function of this MDP is evaluated at the lower level by running Monte Carlo simulation. The effectiveness of our approach is demonstrated using a real-world dataset.

2 - Reliable Facility Location Design under Service Disruption, En-Route Congestion and In-Facility Waiting

Weijun Xie, Georgia Institute of Technology, Atlanta, GA, United States of America, xieweijun06@gmail.com, Na Cui, Yanfeng Ouyang, Yun Bai, Shi An, Mingliu Chen

The quality of service systems highly depends on the accessibility, efficiency and reliability of service facilities. This paper presents a scenario-based stochastic program that integrates service disruption uncertainty, en-route traffic congestion and in-facility delay into a reliable service facility location problem. Numerical bounds and a tractable MINLP approximation model are derived and solved by a customized solution approach based on Lagrangian relaxation and conic quadratic program.

3 - Algebraic Approaches for the Stochastic Shortest Path Problem in General Networks

Katherine Hastings, West Liberty University, 208 University Drive, CUB 165, West Liberty, WV, 26074, United States of America, katherine.hastings@westliberty.edu, Douglas Shier

We present an algebraic approach for computing the distribution of the length of a shortest s-t path in general (possibly cyclic) networks, in which arc lengths are modeled with probability distributions. Fixed-point iteration techniques along with concepts from min-plus algebra are used to develop algorithms for the exact distribution as well as lower bounding distributions. We also obtain bounds on the expected length of a shortest path. Results are presented for example networks.

4 - Dynamic Snow Plow Fleet Management under Uncertain Demand and Service Disruption

Leila Hajibabai, University of Illinois at Urbana–Champaign, Urbana, IL, United States of America, hajibab1@illinois.edu, Yanfeng Ouyang

A set of models and methodologies are developed for dynamic snow plow fleet management in a demand-responsive decision-making process (e.g., under service disruptions or uncertain maintenance demand). The numerical results show that the proposed algorithm can solve the problem effectively.

■ MA22

Hilton- Union Sq 2

Post-Disaster Relief and Response

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Nilay Noyan, Associate Professor, Sabanci University, Istanbul, 34956, Turkey, nnoyan@sabanciuniv.edu

1 - Modeling Public-Private Inventory Management Partnership Policies for Regional Catastrophic Planning

Unsal Ozdogru, Clinical Assistant Professor, University of Illinois at Chicago, 601 South Morgan Street , MC 294, Chicago, IL, 60607, United States of America, uozdogru@uic.edu, Matthew Liotine

Preparedness for disasters such as hurricanes, etc. has been a challenging task to plan for, but is critical to reducing losses in human life, improving economic welfare and limiting environmental damage. We developed analytical models to evaluate tradeoffs between various public and private sourcing arrangements to make necessary items such as water available in the affected regions in order to reduce the impact of disasters. Recommendations are made regarding the efficacy of the policies.

2 - Strategic Planning for Disabled and Elderly Populations in Natural Disasters

Jacqueline Griffin, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA, 02115, United States of America, ja.griffin@neu.edu, Rana Azghandi

New York City received criticism for how it served the disabled in its response to Superstorm Sandy. In order to address disaster response for the mobility challenged, we develop a MIP model to aid in the evacuation of these individuals accounting for real-time location information, availability of limited resources, and time constraints. The evacuation planning problem is complicated by the heterogeneous nature of evacuee's needs, shelter-in-place options, and reusable transportation resources.

3 - G-network Models for Relief Centers at Disaster Sites

Merve Ozen, PhD Student, University of Wisconsin Madison, 1513 University Avenue, Madison, Wi, 53706, United States of America, mozen@wisc.edu, Ananth Krishnamurthy

We use a generalized queuing network (G-network) to model relief centers that distribute aid to victims at a disaster site. We analyze the effects of batch routing and crowd congestion on sojourn times in the network and explore impacts of stock-outs and staffing decisions.

4 - Stochastic Optimization Models for Designing Last Mile Relief Networks

Nilay Noyan, Associate Professor, Sabanci University, Istanbul, 34956, Turkey, nnoyan@sabanciuniv.edu, Burcu Balcik, Semih Atakan

We introduce a last mile relief network design problem under demand- and network-related uncertainties. We focus on providing accessible and equitable services to beneficiaries, and develop two-stage stochastic programming models. We implement an exact branch-and-cut algorithm based on Benders decomposition, and conduct numerical analysis to evaluate the proposed alternative models. We discuss the practical implications of our results on a case study based on the 2011 Turkey earthquake.

■ MA23

Hilton- Union Sq 3

Uncertainty in Transportation Models I

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Maria Elbek, Aarhus University, Fuglesangs Allee 4, Aarhus V, 8210, Denmark, meandersen@econ.au.dk

1 - Effective Truckload Dispatch Decision Method with Incomplete Advance Load Information

Hossein Zolfagharinia, PhD Candidate, Wilfrid Laurier University, 75 University Avenue west, Waterloo, ON, Canada, hzolfagharinia@wlu.ca, Michael Haughton

One source of improved profitability for truckload freight carriers is advanced knowledge of detailed client demand. We quantify the profit improvement by using mixed integer programming (MIP) to model dynamic truckload transportation operations. The MIP model, along with an effective approach to handle incomplete knowledge are the study's major contributions.

2 - Robust Optimization of Truckload Relay Networks under Demand Uncertainty

Zahra Mokhtari, Graduate Research Assistant, Oregon State University, 204 Rogers Hall, Corvallis, OR, 97321, United States of America, mokhtarz@onid.oregonstate.edu, Hector A. Vergara

This study addresses the problem of strategic relay network design for truckload transportation under demand uncertainty. We try to find suitable robust solutions under any possible realization of demand instead of optimizing the relay network design using most likely values. Budgeted uncertainty is applied in defining the demand uncertainty set. Thus, a trade-off between conservatism and optimality determines the quality of the solutions. A robust optimization formulation is presented along with results obtained for several problem instances of this problem.

3 - Shipment Consolidation with Generalized Arrival Processes and Non-linear Customer Disutility Functions

Qishu Cai, University of Waterloo, Waterloo, ON, Canada qcai@uwaterloo.ca, Qi-Ming He, James Bookbinder

We model the process of combining multiple small orders into a larger load, for shipment together to gain economies of scale. Markovian arrival processes of orders with different quantities and priorities, and disutility functions that increase in a customer-order's waiting time, are considered. An optimal dispatch policy is found.

4 - A Stochastic Solution Approach for Multi-period Collection of Recyclable Materials in a Multi-compartment Vehicle

Maria Elbek, Aarhus University, Fuglesangs Allé 4, Aarhus V, 8210, Denmark, meandersen@econ.au.dk, Teodor Gabriel Crainic, Walter Rei

We consider an approach for scheduling the multi-period collection of recyclable materials. To establish a high service level for the citizens, cubes for collection may not be overfilled. Inspired by theory on the Inventory Routing Problem (IRP), we present a two-stage stochastic model and solution method for scheduling the collection in order to minimize the cost.

■ MA24

Hilton- Union Sq 4

Active Traffic Control Strategies for Real-Time Management

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Ketan Savla, Assistant Professor, University of Southern California, 3620 South Vermont Avenue KAP 254A, Los Angeles, CA, 90089, United States of America, ksavla@usc.edu

1 - A Processor Sharing Perspective on Horizontal Traffic Queues

Ketan Savla, Assistant Professor, University of Southern California, 3620 South Vermont Avenue KAP 254A, Los Angeles, CA 90089, United States of America, ksavla@usc.edu, Mohammad Motie

Motivated by emerging ITS technologies, we consider a horizontal traffic queue, where vehicles arrive on a road with finite length according to a spatio-temporal Poisson process, and depart after traveling to a common destination at the end of the road. Vehicle speed is dynamically determined by relative distance with respect to neighbors, and a constant speed limit. We make connection with processor sharing queues to derive fluid limit of proposed system, and use it to study maximum throughput.

2 - Information-based Network Traffic Control using Hybrid Route Guidance Strategy under Vehicle-to-vehicle Communications
Yong Hoon Kim, Purdue University, West Lafayette, IN, United States of America, kim523@purdue.edu, Srinivas Peeta

We address information-based network control using a hybrid route guidance strategy under vehicle-to-vehicle (V2V) communications. It seeks to improve guidance quality by balancing the ability of the centralized layer to generate a predictive guidance with the ability of the decentralized V2V layer to respond rapidly to random incidents. Numerical experiments are illustrated to demonstrate the efficiency of the proposed approach.

3 - Data-driven Linear Decision Rule Approach for Distributionally Robust real-time Signal Control
Tao Yao, Penn State University College of Engineering Electronic and Computer Services, University Park, PA, United States of America, tyy1@engr.psu.edu, H. Liu, K. Han, Terry Friesz

We propose a two-stage linear-decision-rule approach for optimizing traffic signal based on both historical and real-time information. In the offline stage a distributionally robust optimization problem is solved based on historical data whiling accounting for daily variations (uncertainties). The online stage employs a practical linear decision rule that provides the best traffic signal response to real-time data. This methodology is implemented in a realistic network setting.

4 - A Three Level Location-inventory Problem with Correlated Demand
Mehrdad Shahabi, West Virginia University, Morgantown, West Virginia, United States of America, mshahabi@mix.wvu.edu, Avinash Unnikrishnan, Stephen Boyles

A model for three level location-inventory problem correlated demand has been presented. A solution approach based on a customized outer approximation strategy is applied and the algorithmic benefits of such framework are discussed. The results from numerical experiments show that the proposed solution procedure clearly outperforms state-of-the-art commercial solvers.

5 - Dynamic Pricing and Learning in Network Equilibrium Models
Tarun Rambha, tarun.1988@gmail.com, Stephen Boyles

Route choice dynamics of boundedly rational travelers in traffic networks seldom converge to equilibria. Under general assumptions of the learning behavior of travelers, we propose a Markov decision process framework that dynamically prices the network to maximize the probability of reaching a particular equilibrium or system optimal state.

■ MA25

Hilton- Union Sq 5

Infrastructure Investment and Management

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Harry van der Weijde, Vrije Universiteit Amsterdam, Department of Spatial Economics, De Boelelaan 1105, Amsterdam, 1081HV, Netherlands, h.vanderweijde@gmail.com

1 - Regulating the Formation of Transport Networks when Capacity Investment is Discrete
Harry van der Weijde, Vrije Universiteit Amsterdam, Department of Spatial Economics, De Boelelaan 1105, Amsterdam, 1081HV, Netherlands, h.vanderweijde@gmail.com, V. A. C van den Berg, E. T. Verhoef

We examine the effects of different policies that regulate the formation of transport networks by private operators. To do so, we construct a small network in which it is possible to build congestible links with discrete capacities between each pair of nodes. We examine several multi-stage games in which one or more operators choose which links to construct and operate. We find that capacity subsidisation and price regulation are not always sufficient to achieve the first-best welfare maximum. We also discuss when second-best network regulation is better than price regulation.

2 - Analytical Model for Evaluating the Long-Term Benefits of Internal Curing
Yuntao Guo, Purdue University, West Lafayette, IN, United States of America, guo187@purdue.edu, Jason Weiss, Srinivas Peeta, Xiaozheng He

This study seeks to quantify the long-term benefits of internally cured concrete mixtures in terms of cost reduction, sustainability, and congestion mitigation. A nonlinear programming model is developed to maximize the long-term benefits of internal curing by identifying the optimal infrastructure renewal plan. The model can help planners in designing effective and sustainable repair mechanisms in high traffic areas to reduce the impacts of the associated traffic disruptions.

3 - Pavement Rehabilitation Planning using a Mechanistic-empirical Approach
Yun Bai, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, yunbai1@illinois.edu, Yanfeng Ouyang, Jaime Alberto Hernandez-Urrea, Osman Erman Gungor, Imad L. Al-Qadi

This research develops an optimization framework for design and rehabilitation of a single pavement integrating Mechanistic-Empirical roughness transfer models. A mixed integer nonlinear program and a dynamic programming subroutine are developed to determine the optimal rehabilitation timing and asphalt concrete design thickness addressing the trade-off between agency and user costs.

4 - Utilization Optimization of Tolled Freeways
Shokoufeh Mirzaei, California State Polytechnic University,pomona, Industrial and Manufacturing Engineering, 3801 W Temple Ave, Pomona, CA, 91768, United States of America, smirzaei@csupomona.edu, Gabriela Abanto, Santiago Galvis Correa, Alberto Rosa, Sesar Salasar

In this paper a set of parameters that has a significant impact on the traffic intensity of tolled freeway lanes are identified. The impacts of significant parameters are then quantified and their optimal values are obtained so that the utilization level of tolled lanes is maximized while the system constraints (e.g. minimum speed) are met. Finally, a set of he control actions are defined to maintain the traffic flow as optimum as possible.

■ MA26

Hilton- Union Sq 6

Urban Operations Research

Sponsor: Location Analysis

Sponsored Session

Chair: Mihiro Sasaki, Professor, Nanzan University, 27 Seirei, Seto, Japan, mihiro@nanzan-u.ac.jp

1 - A Business Model on the EV Support Infrastructure Focusing on the Number of Stations and Charge Fee
Yudai Honma, Assistant Professor, The University of Tokyo, Komaba 4-6-1, Meguro-ku, Tokyo, 153-8505, Japan, yudai@iis.u-tokyo.ac.jp

Electric vehicles (EV) have attracted an increasing amount of attention. However, the continuous cruising distance of an EV is limited to around 160 km, which is insufficient for everyday use. To promote the diffusion of EV, EV support infrastructure such as EV station is essential and it must become profitable. In this research, we propose a business model on the EV support infrastructure with respect to the number of EV stations and charging fee.

2 - Solving Large-scale Multi-target Tracking Problem to Identify Massive People Flow in Urban Area
Shunji Umetani, Dr., Osaka University, 2-1 Yamadaoka, Suita, Osaka, Japan, umetani@ist.osaka-u.ac.jp, Akira Kumano, Takashi Hasuike, Yuma Konishi

Analysis of spatiotemporal people flow in urban area has become increasingly important in many applications including marketing and public services. Although we can partially monitor people flow by tracking various devices such as mobile phones and IC tickets, it is quite incomplete because some privacy and integration issues still remain. To identify massive people flow from fragmentary observed data, we solve multi-target tracking problem by integer linear programming approach.

3 - Special Considerations in Transit Route Optimization
Richard Church, Professor, University of California, Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106-4060, United States of America, rick.church@ucsb.edu, Timothy Niblett

There are several fundamental models that have been used as the basis for transit route optimization including the shortest covering path model and the maximal covering shortest path model. We show that special issues arise in the use of these two models which may actually prevent optimal routes from being identified.

4 - A Scheduling Problem for Locating EV Battery Charging Stations
Mihiro Sasaki, Professor, Nanzan University, 27 Seirei, Seto, Japan, mihiro@nanzan-u.ac.jp, Kazuya Matsui, Ken-ichi Tanaka

In this paper, we consider a scheduling problem of locating EV battery charging stations where the location of all stations is given. Due to budgetary limitation, it might be generally difficult to locate all stations at a time. In such a case, the stations would be located in order according to a pre-determined schedule. We show how the schedule difference give an impact on user convenience, and propose heuristics to find good schedules.

■ MA27

Hilton- Union Sq 7

Railroad OR Models

Sponsor: Railway Applications

Sponsored Session

Chair: Clark Cheng, Director Operations Research, Norfolk Southern Railway, 1200 Peactree St NE, Atlanta, GA, 30309, United States of America, Clark.Cheng@nscorp.com

1 - Railway Crew Scheduling with Train Departure Delay

Yutian Yang, University of Texas at Austin, 204 East Dean Keeton Street, Austin, TX, 78712, United States of America, yutian_peter@utexas.edu, Brian Roth, Anant Balakrishnan

In this talk, we study a freight railway crew assignment problem in which train departure time can be postponed. We propose a deterministic optimization model which integrates trip scheduling and crew assignment. We provide model improvements and present computational results using real-life data from a major North American railway company.

2 - Developing a Real-time Train Movement Planning System

Ravindra Ahuja, President & CEO, Optym, 2153 SE Hawthorne Road, Gainesville, Fl, 32641, United States of America, ravindra.ahuja@optym.com, Amit Agarwal

We are developing a real-time train movement planning system for a railroad. In this presentation, we will give an overview of the system: our approach and our development methodology. We will also give a demonstration of the system share the lessons learnt in this interesting and educative project.

3 - Scheduling Geometry Cars in Norfolk Southern Rail Network

Andy Yoon, Manager Operations Research, Norfolk Southern Corporation, 1200 Peachtree Street NE, Atlanta, GA, 30309, United States of America, andy.yoon@nscorp.com, Yudi Pranoto, Clark Cheng, Gaohao Luo

We present a scheduling model that minimizes deadhead miles of geometry cars while considering track inspection time interval requirements. A solution procedure was developed to assist decision making in scheduling geometry cars inspecting Norfolk Southern rail network.

4 - Locomotive Shop Routing using Approximation Dynamic Programming

Clark Cheng, Director Operations Research, Norfolk Southern Railway, 1200 Peactree St NE, Atlanta, GA, 30309, United States of America, Clark.Cheng@nscorp.com, Coleman Lawrence, Maurice Cheung, Ricardo Fiorillo

We will present the locomotive shop routing system at Norfolk Southern Railway. The system is built based on the approximation dynamic programming (ADP).

■ MA28

Hilton- Union Sq 8

Airline Network Planning and Schedule Development

Sponsor: Aviation Applications

Sponsored Session

Chair: Ahmed Abdelghany, Associate Professor, Embry-Riddle Aeronautical University, 600 S. Clyde Morris Blvd., Daytona Beach, FL, United States of America, abdel776@erau.edu

1 - Airline Schedule Optimization Model with Efficient Aircraft and Crew Rotations

Ahmed Abdelghany, Associate Professor, Embry-Riddle Aeronautical University, 600 S. Clyde Morris Blvd., Daytona Beach, FL, United States of America, abdel776@erau.edu, Khaled Abdelghany

This research contributes to the clean-sheet flight scheduling problem by presenting a modeling framework that incorporates aircraft and crew rotations in flight scheduling models. Given the desired service frequency in the different city pairs, the framework generates an operational flight timetable that maximizes the airline's revenue, while generating efficient rotations for aircraft and crew. We present the application of the framework using a real-world data of a major US airline.

2 - An Approach to Analyze Consumer Welfare Impacts of U.S. Airline Mergers

Laurie Garrow, Georgia Institute of Technology, School of Civil Engineering, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu, Matthew Higgins, Jeff Newman

The U.S. airline industry has experienced significant consolidation. Economists often use a BLP approach to quantify consumer welfare impacts associated with mergers. Within aviation, the full potential of the BLP approach has yet to be realized, due to limited publicly-available fare information. We discuss a dataset we are using to overcome this limitation, outline our research approach, and discuss and potential benefits for airline itinerary choice modeling applications.

3 - Bank Structure Model

Gizem Keysan, Manager, United Airlines, 233 S Wacker Dr, Chicago, IL, 60606, United States of America, gizem.keysan@united.com

Banks are periods where most flights arrive/depart around the same time. They create more connection possibilities while providing efficiency with opportunities to swap aircraft. In order to build the best bank structure, it is crucial to consider several factors such as valuable connections, manpower availability and gating feasibility. We present an optimization model that recommends bank start and end times to maximize connection revenue while adhering to the operational constraints.

4 - Considering Uncertain Capacity Changes in Airline Revenue Management

Daniel Kadatz, Freie Universität Berlin, Garystr. 21, Raum 201, Berlin, 14195, Germany, daniel.kadatz@fu-berlin.de, Catherine Cleophas, Christina Büsing

We demonstrate a model integrating non-optimal mandatory capacity changes in airline revenue management. Such changes frequently occur in the booking horizon in practice, but theoretical approaches almost entirely neglect them so far. We outline a new approach incorporating uncertain capacity changes, present a set of designs for simulation experiments as well as first numerical results.

■ MA29

Hilton- Union Sq 9

Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice

Cluster: Daniel H. Wagner Prize for Excellence in Operations Research Practice & CPMS, The Practice Section

Invited Session

Chair: C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

1 - Daniel H. Wagner Prize

C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

The competition for the 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in six finalists, who submitted papers to the judging committee and who will present their results in three sessions. In this keynote, the winner of the competition will be announced and the authors will give a reprise of the winning presentation.

2 - Project Portfolio Planning at Intel Corporation

Siddhartha Sampath, Intel Corporation, Decision Engineering Group, 5000 W. Chandler Blvd., Chandler, AZ, 85226, United States of America, siddhartha.sampath@intel.com, Karl Kempf

We address the problem of deciding between project funding opportunities under budget constraints. Projects interactions make selection difficult but senior managers have business intuitions that inform the decisions. We use modeling, simulation and optimization methods to find the best project portfolios including tools for decision makers to apply their insights in making the final selection. Interplay of analytics and intuition produces better solutions faster than was previously achieved.

3 - Airline Crew Augmentation, Decades of Improvements from Sabre

Shahram Shahinpour, Senior of Operations Research, Sabre Holdings, Inc, 3150 Sabre Dr., Southlake, TX, 76092, United States of America, Shahram.Shahinpour@sabre.com, Tina Shaw, Yogesh Dashora

The airline crew pairing problem is to generate optimized legal anonymous pairings that cover the flight complement requirements. The exact crew composition needed on a flight often varies depending on of the pairings that cover it. Different from the conventional approaches, Sabre Long Haul Pairing Optimizer models this dependency explicitly and uses sophisticated Branch and Price techniques. We use real airline examples to show our solution brings considerable savings to the airline industry.

■ MA30

Hilton- Union Sq 10

Stochastic Scheduling and Supply Chains

Cluster: Scheduling and Project Management

Invited Session

Chair: Xiaoqiang Cai, Professor, The Chinese University of Hong Kong, Dept of Systems Engineering, Shatin, NT, Hong Kong, Hong Kong - PRC, xqcai@se.cuhk.edu.hk

1 - Production Planning and Pricing Policy in a Make-to-stock System Subject to Machine Breakdowns

Houcai Shen, Professor, Nanjin University, 22 Hankou Road, Nanjing, Jiangsu, Nanjing, China, hcshen@nju.edu.cn, Ting Wu, Xiutian Shi

We consider a make-to-stock system served by an unreliable machine that produces one type of product. The system manager must determine the production level and selling price at each decision point. We first show that the optimal production and pricing policy is a threshold control. We then establish the structural relationships among the three threshold parameters. Finally we provide some numerical examples to illustrate the analytical results and gain additional insights.

2 - Production Costs, High Worth Players, and Tails in Subcontracting

George Vairaktarakis, Professor, Case Western Reserve University, 10900 Euclid Ave, 323 PBL, Cleveland, Oh, 44106, United States of America, gxv5@case.edu, Vernon Hsu, Ke Fu

We consider multiple manufacturers subcontracting part of their workload at a third-party (3P) production facility with the rest of the work processed in-house. Production costs are customer-specific, both at their own facility as well as at 3P. We explore production plans and cooperative strategies that incentivize optimal behavior.

3 - Carbon Emission Reduction in the Presence of Production Mix Selection

Xiaolin Xu, Professor, Nanjing University, Nanjing, China, xuxl@nju.edu.cn, Jian chen, yongbo xiao, Xiaoqiang Cai

This paper investigates the question of how should the government impose a suitable incentive to induce firms to emit carbons to the level that optimizes the social welfare. We consider a producer that manufactures a product either by an old or new technology, or by a mix of the two technologies. Two carbon emission reduction policies, i.e., taxing on the high-carbon products and subsiding on the low-carbon products, are studied on the side of the government.

4 - Risk Sharing by Delay-in-Supply for a Dual-Channel Supply Chain

Weili Xue, Southeast University, School of Economics and Management, Nanjing, China, wlxue1981@gmail.com, Chen Zhiyuan, Xiaogan Jiang

We study a dual-channel supply chain where the supplier can delay his supply to the retailer. The supplier can satisfy his realized demand of the direct channel by the retailer's order. We find that delay-in-supply can be used to sharing the supplier's demand risk, and benefits the retailer at the same time, to improve the whole supply chain. We also study the delay-in-supply affects' on selling prices and the wholesale price, show the effect of demand variability on the obtained results.

■ MA31

Hilton- Union Sq 11

Service Operations and Marketing Inter-Related Issues

Sponsor: Service Science

Sponsored Session

Chair: Rohit Verma, Singapore Tourism Board Distinguished Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14850, United States of America, rv54@cornell.edu

1 - Primary Task Utilization and Secondary Task Compliance: A Behavioral Investigation

Brett Massimino, Cornell University, School of Hotel Administration, Ithaca, NY, 14850, United States of America, massimino.3@fisher.osu.edu, John Gray, James Hill

We use a laboratory experiment to examine human performance behaviors in a multitasking environment. We examine how the level of utilization on a primary, individual-oriented task and noncompliance penalties for a secondary, organization-oriented task interact in affecting one's propensity to perform the secondary task. We frame our study in the realm of non-IS workers complying with Information Security processes, yet offer implications for many other manufacturing and service settings.

2 - Incorporating Customer Feedback in Service Operations with Text Analytics

Shawn Mankad, Assistant Professor, University of Maryland, 4316 Van Munching Hall, College Park, MD, 20742, United States of America, smankad@rhsmith.umd.edu, Rohit Verma, Spring Han, Nagesh Gavirneni

There is a large literature showing that online reviews have a direct impact on decision making and product sales. Yet, most extant works utilize only the numerical "star" rating or at most the valence of the review text for modelling. In this work, we apply modern text analytics to a corpus of reviews for hotels in a major city from a leading review website to identify key areas of service operations that depend on hotel type and quality.

3 - The Influence of Surprise and Anticipation on Peak and End Effects in Service Operations

Mike Dixon, Assistant Professor, Naval Postgraduate School, 555 Dyer Road, IN-234, Monterey, 93943, United States of America, mjdixon@nps.edu, Rohit Verma, Liana Victorino

In many service designs there is a high point — a peak portion that often defines the entire experience. We investigate how anticipation and surprise influences these peak segments. We test the influence of anticipation and surprise of peaks and their placements using an online survey-based experiment.

4 - Service Design, Customer Reviews and Preferences: Insights from Hospitality Industry

Rohit Verma, Singapore Tourism Board Distinguished Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14850, United States of America, rv54@cornell.edu, Rachna Shah, Kanika Thakran

This paper presents the results of customer preferences and reviews for service design features in the hospitality industry.

■ MA32

Hilton- Union Sq 12

Frontiers in Service Science

Sponsor: Service Science

Sponsored Session

Chair: Changrui Ren, IBM Research - China, Building 19, Zhongguancun Software Park, Beijing, China, rencr@cn.ibm.com

1 - Process Monitoring and Automation to Enable Service Delivery Excellence

Sai Zeng, Research Scientist, IBM T. J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, saizeng@us.ibm.com, Miao He, Changrui Ren

Process Automation is critical to reduce the need for human work in the production of goods and services to make the processes uniform and efficient. In this talk, we present an evidence based analytical approach to identify top opportunities for process automation, and provide objective assessment of benefit to enable process leaders to take informed decisions. A case study in Finance and Administration Process Delivery Services is used to illustrate the core idea of our analytical approach.

2 - Practice in Data-Driven Target Marketing Activities in O2O Commerce

Bing Shao, Staff Researcher, IBM, Building 19, Zhongguancun Software Park, 8 Dongbeiwang West Road, Haidian Distric, Beijing, China, shaobing@cn.ibm.com, Changrui Ren, Miao He, Jinfeng Li, Hao Ji

The essence of online-to-offline (O2O) commerce is closed loop processing of transactions from online consumer decision making through payment to local service. We present a piece of practice to transform big data into actionable insights and guidance using decision analysis and optimization, which may help the O2O merchants optimize its marketing strategy including providing real time, relevant, and personalized product or service promotions, obtaining the early customers.

■ MA33

Hilton- Union Sq 13

Incentives for Innovation/Innovative Projects

Cluster: New Product Development

Invited Session

Chair: Morvarid Rahmani, Assistant Professor, Georgia Tech, 800 West Peachtree Street, N.W., Atlanta, GA, 30308, United States of America, Morvarid.Rahmani@scheller.gatech.edu

Co-Chair: Karthik Ramachandran, Associate Professor, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu

1 - Incentive Alignment and Coordination of Project-Based Supply Chains with Schedule Based Contracts

Shi Chen, Assistant Professor, University of Washington, Foster School of Business, Foster School of Business, ISOM Department, Box 353226, Seattle, WA, 98195, United States of America, shichen@uw.edu, Hau Lee

Consider a project-based supply chain which involves multiple activities each requiring a concentrated use of certain key materials. We derive the optimal material delivery schedule and payment scheme so that a delivery-schedule-based contract coordinates the channel. We show that the manufacturer's profit is not affected by the average supply lead time but is affected by the variance of the lead time. We also show that delivery reliability is the most important factor for channel coordination.

2 - Selling a New Product to Uncertain Customers with Learning Externality

Yufei Huang, PhD Student, University College London, Gower Street, London, United Kingdom, yufei.huang.10@ucl.ac.uk, Onesun Steve Yoo, Bilal Gokpinar

We study a seller's optimal pricing strategy and capacity decision when selling a new/innovative product to risk-averse customers who are uncertain about their valuations. Customers may deliberately delay their purchase for more information from other customers to reduce their valuation uncertainty. We then analyse the effect of learning externality on the market equilibrium, the seller's pricing strategy and capacity decision.

3 - Economics of Co-design: The Role of Product Lines

Sreekumar Bhaskaran, Associate Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, sbhaskar@mail.cox.smu.edu, Amit Basu

Inputs from final customers can be very helpful in creating effective customized products, but this "co-design" process requires customers who participate in it to commit significant time and effort. In this paper, we illustrate the role of product lines to engage the customer in the design process.

■ MA34

Hilton- Union Sq 14

Modeling the Education System

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Donna C Llewellyn, Associate Vice Provost for Learning Excellence, Georgia Tech, CETL Clough 457, 266 4th St. NW, Atlanta, GA, 30332-0383, United States of America, donna.llewellyn@cetl.gatech.edu

1 - The U.S. STEM Undergraduate Model: Applying System Dynamics to Undergraduate STEM Student Persistence

Debbie Hughes, Director of Higher Education & Workforce, The Business-Higher Education Forum, 2025 M St NW Suite 800, Washington DC, 20036, United States of America, debbie.hughes@bhef.com

BHEF's U.S. STEM Undergraduate Model, a first-of-its-kind system dynamics model focused on undergraduate STEM education, contextualizes President Obama's call for 1M additional STEM graduates, and provides an evidence-based approach to the high-impact practices needed to change STEM student persistence at scale. Through its National Higher Education and Workforce Initiative BHEF embeds the Model findings into strategic regional workforce projects in emerging high-skill high-demand fields.

2 - Modeling the Knowledge Economy: Exploring Productivity, Inequality, and Creative Destruction

Dan Sturtevant, CEO, Silverthread, Inc., 12 Lill Ave, Newton, MA, 02465, United States of America, dan@silverthreadinc.com, Merrilea Mayo, Jeanne Contardo

We present the "Aligned Workforce Model," a computer simulation used to explore the misalignment between education production and workforce needs. This agent- and network-based model contains simulated people, firms, and a representation of the ever-changing constellation of human knowledge. Using this model, we can explore the impact of policy choices on unemployment, skills across the workforce, economic productivity, inequality, and the strength of the middle class.

3 - Modeling Market-Based Reforms in Education

Spiro Maroulis, Assistant Professor, Arizona State University, School of Public Affairs, 411 N. Central Ave, Phoenix, AZ, 85004, United States of America, Spiro.Maroulis@asu.edu

In this talk, I will discuss applying the ideas and tools of complexity science to educational policy and management problems. In particular, I will present a computational, agent-based model that captures the dynamic processes involved in moving from a non-market to choice-based system. I will also present an example of applying network analysis to better understand competition within school districts.

4 - Analyzing K-12 Education System Interventions

Pratik Mital, PhD Candidate, Georgia Institute of Technology, North Ave NW, Atlanta, GA, 30332, United States of America, pratik_mital@gatech.edu, Roxanne Moore, Donna C Llewellyn

Schools and school districts are complex, dynamic systems affected by numerous factors. In this work, a framework is developed that can be used to analyze interventions in the K-12 education system in US. Techniques like agent-based modeling and social network analysis are used that allow the user to analyze the barriers and enablers to school change and reform. The framework is applied to model and analyze various case studies of school interventions.

■ MA35

Hilton- Union Sq 15

Public Health II

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, United States of America, chaitrag@umass.edu

1 - Understanding the Crisis in Somali IDPs

James Cochran, University of Alabama, Culverhouse College of Commerce and Bus, 347 Alston Hall, Tuscaloosa, AL, 35487, United States of America, jcochran@cba.ua.edu, Alaa Zeid

1.5 million Somalis have been internally displaced; many live in overcrowded settlements with limited access to water, sanitation, food, and shelter. Not surprisingly, mortality rates for children under 5 and women in these settlements are alarmingly high. We describe our WHO–supported efforts to collect data in these settlements and apply negative binomial regression to determine the conditions most strongly associated with these high mortality rates and provide guidance for relief efforts.

2 - Estimation of Global Impacts and Costs of Cancer Screening

Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, United States of America, chaitrag@umass.edu, Carel Pretorius, Jeremy Lauer, Melanie Bertram, Rachel Sanders

Estimates of health impacts and costs of screening for different types of cancers can guide development of public health policies on screening strategies. We present our ongoing work with WHO in developing simulation models of national populations for estimation of impacts and costs of alternate screening strategies and Markov models for estimation of onset and progression rates for simulating the natural history of cancer.

3 - Modeling the Complex Interaction between Comorbidities: Breast Cancer and Diabetes

Julie Ivy, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, United States of America, jsivy@ncsu.edu, Jennifer Mason, Shadi Hassani Goodarzi, Kendall McKenzie, Nisha Nataraj, Maria Mayorga, Jeremy Tejada

In 2010, over 200,000 women were diagnosed with invasive breast cancer, and 12.6 million women were affected by diabetes in the US, according to the Centers for Disease Control and Prevention. While we know much about these prevalent diseases individually, little has been studied about the interaction between them. Here, we build a modeling framework that explores this complex relationship so as to assess the prognosis for women who are diagnosed with diabetes given their breast cancer risk.

4 - Potential Impact of H7N9 Influenza Virus Pandemic Outbreak in the U.S.

Walter Silva Sotillo, PhD Student, University of South Florida, 4202 E. Fowler Ave, Tampa, FL, 33620, United States of America, silvasotillo@mail.usf.edu, Tapas Das

Until April 8, 2014, WHO reported 409 confirmed cases (with fatality around 30%) of H7N9 virus in China. Current concerns are that H7N9 might become human-to-human transmittable and spread internationally. We use data from recent reports and a simulation model to predict the potential impact of H7N9 pandemic in the U.S.

■ MA36

Hilton- Union Sq 16

Network Design

Sponsor: Telecommunications

Sponsored Session

Chair: Bernard Fortz, Professor, Université Libre de Bruxelles, GOM CP212, Bld du Triomphe, Brussels, 1050, Belgium, bernard.fortz@ulb.ac.be

Co-Chair: Dimitri Papadimitriou, Pr.Eng.Research, Bell Labs, Copernicuslaan 50, Antwerp, 2018, Belgium, dimitri.papadimitriou@alcatel-lucent.com

1 - Robust Optimization Approaches to Virtual Network Embedding

Martin Tieves, RWTH Aachen University, Lehrstuhl II für Mathematik, Wüllnerstrafle 5b, Aachen, 52056, Germany, tieves@math2.rwth-aachen.de, Arie Koster, Stefano Coniglio

Network virtualization is a key technology of modern telecommunications, allowing to decouple management aspects of the physical network from service provisioning. We consider the virtual network embedding problem (VNE) of selecting which virtual networks to embed onto the physical network to maximize profits. We present and investigate extensions of Mixed Integer Programming formulations for VNE handling data uncertainty by adopting both the Hose and the Gamma Robustness uncertainty models.

2 - Virtual Network Embedding with Network Design Elements: Reservation of Physical Resources

Stefano Coniglio, RWTH Aachen University, Lehrstuhl II für Mathematik, Wüllnerstrafle 5b, Aachen, 52056, Germany, stefano.coniglio@gmail.com, Martin Tieves, Arie Koster

Virtualization techniques allow for the coexistence of many virtual networks jointly sharing the resources of an underlying physical network. Unlike previous work, we focus on the service provider's point of view of deciding not only which virtual network requests to accept, but also which quantity of resources to reserve from the physical network owner so to maximize the revenue. We present Mixed-Integer Linear Programming formulations for the problem and investigate them computationally.

3 - Models for Traffic Engineering in Ethernet Networks Implementing the Multiple Spanning Tree Protocol

Bernard Fortz, Professor, Université Libre de Bruxelles, GOM CP212, Bld du Triomphe, Brussels, 1050, Belgium, bernard.fortz@ulb.ac.be, Luis Gouveia, Martim Moniz

The Multiple Spanning Tree Protocol (MTSP) maintains a set of spanning trees that are used for routing the demands in the network. Each spanning tree is allocated to a pre-defined set of demands. We present MIP models for the problem of optimally designing a network implementing MTSP, such that link utilization is minimized and propose a binary-search algorithm that efficiently produces near-optimal solutions for the problem.

4 - The Two-Level Diameter Constrained Spanning Tree Problem

Luis Gouveia, Professor, Univ of Lisbon, Centro de Investigacao Operacional, Bloco C6 - Piso 4- Campo Grande, Lisbon, 1749-016, Portugal, legouveia@fc.ul.pt, Ivana Ljubic, Markus Leitner

In this work, we introduce the Two-Level Diameter Constrained Spanning Tree Problem (2-DMSTP). We first observe that any feasible solution to the 2-DMSTP can be viewed as a DMST that contains a diameter constrained Steiner tree. This observation allows us to prove graph theoretical properties related to the centers of each tree which are then exploited to develop mixed integer programming formulations, valid inequalities, and symmetry breaking constraints.

■ MA37

Hilton- Union Sq 17

Predictive Analytics for Social Media

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Hyun-Woo Kim, PhD Candidate / Graduate Teaching Fellow, Pennsylvania State University, 324 IST Building, University Park, PA, 16802, United States of America, hxk263@ist.psu.edu

1 - Predictive Analytics for Presidential Elections

Hyun-Woo Kim, PhD Candidate / Graduate Teaching Fellow, Pennsylvania State University, 324 IST Building, University Park, PA, 16802, United States of America, hxk263@ist.psu.edu

There are a great amount of non-random signals and opinionated conversations related to presidential election campaigns coming out of social media. This work will demonstrate that understanding social dynamics associated with user affects, influence and information diffusion would help voters, political parties, election candidates and public administrations accurately capture the common understanding of the general public.

2 - 8-K Filings, Twitter Activities and Stock Market Reactions

Tawei Wang, University of Hawaii at Manoa, 2404 Maile Way, BUSAD E602C, Honolulu, HI, 96822, United States of America, twwang@hawaii.edu, Asheq Rahman, Roger Debreceny

This paper investigates Twitter activities around 8-K filing dates and the association between such activities and stock market reactions to 8-K filings. Using a sample of S&P 1500 companies' 8-K filings in 2012, we show the number of tweets, impression, sentiment, and influential tweeters directly affect the stock market reactions.

3 - Geolocation of Twitter Users through NLP, Machine Learning and Social Networking Algorithms

Ryan McKeown, Booz Allen Hamilton, 9800 Gable Ridge Terrace, Rockville, MD, 20850, United States of America, mckeown_ryan@bah.com, Curie Chang, Ryan Corbett

There are many problems that would benefit from Twitter data if geolocation was available. Less than two percent of Twitter users have geolocation enabled. We have developed an approach that combines NLP, machine learning and social networking algorithms to automatically detect a user's residence location at state level.

4 - CRM in Social Media: Predicting Increases in Facebook Usage Frequency

Michel Ballings, Professor, University of Tennessee, Knoxville, Knoxville, United States of America, Michel.Ballings@Gmail.com, Dirk Van den Poel

The purpose of this study is to (1) assess the feasibility of predicting increases in Facebook usage frequency, (2) evaluate which algorithms perform best, (3) and determine which predictors are most important. The results indicate that it is feasible to create models with high predictive performance. The top performing algorithm was Stochastic AdaBoost with a cross-validated AUC of 0.66 and accuracy of 0.74. This study is the first to assess the prediction of usage frequency in a social network

5 - Evaluating Social Media Data Appropriateness for Travel Demand Analysis: A Time Geography Approach

Mohsen Parsafard, Mississippi State University, 319 N Jackson St, Apt 2A, Starkville, MS, 39759, United States of America, mp1273@msstate.edu, Guangqing Chi, Xiaopeng Li

Social media data (e.g., twitter) hold a large amount of geo-tagged records of individuals that can be potentially used to reconstruct their activity trajectories. Based on time geography, this study proposes a set of measures that specify a continuous temporal-spatial bound of an individual's possible activity range with a discrete set of sampled time-location tags of this individual. We apply these measures to show the suitability of the tested twitter data for individual activity studies.

■ MA38

Hilton- Union Sq 18

Exploring Strategies for Innovation and Learning

Cluster: Strategy Science

Invited Session

Chair: Hart Posen, Associate Professor, University of Wisconsin-Madison, 975 University Avenue, Madison, WI, 53706, United States of America, hposen@bus.wisc.edu

1 - Technological Change and Incumbent Search in Music and Movies

Mary Benner, University of Minnesota, 3-365 Carlson School of MGMT, 321-19th Avenue South, Minneapolis, MN, 55455, United States of America, mbenner@umn.edu, Joel Waldfogel

Digital technology has spurred important changes in the music and movie industries, challenging the advantages of incumbents and creating innovative ways to conduct industry activities. Using extensive data on music and movie product releases, we examine how the search strategies of incumbents changed in the wake of the technological changes. We explore their approaches for discovering and selecting new talent and products, and the outcomes of these strategies.

2 - Does Strategic Management Need Neurosciences?

Stefano Brusoni, ETH Zurich, Weinbergstrasse 56/58, Zurich, 8092, Switzerland, sbrusoni@ethz.ch, Maurizio Zollo, Daniella Laureiro-Martinez, Vinod Venkatraman, Stefano Cappa

Neuroscientific methods enable management scholars to observe constructs nowadays central to strategy, e.g. cognition, ambidexterity. Yet, these methods (e.g. fMRI) are not 'general purpose technologies': They are good at solving specific classes of problems, but not all problems. We identify these classes of problems, with specific focus on three areas: attention control, routine emergence, and emotions. We discuss the ethical issues and the managerial implications.

3 - The Roles of the Giant Cluster in Knowledge Diffusion and Recombination

Jeho Lee, Associate Professor, Seoul National University, 599 Gwanangno, Gwanak-gu, Seoul, 151-916, Korea, Republic of, jeho0405@gmail.com, Jaeyong Song, Sungyong Chang

We examine the roles of a giant cluster in fostering knowledge diffusion and recombination. Our numerical analysis shows that the giant cluster acts as a knowledge integrator by facilitating knowledge diffusion between previously unconnected clusters. But, not all giant clusters are equally effective in fostering knowledge recombination. We find that only giant clusters with a modest fraction of bridges with no hubs are conducive to enhancing knowledge recombination.

4 - Performance Responses To Competition Across Skill-Levels In Rank Order Tournaments

Karim Lakhani, Harvard Business School, k@hbs.edu, Kevin Boudreau, Michael Menietti

Tournaments are widely used in the economy to organize production & innovation. We study individual contestant-level data on 2796 contestants in 774 software design contests. We find that performance response to added contestants varies non-monotonically across contestants of different abilities; most respond negatively to competition; highest-skilled contestants respond positively. In counterfactual simulations, we interpret a number of tournament design policies.

■ MA39

Hilton- Union Sq 19

Hospital-based Challenges

Sponsor: Health Applications

Sponsored Session

Chair: Vedat Verter, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, vedat.verter@mcgill.ca

1 - Integrated Surgical Bed Management

Mohammad Mehdi Ghotboddini, McGill University, 1001 Sherbrooke St, Montreal, QC, Canada, mehdi_ghotboddini@yahoo.com, Vedat Verter, Lawrence Rosenberg, Valerie Vandal

In collaboration with Montreal Jewish General Hospital Surgical Unit, we systematically approach surgical block scheduling problem to achieve cost containment by controlling over surgical case cancellation due to downstream bed shortage. We develop a stochastic model and apply a modified sample average approximation method to solve it.

2 - Operating Room Simulation Model Helps Hospitals Quantify their Challenges

Michael Carter, Professor, University of Toronto, Mech & Ind Engineering, 5 King's College Rd., Toronto, ON, M5S 3G8, Canada, mike.carter@utoronto.ca, Carolyn Busby, Daphne Sniekers

Over the past six years, we have developed a generic perioperative simulation model that has so far been implemented in eight Ontario hospitals. Initially, we developed the model to help OR planners optimize the surgical schedule and case mix. However, we discovered that the very act of validating the model provided hospitals with quantitative evidence highlighting flaws in their practices and exactly how to correct them. We will discuss several examples.

3 - Patient Flow Smoothing

Hamidreza Eslami, Canada, hamidreza.eslami@mail.mcgill.ca, Vedat Verter

Observing the current flow of colorectal surgery patients at Montreal General Hospital (MGH) reveals a significant gap between reality and the care pathway designed collectively by the care providers. This study addresses this issue in three phases, care process analysis, simulation, and mathematical modeling.

4 - Design of Financial Incentives for Avoiding Unnecessary C-Sections

Beste Kucukyazici, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, beste.kucukyazici@mcgill.ca, Cheng Zhu

Rates of C-section, which exposes potential harms on mothers and newborns as well as heavy economic burden, have been increasing constantly and this growth raises some concerns for the policy makers. This research focuses on optimizing the financial incentives, i.e. choosing best payment scheme and optimizing how to reimburse obstetricians under this scheme, in order to reduce the C-section rates without sacrificing birth quality while alleviating economic burden for overall health care system.

■ MA40

Hilton- Union Sq 20

Monitoring and Prevention of Hospital Acquired Infections

Sponsor: Health Applications

Sponsored Session

Chair: Eduardo Perez, Assistant Professor, Texas State University, 601 University Drive Ingram School of En, San Marcos, TX, 78666, United States of America, eduardopr@txstate.edu

1 - Agent-Based Mediation Modeling of a Controlled Trial to Reduce MDRO Transmission

Sean Barnes, Assistant Professor, University of Maryland, 4352 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu, Anthony Harris, Lisa Pineles, Daniel Morgan

In 2012-2013, the University of Maryland led a 20-site randomized controlled trial to assess the benefits of universal gloves and gowns to reduce the transmission of multidrug-resistant organisms (MDROs) in acute-care hospitals. We develop an agent-based model to estimate the reduction in MDRO transmission directly due to this intervention.

2 - Further Empirical Evidence for Hand-Hygiene as a Habitual Citizenship Behavior

Reidar Hagtvedt, Assistant Professor, University of Alberta, 2-43 Business Building, Edmonton, Al, T6G2C7, Canada, hagtvedt@ualberta.ca, Sarah Forgie, Ken Schultz

Hand-hygiene is a habitual behavior often neglected, occasionally leading to nosocomial infections, which can be devastating to patients. Health-care workers typically claim to understand the importance of hand-hygiene, yet compliance is routinely low. We propose a theory for the phenomenon of hand-hygiene, based on an expansion of the Theory of Planned Behavior, and test it using observations gathered over four years at a major teaching hospital, as well as surveys.

3 - Reducing Surgical Site Infections

Eva Lee, Professor & Director, Georgia Institute of Technology, Ctr for OR in Medicine & Healthcare, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

This project is joint with Grady Memorial Hospital. Surgical-site infections (SSI) are a national problem, occurring in an estimated 2.8% of all procedures (for some, it is up to 30%). It causes complication, prolong length and stay and unnecessary burden on patients, hospitals and 3-party payers. We describe our recent successes in reducing SSI for coronary artery bypass graft through systems modeling and process optimization.

4 - Analyzing CAUTI Prevention Strategies: A Discrete-Event Simulation Study

Eduardo Perez, Assistant Professor, Texas State University, 601 University Drive Ingram School of En, San Marcos, TX, 78666, United States of America, eduardopr@txstate.edu, Berkcan Uyan

Healthcare associated infections are a significant problem for the U.S. healthcare industry, with 1.8 million patients affected each year. Catheter-associated urinary tract infections (CAUTIs) are the second most common type of HAI. Beyond the obvious patient care implications, Medicare has discontinued paying hospitals for care related to CAUTIs. In this work we utilize systems modeling and simulation methods to reduce the incidence of CAUTIs at a real hospital located in central Texas.

■ MA41

Hilton- Union Sq 21

Online Decision Making in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Diana Negoescu, University of Minnesota, Minneapolis, MN, United States of America, dianegoescu@gmail.com

1 - Approximation Methods for Determining Optimal Allocations in Response Adaptive Clinical Trials

Vishal Ahuja, University of Chicago, Chicago, IL, 60615, United States of America, vahuja@chicagobooth.edu, John Birge, Chris Ryan

Response-adaptive clinical trials, where patient assignment to treatments evolves dynamically, offer potential for efficiency gains over traditional designs, and typically modeled as Bayesian adaptive MDP. A consequence of this setup is the increase in problem size, often exponentially, with trial size & complexity. We propose grid-based approximation as a way to reduce the problem dimensionality and the associated computationally burden, thus widening the scope of implementing adaptive designs.

2 - Active Postmarketing Drug Surveillance for Multiple Adverse Events

Joel Goh, Stanford, Palo Alto, CA, United States of America joelgoh@stanford.edu, Margrét Bjarnadöttir, Mohsen Bayati, Stefanos Zenios

Existing methods for drug surveillance do not capture multiple adverse events and their interactions. We propose a new method to do this based on a queueing network. We apply asymptotic analysis to design a sequential hypothesis test that assesses the effect of a drug on multiple adverse events, by continuously monitoring the times of drug treatment and adverse event occurrences in a patient population. We validate our method on (a) simulated data and (b) actual health insurance claims data.

3 - Dynamic Kidney Exchange: The Effect of Batching and Pooling Across Programs

Vahideh Manshadi, Yale University, New Haven, United States of America, manshadi@mit.edu, Itai Ashlagi, Maximilien Burq, Patrick Jaillet

In kidney exchange, incompatible patient-donor pairs arrive over time; they usually register at one of the exchange programs, and wait to be matched. Because of the abundance of hard-to-match patients, the average waiting time is currently long. Using theoretical analysis and computational experiments, we show that the waiting time can be reduced using certain batching policies, or matching schemes that incentivize programs to share their easy-to-match pairs with other programs.

4 - Dynamic Learning of Patient Response Types

Diana Negoescu, University of Minnesota, Minneapolis, MN, United States of America, dianegoescu@gmail.com, Kostas Bimpikis, Dan Iancu, Margaret Brandeau

We optimize treatment policies for a class of chronic diseases where measurements of treatment effectiveness are noisy and where negative health events occur with frequencies that depend on patient response type. We find analytic expressions for adaptive treatment policies and illustrate the performance of such a policy in a case study on multiple sclerosis.

■ MA43

Hilton- Union Sq 23

Computational Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Matthew Saltzman, Associate Professor, Clemson University, Dept. of Mathematical Sciences, Martin Hall, Box 340975, Clemson, SC, 29634-0975, United States of America, mjs@clemson.edu

1 - Dual-guided Pivot Rules for Linear Programming

Jaques Desrosiers, Professor, HEC Montréal & GERAD, 3000, Ch Cote-Sainte-Catherine, Montréal, Qc, H3T2A7, Canada, jacques.desrosiers@gerad.ca, Jean Bertrand Gauthier, Marco Luebbecke

We describe a generic algorithm for LPs guided by dual feasibility considerations. The resolution process moves according to a direction and a step size. The core component is obtained via the smallest reduced cost upon dividing the dual variables in two subsets: one fixed, the other optimized. The Primal Simplex, the Minimum Mean Cycle-Canceling for network problems, and the Improved Primal Simplex are special cases. We show how to identify directions yielding non-degenerate pivots.

2 - Decomposition Algorithms for Mean-CVaR Multistage Stochastic Linear Programs

Hamed Rahimian, PhD Student, The Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, rahimian.1@osu.edu, Güzin Bayraksan, Weini Zhang

We study a risk-averse approach in the multistage stochastic linear programming, where a convex combination of the expected cost and its associated conditional value-at-risk represents the objective function. Due to the coherency of the CVaR, five decomposition schemes are considered in the general framework of Nested L-shaped method to solve the model. We present the computational performance of the single-cut and multi-cut versions of the algorithms for a multistage water allocation problem.

3 - Computational Experience with the MAS Algorithm for Derivative-free Optimization

Hua Zheng, Carnegie Mellon University, Department of Chemical Engineering, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, huazheng@andrew.cmu.edu, Luis Miguel Rios, Nick Sahinidis

The derivative-free optimization algorithm Model-and-Search (MAS) is a local optimization algorithm designed to improve the objective of the best known point by using models fitted by information from nearby evaluated points. The algorithm relies on global optimization of algebraic models to guide the search and identify improving points. The main purpose of this paper is to present extensive computational experience with this algorithm and comparisons with existing implementations.

■ MA44

Hilton- Union Sq 24

Information Systems and the Digital Society

Sponsor: Information Systems

Sponsored Session

Chair: Jie Zhang, University of Texas at Arlington, 701 S West St. #19437, Arlington, TX, 76019, United States of America, jiezhang@uta.edu

1 - Playing God: Role of Intermediary in Matching Markets

Rajiv Mukherjee, Assistant Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, rmukherjee@mail.smu.edu, Amit Basu, Sreekumar Bhaskaran

We examine the role of an intermediary in matching markets like marriage and labor. In this context, an online intermediary's optimal positioning and pricing strategy is developed. The role of competition and social norms is also considered.

2 - Selecting Tasks in Crowdsourcing Platforms

Jiahui Mo, Assistant Professor, Nanyang Technological University, jiahui.mo@utdallas.edu, Sumit Sarkar, Syam Menon

Crowdsourcing platforms are increasing in popularity, and consequently the number of tasks posted by seekers is also increasing – this makes it difficult for solvers to evaluate all the tasks before making a participation decision. We develop a system that provides recommendations to solvers when they log on to the platform.

3 - Firm's Strategic use of Recommendation System
James Zhang, UC Irvine, Paul Merage School of Business, Irvine, United States of America, zhez1@uci.edu, Vidyanand Choudhary

We examine the impact of the use of recommender systems by an online retailer on his profit and consumers' surplus. The retailer employs both recommender system and search engine to help consumers search for products. We develop an analytical model to examine the firm's strategy when products offer heterogeneous margins to the retailer.

4 - Community Involvement in Online Crowdsourcing Communities
Indika Dissanayake, Doctoral Student, University of Texas at Arlington, Box 19437, 701 S West Street, Arlington, TX, 76019, United States of America, indika.dissanayake@mavs.uta.edu, Jingguo Wang, Jie Zhang

Recent advances in information technology bring significant changes to the nature of social interactions and information exchange. Physical face-to-face communications are slowly replaced by online virtual communities. Motivated by this phenomenon, this research investigates how the voluntary community involvement impact peer-recognition and performance in virtual crowdsourcing communities.

■ MA45

Hilton- Union Sq 25

Behavioral Research on Inventory and Pricing

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Elena Katok, Ashbel Smith Professor, University of Texas at Dallas, 800 W. Campbell Drive, Dallas, TX, 75080, United States of America, ekatok@utdallas.edu

1 - Learning with Censored Information: An Application to Inventory Management
Kyle Hyndman, University of Texas at Dallas, 800 W Campbell Rd (SM31), Richardson, TX, 75080, United States of America, tdp062000@utdallas.edu, Canan Ulu, Dorothee Honhon

We conduct an experiment in which a retailer must learn about the unknown demand of two related products. Customers may substitute in case of a stock-out. Subjects over-estimate demand of the low-demand product and underestimate demand of the high-demand product.

2 - Decision Making Under Service Level Contracts
Tobias Stangl, University of Cologne, Albertus-Magnus-Platz, Koeln, 50923, Germany, tobias.stangl@uni-koeln.de, Gary Bolton, Ulrich Thonemann

Service level contracts are common in practice. By measuring service levels and enforcing penalty payments service level contracts can feature a sharpened expected profit function which makes the economic consequences of deviations from the normative benchmark more severe. In a set of laboratory experiments we show that service level contracts can significantly reduce the pull-to-center effect and ensure high supply chain efficiency.

3 - Pure Reciprocity under Alternative Procurement Mechanisms
Jason Shachat, Professor, Durham University, Millhill Ln., Durham, DH1 3LB, United Kingdom, jason.shachat@gmail.com

Almost all procurement contracts fail to specify standards for all possible supplier performance dimensions, making moral hazard a ubiquitous presence in supply chain relationships. We argue that gift exchange and reciprocity is an alternative force that supports this phenomenon. We test for this presence and relative strength of this gift exchange hypothesis in a stylized procurement setting under alternative auction mechanisms.

4 - Markdown or Everyday-Low-Price? The Role of Behavioral Motives
Karen Zheng, Massachusestts Institute of Technology, Sloan School of Management, Cambridge, MA, 02142, United States of America, yanchong@mit.edu, Özalp Özer

We study a seller's optimal pricing (markdown vs. everyday-low-price) and inventory strategies when consumers are affected by two salient behavioral motives: anticipated regret and misperception of product availability. We determine and quantify the operational and profit implications of these motives. We contrast the roles of consumers' strategic (pecuniary) versus behavioral (non-pecuniary) motives in affecting purchase, pricing, and inventory decisions.

■ MA46

Hilton- Lombard

Convexification Techniques in MIP & MINLP

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Jean-Philippe P Richard, University of Florida, 303 Weil Hall P.O. Box 116595, Gainesville, FL, 32611, United States of America, richard@ise.ufl.edu

1 - Disjunctive Cuts for the Second-Order Cone and its Cross-Sections
Sercan Yildiz, Carnegie Mellon University, Pittsburgh, PA, United States of America, syildiz@andrew.cmu.edu, Fatma Kilinc-Karzan, Gerard Cornuejols

Several recent papers have attempted to extend the disjunctive cut framework from mixed-integer linear to mixed-integer conic programs. In this work we study sets obtained via a two-term disjunction on the second-order cone or its cross-sections. We develop a methodology to derive a family of convex valid inequalities for such sets. We also show that a single inequality is sufficient to describe the convex hull of the disjunction and can be represented in second-order conic form in many cases.

2 - Supermodular Inequalities for Bounded Products of Continuous and 0/1 Variables
Akshay Gupte, Assistant Professor, Clemson University, Martin O-321, Dept. of Math Sciences, Clemson, SC, United States of America, agupte@clemson.edu, Shabbir Ahmed, Santanu Dey

We study the convex hull of the lower-level set of a function defined by the product of a single bounded continuous variable x and a nonnegative monotone submodular function that is zero-valued at some points. This set arises in mixed integer bilinear programs, hyperbolic functions etc. We exploit the supermodular structure in this set and use disjunctive programming to obtain extended formulations. When the upper bound on x is "large enough", the convex hull is described explicitly. The valid inequalities are strengthened under specific generalizations of the level set.

3 - On Cutting Planes for Cardinality Constrained Optimization Problems (CCOP)
Jinhak Kim, Purdue University, 403 W. State Street, Room 532, West Lafayette, IN, 47906, United States of America, kim598@purdue.edu, Jean-Philippe P Richard, Mohit Tawarmalani

We separate the optimal point of an LP relaxation of CCOP from the intersection of a cardinality constraint with a relaxation of the optimal tableau. The separation problem is recast as a network optimization problem on a network formed using the coefficients of the tableau constraints. Our procedure generalizes the equate-and-relax procedure recently developed for complementarity problems.

4 - On Sublinear Inequalities for Mixed-integer Conic Programs
Dan Steffy, Oakland University, Dept. of Mathematics and Statistics, 2200 N. Squirrel Road., Rochester, MI, 48309, United States of America, steffy@oakland.edu, Fatma Kilinc-Karzan

First, without making any assumptions, we show that sublinear inequalities, together with the conic constraint, are sufficient to describe the closed convex hull of the feasible region for MICPs. Second, we show that for Lorentz cone, the description of sublinear inequalities can be significantly simplified.

■ MA47

Hilton- Mason A

Stochastic/Robust Optimization in Energy Systems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Yuping Huang, Ph.D Candidate, University of Central Florida, 12800 Pegasus Dr. RM 320, Orlando, FL, 32816, United States of America, yuping.huang@knights.ucf.edu

1 - Power Generation Expansion Planning: Benders Decomposition with Efficient Cut Calculation
Timo Lohmann, Colorado School of Mines, Division of Economics and Business, Golden, CO, United States of America, tlohmann@mines.edu, Steffen Rebennack

We present a long-term power generation expansion planning model with short-term demand response, i.e., load depends on the electricity market price, in its general form, and introduce a Benders Decomposition approach in GAMS' .net environment to solve the large scale (convex) MINLP. We discuss special cases of the model which allow us to efficiently calculate the Benders optimality cuts. Solving linearized NLP subproblems becomes obsolete which leads to a highly efficient algorithm.

2 - Capacity Expansion of Distributed Generation using Bilevel Mixed Integer Program

Jasper Quach, University of South Florida, 4202 E Fowler Ave, Tampa, Fl, 33620, United States of America, jasper@mail.usf.edu, Bo Zeng

We consider using bilevel mixed integer program to study capacity expansion problem of distributed generation within an electricity market environment. Numerical study on a typical distributed system will be presented, along with detailed discussions and management insights.

3 - A Multistage and Multiscale Stochastic Programming Approach to Electricity Infrastructure Investment

Zhouchun Huang, University of Central Florida, 4000 Central Florida Blvd., University of Central Florida, Orlando, FL, 32816, United States of America, zhouchun.huang@knights.ucf.edu, Qipeng Zheng

To study the infrastructure needs of an electricity grid, we propose a stochastic programming model that integrates long-term investment planning and short-term unit commitment models, both of which are multistage decision problems in nature but have different time scales. The infrastructure expansions are planned several years ahead and the time scales for unit commitment decisions are in hours to meet real-time demand. A nested column generation approach is adopted for solving the problem.

4 - Stochastic Multistage Expansion Planning for an Integrated Energy System

Yuping Huang, Ph.D Candidate, University of Central Florida, 12800 Pegasus Dr. RM 320, Orlando, FL, 32816, United States of America, yuping.huang@knights.ucf.edu

A stochastic multistage expansion planning model is proposed for the integrated natural gas and power generation system. Under uncertainties from energy supply and NG price, the objective is to minimize the expected gas-electricity investment and O&M costs with risk aversion. This model is solved by a modified Benders' decomposition.

■ MA48

Hilton- Mason B

Decomposition Algorithms for Stochastic (Integer) Programs

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Merve Bodur, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu

1 - Dual Decomposition Algorithms for Solving Chance-Constrained Binary Programs

Yan Deng, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, yandeng@umich.edu, Jon Lee, Siqian Shen

Based on the standard mixed-integer programming reformulation of a chance-constrained binary program, we assign multipliers to constraints that involve variables across scenarios and formulate a Lagrangian relaxation that is decomposable into scenario subproblems. The subproblems are mutually independent and free of big-M constants. The algorithm follows an objective bounding process, and exploits inequalities particularly strong for 0-1 polytopes to shrink feasible regions and improve bounds.

2 - Decomposition Algorithms for Two-Stage Chance-Constrained Programs

Xiao Liu, Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, liu.2738@osu.edu, Simge Kucukyavuz, James Luedtke

We study a class of chance-constrained two-stage stochastic optimization problems where second-stage feasible recourse decisions incur additional cost. We propose a new model where recovery decisions are made for the infeasible scenarios to obtain feasible solutions to a relaxed second-stage problem. We develop decomposition algorithms with specialized optimality and feasibility cuts to solve this class of problems. Computational results indicate that our algorithms are highly effective.

3 - Spatial Detection to Minimize Abandonment Rate

David Morton, Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, mortondp@gmail.com, Fang Lu, John Hasenbein

We consider a spatial detection problem in which we seek to protect an offshore oil drilling platform in the Arctic Ocean from sea ice (ice floes) by locating docking stations and allocating autonomous underwater vehicles to those docking stations. We formulate and approximate a multi-stage stochastic integer program for this purpose. The model differs from a typical stochastic facility location model in that service times depend on how long a customer (ice floe) waits for service.

4 - Strengthened Benders Cuts for Stochastic Integer Programs with Continuous Recourse

Merve Bodur, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu, Sanjeeb Dash, Oktay Gunluk, James Luedtke

With stochastic integer programming as the motivating application, we investigate techniques to use integrality information to obtain improved cuts within a Benders decomposition algorithm. We analyze the use of split cuts in the extended and projected spaces. We demonstrate that although the two approaches yield equivalent relaxations when considering a single split disjunction, applying multiple splits in the extended space generally yields significantly stronger relaxations.

■ MA49

Hilton- Powell A

Network Analysis Methods and Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Sergiy Butenko, Texas A&M University, 4037 ETB, TAMU-3131, College Station, TX, 77843, United States of America, butenko@tamu.edu

1 - On S-plex and S-defective Clique Numbers of a Graph

Oleg Shirokikh, Frontline Systems Inc., 1575 Delucchi Ln, Suite 112, Reno, NV, United States of America, oleg@solver.com, Austin Buchanan, Vladimir Boginski, Sergiy Butenko

We consider degree-based clique relaxations – s-plex and s-defective clique – which have appeared in social network analysis and bioinformatics. We investigate theoretical properties, provide analytical and computational bounds for the related optimization problems. We provide exact solutions for both problems and show polynomial solvability for special graphs. We propose new scale reduction techniques and attempt to find optimal solutions for both problems on extremely large sparse networks.

2 - Large Cohesive Subgroups with High Clustering Coefficient

Zeynep Ertem, Texas A&M, 3131 University Dr, College Station, 77840, United States of America, zeynep84@tamu.edu, Sergiy Butenko

Cohesive subgroups often correspond to significant community structures. Clique finding methods can detect such groups, however, such groups usually have missing edges (i.e., not perfectly connected). We propose a clustering coefficient based relaxation, called α-cluster, which calculates a subgraph whose nodes satisfy at least α level of clustering coefficient. We introduce a clustering algorithm based on α-cluster.

3 - On Lifted Facet-defining Inequalities for Connected Subgraph Polytope

Yiming Wang, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, kkelvin@neo.tamu.edu, Austin Buchanan

We study the facet-defining inequalities for connected subgraph polytope. We mainly focused on the inequalities via lifting. We develop an algorithm to generate facet-defining inequalities in linear time if the graph is a forest and show in general graphs generating such an inequality is NP-hard. We also find a class of inequalities that are valid and discuss when these inequalities can be facet-defining.

4 - Applying a Hybrid Metaheuristic to the Routing on Multicast Problem

Carlos Oliveira, F-Squared Inc, Princeton, NJ, United States of America, oliveira@ufl.edu

Multicast routing systems are used to simultaneously transfer data to multiple destinations. We consider the delay constrained multicast routing problem (DCMRP), which is of great interest for telecommunication engineers. We propose a hybrid metaheuristic approach for the DCMRP, where a GRASP is used along with VNS algorithm. Experiments show that the proposed technique provides superior solution quality, while it is also efficient in terms of the use of computational resources.

■ MA50

Hilton- Powell B

Network Design with Hubs II

Cluster: Network Design

Invited Session

Chair: Hans-Jurgen Sebastian, Professor, RWTH Aachen University, Kackertstrafle 7B, Aachen, NR, D-52062, Germany, sebastian@or.rwth-aachen.de

1 - Solution Approaches for the Dynamic Hub Location Problem
Astrid Dettenbach, RWTH Aachen University, Aachen, Germany, hoerhammer@or.rwth-aachen.de

We consider a dynamic hub location problem with single allocation and multiple capacity levels. We contribute by developing a model that incorporates changes in cost and demand structure over time. Which locations serve as hubs, the capacity of these hubs and the allocation of non-hub locations to hub locations are the key decision variables in each period. We develop and evaluate heuristics to solve large problems.

2 - Continuous Facility Location with Backbone Network Costs
John Gunnar Carlsson, University of Minnesota, Minneapolis, MN, United States of America, jgc@isye.umn.edu

We consider a continuous facility location problem in which our objective is to minimize the weighted sum of three costs: fixed costs from installing the facilities, backbone network costs incurred from connecting the facilities to each other, and coverage costs incurred from providing services from the facilities to the service region. We derive two optimal facility configurations: one of these is the well-studied honeycomb heuristic, while the other is an Archimedean spiral.

3 - The Design of Capacitated Intermodal Hub Networks with Different Vehicle Types
Sibel Alumur, Assistant Professor, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, sibel.alumur@uwaterloo.ca, Elif Zeynep Serper

We propose a mixed-integer programming formulation of this hub network design problem. The aim of the model is to minimize total costs while determining the location of hubs, the allocation of non-hub nodes to hubs, which hub links to establish, and how many vehicles to operate on each hub link to route the demand between given origin-destination pairs. We propose a local search heuristic and present computational analysis on the CAB and Turkish network data sets.

■ MA51

Hilton- Sutter A

Optimization of Energy Systems

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Naiyuan Chiang, Argonne National Laboratory, 9700 S Cass Ave, Bldg 240, Lemont, IL, 60439, United States of America, nychiang@mcs.anl.gov

1 - A Multi-scale Optimization Approach to Dynamic Optimal Power Flow Problems
Fu Lin, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, fulin@mcs.anl.gov, Sven Leyffer, Todd Munson

We study dynamic optimal power flow problems with temporal constraints. These constraints couple variables over different time periods, and they arise in modeling dynamical aspects of power generation and storage. We develop a multi-scale approach that exploits the multi-period structure. Our column-generation-based algorithm solves a sequence of problems from coarsest to finest time scales. This approach strikes a balance between solution quality and computational complexity in large problems.

2 - Advanced Vehicle Routing Based on Powertrain Type, Battery State of Charge and Traffic Conditions
Orkun Karabasoglu, Assistant Professor in ECE, SYSU-CMU, Joint Institute of Engineering, 5000 Forbes Ave, pittsburgh, PA, 15213, United States of America, karabasoglu@cmu.edu, Zhiqian Qiao

Most navigation systems use data from satellites to provide drivers with the shortest-distance, least-time or highway-preferred paths. We propose a novel navigation strategy where vehicle powertrain type, battery state of charge and traffic conditions are used in addition to the traditional parameters. It is found that optimal paths might change significantly for different vehicle types and different initial battery state of charge.

3 - Development of Control-Oriented Models for Model Predictive Control in Buildings
OíNeill Zheng, University of Alabama, Dept. of Mechanical Engineering, Box870276, Tuscaloosa, AL, 35487, United States of America, zoneill@eng.ua.edu

Model Predictive Control (MPC) has gained attention in recent years for application to building controls because of significant potential for energy savings. MPC utilizes dynamic models and input forecasts to estimate future energy usage and employs optimization to determine control inputs that minimize an integrated cost function or a specified prediction horizon. This talk will present the development of control-oriented models in buildings.

4 - Scalable Strategies for Large-scale Structured Nonlinear Optimization
Naiyuan Chiang, Argonne National Laboratory, 9700 S Cass Ave, Bldg.240, Lemont, IL, 60439, United States of America, sorakid507@gmail.com, Victor Zavala

A robust and efficient solver is alway a challenge for large-scale stochastic NLP problems. We discuss the details of our implementation PIPS-NLP, a parallel nonlinear interior-point solver. PIPS-NLP is designed to exploit different types of the problem structure. It adopts a filter-based line search method and applies a curvature test instead of the inertia test. We present the global convergence analysis and also some numerical results based on CUTEr test problems and real energy applications.

■ MA52

Hilton- Sutter B

Stochastic Methods and Machine Learning in Optimization

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Katya Scheinberg, Lehigh University, 200 West Packer ave,, Bethelehem, PA, 18015, United States of America, katyas@lehigh.edu

1 - Distributed Coordinate Descent Method for Learning with Big Data
Martin Takac, Lehigh University, 27 Memorial Drive West, Bethlehem, United States of America, martin.taki@gmail.com, Peter Richtarik

We initially partition the coordinates (features) and assign each partition to a different node of a cluster. At every iteration, each node picks a random subset of the coordinates from those it owns, independently from the other computers, and in parallel computes and applies updates to the selected coordinates based on a simple closed-form formula. We give bounds on the number of iterations sufficient to approximately solve the problem with high probability.

2 - Stochastic Approximation Schemes for Stochastic Optimization with Imperfect Information
Uday Shanbhag, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16803, United States of America, udaybag@engr.psu.edu, Hao Jiang

We consider the solution of a stochastic convex optimization problem complicated by a parametric misspecification. We assume that this misspecification may be resolved by the solution of a suitable defined convex learning problem. To resolve the absence of convergent efficient schemes, we present a coupled stochastic approximation scheme (with rate estimates) which simultaneously solves the computational and the learning problems.

3 - A Dynamic Penalty Parameter Updating Strategy for Matrix-free SQO Methods
Hao Wang, Lehigh University, H.S. Mohler Laboratory, 200 West Packer Avenue, bethlehem, pa, 18015, United States of America, haw309@lehigh.edu, James V. Burke, Frank E. Curtis, Jiashan Wang

A penalty parameter updating strategy is proposed within a penalty-SQO algorithm for solving nonlinear optimization problems. Our strategy dynamically updates the penalty parameter during the solution process for each subproblem, producing a search direction that simultaneously predicts progress towards feasibility and optimality. We prove that our strategy yields reasonable (not excessively small) values of the penalty parameter and illustrate the behavior of our strategy via numerical test.

4 - Non-linear Label Ranking for Large-scale Prediction of Long-Term User Interests

Mihajlo Grbovic, Yahoo Labs, 701 First Avenue, Sunnyvale, CA, 94089, United States of America, mihajlo@yahoo-inc.com, Vladan Radosavljevic, Nemanja Djuric, Narayan Bhamidipati

We consider the problem of personalization of online services from the viewpoint of ad targeting. We propose to address this problem as a task of ranking the ad categories depending on a user's preference, and introduce a novel label ranking approach capable of efficiently learning non-linear, highly accurate models in large-scale settings. Experiments on real-world advertising data set with more than 3.2 million users show that the proposed algorithm outperforms the existing solutions.

■ MA53

Hilton- Taylor A

Portfolio Planning

Cluster: Optimization in Finance

Invited Session

Chair: John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - Comparing Front-end Load and Balance Fees in Individual Account Pension Systems

Luis Chavez-Bedoya, Research Professor, Esan Graduate School of Business, Alonso de Molina 1652, Surco, Lima, Peru, l.chavezbedoya@gmail.com

We study the effect of risk aversion and density of contribution on the comparison of proportional charges on flow (contributions) and balance (assets) during the accumulation phase of a defined contribution pension under the system of individual accounts. Theoretical results are shown when the comparison is done through expected utility of terminal wealth, expected terminal wealth and the inverse of its coefficient of variation.

2 - Expected Utility Maximization in Large-scale Portfolio Optimization

Gerd Infanger, Department of Management Science and Engineering, Stanford University, Stanford, CA, 94305, infanger@stanford.edu

We discuss a new approach of expected utility maximization for large-scale portfolio optimization when asset returns are represented via a factor model (fundamental, economic and/or statistical). We show how to obtain equilibrium returns and discuss active management based on factor exposures. Expected utility maximization is more general than mean-variance optimization and can better consider fat tails in asset return distributions. Numerical results are discussed.

3 - Heuristic Algorithms for Financial Model Calibration

Amber Zhang, IBM, 185 Spadina Ave, Toronto, Canada, Amber.Zhang@ca.ibm.com, Asif Lakhany, Helmut Mausser

Estimating the parameters of a financial model is an important part of any pricing framework. Calibration tries to find the parameter values that minimize the discrepancy between model and market prices. Heuristic search methods, which can escape from local minima, are an effective alternative to commonly-used gradient-based methods. We develop heuristic algorithms to calibrate the parameters of a two factor Hull-White interest rate model.

■ MA54

Hilton- Taylor B

Stochastic Control and Optimal Stopping in Finance

Sponsor: Financial Services Section

Sponsored Session

Chair: Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave, New York, NY, 10027, United States of America, hz2244@columbia.edu

Co-Chair: Xuedong He, Assistant Professor, Columbia University, 316 Mudd, 500 W. 120th street, New York, NY, 10027, United States of America, xh2140@columbia.edu

1 - Optimal Stopping Problems in Diffusion-type Models with Running Maxima and Drawdowns

Neofytos Rodosthenous, Lecturer Financial Mathematics, Queen Mary, University of London, Mile End Rd, London, E1 4NS, United Kingdom, N.Rodosthenous@qmul.ac.uk, Pavel Gapeev

We study optimal stopping problems related to the pricing of perpetual American options. We consider a risky asset with dividend and volatility rates depending on its maximum and maximum drawdown processes. We obtain closed-form solutions to the equivalent free-boundary problems for the value functions in the state space of the resulting 3-dimensional Markov process. The 2-dimensional optimal stopping boundary functions are characterized by 1st-order nonlinear ordinary differential equations.

2 - A Super-solution Based Iterative Approach for Stochastic Dynamic Programming

Nan Chen, The Chinese University of Hong Kong, 609 William Mong Engineering Building, Hong Kong, Hong Kong - PRC, wyu@se.cuhk.edu.hk, Nan Chen

We use the information relaxation technique to develop a value-and-policy iterative method to solve stochastic control problems. In each iteration, an upper bound for the true value function and a suboptimal policy with its corresponding value (a lower bound) are obtained so that we can use the gap between the bounds to measure the quality of the policy. Our iterative approach also points to a systematic way to improve heuristic policies widely used in large-scaled control problems.

3 - Realization Utility with Adaptive Reference Points

Linan Yang, Columbia University, United States of America, ly2220@columbia.edu

We consider a dynamic stock liquidation problem in which an investor decides when to sell a stock to maximize her realization utility with reference points adaptive to prior gains and losses. We study both theoretically and numerically the trading strategies and asset pricing implications of three types of investors: those who don't realize the reference point adaptation, those who realize but fail to adjust their strategies for the adaptation, and those who are able to do the adjustment.

4 - Optimal Multiple Stopping with Negative Discount Rate and Random Refraction Times under Levy Models

Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave, New York, NY, 10027, United States of America, hz2244@columbia.edu, Tim Leung, Kazutoshi Yamazaki

We study an optimal multiple stopping problem driven by Levy processes. Our model allows for a negative effective discount rate, which arises in a number of financial applications such as stock loans and real options. Moreover, successive exercise opportunities are separated by i.i.d. random refraction times. Under a wide class of Levy models, we rigorously show that the optimal strategy to exercise successive call options is uniquely characterized by a sequence of up-crossing times.

■ MA55

Hilton- Van Ness

Expediting Global Optimization Algorithms via Special Mathematical Structure

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Ruth Misener, Royal Academy of Engineering Research Fellow, Imperial College London, South Kensington Campus, London, United Kingdom, r.misener@imperial.ac.uk

1 - Undercover: A Primal MINLP Heuristic Exploring a Largest Sub-MIP

Timo Berthold, Fair Isaac Europe Ltd, Takustr. 7, Berlin, 10551, Germany, timoberthold@fico.com, Ambros Gleixner

We present Undercover, a primal heuristic for nonconvex MINLP that explores a linear sub-MIP of a given MINLP. Therefore, we identify a smallest set of variables to fix, a so-called cover, such that each constraint is linearized. It turns out that many instances allow for small covers. Although general in nature, we show that the heuristic is most successful on MIQCPs.

2 - A Second Order Multilevel Algorithm for Nonconvex Optimization

Chin Pang Ho, Imperial College London, South Kensington Campus, London, SW7 2AZ, United Kingdom, c.ho12@imperial.ac.uk

Using classical methods, it does not seem possible to overcome the well known curse of dimensionality in nonconvex optimization. However, high-dimensional systems often behave as if governed by a model with only few degrees of freedom. In this talk we discuss how to make systematic use of low dimensional models to speed up the computations in second order optimisation algorithms such as Newton method. We discuss the convergence rate and its application to problem of exploring energy landscapes.

3 - A New Relaxation Technique for Nonconvex Stochastic Programs with Continuous Random Variables
Joseph Scott, Assistant Professor, Clemson University, 206 S. Palmetto Blvd, 207B Earle Hall, Clemson, SC, 29634, United States of America, jks9@clemson.edu

We consider the global solution of nonconvex stochastic optimization problems with expected-value objectives, continuous and compactly supported random variables, and no recourse decisions. This problem is common in engineering design applications including power generation from renewable resources. We present a method for computing underestimating programs that are convex, rigorously account for sampling error, and are convergent, enabling the use of branch-and-bound optimization algorithms.

■ MA56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - AnyLogic North America - AnyLogic Demonstration
Nikolay Churko, Head of Department, AnyLogic, 53 Frontage Road, Hampton, NJ, 08827, United States of America, nikolay@anylogic.com

AnyLogic is a System Dynamics, a Discrete Event and an Agent Based tool at the same time. This gives you a great advantage as you can tailor the modeling approach to best fit your challenge. On the other hand, with AnyLogic you are frequently facing the choice of the right techniques and methodologies. Our AnyLogic demonstration serves two goals: first, to give you a tour through AnyLogic modeling language, second, to teach you how to select the right approach and abstraction level.

2 - ExtendSim Simulation Software
David Krahl, Imagine That, Inc., 6830 Via Del Oro, Suite 230, San Jose, CA, 95119, United States of America, davek@extendsim.com

ExtendSim is a multi-domain simulation environment in which you can dynamically model continuous, discrete event, discrete rate, agent-based, and mixed-mode systems. The authoring environment facilitates the building of front ends that simplify model interaction and enhance communication. Core features such as hierarchy, built-in relational database, evolutionary optimization, and interactive modeling make ExtendSim models more engaging and easier to experiment with. Use ExtendSim to achieve your modeling objectives rapidly and be assured success.

■ MA64

Parc- Cyril Magnin I

Matching in Markets

Sponsor: Applied Probability Society

Sponsored Session

Chair: Ciamac Moallemi, Barbara and Meyer Feldberg Associate Professor of Business, Columbia Business School, 3022 Broadway, Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

Co-Chair: Costis Maglaras, Columbia Business School, New York, NY, United States of America, cm479@columbia.edu

1 - Dynamic Matching Markets with an Application in Residential Real Estate
Hua Zheng, Columbia Business School, 3022 Broadway, Uris 4S, New York, NY, 10027, United States of America, hzheng14@gsb.columbia.edu, Ciamac Moallemi, Costis Maglaras

We study a dynamic microstructure model of a dynamic market where buyers and sellers arrive stochastically over time, and are heterogeneous with respect to their product characteristics and preferences and their idiosyncratic financial information. We analyze its dynamics, market depth, and buyer/seller bidding strategies. The motivating application stems from residential real estate.

2 - Optimal Allocation without Money: An Engineering Approach
Itai Ashlagi, MIT, 100 Main st., Cambridge, MA, United States of America, iashlagi@mit.edu, Peng Shi

We study the allocation of heterogeneous services to agents without monetary transfers under incomplete information. The social planner's goal is to maximize a possibly complex public objective. We take an ``engineering" approach, in which we solve a large market approximation, and convert the solution into a feasible finite market mechanism that still yields good results. We apply this framework to real data from Boston to design a mechanism that assigns students to public schools.

3 - Managing Congestion in Dynamic Matching Markets
Nick Arnosti, Stanford University, Stanford, CA, United States of America, narnosti@stanford.edu, Yash Kanoria, Ramesh Johari

It is often costly for agents in matching markets to determine whether potential partners are interested in forming a match. This creates friction in the marketplace, lowering welfare for all participants. We use a dynamic model to quantitatively study this effect. We demonstrate that by reducing visibility, the market operator may benefit both sides of the market. Somewhat counter-intuitively, benefits of showing fewer sellers to each buyer are greatest when there is a shortage of sellers.

■ MA65

Parc- Cyril Magnin II

Diffusion Models for Queues

Sponsor: Applied Probability Society

Sponsored Session

Chair: Shuangchi He, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, heshuangchi@nus.edu.sg

Co-Chair: Jim Dai, Cornell University, 226 Rhodes Hall, Cornell University, 136 Hoy Road, Ithaca, NY, 14853, United States of America, jd694@cornell.edu

1 - Further Reflections on Reflected Brownian Motion in the Octant
John Hasenbein, University of Texas at Austin, Grad Program in OR/IE, Austin, United States of America, jhas@mail.utexas.edu, Ziyu Liang

This work is an extension of earlier work on optimal paths in large deviations for rotationally symmetric RBM in the octant. In particular, for the Harrison-Reiman case, we show that only gradual paths can be optimal. Furthermore, we show that, unlike the general case, spiral optimal paths are not optimal in this case. This conforms with the intuition that approximations of single-class queueing networks are more well-behaved than those for multiclass networks.

2 - SRBM, Geometric Views, and Optimal Paths
Jim Dai, Cornell University, 226 Rhodes Hall, Cornell University, 136 Hoy Road, Ithaca, NY, 14853, United States of America, jd694@cornell.edu, Masakiyo Miyazawa

For a multidimensional semimartingale reflecting Brownian motion (SRBM), I will first describe a geometric condition for the existence of product-form stationary distribution (Dai, Miyazawa and Wu 2014). I will then discuss a connection between this condition and the "entrance velocity" of the optimal path for the associated variational problem. Examples and conjectures will be presented.

3 - Hazard Rate Scaling for the G/M/1+G Processor Sharing Queue
Josh Reed, New York University, 44 W 4th St, New York, NY, 10012, United States of America, jreed@stern.nyu.edu, Guodong Pang, Bert Zwart

We study the G/M/1+G processor sharing queue. In our first result, under the assumption of Poisson arrivals and exponential abandonment distributions, we provide a partial differential equation satisfied by the Laplace transform of the sojourn time distribution of an infinitely patient customer arriving to the system and requesting service. In our second set of results, we obtain diffusion approximations to several performance measures of the system.

4 - A Diffusion Model for Efficiency-Driven Queues
Shuangchi He, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, heshuangchi@nus.edu.sg

We propose a one-dimensional diffusion model for GI/GI/n+GI queues in an overloaded regime. Using this model, we obtain performance formulas, including the distributions of the steady-state queue length and virtual waiting time, for service level estimation in efficiency-driven call centers. The proposed diffusion model and performance formulas are justified by limit theorems. We prove the convergence of queue length and virtual waiting time processes when they are scaled in both space and time.

■ MA66

Parc- Cyril Magnin III

QSR Best Student Paper Competition

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Reliability of Systems with Spatially Distributed Units

Dingguo Hua, Graduate Student, Rutgers University, Department of Industrial and Systems Eng, Rutgers University, Piscataway, NJ, 08854, United States of America, hua.dingguo@gmail.com, Elsayed Elsayed

The reliability of systems with spatially distributed units has emerged as an important topic in aerospace and military industries. In this paper, we investigate spatially distributed k-out-of-n pairs:G balanced systems with different requirements. Reliability and other metrics such as time to a specified failure are estimated.

2 - Optimal Supersaturated Design via Lasso

Dadi Xing, Purdue University, 210 Airport Rd, Apt 4, West Lafayette, IN, 47906, United States of America, dxing@purdue.edu, Michael Yu Zhu, Hong Wan

In the supersaturated design(SSD)study, most existing criteria for constructing optimal SSD are motivated and further justified from the estimation perspective. We will propose a number of optimality criteria for the construction of SSD from the perspective of penalized variable selection methods. The properties of these criteria will be discussed. A computing algorithm will be used to construct such optimal SSD, examples of simulation and an application of the algorithm will also be presented.

3 - Heterogeneous Time-to-event Data Modeling and Inference with an Unknown Number of Sub-populations

Mingyang Li, University of Arizona, 1127 James E. Rogers Way, Tucson, AZ, 85721, United States of America, mingyangli@email.arizona.edu

A Bayesian non-parametric model is proposed to model heterogeneous time-to-event data by assuming an unknown number of sub-populations and quantifying influence of covariates. An inference algorithm is further proposed to achieve joint model estimation and selection and to deal with non-conjugate priors.

4 - Non-crossing Quantile Regression Processes Based on Monotone B-splines

Yuan Yuan, Student, University of Wisconsin-Madison, 1513 University Ave, room 3255, Madison, WI, 53706, United States of America, yyuan4@wisc.edu, Nan Chen, Shiyu Zhou

In this paper, we solve the well-known problem, i.e. crossing of multiple quantile curves, by developing a model based on monotone B-splines. We have also developed a procedure to adaptively select variables and reduce model complexity. Numerical studies illustrate its effectiveness well. The proposed model is also applied to study how wind characteristics affects the wind power generation.

■ MA67

Parc- Balboa

Reliability Analysis and Fault Management for Complex Engineering Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qingyu Yang, Assistant Professor, Wayne State University, 4815 fourth street, Detroit, United States of America, qyang@wayne.edu

1 - Maintenance Policies for Complex Systems with Stochastic and Economic Dependent Components

Linkan Bin, Assistant Professor, Mississippi State University, lb1425@msstate.edu, Nagi Gabraeel

Methods that study the maintenance of complex systems focus on policies based on independent components. We develop a dynamic maintenance policy that accounts for both economic dependence due to shared set-up costs and stochastic dependence resulting from the interactions among the degradation processes by grouping maintenance activities. We show in the numerical studies that the total maintenance cost of the system is significantly reduced by incorporating both types of component dependence.

2 - Optimal Maintenance and Parts Reordering for a One-unit System with a Deteriorating Spare Part

Hongwei Luo, Research Assistant, University of Arizona, 1127 E. James E. Rogers Way Room 111, P.O. Box 210020, Tucson, AZ, 85721, United States of America, harveyluo@email.arizona.edu, Haitao Liao

In this research, we consider an operating system with one-unit operating component and a deteriorating on-site spare part. The goal of this study is to derive the long-run average cost during the maintenance cycle by introducing related costs and also determine the optimal spare part replacement and reordering policy to minimize the cost. Numerical examples are provided to illustrate the use of the model in practice.

3 - Reliability Assessment during a Product's Early Design Stage using Bayesian Networks

Petek Yontay, Arizona State University, 699 S Mill Ave, Tempe, AZ, 85281, United States of America, pyontay@mainex1.asu.edu, Luis Mejia, Rong Pan

In this research, we propose a Bayesian Network model for reliability prediction of a new product at its conceptual design stage. We focus on the concept of integrating functional analysis with the product failure information derived from multiple sources such as historical data from parent products and expert opinions. We will demonstrate our methodology with an industrial example.

4 - A Physical-Statistical Model of Overload Retardation in Crack Propagation under Cyclic Loading

Wujun Si, Wayne State University, 4815 fourth street, Detroit, MI, 48202, United States of America, wujun.si@wayne.edu, Qingyu Yang

Reliability analysis for units subjected to cyclic stress loading has been intensively studied under the assumption that the loading stress is ideally periodic. In reality, however, many factors such as overloads during cyclic loading will have a remarkable effect on unit life prediction. In this paper, a physical-statistical model is proposed to capture the overload retardation effect in crack propagation. An experiment is designed and conducted to verify the developed model.

■ MA68

Parc- Davidson

Recent Advances in Simulation-Based Optimization

Sponsor: Simulation

Sponsored Session

Chair: Jie Xu, Assistant Professor, George Mason University, 4400 University Dr., MS 4A6, Fairfax, VA, 22030, United States of America, jxu13@gmu.edu

1 - Multi-objective Particle Swarm Optimization

Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, Singapore, iseleelh@nus.edu.sg, Ek Peng Chew, Haobin Li

Particle Swarm Optimization (PSO) is a popular search method for single objective problem. In this talk, we will demonstrate how the PSO can be extended to tackle the multi-objective problems. Through the numerical runs, we will show the promising performance of this algorithm. We will also discuss how the approach can be extended for stochastic problem.

2 - Stochastically Constrained Simulation Optimization on Integer Lattices

Raghu Pasupathy, Associate Professor, Purdue University, Dept. of Statistics, West Lafayette, United States of America, pasupath@vt.edu, Kalyani Nagaraj

We present theoretical and implementation details of a random-restarts solver for solving constrained simulation optimization problems on integer lattices. Our theory and implementation is particularly sensitive to the difficult context where the stochastic constraints are binding. We will discuss choice of constraint relaxation, relationship between restarts and sample size, and consistency/efficiency.

3 - Gradient-based Adaptive Stochastic Search for Simulation Optimization over Continuous Space

Enlu Zhou, Georgia Institute of technology, 755 Ferst Drive, NW, Atlanta, GA, 30319, United States of America, enlu.zhou@isye.gatech.edu, Shalabh Bhatnagar

We extend the idea of model-based algorithms for deterministic optimization to simulation optimization over continuous space. Our idea starts with reformulating the original simulation optimization problem into another optimization problem over the parameter space of the sampling distribution, and thus we can use a direct gradient search on the parameter space to update the sampling distribution. To improve the computational efficiency, we further develop a two-timescale updating scheme.

4 - Developing an Agent-based Model for Cardiovascular Health
Yan Li, Purdue University, West Lafayette, IN, 47907, United States of America, li528@purdue.edu, Jose Pagan, Mark Lawley, Nan Kong

Cardiovascular disease (CVD) is the leading cause of death in the U.S. We develop an agent-based model to capture individual health progression and social influencing on health behaviors, as well as study emergent CVD-related population health outcomes (e.g., diabetes, MI, stroke, death). The numerical results demonstrate predictive validity of the model and show how it can be used in practice by assessing the impact of various hypothetical lifestyle interventions on CVD-related outcomes.

■ MA69

Parc- Fillmore

Applications of OR in Bioenergy

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Sandra D. Eksioglu, Associate Professor, Department of Industrial Engineering, Clemson University, 134 Freeman Hall, Clemson, SC, 29634, United States of America, seksiog@clemson.edu

1 - Designing a Reliable and Dynamic Intermodal Hub and Spoke Supply Chain for Biomass
Mohammad Marufuzzaman, Mississippi State University, Industrial & Systems Engineering, PO Box 9542, Starkville, MS, 39762, United States of America, maruf237@gmail.com, Sandra D. Eksioglu

The objective of this paper is to design cost-efficient and reliable supply chain networks for biomass delivery to biofuel plants. We propose a dynamic, mixed integer nonlinear programming model that is solved using a Benders based rolling horizon algorithm. Numerical experiments show that the proposed algorithm can solve large scale problem instances to a near optimal solution in a reasonable time.

2 - A Hub-and-Spoke Supply Chain Design with Multi-objective Analysis for Cellulosic Biofuel
Md Roni, Computational Energy Analyst, Idaho National Laboratory, PO BOX 1625, Idaho Falls, Id, 83401, United States of America, mohammad.roni@inl.gov, Jacob Jacobson, Hadi Karimi, Kara Cafferty

We propose a multi-objective, hub-and-spoke model to design the supply chain for biofuels. The multi-objective optimization model captures the trade-offs that exist between costs, environmental and social impacts of delivering biofuels. The multi-objective, mixed-integer, linear programming model is solved using an augmented ?-constraint method. In order to perform the multi-objective analysis, we develop a case study using data from the Midwest region of the USA.

3 - Models for Analyzing the Impact of Production Tax Credit on Renewable Electricity Production
Sandra D. Eksioglu, Associate Professor, Department of Industrial Engineering, Clemson University, 134 Freeman Hall, Clemson, SC, 29634, United States of America, seksiog@clemson.edu

This work is focused on using biomass for co-firing in coal-fired power plants. We develop models to capture the impact of the production tax credit (PTC) on renewable electricity production. The existing PTC is a flat tax credit that is not affected by the amount of renewable electricity produced, plant capacity, etc. We develop a case study and use numerical analysis to compare renewable electricity production through the existing PTC scheme and all-units, and incremental discount schemes.

4 - Stochastic Biomass Logistics Network Design under Price-based Supply
Gokhan Memisoglu, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, gmemis@tamu.edu, Halit Uster

We present a two-stage stochastic program to construct biomass logistics networks under price dependent biomass supply at farms and yield uncertainty. An efficient solution approach based on Sample Average Approximation (SAA) and an analysis of the relationship between price and the network structure decisions are presented.

■ MA70

Parc- Hearst

Natural Hazard Management

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Steffen Rebennack, Colorado School of Mines, 1500 Illinois Street, Golden, 80401, United States of America

Co-Chair: Vitaliy Krasko, Colorado School of Mines, United States of America

1 - Optimal Treatment Strategies for Invasive Species Control under Dispersal Uncertainty
Eyyüb Kibis, Research Assistant, Wichita State University, 1845 Fairmount St., Wichita, KS, 67260, United States of America, eyyubyunus@gmail.com, Esra Büyüktahtakin

In this study, we present a mixed integer linear programming method for invasive species control. The study integrates the biological characteristics of invasive species into a complex spatially explicit model which stimulates the stochastic seed dispersal behavior of an invasive weed in Kansas.

2 - A Stochastic Dynamic Programming Model of Large Wildfire Management
Matthew Thompson, Research Forester, Rocky Mountain Research Station, US Forest Service, Missoula, MT, 59802, United States of America, mpthompson02@fs.fed.us

Previous research has shown that the dynamics of large wildfire incidents can be represented as a Markov chain, capturing the effects of environmental variation and partial control on incident management decisions through time. Here that work is expanded to consider a stochastic dynamic programming formulation to help fire managers determine the optimal organizational capacity as a function of current incident complexity, suppression cost, and density of at-risk resources and assets.

4 - Some Thoughts on Human Resources Analytics
Hila Chalutz, Tel Aviv Afeka College of Engineering, Tel Aviv, Israel, Hilab@afeka.ac.il, Gonen Singer

The paper examines predictive capabilities of service organizations in regards to client success measures based on human resources data. The precision framework of human factors is of paramount importance when predicting client success. The paper provides evidence that predicting client's human resources variables play a vital role on service success in the long run. This approach may assist practitioners to invest the appropriate resources throughout the service delivery process. The paper also provides evidence that service organizations can be selective in regards to their clients based on predetermined criteria.

3 - Natural Hazard Management for Post-Wildfire Debris Flows
Vitaliy Krasko, Colorado School of Mines, Division of Economics and Business, Golden, CO, United States of America, vkrasko@mines.edu, Paul Santi, Kevin McCoy, Timo Lohmann, Steffen Rebennack, Daniel Kaffine

The focus of this talk is a natural-social science optimization model that provides guidance for allocating mitigation funds towards reducing the economic impacts of post-wildfire debris flows. The model minimizes expected damages by optimally allocating funds into mitigation treatments across individual drainage basins that decrease the probability of an event and/or reduce the volume conditional on occurrence. Several case studies are presented.

4 - An Agent-based Modeling of a Multimodal Near-field Tsunami Evacuation: Decision-Making and Life Safe
Haizhong Wang, Assistant Professor, Oregon State University, 101 Kearney Hall, Corvallis, OR, 97331, United States of America, Haizhong.Wang@oregonstate.edu, Dan Cox, Lori Cramer

The goal of this research is to investigate the impacts of different evacuee decision-making time on the estimation of casualties in a multi-modal tsunami evacuation. We are using NetLogo to simulate the evacuee decision-making process in a near-field tsunami evacuation scenario. The simulation results would provide the coastal community an effective evacuation decision making guidelines for a tsunami event, minimizing the loss of life in the limited warning time.

5 - Estimating the Burn Probability of the Forest Reserve of Bogota, Colombia
Ridley S. Morales, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, DC, 0000, Colombia, rs.morales64@uniandes.edu.co, Gilberto Morales, Carlos Felipe Valencia, Raha Akhavan Tabatab

Forest fires are time evolving disasters that consume environmental and financial resources, endangering the rescue units that try to mitigate them. In this study, we use simulation integrated with Geographic Information Systems (GIS) to map the burn probability of the forest reserve of Bogot·. This study is conducted in collaboration with Bogota's Fire Department, with the goal of providing a tool for long-term planning in fire prevention activities.

■ MA71

Parc - Lombard

Auctions for Procurement

Cluster: Auctions

Invited Session

Chair: Sasa Pekec, Duke University, Durham, NC, United States of America, pekec@duke.edu

1 - Budget Constrained Procurement

Giuseppe Lopomo, giuseppe.lopomo@duke.edu, Alexandre Belloni, Roberto Steri, Leslie Marx

We characterize optimal mechanisms for a financially constrained buyer facing multiple suppliers with privately known costs. We first establish the optimality of a simple direct mechanism, using basic duality, within the class of all mechanisms with a dominant strategy equilibrium. We then provide a dynamic implementation, and calibrate the parameters of our model to data and show numerically that our mechanism outperforms auctions formats currently used by the Brazilian government and the FCC.

2 - Split-Award Procurement Auctions – Can Bayesian Equilibrium Strategies Predict Bidding Behavior?

Martin Bichler, mar.bichler@gmail.com, Kemal Guler, Stefan Mayer

We analyze to which extent Bayes Nash equilibrium predictions can explain human bidding behavior in sealed-bid split-award auctions with ex ante split decisions. There was no significant difference to the risk-neutral Bayes Nash equilibrium bid function in computerized experiments in the lab where bid functions are reused, however, there was underbidding in human subject experiments. The experiments suggest that strategic complexity does not serve as an explanation for underbidding.

3 - Split Award Auctions: Insights from Theory and Experiments

Damian Beil, Associate Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI, 48109, United States of America, dbeil@umich.edu, Aadhaar Chaturvedi, Elena Katok

We consider two (sealed and open) split-award auction formats where the buyer announces the award splits before the auction. We show revenue equivalence between the two formats and find that for non-regular cost distributions more multi-sourcing might actually reduce the buyer's overall expected payment. Lab experiments indicate that revenue equivalence fails, and the buyer's expected payment in a sealed-bid auction may decrease with more multi-sourcing even with regular distributions.

■ MA72

Parc- Stockton

Study of Reliability and Security in Power Systems

Sponsor: Energy, Natural Res & the Environment/ Energy

Sponsored Session

Chair: Bo Zeng, Assistant Professor, University of South Florida, 4202 E Fowler Ave, Tampa, FL, 33620, United States of America, Bzeng@usf.edu

1 - Demand Response Portfolio Management via Robust Optimization

Andy Sun, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

We consider the demand response (DR) portfolio management problem faced by demand response service providers, where the portfolios are composed of a large number of commercial and industrial organizations. We construct new mixed-integer optimization models to describe the specific dynamics of such DR resources. Then we propose a robust optimization model with a new type of uncertainty sets to model the realization uncertainty of DR. We will discuss solution methods and preliminary test results.

2 - The Value of a Spare Transformer Inventory to an Electric Power Grid's Security against Attack

Wood Kevin, Professor, Naval Postgraduate School, Operations Research Dept., Glasgow Hall, Monterey, CA, 93943, United States of America, kwood@nps.edu, Javier Salmeron

We develop an attacker-defender model for an electric power grid in which certain high-voltage transformers (HVTs) damaged by an attacker can be replaced quickly with inventoried spares. The model can help guide a utility company's inventory strategy for HVTs. Global Benders decomposition solves the model, which includes a mixed-integer subproblem that extends a DC power flow model. A new enumerative solution of the master problem shows great promise for improving efficiency.

3 - Detect Unobservable Attacks with Phasor Measurement Units

Feng Pan, Los Alamos National Laboratory, M.S. C933, Los Alamos, NM, 87545, United States of America, fpan@lanl.gov, Annarita Giani, Russell Bent, Kameshwar Pooll

There've been increasing concerns about cyber-attack to power grids, partly due to the reliance on remote sensing. We first discuss unobservable attacks and introduce a bilevel program to model such attacks. Under sparse attacks, we show that enumerating upper-level extreme point is sufficient to get an optimal solution and is more efficient than KKT based approaches. We then introduce a model for placing phasor measurement units to detect unobservable attacks and present our empirical studies.

4 - Investment of Wind Power with Dynamic Topology in a Market Environment

Yifan Wang, University of South Florida/Northeastern University, China, 3707 Jefferson Commons DR., apt 202, Tampa, FL, 33613, United States of America, yifanw@mail.usf.edu, Bo Zeng, Shixin Liu

We consider wind plant installation within an existing grid operated within an electricity market. A bi-level model is formulated with the consideration of intentional transmission line switching off. A novel algorithm is implemented to solve the problem in an efficient way.

■ MA73

Parc- Mission I

Investment in Renewables & CCS Technology and Cost of Renewables

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Nur Sunar, University of North Carolina at Chapel Hill, Nur_Sunar@kenan-flagler.unc.edu

1 - Incentives for Early Adoption of Carbon Capture Technology

Stephen Comello, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, scomello@stanford.edu, Stefan Reichelstein

We analyze a policy proposal for regulating future electricity power plants in the U.S. The cornerstone of this regulation is an emission standard of 80 kg CO2/MWh, beginning in 2027 for all plants that come into operation after 2017. Initial compliance costs are high, yet learning effects reduce this cost by 2027, provided all plants adopt carbon capture in the intervening years. We identify a set of tax credits that provide the required incentive to comply with the standard before the mandate.

2 - Cost- and Price Dynamics of Solar PV Modules

Anshuman Sahoo, PhD Candidate, Stanford University, 473 Via Ortega, Stanford, CA, 94305, United States of America, asahoo@stanford.edu, Stefan Reichelstein

Recent solar module price declines have exceeded those predicted by an 80% learning curve that has characterized prices. We develop a dynamic model of a competitive module industry; the equilibrium price, which we call the economically sustainable price (ESP), equals the long-run marginal cost. Comparing ESPs to selling prices, we find that the dramatic price reductions were due to excess capacity. We extrapolate a trajectory of future costs to which equilibrium prices should converge over time.

3 - A Decision Support Tool for Assessing the Installation Logistics of an Offshore Wind Farm

Euan Barlow, Department of Management Science, University of Strathclyde, Glasgow, United Kingdom, euan.barlow@strath.ac.uk, Diclehan Tezcaner Ozturk, Evangelos Boulougouris, Kerem Akartunali, Sandy Day, Matthew Revie

This study describes a simulation tool designed to support decision makers during the planning and bidding phase of an offshore wind farm (OWF) installation. Duration and costs of an installation scenario subject to uncertain weather conditions are modelled, and different installation scenarios compared. A case study of an OWF installation explores the impact of key logistical decisions, such as installation fleet composition and vessel scheduling. Recommendations on good practice are proposed.

4 - Diffusion Networks of Residential Solar Panels

Sebasti·n Souyris, Ph.D. Candidate, The University of Texas at Austin, 1652 W 6th St Apt P, Austin, TX, 78703, United States of America, sebastian.souyris@utexas.edu, Varun Rai

We investigate the diffusion of residential solar panels in Texas using a novel point process approach. We collect a unique data set at disaggregate household level that allows us to understand how the demographic and economic characteristics influence the adoption decision. We project the dynamics of the market; thereby, giving insights about where the developers should focus their customer acquisition efforts and what type of policies are more efficient to incentivize the adoption.

■ MA74

Parc- Mission II

Design and Control of Energy Systems

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Jay Rosenberger, Associate Professor, University of Texas Arlington, P.O. Box 19017, Arlington, TX, 76019, United States of America, jrosenbe@uta.edu

1 - Sustainable Design of Plug-in Hybrid Electric Vehicle Charging Stations Considering Service Level

Amirhossein Khosrojerdi, University of Oklahoma, 1021 East Brooks St Apt F, Norman, Ok, 73071, United States of America, akhosrojerdi@ou.edu, Janet Allen, Farrokh Mistree, Alexander Rodriguez

We propose a method for considering trade-offs among economic, social and environmental aspects of sustainability when designing a plug in hybrid electric vehicle (PHEV) charging station. Our approach is based on simulations of charging demand of PHEV users and then projecting the charging service level using Multi-Variant Adaptive Regression Splines (MARS) for different design alternatives. We also discuss the impact of various charging scenarios on promoting PHEV adoption.

2 - Hybrid SVM for Market Price Forecasting for the Adaptive Design of PHEV Charging Stations

Piampoom Sarikprueck, The University of Texas at Arlington, 1020 W.Abram St.,, Apt.146, Arlington, TX, 76013, United States of America, piampoom.sarikprueck@mavs.uta.edu, Wei-Jen Lee, Asama Kulvanitchaiyanunt, Victoria Chen, Jay Rosenberger

PHEV charging stations utilized with renewable energy sources and storage device can participate to a deregulated market. The accurate predictions of availability and/or prices of energy sources are essential to minimize the forecast uncertainty for optimal dynamic control. For electric price prediction, hybrid SVM with data clustering techniques is proposed to particularly improve spike price estimation. Future research will analyze forecasting results by Martingale Model Forecast Evolution.

3 - Two-Stage Approach for Controlling a System of Plug-In Hybrid Electric Vehicle Charging Stations

Jay Rosenberger, Associate Professor, University of Texas Arlington, P.O. Box 19017, Arlington, TX, 76019, United States of America, jrosenbe@uta.edu, Wei-Jen Lee, Asama Kulvanitchaiyanunt, Victoria Chen, Piampoom Sarikprueck

This research uses a Design and Analysis of Computer Experiment (DACE) approach to build a metamodel representing the expected value function of a second-stage dynamic control problem in a two-stage framework for plug-in hybrid electric vehicle (PHEV) charging stations. The control problem is formulated and initially solved by the mean value problem using linear programming. The metamodel is developed based on an experimental design over possible solutions from the first stage design problem.

4 - Designing a System of PHEV Electric Charging Stations Considering Market Penetration

Janet Allen, University of Oklahoma, University of Oklahoma, Norman, Ok, 73071, United States of America, janet.allen@ou.edu, Farrokh Mistree, Amirhossein Khosrojerdi

A method is proposed for designing a system of plug-in hybrid electric vehicle charging stations. The rate of the PHEV penetration is projected using a Bass diffusion model, and a simulation model is developed to determine PHEV charging service level of the system for various design scenarios. Finally, a mixed-integer mathematical model is developed to consider the control stage and to design both charging stations (node level decision) and a network of charging stations (network level decision)

■ MA75

Parc- Mission III

Simulation and Optimization I

Contributed Session

Chair: Ingmar Vierhaus, Zuse Institute Berlni, Takustrafle 7, Berlin, 14195, Germany, vierhaus@zib.de

1 - Design and Management of Mobility-on-Demand Systems (MoD) under Uncertainty

Yinghan Deng, National University of Singapore, Blk E1 07-17, 1 Engineering Drive 2, Singapore, Singapore, yinghandeng@nus.edu.sg, Michel Cardin, Amedeo Odoni

This is a first effort to demonstrate the complex interactions between strategic and operational decisions in MoD systems, and provide an effective approach to addressing them. An agent-based simulation model was developed to evaluate the performance of a generic MoD system. A simulation-based optimization approach is then applied to determine the strategy for deploying the system's resources in a way that minimizes both set-up cost and the operating cost associated with load rebalancing.

2 - A Prediction Interval Estimator for the Original Response when using Box-Cox Transformations

Michael Walker, The University of Alabama, 305 Alston Hall, 361 Stadium Dr., Tuscaloosa, AL, United States of America, mlwalker3@crimson.ua.edu, Marcus Perry

Motivated by electron microscopy experiments, we develop an approximate prediction interval on the original response variable Y, where a normal-theory linear model is fit using a transformation on Y from the Box-Cox family. In simulation we assess the performance of our estimators for the mean and variance of Y as well as our proposed interval. We then apply our method to two experimental data sets, one with a standard design, and the other with a split-plot error structure.

3 - Patient and Impatient Pedestrians in a Spatial Game for Egress Congestion

Harri Ehtamo, Professor, AALTO University, Otakaari 1, Espoo, Finland, harri.ehtamo@aalto.fi, Simo Heliövaara

In this study, we present a spatial game theoretic model for pedestrian behavior in situations of exit congestion. The behavioral game model is coupled with a popular social-force egress simulation model. The simulation results to optimize the pedestrian motion are discussed.

4 - Re-Engineering Tree Ensemble Algorithms to Capture Individual-Level Effects for Agent-Based Models

Michael Egner, Senior Vice President, Ipsos, 10567 Jefferson Blvd., Culver City, CA, 90232, United States of America, megner@gmail.com

Tree ensembles are powerful and well-known machine learning classification methods. In this research, we re-engineer these ensembles to split on the magnitude of bivariate or multivariate relationships, in order to transform the trees from classifiers into estimators of individual-level model impacts (e.g., an individual-level estimate of the effect of price on purchase). A real-world business case study applying this method to an agent-based market forecasting model will be discussed.

5 - Layers of Experiments with Adaptive Combined Design

Sungil Kim, Samsung SDS, 512, Samseongro, Gangnamgu, Seoul, Korea, Seoul, Korea, Republic of, sungil.kim@outlook.com

In the field of nanofabrication, where engineers often work with resource-limited experimental budgets, it is essential to involve methodology regarding the selection of experimental regions over batches of experiments. This article proposes such a methodology for sequential design of experiments for batches of experimental runs, termed Layers of Experiments with Adaptive Combined Design (LoE/ACD).

■ MA76

Parc- Embarcadero

Predictive Analytics for Structured and Unstructured Data

Sponsor: The Practice Track

Sponsored Session

Chair: Simon Sheather, Texas A&M University, Department of Statistics, College Station, TX, 99843, United States of America, sheather@stat.tamu.edu

1 - Text Analytics - Today and Tomorrow

Edward Jones, Exec. Vice President, Texas A&M Statistical Services, LP, 4285 Hollowstone Dr., College Station, TX, 77845, United States of America, Edward.Jones@TAMStatServices.com

Applications of text analytics increase daily as analysts develop and explore new techniques for analyzing unstructured data. Integrating text analytics with traditional structured data analysis is an area of increasing interest and opportunity. Analysts are now able to explore not only what people say, but also what they think and feel using text analytics. This paper describes these techniques and presents examples of their use in quality assurance, marketing and politics.

2 - High Performance Statistical Procedures

Mike Speed, Analytical Consultant, SAS Institute, 9312 Lake Forest Ct, S, College Station, TX, 77845, United States of America, mike.speed@sas.com

The SAS high-performance analytics infrastructure forms the backbone of your ongoing analytic endeavors – no matter how big your big data demands get, nor how complex your analysis needs become. While, these procedures are great when you have big data and the infrastructure to do the analyses, these procedures are still very important for those who have a typical desktop and/or laptop. This talk will explore those features.

3 - Predictive Analytics for Structured Data using SAS and JMP
Simon Sheather, Texas A&M University, Department of Statistics, College Station, TX, 99843, United States of America, sheather@stat.tamu.edu

We shall focus on the challenges and issues associated with applying regression methods to big data problems in business. In particular, we will consider the pros and cons of subset selection versus shrinkage methods approach (including lasso and elastic net) to model selection. We will also discuss the use of multiple adaptive regression splines (MARS). Real examples to be discussed include average airline ticket prices and fan interest in NFL games.

■ MA77

Parc- Market Street

Joint Session Analytics/CPMS: Predictive Analytics Applicatons

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Hila Chalutz Ben-Gal, Dr., Afeka College of Engineering, Industrial Engineering, Tel Aviv, Israel, hilab@afeka.ac.il

1 - Predicting Future Trends by Social Excitement Patterns
Irad Ben-Gal, Professor, Tel Aviv University, Faculty of Engineering, Tel Aviv, Israel, bengal@tau.ac.il, Roi Libman, Hila Chalutz Ben-Gal, Alon Sela

The spread of new ideas has much in common with the spread of viral infections. We will present two works that have used these "Social Hypes Finger Print" in order to predict new hypes. The first work is the "Hot Trends Detector". It predicted the growth of new trends with a success of 80%. The second is the Tweet Advice project that confronted the complex prediction of "hot" stock by analyzing tweets sentiment in combination with the Social Hypes Finger Print.

2 - Project Management Analytics
Hila Chalutz Ben-Gal, Dr., Afeka College of Engineering, Industrial Engineering, Tel Aviv, Israel, hilab@afeka.ac.il

We propose a method to monitor and analyze large-scale projects in order to reduce the uncertainty regarding the project completion time. We show that there are optimal control/observation points for the above purpose. Examples will be given.

3 - Multiclass Classification Based on Random Subspaces, Bagging and Bayesian Inference
Marcelo Bacher, PhD Student, Tel Aviv University, Tel Aviv University, Ramat Aviv, Israel, Tel Aviv, Israel, mgbacher@post.tau.ac.il, Hila Chalutz Ben-Gal

We propose a classification method combining Random Subspace with Bagging and Bayesian inference. We investigated our method on multiclass data containing categorical, numerical and missing values. Moreover, we assume data clusters might overlap, the independence among its features can be violated and the assumption that the data is Gaussian-like distributed does not necessarily hold. Preliminary results show that the proposed method has good potential to cope with the above-mentioned scenarios.

4 - Some Thoughts on Human Resources Analytics
Hila Chalutz,Tel Aviv Afeka College of Engineering, Tel Aviv, Israel, Hilab@afeka.ac.il, Gonen Singer

The paper examines predictive capabilities of service organizations in regards to client success measures based on human resources data. The precision framework of human factors is of paramount importance when predicting client success. The paper provides evidence that predicting client's human resources variables play a vital role on service success in the long run. This approach may assist practitioners to invest the appropriate resources throughout the service delivery process. The paper also provides evidence that service organizations can be selective in regards to their clients based on predetermined criteria.

■ MA78

Parc- Mason

JIPE and IJOR Special Session on Analytics

Sponsor: Analytics

Sponsored Session

Chair: Kuo-Hao Chang, Dep. of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan - ROC, chang@mx.nthu.edu.tw

1 - The Ship Routing and Freight Assignment Problem for Daily Frequency Operation of Liner Shipping
Dung-Ying Lin, National Cheng Kung University, 1 University Road, Transportation Management, Tainan City, Ch, 70101, Taiwan - ROC, dylin@mail.ncku.edu.tw

To cope with excess capacity and improve service quality, liner carriers have recently adopted a new operational model known as daily frequency. In this new model, carriers provide daily pickup and delivery service to customers at major ports along the Pacific Rim. We investigate the problem for daily frequency operation of liner shipping and find that Shanghai, Hong Kong and Singapore are ports that are ideal for carriers in establishing daily frequency operations along the Pacific Rim.

2 - Computing the Waiting Time in a Security Check System
Hsing Luh, Professor, Dep. of Mathematical Sciences, National Chengchi University, Taiwan - ROC, orlab63@gmail.com

The objective of this presentation is to introduce a queueing model to assist the Transportation Security Office understand how to design and manage the security wait environment with customers' satisfaction, for example the normal wait time is no more than 30 minutes. To meet the security conditions in practice, such as checks in various security stages, we use a queueing model with service time of semi-Coxian distributions. The semi-Coxian distribution in fact complicates the computation but reflects relatively better estimation than a traditional model. Thus, it is useful both to maintain the security level and to release the tense in the security check points in airports, or international borders.

3 - On Scheduling Recovery Teams for Reaching Shelters in Minimum Time in Disaster Management
I-Lin Wang, Professor, Department of Industrial and Information Management, National Cheng Kung University, Tainan 70101, Taiwan - ROC, ilinwang@mail.ncku.edu.tw

How to rescue people from dangerous regions affected by a disaster in minimum time is usually a top-priority task in humanitarian logistics. We consider a network restoration problem where the time and resources for restoring broken roads (arcs) have been estimated. We aim to schedule the recovery teams of different capabilities to restore roads such that all shelters (nodes) can be reached with minimum time. Efficient algorithms for special cases of our problem will be analyzed and discussed.

4 - Optimal Power Storage Strategy of Hybrid Renewable Energy Systems in Uncertain Environments
Kuo-Hao Chang, Dep. of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan - ROC, chang@mx.nthu.edu.tw, Grace Lin

In this paper, we consider the optimal power storage strategy of Hybrid Renewable Energy Systems (HRES) in uncertain environments. The goal is to achieve minimum expected total cost over a finite time horizon, while satisfying the power demand of each area. We propose a simulation model to characterize the operation of HRES and develop a metamodel-based solution method to solve the problem. An extensive computational study shows that the solution method can solve the proposed model of realistic size efficiently, facilitating the decision process in practice.

■ MA79

Parc- Powell I

Panel Discussion: Early DA Applications — What Would We Do Differently Today? A Panel of Early DA Pioneers will Review Their The Classic Applications and Share what they Would do Differently Today

Sponsor: Decision Analysis

Sponsored Session

Chair: Carl Spetzler, Chairman and CEO, SDG, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

1 - A Panel of Early DA Pioneers will Review Their The Classic Applications and Share what they Would do Differently Today

Moderator: Carl Spetzler, Chairman and CEO, SDG, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com, Panelists: Jim Matheson, Edward Cazalet, Warner North, Ralph Keeney, Ronald Howard

What would we do differently today? A panel of early DA pioneers will review their classic applications and share what they would do differently today.

2 - My Lessons from Early DA Applications

Warner North, President and Principal Scientist, NorthWorks, Inc., 1715 Taylor Street, San Francisco, CA, 94133, United States of America, northworks@mindspring.com

Among my early DA applications were projects with Mexico on planning the future of this country's electric power system, the US Department of Commerce on cloud seeding for hurricanes, NASA on planetary contamination of Mars by terrestrial microbes, and the US Forest Service on managing wildland fires. Lessons include problem formulation, understanding history and stakeholder concerns, iterating from a pilot version of the analysis, and sensitivity analysis.

■ MA80

Parc- Powell II

Evaluating Forecasts

Sponsor: Decision Analysis

Sponsored Session

Chair: Victor Richmond Jose, Georgetown University, McDonough School of Business, 544 Hariri Building, Washington, DC, 20057, United States of America, vrj2@georgetown.edu

1 - Evaluating Forecasts Reported at Different Points in Time

Edgar Merkle, University of Missouri, 28A McAlester Hall, Columbia, MO, 65211, United States of America, merklee@missouri.edu, Barbara Mellers, Philip Tetlock, Mark Steyvers

We consider situations where forecasts associated with the same question are reported at different times. Question difficulty often decreases over time, so forecasts made earlier in time should receive a better score than equivalent forecasts made later in time. To address these issues, we tailor models from item response theory to handle probabilistic forecasts and to estimate change in question difficulty over time. We apply the models to geopolitical forecasts from a recent tournament.

2 - Scoring Rules for Sequences of Probabilistic Forecasts

Eva Regnier, Associate Professor, Naval Postgraduate School, 699 Dyer Road, Monterey, CA, 93943, United States of America, eregnier@nps.edu

There are more and more forecasting systems that generate a sequence of probability forecasts for the same event, such as sporting, political, and weather events. Based on a non-improvability axiom, we propose properties of a "good" forecasting system and offer scoring functions for evaluating the performance of a forecasting system and a sample of probability sequences.

3 - On Proper Scoring Rules and Cumulative Prospect Theory

Arthur Carvalho, University of Waterloo, 200 University Avenue West, School of Computer Science, Waterloo, On, N2L 3G1, Canada, a3carval@uwaterloo.ca, Stanko Dimitrov, Kate Larson

We discuss how to adapt proper scoring rules to cumulative prospect theory, and why comonotonicity is a sufficient condition for proper scoring rules to be indeed proper under cumulative prospect theory. We also show how to construct a comonotonic proper scoring rule from any proper scoring rule. Finally, we propose a new approach that uses non-deterministic payments based on proper scoring rules to elicit an agent's true belief when his value function and weighting functions are unknown.

4 - Percentage Error, Relative Error, and the Combination of Forecasts

Victor Richmond Jose, Georgetown University, McDonough School of Business, 544 Hariri Building, Washington, DC, 20057, United States of America, vrj2@georgetown.edu

We present properties of two families of scale-free forecast accuracy measures, which generalize the percentage and relative error measures, and discuss how these families provide incentives toward either over- or under-reporting of forecasts. We illustrate these properties in a forecast combination setting.

■ MA81

Parc- Divisadero

Data Analytics & Optimization with its Applications

Sponsor: Data Mining

Sponsored Session

Chair: Chun-An Chou, SUNY Binghamton, 4400 Vestal Pkwy, Binghamton, NY, United States of America, cachou@binghamton.edu

Co-Chair: Fatma Gumus, PhD Student, SUNY Binghamton, 4400 Vestal Pkwy, Binghamton, NY, United States of America, fgumus1@binghamton.edu

1 - Modeling Recovery Curves with Application to Prostatectomy

Fulton Wang, MIT, 5 Cambridge Center, Office 792, Cambridge, MA, 02139, United States of America, fultonw@mit.edu, Cynthia Rudin, John Gore, Tyler McCormick

We propose a Bayesian model that predicts recovery curves based on information available before the disruptive event. A recovery curve of interest is the quantified sexual function of prostate cancer patients after prostatectomy surgery. We illustrate the utility of our model as a pre-treatment medical decision aid, producing predictions that are both interpretable and accurate, and uncover covariate relationships that agree with and supplement past prostatectomy studies

2 - Spatiotemporal Analytics of Heart Diseases

Chen Kan, Graduate Student, University of South Florida, Tampa, FL, United States of America, chenkan@mail.usf.edu, Hui Yang

Cardiovascular diseases are the leading cause of death in the world. This paper presents a novel spatiotemporal warping approach to quantify the dissimilarity of disease-altered cardiac electrical activity. Furthermore, we optimize the embedding of each functional recording as a node in a high-dimensional complex network. This, in turn, significantly improves the recognition of disease patterns and advances the smart management of heart health.

3 - Network Optimization Formulation for Multi-voxel Pattern Analysis of Brain Functional Connectivity

Fatma Gumus, PhD Student, SUNY Binghamton, 4400 Vestal Pkwy, Binghamton, NY, United States of America, fgumus1@binghamton.edu, Chun-An Chou

We propose a network optimization method for multi-voxel pattern analysis of brain functional connectivity. The overall objective is to determine informative brain voxels that are functionally similar to each other. The selected voxels for benchmark fMRI datasets are tested with several machine learning techniques, and the experimental results shows comparable classification accuracy compared to previous approaches.

■ MA82

Parc- Haight

Multi-Criteria Analysis for Supply Chain and Logistics

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Hugo Yoshizaki., Associate Professor, University of Sao Paulo, Av. Professor Almeida Prado, Trav. 2, 128, Cidade Universitaria, Sao Paulo, SP, 05508-900, Brazil, hugo@usp.br

1 - Facilitated Modelling for Logistic Decisions: A Case Study on Ethanol Distribution in S.Paulo/Brazil

Claudio Barbieri da Cunha, Associate Professor, University of Sao Paulo, Department of Transportation Engineering, Escola Politecnica, Sao Paulo, SP, 05508-900, Brazil, cbcunha@usp.br, Rachel Silva

Decision-making techniques usually focus on the alternative comparison, rather than studying the values and preferences of the decision-makers. This research aims to demonstrate how individual stakeholders' criteria can be extracted and incorporated using the "Facilitated modeling mode" in order to consider the greenhouse gas emissions from different transport modes in view of the environmental prerequisites for ethanol exports.

2 - Multi-attribute Value Theory Applied to Last-mile Delivery of Disaster Relief Items

Luìsa Cavalcanti, Researcher, University of Sao Paulo, Logistic Systems Program - POLI/USP, Cidade Universitaria, Sao Paulo, SP, 05508-900, Brazil, luba0587@gmail.com, Andre Mendes

After a disaster strikes, decisions regarding cargo transportation have a high impact on the vulnerable victims waiting for help. The multiplicity of objectives, especially when demand outsources capacity, suggests the applicability of the Multi-Attribute Value Theory (MAVT) approach. In this research, the method was applied to a Logistics Cluster training scenario, and the results encourage using MAVT as a tool for humanitarian decision makers.

3 - Multi-criteria in Location Decisions for Pre-positioning Relief Supplies in Brazil

Irineu Brito Jr, Professor, Fatec Jessen Vidal SJ dos Campos, Rua Helena Davi Neme, 94 ap 41, Sao Jose dos Campos, SP, 12245310, Brazil, ibritojr@yahoo.com.br, Adriana Leiras, Hugo Yoshizaki.

This paper proposes a methodology to define locations for pre-positioning disaster relief supplies through a two-stage stochastic optimization model with multi-criteria decision analysis considerations. An application in Brazil illustrates the effectiveness of the proposed approach. Results show that stochastic models promote more reliable outcomes than deterministic ones; and multi-criteria methods help in the modeling process by considering variables often treated exogenously to the problem.

■ MA83

Parc- Sutro

Statistical Approaches for Medical Engineering

Sponsor: Data Mining

Sponsored Session

Chair: Daehan Won, ph.d. student, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, wondae@uw.edu

1 - Feature Selection and Classification of Visual Evoked Responses in Idiopathic Generalized Epilepsy

Daehan Won, PhD Student, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, wondae@uw.edu, Jeffrey Tsai, Cao (Danica) Xiao, W. Art Chaovalitwongse

Our goal of this study is to determine whether steady-state visual evoked potentials (SSVEPs) can facilitate diagnosis of Epilepsy. SSVEPS were recorded using a 128-channel EEG to a foveal Gabor pattern whose contrast was modulated. By stepwise incrementing the contrast, we obtained a contrast versus response function (CRF) yielding parameters that characterized the shape of the CRF. Features selections are applied to determine channel importance for classifying individuals.

2 - An Integrated Feature Ranking and Selection Framework for ADHD Diagnosis

Cao (Danica) Xiao, PhD Student, University of Washington, Seattle, 3900 Northeast Stevens Way, Mechanical Engineering Building, room G6, Seattle, WA, 98195, United States of America, danicaxiao@gmail.com, W. Art Chaovalitwongse, Jesse Bledsoe, Margaret Semrud-Clikema, Thomas Grabowski, Sonya Mehta

We propose an Integrated Feature Ranking and Selection Framework that utilizes normalized brain cortical thickness extracted from MRI data to help diagnose ADHD in an early age with objective measures and promising accuracy.

3 - using Physiological Signals to Assess Mental Workload on Human-Computer Interaction Tasks

Shouyi Wang, Assistant Professor, University of Texas at Arlington, 500 West First Street, 420H Woolf Hall, UT Arlington, Arlington, TX, 76019, United States of America, shouyiw@uta.edu

Degraded state of cognitive functioning due to high cognitive workload can lead to errors and overall suboptimal performance. In this work, we made a comprehensive signal features analysis and classification study to investigate the feasibility of wireless physiological signals for mental workload assessment in real-life. Our study shows the affordable wireless acquisition systems may have a great potential to facilitate the development of Brain-Computer-Interfaces (BCI) technologies.

4 - An Algorithm for Non-convex Structural Regularization

Minh Pham, ptuanminh@gmail.com, Xiaodong Lin, Andrzej Ruszczynski

Structural L1 penalties have many applications in machine learning, biology, cancer research, medical imaging...The non-convex counterpart of L1 penalties such as SCAD and MCP are shown to have less bias than L1 penalties. A few algorithms have been proposed to solve the case when the structural matrix is identity. We propose an algorithm based on alternating linearization for the general structural matrix.

5 - A Center-based Community Detection Method

Dohyun Kim, Myongji University, Dept. of Industrial & Management Eng., 116 Myongji-ro, Cheoin-gu, Yongin, Gyeonggi-do, 449-728, Korea, Republic of, norman.kim@gmail.com, June Young Lee, Sejung Ahn

Community detection problem is one of the main topics in network analysis. One of the most popular method is the modularity maximization, which optimizes the strength of the communities. However, the modularity maximization often fails to detect communities smaller than some scale. To avoid the problem, the proposed approach finds centers considering the node density and distance and then explores center-based communities. We demonstrate the proposed method on real-world networks.

Monday, 11:00am - 12:30pm

■ MB01

Hilton- Golden Gate 6

Analytics for New Efficiencies: Quality and Lifecycle Management in the DoD

Sponsor: Military Applications Society

Sponsored Session

Chair: Aaron Burciaga, Senior Manager, North America Inventory Analytics Lead, Accenture, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, adburciaga@gmail.com

1 - Product Segmentation and Lifecycle Methodologies for Target Service Levels

Rodrigo Hernandez, Analyst, Accenture, 1841 W. Evergreen, Apt 1R, Chicago, IL, 60622, United States of America, rodrigo.hernandez@accenture.com

Service Levels are critical components for managing inventory levels and expected rewards, namely revenue in business or readiness in the DoD and National Security. Our methodology weighs product lifecycle, value, demand and variability in order to maximize reward. Security issues share similar volatility with retail products, as characterized by conflict intensity and phase of operations. We demonstrate advanced algorithms that handle volatile demand in order to right-size inventories.

2 - A Quality Assessment Approach to Army Unit Readiness

Natalie Scala, Assistant Professor, Towson University, Dept. of e-Business and Technology Manag, 8000 York Road, Towson, MD, 21252, United States of America, nscala@towson.edu, Paul Goethals

This research examines the current U.S. Army readiness reporting method and proposes a system based on desirability functions from quality theory. We present case studies contrasting current and proposed systems and function weight guidelines. Under this methodology, readiness assessment becomes dynamic, increases in accuracy, and transforms to a holistic metric.

3 - Rethinking Military Applications of Modern Principles in Data Strategy across Military Organizations

Harpreet Toor, Big Data and Cloud Strategist, Booz Allen Hamilton, 360 H St. NE, Apt. #431, Washington, DC, 20002, United States of America, toor_harpreet@bah.com

Military applications of data strategies, specifically analysis capabilities that result from deploying "big data" methodologies for data management, are too often linearly focused on intelligence and logistics functions and not on application across the enterprise. This paper will explore how the application of modern principles in data strategy across military organizations to create an analysis-first approach to decision-making will result in better execution of military strategy.

■ MB02

Hilton- Golden Gate 7

Best Dissertation Award Finalists – Technology, Innovation Management and Entrepreneurship Section

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Sinan Erzurumlu, Associate Professor, Babson College, 231 Forest St, Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Organizational Ambidexterity and Networks in Successful Technology Commercialization

Andrew Earle, Assistant Professor, University of New Hampshire, Paul College of Business and Economics, 10 Garrison Ave., Durham, NH, 03824, United States of America, Andrew.Earle@unh.edu

This dissertation relieves tension between organizational ambidexterity and network perspectives by developing a contingent model of exploration and exploitation. I hypothesize firms benefit by configuring their inter-organizational networks to gather novel information when discovering new technologies but gather redundant information when bringing these to market. I test these hypotheses with panel data on firms active in commercializing technologies in the field of green chemistry.

2 - Identity and Institutional Change in a Mature Field: The Re-Emergence of the Swiss Watch Industry

Ryan Raffaelli, Assistant Professor of Business Administration, Harvard Business School, Morgan Hall, Boston, MA, 02163, United States of America, rraffaelli@hbs.edu

I examine the decline and re-emergence of the Swiss mechanical watch industry from 1970-2008, exploring how, when, and why market demand for legacy technologies resurrect and reshape a field. I focus on mechanisms of identity and institutional change, and how leaders reframe values associated with a legacy technology. I demonstrate how the reclamation of identity can reposition an industry, and how incumbent firms re-define their identity after a technology threatens their market position.

3 - Synchronizing Exploration and Exploitation: Knowledge Creation Challenges in Innovation

Jennifer Bailey, Babson College, Technology and Operations Management, Babson Park, MA, United States of America, jbailey@babson.edu

This research considers the challenges of simultaneously pursuing exploration and exploitation within an innovation project. An important theme across all three papers is the path-dependent nature of the knowledge creation process. Collectively, they consider issues related to the dynamic generation and resolution of uncertainty during the innovation process, managing short-term versus long-term performance tradeoffs, learning from innovation experience and knowledge-sharing under competition.

4 - Understanding Breakthrough Emergence through Missed Opportunities

Sen Chai, Harvard University, 1050 Mass Ave, Cambridge, MA, 02138, United States of America, chais@nber.org

Who misses breakthroughs? Why are some scientists more successful than others? I take a counterfactual perspective and explore the mechanism by which breakthroughs fail in the form of misses and delays. Instead of sampling on rare successes, I conceptualize breakthroughs as marked by multiple failures before eventual success. My findings suggest that the seminal discovery was missed several times due to difficulties in solving a particular problem and identifying breakthrough opportunities.

■ MB03

Hilton- Golden Gate 7

Economics of Information

Sponsor: eBusiness

Sponsored Session

Chair: Rajiv Garg, McCombs School of Business, University of Texas, Austin, TX, United States of America, Rajiv.Garg@mccombs.utexas.edu

1 - The Effect of Store Transportation Costs on Customers' Multichannel Purchase Behavior

Amit Mehra, Professor, Indian School of Business, AC 6124, Gachibowli, Hyderbad, AP, 500032, India, amit_mehra@isb.edu, Anuj Kumar, Subodha Kumar

We examine the causal effect of changing customers' store access costs on their store and online purchase behavior. We use new store opening data for a large fashion retailers in the US and employ propensity score matching estimates to show that when store openings reduce customers' store transportation costs, it results in increase in their store and online purchases. But when store openings do not reduce customers' store transportation costs, their purchase behavior remains unchanged.

2 - The Spillover Effects of Health IT Investments on Regional Health Care Costs

Hilal Atasoy, Assistant Professor, Temple University, 455 Alter Hall, Philadelphia, PA, 19102, United States of America, hilal.atasoy@temple.edu, Pei-yu Chen, Kartik Ganju

Health IT investments are presumed to decrease health care costs, however the empirical evidence is mixed. Effects of health IT can go beyond hospitals due to patient mobility and information sharing. We find that, although EMR adoption increases the costs for the adopting hospitals, it has significant spillover effects by reducing the health care costs of the other hospitals in the same region. Higher software integration among adopting hospitals further strengthens the spillover effects.

3 - Impact of Location on Knowledge Sharing within Enterprise

Yingda Lu, Assistant Professor, Rensselaer Polytechnic Institute, 110 8th street, Troy, NY, 12180, United States of America, luy6@rpi.edu, Baohong Sun, Sunder Kekre

In this study, we propose a Hierarchical Bayes model to capture how employees from different markets have different contribution patterns on social media platform. We find that employees from emerging markets are mainly active whenever they have questions to answer, and immediately drop out of the community when all their questions are answered. On the other hand, employees from developed markets are more consistent over time on their contribution level on the platform.

4 - Knowledge Transfer and Depreciation in Online Medical Consultation: Study of eVisit Operation

Changmi Jung, changmi@andrew.cmu.edu, Linda Argote, Rema Padman, Ateev Mehrotra

Online medical consultation (eVisit), a digital innovation in healthcare, raises concerns among healthcare organizations due to challenges in incorporating the new service, we need to understand how the operational efficiency is linked to organizational experience in the care delivery environment and the effect of knowledge transfer among intra-practice offices. However, knowledge accumulated through experience may depreciate as the task of assigning and triaging eVisits is knowledge intensive.

5 - Jack of All, Master of Some: The Interaction Effect of Knowledge Breadth and Depth on Innovation

Elina Hwang, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15215, United States of America, elinah@cmu.edu, Param Singh, Linda Argote

To be innovative, individuals should possess both broad and deep knowledge. Although the value of knowledge breadth has been recognized, the role of deep knowledge in innovation has been overlooked. Our findings suggest that knowledge breadth feeds into novelty, but its effect on usefulness and innovativeness of ideas is contingent on the presence of deep knowledge. Consequently, breakthrough ideas were more likely to be spawned by innovators who possess both diverse and deep knowledge.

■ MB04

Hilton- Continental 1

Information, Incentives and Behavioral Decision Making in Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Guangwen Kong, Assistant Professor, University of Minnesota, 111Church Street SE, Minneapolis, MN, 55455, United States of America, gkong@umn.edu

1 - How do Delay Announcements Shape Customer Behavior? An Empirical Study

Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Qiuping Yu, Achal Bassamboo

We explore the impact of delay announcements by studying the data from a medium sized call center, where customers are provided with anticipated delay. Our key insights show that delay announcements not only impact customers' beliefs about the system, but also directly impact customers' per unit waiting cost. Specifically, customers' per unit waiting cost decreases with the offered waiting times associated with the announcements.

2 - All You Need is Trust? An Examination of Interorganizational Supply Chain Projects

Gökçe Sargut, Assistant Professor, College of Business and Public Adm., Governors State University, 1 University Parkway, University Park, IL, 60484, United States of America, gsargut@govst.edu, Andreas Brinkhoff, Özalp Özer

We examine the effects of relationship-level (trust and asymmetric dependence) and project-level factors (between-firm communication and within-firm commitment) on the success of inter-firm supply chain projects (e.g. VMI, 3PL, and EDI implementation). In order to further probe our surprising findings, we introduce a categorical scheme that differentiates supply chain projects based on decision rights configuration. We discuss how firms can effectively manage supply chain projects and alliances.

3 - The Impact of Competition for Common Customer Base on Agent's Compensation Plan

Elnaz Jalilipour Alishah, PhD Student, University of Washington, Michael G. Foster School of Business, ISOM Department, Seattle, WA, 98195, United States of America, jalilipo@uw.edu, Hamed Mamani, Yong-Pin Zhou

We study effect of agent's competition for common customer base on incentive efficiency of compensation packages. We model an environment where customers make the final decision based on perceived service quality, while incurring disutility from waiting. We show that some well-known contracts in the literature are unable to coordinate. Therefore we suggest contracts and operational tools to coordinate and analyze their flexibility and implication for practical implementation.

4 - Farmers' Information Management in Developing Countries – A Highly Asymmetric Information Structure

Chen-Nan Liao, Department of Industrial Engineering and Operations Research, 4141 Etcheverry Hall, University of California Berkeley, Berkeley, CA, 94720, United States of America, chennanliao@gmail.com, Ying-Ju Chen

In developing countries, information is usually transmitted through local networks, and, thus, farmers may have very different information channels. We establish a general framework that accommodates highly asymmetric information structures to study farmers' information management and utilization problems. We find the unique Bayesian Nash equilibrium, show that asymmetric information structures can lead to various novel results, and conduct a comprehensive study in the weak signal limit.

■ MB05

Hilton- Continental 2

Empirical Research and Quality Risk

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Aleda Roth, Professor, Clemson University, 100 Sirrine Hall, Clemson, SC, United States of America, aroth@clemson.edu

1 - The Impact of Supply Chains on Firm-Level Productivity

Juan Serpa, Ph.D Candidate, University of British Columbia, 2053 Main Mall, Henry Angus 391, Vancouver, BC, V6T1Z4, Canada, juan.serpa@sauder.ubc.ca, Harish Krishnan

By collecting data on supply chain relationships, we explore the channels through which productivity can spill over across firms. We consider two key types of channels: endogenous and exogenous. The endogenous channel measures the extent to which a firm's productivity is influenced by the productivity of its supply chain partners; the exogenous channels measure how productivity is influenced by the partners' characteristics (e.g. inventory turnover, financial leverage).

2 - The Decision to Recall: A Behavioral Experiment in the Medical Device Industry

George Ball, University of Minnesota, 321 19th Ave, Minneapolis, MN, United States of America, ball0197@umn.edu, Rachna Shah

We present results of a behavioral experiment investigating biases in the product recall decision making process in the medical device industry. Using industry expert subjects, this experiment identifies opportunities for firms to improve the objectivity of the product recall decision.

3 - Recall Strategies and Supply Chain Capabilities: Time to Recall in the FDA-Regulated Food Industry

Aleda Roth, Professor, Clemson University, 100 Sirrine Hall, Clemson, SC, United States of America, aroth@clemson.edu, Tracy Johnson-Hall, Manpreet Hora

We examine the effects of recall strategies and supply chain capabilities on time to recall. Using survival analysis on data related to food recalls of FDA-regulated products from 2004-2010, we demonstrate the importance of supply chain capabilities in shortening time to recall, and discuss implications for firms and policy-makers.

■ MB06

Hilton- Continental 3

Contract Design in Various Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Zhixi Wan, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 S Six Street, Champaign, 61820, United States of America, wanzhixi@illinois.edu

1 - Impact of Downstream Competition for an Innovative Supplier in a Supply Chain

Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Jingqi Wang

We study a supply chain with a supplier who invests in innovation, which increases the value of products, and downstream manufacturers who sell to users. Analyzing a bargaining model, we find that the supplier's optimal innovation level is higher under downstream competition than under downstream monopoly if innovation cost is relatively high, and lower if it is relatively low. Interestingly, we find that under certain conditions, the downstream competition negatively impacts the supplier.

2 - Coordinate Semi-Centralized Production Network through Fix Cost Sharing under Incomplete Information

Fang Liu, Nanyang Technological University, 50 Nanyang Drive, Singapore, Singapore, Liu_Fang@ntu.edu.sg, Jing-Sheng Song

A typical semi-centralized network comprises the headquarters (HQ), a home plant (H), and a foreign branch (B). H supplies a key component to B with guaranteed service. B incurs a high fix cost, which causes high expediting costs at H. We propose to have H share a portion of B's fix cost and find: 1) HQ-initiated contract can lead to the first-best solution, but H may be worse off. 2) H-initiated contract under full information and 3) asymmetric information can lead to near optimal performance.

3 - using Procurement Service Providers in Supplier Screening

Zhixi Wan, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 S Six Street, Champaign, 61820, United States of America, wanzhixi@illinois.edu, Sripad Devalkar

We consider a buyer who hires a procurement service provider to conduct preliminary screening and recommend suppliers from a supplier pool for final screening. We study the contract design problem and characterize the optimal number of suppliers the buyer should ask the provider to recommend.

4 - Bundle Payments vs. Fee-for-Service: Impact of Payment Scheme on Performance

Shima Nassiri, University of Washington, Foster School of Business, Seattle, WA, United States of America, shiman@uw.edu, Hamed Mamani, Elodie Adida

Healthcare payments in the US have been based on a fee-for-service scheme, which provides incentives for high volume of care. The new healthcare legislation tests Bundle Payments that remove such incentives. We consider a population of patients that wish to undergo treatment. Treatments may result in failure, where unforeseen complications can occur. We analyze effects of different payment schemes on the extent of patient selection, treatment intensity, payer costs, and the total social welfare.

■ MB07

Hilton- Continental 4

Clearing the Jungle of Stochastic Optimization

Cluster: Tutorials

Invited Session

Chair: Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu

1 - Clearing the Jungle of Stochastic Optimization

Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu

Stochastic optimization is a highly fragmented field, reflecting the diversity of applications and computational challenges. We bring the competing approaches for sequential decision problems under a common umbrella. We first suggest a five-element modeling framework which replaces the challenge of finding decisions to one of finding policies. We then describe four fundamental classes of policies that integrate stochastic programming, dynamic programming with other communities.

■ MB08

Hilton- Continental 5

Celebrating the Contributions of George Dantzig: Applications and Software

Cluster: Celebrating George B. Dantzig's 100th Birthday and His Influence on MS/OR

Invited Session

Chair: Mukund Thapa, Stanford Business Software, Inc, CA, United States of America, Mukund.Thapa@sbsinc.net

1 - Applications of Stochastic Optimal Power Flow

Robert Entriken, Principal Technical Leader, EPRI, 3420 Hillview Avenue, Palo Alto, CA, 94304, United States of America, rentrike@epri.com, Taiyou Yong

Stochastic optimal power flow techniques have been used in formulating a reserve determination problem to address the issue of the increasing penetration of intermittent generation in the U.S. electric power system. Two immediate applications, market reserve validation and post-contingency rapid redispatch, are described to illustrate value that can be derived from using the reserve determination model. Utility system operations and planning personnel can use these applications to mitigate system uncertainty and improve system reliability.

2 - The Origins of a Practical Simplex Method

Robert Fourer, President, AMPL Optimization Inc, 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com

Although the modern simplex method is traced to George Dantzig's "Programming of Interdependent Activities" of 1949, the algorithm described there has never been practical. It was rather Dantzig's later work with William Orchard-Hays at RAND that provided a template for a simplex method that could be implemented on early computers and steadily refined thereafter. This talk describes how the "revised" simplex method has made today's powerful linear (and integer) programming solvers possible.

3 - On Probabilistic Bounds in Two-stage Stochastic Programming

Gerd Infanger, Department of Management Science and Engineering, Stanford University, Stanford, CA, 94305, infanger@stanford.edu

George B. Dantzig, a great pioneer of stochastic programming, suggested very early on that sampling could be used to approximate expected values of second-stage cost and gradients. By now, sampling-based approximations have emerged as powerful techniques for solving practical stochastic problems. Based on joint work and recent results, this presentation will review confidence bounds on the optimal objective of two-stage stochastic programs.

4 - On Applied Mathematics

Richard Van Slyke, Department of Computer Science, NYU Polytechnic School of Engineering, Brooklyn, NY, 11201, rvslyke@poly.edu

This talk will cover what I learned from George Dantzig, during the years that he was at the RAND Corporation, U.C. Berkeley, and Stanford. As a result of our interactions I imagined myself an "applied mathematician". George was certainly a superb model, but intimidating to follow. I will illustrate some of the approaches I ultimately followed. To specify an applied mathematician one needs to specify the applications and the mathematics. I will emphasize applications to telecommunications and finance. The mathematical methods include a variety of optimization techniques.

■ MB09

Hilton- Continental 6

Empirical Studies on Hospital Operations

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Stefan Scholtes, University of Cambridge, UK, ss248@cam.ac.uk

Co-Chair: Nicos Savva, London Business School, Regentís Park, London, NW1 4SA, United Kingdom, nsavva@london.edu

1 - Do Mandatory Overtime Laws Improve Quality? Staffing and Operational Flexibility in Nursing Homes

Susan Lu, Assistant Professor, Purdue University, Krannert School of Business, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu, Lauren Lu

During the 2000s, a number of states passed laws that restrict the use of mandatory overtime and cap the maximum work hours for nurses. Using U.S. nursing homes data from 2004 to 2012, we find that the passage of mandatory overtime laws reduces the overall quality in nursing homes.

2 - An Empirical Analysis on the Effect of Nursing Team Characteristics on Patient Outcomes

Stefan Scholtes, Judge Business School, University of Cambridge, Cambridge, CB2 1AG, United Kingdom, s.scholtes@jbs.cam.ac.uk, Sandra Suelz

We match a sample of 40,025 patients across 19 wards of a major hospital over a 5-year period with nursing shift data to assess the impact of nursing team characteristics, specifically team familiarity and diversity, on patient outcomes.

3 - Managing Variety in Professional Service Firms: A Study of Service Platforms in Hospitals

Sandra Suelz, Faculty of Management, Economics and Social Science, University of Cologne, Albertus-Magnus-Platz, Cologne, 50923, Germany, suelz@wiso.uni-koeln.de, Stefan Scholtes, Ludwig Kuntz

This paper presents an empirical study of the quality implications of service platforms in the hospital industry. We show that for related services, platform-based delivery is associated with higher quality; that the beneficial effect of departmental focus on quality is reduced if the service is part of a service platform; and that quality deteriorates if merged service bundles are relatively unrelated. We outline the implications with a counterfactual departmental redesigns based on our sample.

■ MB10

Hilton- Continental 7

Learning in Queues

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Costis Maglaras, cm479@columbia.edu

1 - Observation-Based Abandonment in Queues

John Yao, Columbia University, New York, NY, United States of America, jyao14@gsb.columbia.edu, Costis Maglaras, Assaf Zeevi

We present a queueing model in which customers use their experience in line to infer system parameters, estimate waiting times, and make strategic abandonment decisions. The key feature is that customers do not know the service capacity when they join the queue, and instead observe their progress through the line - their queue position and estimated speed – to decide whether to abandon. We show how the large-scale system dynamics under our model differs from traditional abandonment models.

2 - A Model of Rational Retrials in Queues

Shiliang Cui, Georgetown University, McDOnough School of Business, Washingrton, DC, 20057, United States of America, shiliang.cui@georgetown.edu, Senthil Veeraraghavan, Xuanming Su

Consumers suffer disutility in waiting for a service. When they can self-organize the timing of their service visits, they may avoid long queues and choose to retry later. We study an observable queue in which consumers make rational join, balk and costly "retry" decisions upon their arrival. Retrial attempts could be costly due to factors such as transportation costs, retrial hassle and visit fees. We characterize the equilibrium under such retrial behavior, and study its welfare effects.

3 - First Ranked First to Serve: A Tournament Approach to Call Centers

Konstantinos Stouras, PhD Candidate, INSEAD, Bd. de Constance, Fontainebleau, 77305, France, Konstantinos.STOURAS@insead.edu, Serguei Netessine, Karan Girotra

We develop a stylized model of a virtual call center that pays its agents on-demand, by committing to a (relative) performance ranking prioritization scheme. We characterize the optimal design of such a "service contest" under different objectives of the firm, as well as different models of agents' performance. We show that using less information, or deploying coarser priority classes, can paradoxically create higher incentives for agents to most efficiently deliver service to its customers.

4 - How to Charge and Prioritize Time-sensitive Customers with Heterogeneous Demand Rates

Ricky Roet-Green, Postdoctoral Fellow, Rotman School of Management, University of Toronto, 105 St.George Street, Toronto, On, Canada, rgricky@gmail.com, Philipp AfËche, Opher Baron, Joseph Milner

Providers often face time-sensitive customers that differ in their demand rates. However, the pricing literature for queues typically assumes unit demand for all customers. We study a revenue-maximizing provider that designs a price/lead-time menu for customers with heterogeneous demand rates and private information on their preferences. We show under what conditions it is optimal to prioritize customers based on their demand rates and transaction values, even if all are equally time-sensitive.

■ MB11

Hilton- Continental 8

Empirical Research in Supply Chain Management

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Vishal Gaur, Cornell University, Johnson School, Ithaca, NY, United States of America, vg77@cornell.edu

1 - Inventories and the Bullwhip: A Chicken and Egg Situation
Maximilliano Udenio, Doctoral Student, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, M.Udenio@tue.nl, Vishal Gaur, Jan C. Fransoo

We explore the role of inventories in the bullwhip effect. Through an empirical study of firm-level data, we investigate whether inventory-related decisions exacerbate or smoothen the distortions commonly associated with the bullwhip effect.

2 - The Impact of Supplier Inventory Service Level on Retailer Demand
Nathan Craig, Ohio State University, 2100 Neil Avenue, Columbus, OH, 43210, United States of America, craig.186@osu.edu, Ananth Raman, Nicole DeHoratius

While the effects of inventory service level changes have been studied empirically at the end consumer level, relatively little is known about the interaction between a retailer and a supplier. Using data from an apparel supplier, we show increases in service level to be associated with substantial increases in retailer orders. Retailers that order frequently exhibit a larger reaction to service level changes, an outcome consistent with retailers learning about and reacting to such changes.

3 - Driving Open Innovation in Supply Networks
Marcus Bellamy, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, marcus.bellamy@scheller.gatech.edu, Soumen Ghosh, Manpreet Hora

We investigate how firms can benefit from open innovation in supply networks. This is particularly interesting since supply networks are primarily created to drive operational efficiency in the supply process, but can also be leveraged to drive open innovation. Using secondary empirical supply chain data on customer and supplier relationships, we show that certain structural characteristics and relationship strength can drive open innovation and impact firm performance.

■ MB12

Hilton- Continental 9

Environmental Sustainability in Service Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Nagesh Gavirneni, Cornell University, Johnson Graduate School of Management, Ithaca, NY, 14853, United States of America

1 - Servicizing and Other Models for Reduced Consumption: A Literature Review and Call for Research
Sandra Rothenberg, Professor, Rochester Institute of Technology, 108 Lomb memorial drive, Rochester, Ny, 14623, United States of America, srothenberg@saunders.rit.edu, Anne Sherman, Jonathan Eppolito

In this paper, we first review the role of services in reduced consumption, and discuss the means by which a company can make more by selling less. We then take a broad look at the business models that move the economy toward lower levels of consumption. Our review suggests that there is a critical gap in our understanding of more collaborative consumption models. Implications for scholars, business and policy makers are discussed.

2 - Sustainability Practices in Convention Centers
Spring Han, Assistant Professor, Faculty of Management, Higher School of Economics, Moscow, Russia, hjh56@cornell.edu, Rohit Verma

The environmental impacts of meetings, incentives, conventions, and exhibitions (MICE) industry are as far reaching as its economic reach. Research on sustainability in the MICE sector, however, is scarce. This study explores the most prevalent practices that the industry employs in European countries and the US and, relative importance of sustainability to convention consumers.

3 - Positively Deviant: A Behavior Science Approach to Promoting Sustainability
Emily Leeming, University of Nevada Reno, Psychology Department MS/296, Reno, NV, 89557, United States of America, emilyleeming@yahoo.com, Daniel Reimer, Chelsea Wilhite

The concept of deviance often possesses negative connotations. However when societies face pervasive problems, deviant responses can be seen as valuable. Sustainability provides examples of positive deviance. This paper will provide case examples of behavior change within sustainability and human services. Contemporary behavior science is presented to discuss principles in these positively deviant successes. An in-depth evaluation of a Lake Tahoe resort's sustainability program is highlighted.

4 - An Investigation into the Association between Sustainability and Patient Satisfaction in US Hospitals
Tanya Boone, Associate Professor, College of William and Mary, 705 College Terrace, Williamsburg, VA, 23185, United States of America, Tonya.Boone@mason.wm.edu

Hospitals have significant environmental and social impacts yet lag in adoption of sustainability. This paper examines the association between successful sustainability programs and patient satisfaction in US hospitals. We match a set of hospitals that have demonstrated improvement in environmental performance with a set of comparable hospitals that have not. We find significant differences for some measures with sustainable hospitals viewed more favorably by patients.

■ MB14

Imperial B

Airport/Airline Operations Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Farbod Farhadi, University of Massachusetts Amherst, 121 Presidents Drive 230, Amherst, MA, 01003, United States of America, ffarhadi@som.umass.edu

1 - An Effective Branch-and-Price Algorithm for Runway Scheduling Problems
Mohammad Reihaneh, University of Massachusetts Amherst, Isenberg School of Management, 121 Presidents Drive 230, Amherst, MA, 01002, United States of America, mreihaneh@som.umass.edu, Ahmed Ghoniem, Farbod Farhadi

This paper presents a branch-and-price algorithm for multiple-runway aircraft sequencing problems. The subproblem of column generation is solved as an elementary shortest path problem with resource constraints using an enhanced dynamic programming procedure. This approach greatly improves the tractability of the problem when compared with solving a classical 0-1 MIP model over a set of computationally challenging instances.

2 - Mergers and Service: Investigating the Merger-customer Service Relationship in the Airline industry
Amirhossein Alamdar Yazdi, Isenberg School of Management, 24 Rolling Green Dr., Amherst, MA, 01002, United States of America, aalamdaryazd@som.umass.edu, Adams Steven

We analyze the effect of the recent airline mergers on customer service and satisfaction both at carrier and route levels. Both service and satisfaction levels affect performance and it is therefore surprising why mergers are understudied from service level perspective. Our study extends the existing merger literature by incorporating service level into capacity and pricing effects of the consequent concentration of service providers.

3 - A Model for Airline Operations Recovery
Peng Duan, Lead Operations Research Analyst, Sabre Holdings, Inc, 1008 Zhongshan Road #1008, Shanghai, China, peng.duan@sabre.com, Xiaodong Luo, Shahram Shahinpour

Over the course of airline operations, disruptions can be caused by different factors which could lead to the cancellation and/or delay of flights. We presents a model that developed by Sabre Airline Solutions which will identify the disruptions and create options to help the operations controller to recover disruptions and bring operations back to normal. The model considers a variety of recovery options and takes into account of the impact to crew operation and passenger connections.

4 - On the Impact of Jet-fuel Price on the Size of Airlines
Soheil Sibdari, UMass Dartmouth, 248 Old Westport Rd, Dartmouth, MA, 02135, United States of America, ssibdari@umassd.edu, Iman Mohammadian

We address an interesting phenomenon in the US domestic airline market during 2003-2013 that despite higher load factors and inflated airfares most airlines were experiencing profit losses. We explore the operations of seven US major airlines and observe that this profit instability can be partly due to the fuel cost fluctuations in that period.

■ MB15

Hilton- Exec. Boardroom

Efficiency Analysis Applications

Cluster: Data Envelopment Analysis

Invited Session

Chair: Nataliya Plesha, University of Connecticut, Storrs, CT, 06269, United States of America, nataliya.plesha@uconn.edu

1 - Capial Misallocation and Firm Innovation: A Structural Analysis
Lihong Yang, Assistant Professor, Renmin University of China, School of Business, Zhongguancun 59 Street, Beijing, 100872, China, lihong.yang@ruc.edu.cn

In this paper we examine micro-level channels of how capital misallocation can affect a firm's innovation activities. In particular, we investigate theoretically and empirically how the misallocation of capital assets across firms inhibits a firm's incentive for product innovation and process innovation. Theoretical predictions are tested using unique firm level data which provides direct measures for innovation and firm-specific capital misallocation.

2 - Total Factor Productivity Growth in the U.S. Agricultural Sector: Interstate Analysis
Nataliya Plesha, University of Connecticut, Storrs, CT, 06269, United States of America, nataliya.plesha@uconn.edu, Subhash Ray

Growing concern toward global environmental and public health problems, the burden placed by agricultural activities on environmental quality have encouraged scientists to use models of productivity analysis to assess joint production of "goods" and "bads". We use directional distance function to measure TFP growth accounting for use of by-product assumption.

3 - Measuring Environmentally Sensitive Efficiency and Productivity Growth in the Urban Water Sector
Jayanath Ananda, Senior Lecturer, La Trobe University, School of Economics, Albury-Wodonga Campus, Wodonga Vi 3690, Australia, j.ananda@latrobe.edu.au, Benjamin Hampf

Using the global Malmquist-Luenberger index approach, this paper analyses the efficiency and productivity growth trends in the Australian urban water sector whilst incorporating an undesirable output – greenhouse gas emissions. Results indicate that the productivity growth of the sector has declined when greenhouse gas emissions are included. The findings call for a greater understanding of energy intensity of various water supply options and sewerage operations.

■ MB16

Hilton- Franciscan A

Managing Financial Flows in Supply Chain

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Lingxiu Dong, Associate Professor, Olin Business School, Washington University in St. Louis, One Brookings Drive, St. Louis, MO, 63130, United States of America, dong@wustl.edu

1 - Franchise Contracting with Dynamic Franchisee Response, Debt Financing, and Bankruptcy Risk
Volodymyr Babich, Georgetown University, McDonough School of Business, Washington D.C., United States of America, vob2@georgetown.edu, Chris Tang

In a sequential moves game the franchisor chooses values of franchise fee and a royalty rate, the franchisee solves an optimal stopping problem, deciding when to sign the contract and open a store, and banks offer competitive loan rates (accounting for bankruptcy risk). We explain the existence of royalty rates in contracts due to dynamics in the model, recommend that the franchisor assumes greater share of store operating costs, and quantify ramifications of ignoring financing considerations.

2 - The Strategic Role of Business Insurance in Managing Supply Chain Risk
Harish Krishnan, University of British Columbia, Sauder School of Business, Vancouver, BC, V6T 1Z2, Canada, krishnan@sauder.ubc.ca, Juan Serpa

Supply chain risk management involves coordinating the unobservable efforts of multiple firms. This can be done through contracts, which transfer risk to firms best positioned to mitigate it. Firms can also manage risk by purchasing insurance. Unlike contractual incentives, which allocate risk within a supply chain, insurance externalizes this risk and decreases effort incentives. We show, however, that firms may strategically use insurance to prevent excessive free riding in a supply chain.

3 - Softening Competition through Trade Credit
S. Alex Yang, Assistant Professor, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, sayang@london.edu, Heikki Peura

We analyze the role trade credit plays in softening horizontal competition and show this role of trade credit induces higher capacity investment, benefiting customers and improving social welfare.

4 - Push, Pull, and Trade Credit Contracts in Competitive Markets
Xiaomeng Guo, Phd Candidate, Washington University in St. L, 605 Leland Ave, Apt 605, Saint Louis, MO, 63130, United States of America, xiaomeng.guo@wustl.edu, Lingxiu Dong, Danko Turcic

Supply chain contracts vary by the inventory responsibility imposed on supply chain members and the timing of payment. We consider three basic wholesale price contracts that are different from each other in one or both of the dimensions, push, pull, and trade credit. The research focuses on understanding the implications of product offerings and downstream retail competition for the equilibrium contract offering in the supply chain.

■ MB17

Hilton- Franciscan B

Queuing Models for Service Management

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Laurens Debo, Associate Professor, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu

1 - Characterizing the Steady State Distribution of a Call Center with Forward-Looking Callers
Xiaoshan Peng, PhD Student, Booth School of Business, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, x-peng@chicagobooth.edu, Baris Ata, Peter Glynn

We analyze a queue system with endogenous abandonment. The customers waiting in the queue in the call center decide either leave the system or keep waiting in the queue dynamically. On the other hand, the system evolution and thus the waiting time distribution are determined by customers' dynamic decisions. We characterize the equilibrium of the system.

2 - Optimal Pricing in Tandem Queueing Systems with Finite Buffers
Hayriye Ayhan, Professor, Georgia Institute of Technology, School of ISyE, Atlanta, GA, 30332, United States of America, hayhan@isye.gatech.edu, Sigrun Andradottir, Xinchang Wang

We study pricing in a two-station tandem queue with finite buffers. Our goal is to determine the pricing policies that maximize the long-run average profit. We show that the optimal dynamic policy exhibits a monotone structure in which the quoted prices have greater dependency on the queue length at station 1 than at station 2. We also show that the optimal static pricing policy performs as well as the optimal dynamic policy when the buffer size before station 1 becomes large.

3 - An Analytical Throughput Approximation for Closed Fork/Join Networks
Erkut Sonmez, Assistant Professor, Boston College, Carroll School of Management, 140 Commonwealth Ave, Chestnut Hill, MA, 02467, United States of America, erkut.sonmez@bc.edu, Alan Scheller-Wolf, Nicola Secomandi

Fork/Join stations are used to model synchronization between entities, and fork/join queueing networks are natural models for a variety of service, communication and manufacturing systems. In this paper, we present a new and simple analytical approximation to estimate the throughput of a closed queueing network that features a single fork/join station receiving inputs from general subnetworks.

4 - Optimization of Industrial-Scale Assemble-to-Order Systems
Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu, Willem van Jaarsveld

We provide insights and algorithms for inventory control in industrial-sized Assemble-to-Order systems. Our initial focus is first-come first-serve (FCFS) allocation of components to products. By developing a novel stochastic programming formulation, we compute solutions that are within one percent of the lower bound for realistically sized systems. We then answer the following questions: How do common heuristics used in practice compare to our performance, and how costly is the FCFS assumption?

■ MB18

Hilton- Franciscan C

RM & Pricing Topics

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Wei Wang, Scientist, PROS Inc, 3100 Main St, #900, Houston, TX, 77002, United States of America, weiwang@pros.com

1 - Integrating Price Optimization Modeling with Marketing Initiatives

Yanqi Xu, Director of Applied Technology, Princess Cruises, 24305 Town Center Road, Valencia, CA, 91355, United States of America, yanqi6@yahoo.com

The session will focus on: 1. an algorithm that we used in the accurate estimation of price elasticity, and 2. a model that integrates price optimization with other key marketing objectives. We will present an example to illustrate an approach that jointly optimizes both company strategic objectives and short term profits. We will also discuss the influence of big data technology on the analytics applications in the travel industry.

2 - Channel and Competitor Based Pricing and Distribution Optimization for Rental Car Industry

Mohit Mahajan, Senior Manager, Science and Research, PROS, 3100 Main St, Suite 900, Houston, TX, 77002, United States of America, mmahajan@pros.com, Ezgi Eren, Nikhil Kumar

Pricing and distribution optimization solution for car rental industry jointly optimizes pricing and yielding decisions, and fleet movement recommendations. It incorporates demand forecast relative to competitor prices and differentiates pricing across booking channels and through booking horizon. The number of decision variables and constraints considered in the optimization problem leads to computational challenges which are addressed by decomposing the problem into three step optimization.

3 - Demand Learning in Dynamic Auctions

Fatemeh Saberian, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, negar.saberian@gmail.com, Archis Ghate

We will present a Bayesian framework for learning bidder demand in dynamic auctions while minimizing the minimum bids. We will first present a complete structural analysis of the clairvoyant model and then discuss computational procedures to approximately solve the optimal learning problem.

4 - Revenue vs. Load Factor in Dynamic Revenue Management

Darius Walczak, Principal Research Scientist, PROS Inc., Science and Research, 3100 Main Street, Houston, TX, United States of America, dwalczak@pros.com, Wei Wang

Revenue and load factor are two basic metrics in revenue management. The trade-off between these metrics can be effectively analyzed by means of an efficient frontier. We explore practical ways to generate it in a dynamic, single-resource context including optimization with a mixed objective as well as using heuristics.

■ MB19

Hilton- Franciscan D

Demand Response Pricing in Data Centers and Grids

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Parijat Dube, IBM, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, pdube@us.ibm.com

1 - Market Design for Data Center Demand Response

Zhenhua Liu, California Institute of Technology, Pasadena, United States of America, zhenhua@caltech.edu, Adam Wierman, Steven Low

Energy and sustainability have become one of the most critical issues of our generation. Demand response is considered crucial for the renewable energy incorporation. In this talk, we focus on a particularly promising industry for demand response: data centers. We use simulations to show that data centers can provide as much flexibility as large-scale storage if given the proper incentives. Then we discuss the challenges and our recent progress in the market design to improve social welfare.

2 - Equilibrium Analysis of the LMP Mechanism for Economic Dispatch

Rahul Jain, Associate Professor, University of Southern California, Electrical Engineering Department, Los Angeles, CA, 90089, United States of America, rahul.jain@usc.edu, Wenyuan Tang

Locational marginal pricing (LMP) is widely employed for pricing in the wholesale electricity market. Although it's known that the LMP mechanism is vulnerable to market manipulation, there is little systematic analysis. We show via counterexamples a Nash equilibrium may not exist in the LMP mechanism. And when it exists, the price of anarchy may be arbitrarily large. We then provide two sufficient conditions under either of which an efficient Nash equilibria exists.

3 - Transactive Energy Management (TEM) with Economic Value-based Signals

Mark Yao, Research Scientist, IBM Research, 1101 Kitchawan Rd, Ossining, NY, 10598, United States of America, markyao@us.ibm.com

TEM is a method of managing electricity system locally and globally. At its core an electricity system managed by TEM uses economic value-based signals as the primary control signal in a network of Transactive Control Nodes on the grid. Such economic value-based signals are computed by the TCNs along the electricity supply path based on local objectives and constraint. In response to these economic signals are feedback signals based on current and forecasted electrical loads.

4 - Optimal Battery Pricing under Undetermined Demand Response Programs

Yanyi He, Postdoctoral Researcher, NEC Lab America, 10080 North Wolfe Road, SW3-Suite 305, Cupertino, CA, 95014, United States of America, heyanyi@nec-labs.com, Ratnesh Sharma

The Goal of the study is to find the optimal battery selling pricing based on the benefits of participating on various demand response programs. The expected multi-objective benefits of representative customers are calculated under different load scenarios and demand response programs. The aggregated demand-price curve along with the cost curve is used to derive for the optimal battery prices under different market structures.

■ MB20

Hilton- Yosemite A

Pierskalla Award

Sponsor: Health Applications

Sponsored Session

Chair: Dimitris Bertsimas, Professor of Operations Research and Statistics, Massachusetts Institute of Technology, Massachusetts Institute of Technology, Sloan School of Management, E40-147, Cambridge, MA, 02139, United States of America, dbertsim@mit.edu

1 - Pierskalla Award

Dimitris Bertsimas, Professor of Operations Research and Statistics, Massachusetts Institute of Technology, Massachusetts Institute of Technology, Sloan School of Management, E40-147, Cambridge MA 02139, United States of America, dbertsim@mit.edu

The Health Applications Society of INFORMS sponsors an annual competition for the Pierskalla Award, which recognizes research excellence in the field of health care management science. The award includes a honorarium for the best paper presented in a Health Applications Society sponsored session at the annual INFORMS conference. The award is named after Dr. William Pierskalla to recognize his contribution and dedication to improving health services delivery through operations research. The Pierskalla award information can be found on the website at: https://www.informs.org/Community/HAS/Pierskalla-Award.

■ MB21

Hilton- Union Sq 1

Novel Techniques for Vehicle Routing

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Burcu Keskin, Associate Professor, University of Alabama, 300 Alston Hall, Tuscaloosa, Al, 35487, United States of America, bkeskin@cba.ua.edu

Co-Chair: Ibrahim Capar, Graduate Research Assistant, ISM Dept. 300 Alston Hall, 361 Stadium Drive, Tuscaloosa, Al, 35487-0226, United States of America, icapar@cba.ua.edu

1 - The Split Delivery Min-Max Multi-Depot Vehicle Routing Problem with Minimum Delivery Amounts

Xingyin Wang, University of Maryland, Mathematics department, University of Maryland, College Park, MD, 20742, United States of America, wang_xingyin@yahoo.com, Bruce Golden, Edward Wasil

The split delivery min-max multi-depot vehicle routing problem with minimum delivery amounts is a variant of the standard multi-depot VRP. The objective is to minimize the total time of the most costly route taking into account the travel times and the customer service times. The service time of a customer can be split among the vehicles, provided that each visit serves a minimum fraction of the total service required. We develop a heuristic that produces high-quality results.

2 - The Split Delivery Vehicle Routing Problem
Gizem Ozbaygin, Ph.D. Candidate, Bilkent University, Industrial Engineering Department, Ankara, Turkey, ozbaygin@bilkent.edu.tr, Hande Yaman Paternotte, Oya Karasan, Barbaros Tansel

The split delivery VRP is a relaxation of the capacitated VRP where multiple vehicles can visit and serve the demand of a customer. We try to solve this problem with a formulation using two indexed flow variables. This formulation may have solutions where several vehicles exchange loads at some customers. We cut-off such solutions using a) cutting planes, b) extending the formulation locally with vehicle indexed variables, and c) node splitting. We report some preliminary computational results.

3 - Online and Open Vehicle Routing Problem with Split Delivery
Ibrahim Capar, Graduate Research Assistant, ISM Dept. 300 Alston Hall, 361 Stadium Drive, Tuscaloosa, Al, 35487-0226, United States of America, icapar@cba.ua.edu, Burcu Keskin

We consider an online, nomadic vehicle routing problem with split deliveries. This type of problem is common for shippers that use common carriers with TL, LTL, or container services. We develop an integer programming based online optimization model to minimize long run total transportation cost.

■ MB22

Hilton- Union Sq 2

Disaster Planning

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Yingyan Lou, Assistant Professor, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, yingyan.lou@asu.edu

1 - Pre-disaster Investment Decisions for Strengthening the Chinese Railway System to Earthquakes
Liu Hong, Huazhong University of Science and Technology, 1037#, Luoyu Road, Wuhan, 430074, China, liu.hong@hust.edu.cn, Xiaozheng He, Srinivas Peeta, Yongze Yan, Min Ouyang

We propose an analytical model for a pre-disaster investment problem that seeks to select and prioritize links in China Railway Network (CRN) to strengthen under a limited budget with the objective of minimizing the post-earthquake loss of the CRN, which is represented in terms of the functionality deterioration of railway system service. A heuristic is used to solve the problem. Numerical experiments using real-world data illustrate the tractability and effectiveness of the proposed method.

2 - Designing Service Coverage and Measuring Accessibility and Serviceability
EunSu Lee, Associate Research Fellow, Upper Great Plains Transportation Institute, 1616 12th Ave. N #210E, Fargo, ND, 58102, United States of America, eunsu.lee@ndsu.edu

This study proposes a novel approach to analyze potential accessibility to ambulance services by combining the demand-covered-ratio and potential serviceability with the ambulance-covering-ratio.

3 - A Bilevel Model and GPU Computing Solution Strategy for Evacuation Route Planning
David Prentiss, University of Maryland, 1173 Glenn Martin Hall, College Park, MD, 20742, United States of America, dprentiss@gmail.com, Elise Miller-Hooks

We propose a bilevel evacuation and shelter design problem with a space-based risk exposure objective that minimizes the maximum risk exposure of evacuees under stochastic, heterogeneous hazard scenarios. A solution strategy is developed that exploits a fast, low-memory, equilibrium-finding algorithm as well as parallel implementation on graphics processing units.

■ MB23

Hilton- Union Sq 3

Uncertainty in Transportation Models II

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Nico Dellaert, Associate Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, n.p.dellaert@tue.nl

1 - Real-time Recovery in Berth Allocation with Stochastic Arrival and Handling Times
Nitish Umang, École Polytechnique Fédérale de Lausanne, Switzerland, nitish.umang@epfl.ch

In this research we study the berth allocation problem (BAP) in real time as disruptions occur. In practice, the actual arrival times and handling times of the vessels deviate from their expected or estimated values, which can disrupt the original berthing plan and potentially make it infeasible. We consider a given baseline berthing schedule, and solve the BAP on a rolling planning horizon with the objective to minimize the total realized costs of the updated berthing schedule as the actual arrival and handling time data is revealed in real time. The uncertainty in the data is modeled by making appropriate assumptions about the probability distributions of the uncertain parameters based on past data. We present an optimization based recovery algorithm based on set partitioning method and a smart greedy algorithm to reassign the vessels in the events of disruption. A simulation study is carried out to assess the solution performance and efficiency of the proposed algorithms, in which the baseline schedule is chosen as the solution of the deterministic berth allocation problem without accounting for any uncertainty. Our research problem derives from the real world issues faced by the SAQR port, Ras Al Khaimah, UAE, where the berthing plans are regularly disrupted owing to a high degree of uncertainty in information. Results indicate that the proposed algorithms can significantly reduce the total realized costs of the berthing schedule as compared to the ongoing practice of reassigning vessels at the port.

2 - A Constructive Heuristic for Stochastic Time-dependent Service Network Design
Stein W. Wallace, Professor of Operational Research, Norwegian School of Economics, Department of Business and Management Sc, Norwegian School of Economics, Bergen, NO-5045, Norway, Stein.Wallace@nhh.no, Teodor Gabriel Crainic, Xin Wang

This research looks at a stochastic, time-dependent, capacitated, multi-commodity service network design problem in which periodic, cyclic schedules are built. We find and illustrate the underlying structures of stochastic solutions by studying the optimal solutions to the stochastic network design problem and comparing them with deterministic counterparts. To achieve this, the following issues are addressed: Why does the solution select one particular route rather than others? What drives the solution to add/drop a service? Structural properties that characterize the stochastic solutions are found when addressing these issues and are then used to develop a constructive heuristic.

3 - Influence of Spillback Effect on the Dynamic Shortest Path Problem with Network Disruptions
Nico Dellaert, Associate Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, n.p.dellaert@tue.nl, Derya Sever, Tom Van Woensel

Due to the limited capacity of roads, we observe that when a particular road is disrupted because of accident or traffic jam, the traffic queue propagates backwards. We consider this so-called spillback effect in a dynamic shortest path problem, with network disruptions following a stochastic process. We model this problem as a Markov Decision Process, and consider several options to come to good solutions, using only a fraction of the available knowledge on the traffic situation.

■ MB24

Hilton- Union Sq 4

Advances in Network Modeling

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Nan Jiang, University of Texas, Austin TX, United States of America, jiang@utexas.edu

1 - Modeling Mixed Equilibrium Behaviors in Transportation Networks with Link Flow Constraints
Xia Yang, University of Texas, Austin, TX, United States of America yangxiacsu.shiny@gmail.com, Xuegang (Jeff) Ban

We model mixed equilibrium behaviors with user equilibrium (UE), system optimum (SO) and Cournot-Nash (CN) players as a generalized Nash equilibrium problem (GNEP). Link flow constraints are considered and numerical results are presented to illustrate the model.

2 - Parallel Implementation of Agent-based and Kinematic Wave Model-based Dynamic Traffic Simulation
Jeff Taylor, The University of Utah, Salt Lake City, UT, United States of America, jeff.d.taylor@utah.edu, Xuesong Zhou

This talk will present a computationally efficient implementation of a simplified kinematic wave model based dynamic network simulator. To enable flexible parallel computing on a multi-core shared memory architecture, we discuss how to (1) how to embed an event-based simulation logic; (2) how to decompose simulation steps to reduce communications overheads in parallel execution; (3) how to automate the partition and map computation tasks. The algorithms are implemented in an open-source dynamic traffic assignment package.

3 - A Simulation-based Optimization Algorithm for Dynamic Transportation Problems

Carolina Osorio, MIT, Cambridge, MA, United States of America osorioc@mit.edu, Linsen Chong

This work proposes a simulation-based optimization algorithm for continuous generally constrained dynamic urban transportation problems with stochastic simulation-based objective functions. The algorithm combines ideas from metamodel simulation-based optimization, transient queueing theory, traffic flow theory and stochastic microscopic traffic simulation. We benchmark and evaluate the performance of the algorithm with a large-scale traffic signal control problem.

4 - System Optimal Dynamic Traffic Assignment with Schedule Delay on Two-terminal Networks

Hong Zheng, Purdue University, West Lafayette, IN, United States of America, zheng225@purdue.edu, Srinivas Peeta

We analyze system optimal dynamic traffic assignment with schedule delay on a single-origin single-destination network. We show the problem is equivalent to the earliest arrival latest departure flow. A numerical example is illustrated.

■ MB25

Hilton- Union Sq 5

New Methods for Leveraging Open Data in Public Transit Analysis and Modeling

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Nicholas Lownes, University of Connecticut, 261 Glenbrook Rd, U-3037, Storrs, CT, 06269, United States of America, nlownes@engr.uconn.edu

1 - Clustering in Metric Space for Transit Route Stop Set Identification

Kelly Bertolaccini, Graduate Assistant, University of Connecticut, 260 Glenbrook Rd, Storrs, CT, 06269, United States of America, klb06003@engr.uconn.edu, Nicholas Lownes

Identifying sets of stops to group into routes is an important component of transit network design. This research presents a clustering model formulated in a metric space defined by the ratio of the LEHD trajectories between stop pairs to the shortest path distance between them with the objective of maximizing the metric space covered by the stop sets.

2 - A Bus Dispatching Policy to Minimize Headway Variance

Simon Berrebi, Georgia Tech, 790 Atlantic Drive, Atlanta, GA, 30332-0355, United States of America, sberrebi3@gatech.edu, Kari Watkins

On high frequency bus routes, passenger-waiting time increases with headway variance. In this research, the bus-dispatching problem was addressed as a continuous-time stochastic decision process, with time-dependent transition probabilities. A policy to minimize headway variance was derived analytically by backward induction and compared to methods used in practice through simulation. The policy yielded lower passenger waiting time and was more resilient to perturbation.

3 - Incorporating Travel Time Reliability in Schedule-based Transit Assignment

Alireza Khani, Postdoctoral Fellow, University of Texas at Austin, 1616 Guadalupe St, Suite 4.202, Austin, TX, 78701, United States of America, akhani@utexas.edu, Tyler Beduhn, Mark Hickman

A hyperpath model is proposed for modeling the effect of service reliability on user behavior in a schedule-based transit network. The reliability of the transit service is modeled through stochastic arrival and departure times at the stops, and a logit route choice model is proposed to assign passengers to the reliable paths.

4 - Schedule-based Transit Assignment with Capacities and Priority: A Multicommodity Flow Application

Mark Hickman, University of Queensland, St Lucia, 4072, Queensland, Australia, m.hickman1@uq.edu.au, Alireza Khani

We consider the problem of a user equilibrium in a schedule-based transit assignment. When fixed capacity constraints and boarding priority are applied, the assignment can be modelled as a multicommodity flow problem with side constraints. We show how this might be solved using a combination of dual prices and column generation. We implement this solution procedure in an agent-based passenger assignment and simulation for a network of a mid-sized city.

■ MB26

Hilton- Union Sq 6

Location Modeling & Applications

Sponsor: Location Analysis

Sponsored Session

Chair: Richard Church, Professor, University of California, Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106-4060, United States of America, rick.church@ucsb.edu

1 - Solving Location Problems by a Trajectory Approach

Zvi Drezner, California State University, 800 N. State College, Fullerton, CA, 92834, United States of America, zdrezner@fullerton.edu, Tammy Drezner

We solve location problems by following a trajectory from a solution point to a related problem to the desired solution location.

2 - Geospatial Analysis on Somali Piracy

Daisuke Watanabe, Tokyo University of Marine, Tokyo, Japan daisuke@kaiyodai.ac.jp, Shigeki Toriumi

Recently, piracy attacks occurred off the coast of Somalia and threaten the ships and vessels navigating on the sea lane between Asia and Europe. The purpose of this study is to determine geographical characteristics of the areas where Somali piracy has occurred. To achieve this purpose, we plotted the piracy incidents from 2005 to 2013 on a map and analysis using spatial analysis method including kernel density method and optimal location model.

3 - A Simple Framework for Parallel Multi-Objective Optimization using Java

F. Antonio Medrano, UC Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106, United States of America, medrano@geog.ucsb.edu, Richard Church

Solving multi-objective combinatorial optimization (MOCO) problems can quickly become intractable when applied to big data. Top MIP solvers have built-in parallelism, but specialized algorithms are typically coded serially. Java provides a new concurrency API that allows for simple conversion of a serial method to parallel that is well suited to approaches for finding the supported Pareto set of a MOCO problem. These methods are discussed, along with extensions for finding unsupported solutions.

4 - Comparing Anti-Covering Location Problem New Heuristic Solutions and Times to Optimal Ones

Matthew Niblett, University of California, Santa Barbara, 1832 Ellison Hall, UC Santa Barbara, Santa Barbara, CA, 93106-4060, United States of America, mniblett@geog.ucsb.edu, Richard Church

The Anti-Covering Location Problem (ACLP) involves maximizing the number of facilities located within a region such that each is separated by a minimum separation standard. For small problems optimal solutions are obtained quickly, while larger problems require much more time. A new heuristic solution approach, Marching Army, has been developed. The heuristic solution performance is compared to optimal ones.

■ MB27

Hilton- Union Sq 7

Railway Analytics

Sponsor: Railway Applications

Sponsored Session

Chair: Qing He, University at Buffalo (SUNY), 225 Ketter Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu

1 - Multivariate Deterioration Model using Railway Track Geometric Data

Zhiguo Li, IBM T J Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, 10598, United States of America, zhiguo.li.wisc@gmail.com, Qing He

Track geometric data play an important role in ensuring a safe, reliable and comfortable railway service. For optimization of track maintenance and renewal works, the track geometry deterioration model can be developed to represent a geometric parameter's behavior and predict its future trend. While the previous studies focused on the models for single parameters, we develop a multivariate model for multiple measurements. Its effectiveness is validated by using real track irregularity data.

2 - Risk Analysis of Petroleum Crude Oil Transportation by Rail
Xiang Liu, Assistant Professor, Rutgers, The State University of New Jersey, CoRE 606, 96 Frelinghuysen Road, Piscataway, NJ, 08854-8018, United States of America, xiang.liu@rutgers.edu, Christopher PL Barkan, Mohd Rapik Saat

Managing the risk of rail transport of petroleum crude oil receives growing national attention. In this research, a model is developed to estimate the probability of large, multiple-tank-car release indents accounting for a variety of track and train characteristics. The model is used to evaluate the safety effectiveness of various tank car designs.

3 - Rail Network Simulation System for Mining Industry
Alexey Sorokin, Senior Systems Engineer, Optym, LLC, 2153 SE Hawthorne Road, Gainesville, Fl, 32641, United States of America, alexey.sorokin@optym.com, Krishna Jha, Amit Agarwal, Ravindra Ahuja

We developed a simulation system designed to realistically simulate rail operations of mining companies and to perform a variety of what-if case studies regarding capital expansion and operational changes. This is a sophisticated discrete-event simulation system with many interdependent decision modules designed to handle all important aspects of rail operations. The system helps in effective capital expansion plans for a rail network in terms of throughput and maintenance operations.

4 - Identification of Asymmetric Wheel Profile Wear and Its Benefit Analysis
Qing He, University at Buffalo (SUNY), 225 Ketter Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu, Zhiguo Li

Compared to normal wheel profile wear, asymmetric wheel profile wear accelerates the degradation process and cause much more consequential damages to the wheels, rails, turnouts and bogie components. This study develops a statistical method to identical the asymmetric wheel profile wear for a wheel set based on wayside detector data. Further, we conduct benefit analysis to classify the railcars with asymmetric wheel profile wear based on maintenance records.

■ MB28

Hilton- Union Sq 8

Air Cargo and Aviation Operational Performance

Sponsor: Aviation Applications

Sponsored Session

Chair: Bo Zou, University of Illinois at Chicago, 2073 Engineering Research Facility, 842 West Taylor Street, Chicago, IL, 60607, United States of America, bzou@uic.edu

1 - Identifying Arrival and Departure Demand Metrics for an Empirical Runway Capacity Model
Amy Kim, Assistant Professor, University of Alberta, 3-007 NREF, Civ & Env Eng., University of Alberta, Edmonton, AB, T6G2W2, Canada, amy.kim@ualberta.ca, Yi Liu

Precisely identifying the number of flights that wish to both arrive to and depart at an airport is required to effectively assess its runway capacity. We extract this information by combining several existing and readily available data sources. We develop an empirical runway capacity model, and assess how data regarding arrival and departure demands should be represented in this model. The developed methodology was applied to case studies of several major commercial airports in the U.S.

2 - Optimization of Arrival Patterns for Time-dependent Queueing Models
Raik Stolletz, Professor, University of Mannheim, Schloss, Mannheim, 68131, Germany, stolletz@bwl.uni-mannheim.de, Axel Franz

We consider a time-dependent queueing system of truck handling operations at an air cargo terminal. Our optimization approach is based on the stationary backlog-carryover approach. The time-dependent arrival rates serve as decision variables, i.e., changes in the original demand pattern are allowed and intentional. The objective of this non-linear optimization model is to minimize total expected waiting times while limiting the change in the arrival pattern.

3 - Modeling Delay Propagation: A Joint Analytical-Statistical Approach
Bo Zou, University of Illinois at Chicago, 2073 Engineering Research Facility, 842 West Taylor Street, Chicago, IL, 60607, United States of America, bzou@uic.edu, Nabin Kafle

An analytical tool is developed to compute propagated flight delay in the US. The results are used to empirically model the impact on delay propagation of various influencing factors. Spatial and temporal analysis and assessment of the propagated delay are performed which is useful for airline scheduling and airport planning and performance benchmarking purposes. In particular, the delay multipliers are quantified for major carriers and airports in the system.

4 - The Air Cargo Scheduling Problem
Yavuz Durdak, Phd. Student, Middle East Technical University Operations Research Department, ODT Universiteler Caddesi, Dumlupinar Bulvari No:1, Ankara, 06800, Turkey, yavuz.durdak@metu.edu.tr, Haldun Süral, Sinan Gürel

In this study, we consider the Air Cargo Scheduling Problem based on real life application. The aim is to move cargo and passengers that have different priorities and delivery time windows, from a number of origin airports to destinations by a transportation system. The system has predefined routes and a heterogeneous fleet of aircraft. The problem is formulated as a heterogeneous vehicle, multicommodity, pick-up, and delivery network flow problem with a large set of system specific constraints.

■ MB29

Hilton- Union Sq 9

Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice

Cluster: Daniel H. Wagner Prize for Excellence in Operations Research Practice & CPMS, The Practice Section

Invited Session

Chair: C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

1 - Daniel H. Wagner Prize
C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

The competition for the 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in six finalists, who submitted papers to the judging committee and who will present their results in three sessions. In this keynote, the winner of the competition will be announced and the authors will give a reprise of the winning presentation.

2 - Vaccine Prioritization for Effective Pandemic Response
Eva Lee, Professor & Director, Georgia Institute of Technology, Ctr for OR in Medicine & Healthcare, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

When vaccine availability is limited, prioritized vaccination is considered the best strategy to contain a (flu) pandemic. We derive a mathematical decision framework to track the effectiveness of prioritized vaccination through the course of a pandemic. Our approach couples a disease propagation model with both a vaccine queuing model and optimization engine to determine the optimal prioritized coverage in a mixed vaccination strategy. This approach demonstrably minimizes infection and mortality. This work is joint with the Centers for Disease Control and Prevention.

3 - Identifying Risks and Mitigating Disruptions in the Automotive Supply Chain
Don Zhang, Technical Expert, Research & Advanced Engineering, Ford Motor Company, Dearborn MI, United States of America, xzhang35@ford.com, Yao Ge, Oleg Gusikhin, Michael Sanders, Keith Combs, William Schmidt, David Simchi-Levi, Yehua Wei, Peter Y. Zhang

Firms are exposed to a variety of low probability / high impact risks which may disrupt their operations and supply chains. These risks are difficult to predict and quantify, and therefore difficult to manage. As a result, managers may deploy countermeasures sub-optimally, leaving their firms exposed to some risks while wasting resources to mitigate other risks that would not cause significant damage. In a three-year research engagement with Ford Motor Company, we address this practical need by developing a novel risk exposure model that assesses the impact of a disruption originating anywhere in the firm's supply chain. Our approach defers the need to estimate the probability associated with any specific disruption risk until after the company learns how the realization of such a disruption will impair its operations. As a result, the company can make more informed decisions about where to focus its limited risk management resources. We demonstrate how Ford has applied this model to identify previously unrecognized risk exposures, evaluate pre-disruption risk mitigation actions, and develop optimal post-disruption contingency plans, including circumstances in which the duration of the disruption is unknown.

■ MB30

Hilton- Union Sq 10

Scheduling in Practice

Cluster: Scheduling and Project Management

Invited Session

Chair: Emrah Cimren, Sr. Analytics Lead, Nike, One Bowerman Drive, Beaverton, OR, 97005, United States of America, Emrah.Cimren@nike.com

1 - University of California Increases Procurement Efficiency with Optimal eCommerce Scheduling

Andrew Clark, Director, Strategic Sourcing, UCSF, 1855 Folsom St, San Francisco, Ca, 94141, United States of America, andrew.clark@ucsf.edu, Susan Cholette, Ozgur Ozluk

This paper documents the creation of a scheduling tool to find an optimal schedule for loading suppliers into the eCommerce systems at UC San Francisco and UC Berkeley. Automating supplier enablement decisions for these two campuses alone has led to a clear work plan with a clear understanding of the potential benefit; $15 Million over the next 5 years. Further, we formulated the model to permit expansion to all 10 UC campuses and explored various operational models.

2 - An Integration of Fatigue Risk Management into Crew Scheduling

Gulsah Hancerliogullari, Assistant Professor, Istanbul Bilgi University, Eski Silahtaraga Elektrik Santrali Kazim, Karabekir Cad. No: 2/13 34060 Eyüp, Istanbul, 34060, Turkey, gulsah.hancerli@bilgi.edu.tr, Emrah Koksalmis

The feasibility of a Crew Scheduling Problem (CSP) depends on many rules and regulations imposed by government, international organizations, labor unions and airline companies themselves. In this study, we compare the Fatigue Risk Management Systems (FRMS) enforced by civil aviation authorities such as Federal Aviation Authority (FAA), Directorate General of Civil Aviation (Turkey), and develop a mathematical model, in which these rules and regulations are included as constraints.

3 - Integrated Scheduling of Jobs and Maintenance Activities

Dirk Briskorn, University of Wuppertal, Rainer-Gruenter-Str. 21, Wuppertal, Germany, briskorn@wiwi.uni-wuppertal.de

We consider a problem to integratedly schedule jobs and maintenance activities. Maintenance levels of machines are lowered by jobs and must be increased by maintenance activities once in a while. We analyze approximability and provide heuristics with excellent avergage case performance.

■ MB31

Hilton- Union Sq 11

Stochastic Methods in Cloud Computing Services

Sponsor: Service Science

Sponsored Session

Chair: Cathy Xia, Associate Professor, Ohio State University, Columbus, OH, United States of America, xia.52@osu.edu

1 - Cloud Provider Selection – An Expedia View

Ilyas Iyoob, Director, Advanced Analytics, Gravitant, 11940 Jollyville Rd, Ste 325-N, Austin, TX, 78759, United States of America, iyoob@utexas.edu, Aaron Yan

Wouldn't it be nice if we could pick and choose cloud providers like we do flights on Expedia? Consumers today are faced with a very large number of options, and a big part of the confusion is knowing which provider, offering, and location combination to pick for each of their IT environments such that their requirements are best satisfied. Using consumer requirements data from our cloud brokerage business, we model this as a vendor selection problem in the Cloud IT Supply Chain.

2 - Stochastic Optimal Control for Dynamic Resource Allocation in the Clouds

Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, mss@us.ibm.com, Xuefeng Gao, Yingdong Lu, Mayank Sharma, Joost Bosman

We consider a general class of dynamic resource allocation problems that arises in many cloud environments, with the goal of dynamically allocating capacity for every resource type to serve uncertain/variable demand and maximize expected net-benefit over a given time horizon. We derive the optimal control policy and efficient algorithms for governing adjustments to resource allocation capacities over time. Numerical experiments investigate various issues of theoretical and practical interest.

3 - Performance Modeling and Approximations for Heterogeneous Servers

Natarajan Gautam, Associate Professor, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, gautam@tamu.edu

We consider multiple parallel heterogeneous servers which are typical in cloud computing services. The servers use processor sharing for cloud computing jobs. In addition, the server speeds change over time. Exact analysis of such a system is typically intractable. However, it is crucial that the servers provide probabilistic performance guarantees. To that end, we develop a few approximations based on fluid queues, large deviations and matrix analytic methods.

4 - Resource Provisioning for Cloud Computing Services via Poisson Approximation

Yue Tan, PhD Candidate, The Ohio State University, 1971 Neil Ave, Columbus, OH, 43210, United States of America, tan.268@osu.edu, Yingdong Lu, Cathy Xia

This talk presents a stochastic modeling approach to guide the resource-provisioning task for future service clouds with large-scale demands. By replacing commonly used normal approximation with Poisson approximation, then based on Stein-Chen methods, we show that the asymptotic provisioning methodology provides better provisioning solutions.

■ MB32

Hilton- Union Sq 12

Service Science Best Paper Award

Sponsor: Service Science

Sponsored Session

Chair: P K Kannan, University of Maryland, Smith School of Business, College Park, MD, United States of America, PKannan@rhsmith.umd.edu

1 - Truthful Mechanisms for Resource Allocation and Pricing in Clouds

Mahyar Movahed Nejad, Wayne State University, 4815 Fourth St., Rm. 2033, Detroit, MI, 48202, United States of America, mahyar@wayne.edu, Daniel Grosu, Lena Mashayekhy

Cloud computing systems provide a large pool of virtualized and dynamically scalable resources as Infrastructure as a Service (IaaS), and offer them to users in the form of virtual machine (VM) instances. We design truthful greedy and optimal mechanisms for the problem of VM provisioning, allocation, and pricing. We prove that our proposed mechanisms are truthful, that is, the users do not have incentives to manipulate the system.

2 - A Unified, Operational View of Service, Service Systems, and Service Science

Steven Alter, Professor of Information Systems, University of San Francisco, alter@usfca.edu

To be taken seriously, service science should use concepts and frameworks that are easy to apply to real situations. I propose: 1) a broadly applicable definition of service 2) a conceptual model linking the definition to work systems that produce services 3) a related conceptual model linking work system resources to value for customers 4) use of those conceptual models to create operational meanings of co-production, value co-creation, value proposition, user experience, and other concepts

3 - Service Systems Engineering: A Field for Future Information Systems Research

Tilo Boehmann, Professor, University of Hamburg, Department of Informatics, Vogt-Koelln-Str. 30, Hamburg, 22527, Germany, Tilo.Boehmann@uni-hamburg.de, Jan Marco Leimeister, Kathrin Möslein

Service systems are complex socio-technical systems that enable value co-creation. Service systems engineering (SSE) calls to advance evidence-based design knowledge for such systems with regard to the architecture, the interactions, and the resource base of service systems, helping value creation to become better adapted to the context of need.Information systems research is ideally positioned to contribute through (action) design research or the piloting of IT-enabled innovation.

4 - Growing the Service Brand

Ming-Hui Huang, Professor, National Taiwan University, 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw, Chekitan Dev

Given the unique characteristics of service, it is important to have a better understanding about service branding. Analyzing a proprietary panel data set with a two-step system GMM panel model we observe the growth and decline of the service brand, identify core-value and value-added drivers for growing the service brand, and uncover the best service-driver combinations. Our findings provide important theoretical and managerial implications for growing the service brand.

■ MB33

Hilton- Union Sq 13

New Research Topics on Innovation

Cluster: New Product Development

Invited Session

Chair: Manuel Sosa, Associate Professor of Technology and Operations Management, INSEAD, 1 Ayer Rajah Ave., Singapore, Singapore, manuel.sosa@insead.edu

1 - The Evolution of Product Form: Identifying and Analyzing Styles in Design Patents

Tian Chan, PhD, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, TianHeong.CHAN@insead.edu, Jurgen Mihm, Manuel Sosa

We introduce an approach to identify styles (categories of product designs similar in form) among 400,000 US design patents. We combine state-of-the-art clustering techniques with experimental validation to create, for the first time, a dataset of styles. Building on this platform, we find that i) the level of turbulence (unpredictability of changes) in product form follows a U-shaped pattern to the level of turbulence in product function, and ii) product form turbulence is increasing over time.

2 - Search Behavior in Innovation Communities and Contests

Karim Lakhani, Harvard Business School, k@hbs.edu, Kevin Boudreau

Crowds can be organized in the forms of communities and contests. Both of these approaches have within them different assumptions about incentives, intellectual property and the underlying innovative search process. We compare and contrast the assumptions and provide field experimental data to show the salience of the differences.

3 - Creativity in Contests

Sanjiv Erat, UCSD, Gilman Dr, La Jolla, CA, United States of America, sanjiv_erat@isb.edu

We investigate through an experiment whether contest incentives improve creativity. Our main finding is that while incentives can help improve creativity, the type of incentives matter. Specifically, while rewarding creativity through piece-rate enhances creativity, competition incentives are ineffective.

■ MB34

Hilton- Union Sq 14

Joint Session SPPSN/MIF: Disaster Relief and Humanitarian Logistics

Sponsor: Public Programs, Service and Needs & Minority Issues Forum

Sponsored Session

Chair: Christopher Zobel, Professor, Virginia Tech, Dept. of Business Information Technology, 1007 Pamplin Hall, Blacksburg, VA, 24061-0235, United States of America, czobel@vt.edu

1 - Volunteer Assignment Policies Following a Large-scale Disaster

Emmett Lodree, University of Alabama, 361 Stadium Drive, Tuscaloosa, AL, United States of America, ejlodree@cba.ua.edu, Lauren Davis

After a disaster event, volunteers sporadically emerge to perform relief tasks at various sites within the affected area. This paper investigates optimal policies for assigning volunteers to relief sites such that the expected work remaining at the end of a finite planning horizon is minimized. We introduce a nested Markov decision problem to address this situation, and discuss various solution approaches.

2 - Shortest Path Problem with Arc Failure Scenarios

Preethi Issac, University Of Iowa, S243 John Pappajohn Bus Bldg, Iowa City, 52242, United States of America, preethi-issac@uiowa.edu, Ann M. Campbell

We consider a shortest path problem from source to destination over a set of arc failure scenarios. Our aim is to create a primary path and a set of alternative paths that provide the driver an option when an impassable road is encountered after a disaster. We provide an integer programming model and an exact algorithm that can be used to solve instances derived from real road networks.

3 - Improving Disaster Relief Supply Pre-positioning in the Rocky Mountain Region

Andrew Arnette, Assistant Professor, University of Wyoming, aarnette@uwyo.edu, Christopher Zobel

This research is being conducted with the American Red Cross in Colorado and Wyoming to examine the effectiveness of pre-positioning decisions for relief supplies to help improve the accessibility and location of distribution centers and shelters, as well as the scheduling and delivery of materials needed in the relief efforts. Combining GIS functionality and mathematical modeling with real-world data, the effort seeks to develop a model to make future disaster response efforts more effective.

4 - Managing Bottlenecks in Port and Overland Transport Networks for Food Aid

Mallory Soldner, PhD Candidate, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, msoldner@gatech.edu, Ozlem Ergun, Jarrod Goentzel, Julie Swann

Delays in transportation in humanitarian supply chains prevent life-saving aid from reaching beneficiaries when needed. These delays are often driven by reliability issues (e.g., at congested ports) and can change greatly depending on the quantities arriving. We describe a queuing model with breakdowns to model delays, and include our congestion-based delay characterization into a convex cost network flow model that determines optimal routing when several port and corridor options are available.

■ MB35

Hilton- Union Sq 15

Decisions in a Nonprofit Supply Chain II

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Gemma Berenguer, Purdue University, 403 W. State St., West Lafayette, IN, 47906, United States of America, gemmabf@purdue.edu

1 - A Framework to Support Direct-Marketing Strategies in Non-Profit Fundraising

Elizabeth Durango-Cohen, Associate Professor of, Illinois Institute of Technology, 565 W. Adams Street, Chicago, IL, United States of America, durango-cohen@iit.edu, Pablo Durango-Cohen

In this talk, we present an integrated framework to support nonprofit fundraising. The proposed models enable fundraisers to exploit the wealth of data now available to nonprofit organizations, and support the implementation of policies that discriminate based on both observed and unobserved characteristics that contribute to systemic differences between individuals.

2 - Resources for Results: Optimal Endowment Allocation for a Resource-constrained Early-stage NPO

Pryiank Arora, PhD Student, Georgia Institute of Technology, 800 W Peachtree St NW, Atlanta, GA, 30308, United States of America, Priyank.Arora@scheller.gatech.edu, Milind Sohoni, Sripad Devalkar

We study a novel `results-based' approach, to raise donations for projects, by an early-stage, resource-constrained, non-profit organization (NPO) that implements projects for public benefit. The NPO uses its endowment to implement initial phases, securitizes results as certificates, and invites donors to purchase them. We characterize the optimal endowment required to maximize benefit and compare it with `traditional' fund-raising approaches.

3 - Market Practices and Costs for Food Commodities in Darfur

Jarrod Goentzel, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, United States of America, goentzel@mit.edu, Tim Russell, Yasmin Abdel Gadir

Humanitarian organizations that increasingly complement aid distribution with cash or vouchers need to assess the supply of commodities in local markets. In 2013, the authors led a supply assessment of food commodities in markets across the Darfur region of Sudan. This paper uses the results of 145 trader surveys, 16 transporter surveys, and four focus groups to characterize practices and costs for sourcing, transporting, and managing key commodities in these markets.

4 - Supply Chains and Food Vouchers in Darfur

Michael Veatch, Gordon College, 255 Grapevine Rd, Wenham, MA, 01923, United States of America, Mike.Veatch@gordon.edu, Austin Drukker, Jarrod Goentzel

The U.N. World Food Program has tested food vouchers in the Darfur region of Sudan as an alternative to food aid. Because of high transport costs and other constraints, it is not clear that the market can meet the demand for food. We develop a simple food availability model, using optimization rather than market equilibrium, to support voucher planning.

■ MB36

Hilton- Union Sq 16

Reliable Sensor Cover and Network Design

Sponsor: Telecommunications

Sponsored Session

Chair: Richard Li-Yang Chen, Principal Member of Technical Staff, Sandia National Laboratories, 7011 East Ave, Livermore, CA, 94550, United States of America, rlchen@sandia.gov

1 - Algorithms for a Robust Sensor Cover and Communication Problem

Andrew Romich, Sandia National Laboratories, 7011 East Avenue, MS 9154, Livermore, CA, United States of America, aromich@sandia.gov, George Lan, J. Cole Smith

We consider sensor placement to cover a set of targets in a region, in a manner that allows sensors to communicate with one another. Communication effectiveness for each sensor pair is determined by a concave function of distance between the sensors. Also, final sensor placement is stochastic, as caused by drifting. We maximize a communication effectiveness metric, and require all targets to be covered by some sensor, where sensor drift occurs according to a robust (worst-case) mechanism.

2 - Directed Edge-Failure Resilient Network Design

Deon Burchett, PhD Student, University of Florida, Weil Hall, Gainesville, Fl, 32611, United States of America, deonlb@hotmail.com, Cynthia Phillips, Richard Li-Yang Chen

We consider the directed edge-failure resilient network design problem (DRNDP). This problem entails the design of a directed multi-commodity flow network that is capable of fulfilling a specified percentage of demands in the event that any Γ arcs are destroyed, where Γ is a constant parameter. We provide a formulation of DRNDP and solve it in a branch-and-cut framework. We present computational results.

3 - LP Relaxations and a Branch-and-Cut Approach for the Resilient PMU Placement Problem

Robert Carr, Senior Member of Technical Staff, Sandia National Laboratories, 6350 Eubank #1517, Albuquerque, NM, 87111, United States of America, rdcarr@sandia.gov, Joseph Ruthruff, Richard Li-Yang Chen

Having a Phasor Measurement Unit (PMU) at a node of an electrical network helps detect a local electrical malfunction. The PMU placement problem seeks to place the minimum number of PMUs so as to detect all local malfunctions. In the resilient version, some small constant number of PMUs might fail. We give small non-trivial LP relaxations and describe a branch-and-cut approach to this problem.

4 - Reliable Network Design by Graph Algorithms and Integer Programming Approaches

Neng Fan, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, nfan@email.arizona.edu

In this talk, we use graph algorithms and integer programming approaches to solve reliable network design problems. The application cases include power grid design, water system planning, etc.

■ MB37

Hilton- Union Sq 17

Joint Session AI/QSR: Multidisciplinary Information Fusion for System Informatics

Sponsor: Artificial Intelligence & Quality, Statistics and Reliability

Sponsored Session

Chair: Changqing Cheng, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ccheng@tamu.edu

Co-Chair: Hui Wang, Florida State University, 2525 Pottsdamer St., Tallahassee, FL, 32310, United States of America, hwang10@fsu.edu

1 - Surface Quality Monitoring in Ultra-precision Machining with Physical and Data-driven Model

Changqing Cheng, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ccheng@tamu.edu, Satish Bukkapatnam

We investigated a delayed differential equation model to identify chatter-free process parameters in ultra-precision machining, based on which we developed a data-driven approach for real-time surface roughness monitoring with features extracted from in situ sensor signals. By combining physical and statistical models, we achieved R^2 over 0.8 for surface roughness estimation in a real-time sense.

2 - Local Calibration of Parameters in Poly (Vinyl Alcohol)-treated Buckypaper Fabrication

Arash Pourhabib, Assistant Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, arash.pourhabib@okstate.edu, Yu Ding, Jianhua Huang, Chuck Zhang, Kan Wang

We propose a framework for the the local calibration of parameters when a simulation model is used to approximate a physical process. The proposed framework acknowledges the dependency of parameters on input variables. We present the model in terms of a regularized optimization and solve it using a representer theorem. We apply the method to calibrate a finite element (FE) simulation for predicting Young's moduli of PVA-treated CNT buckypaper.

3 - A Transfer Learning Approach to Surface Variation Modeling and Cost-effective Monitoring

Chenhui Shao, University of Michigan, Ann Arbor, 2350 Hayward St., Ann Arbor, MI, 48109, United States of America, chshao@umich.edu, S. Jack Hu, Judy Jin, Hui Wang

This talk presents a method for modeling and monitoring surface variations by exploiting similarities among manufacturing processes. A novel approach is developed to improve spatial data modeling in surface manufacturing by fusing multidisciplinary information from similar but not identical manufacturing processes. The method is able to improve modeling precision without increasing measurements while help cost-effectively establish monitoring baseline when launching a new manufacturing process.

4 - Collaborative Degradation Modeling by Fusing Data on a Networked Structure

Shuai Huang, Assistant Professor, University of Washington, Industrial and Systems Engineering, United States of America, shuaihuang@usf.edu, Kaibo Liu

Degradation signals are sometime expensive to collect in many healthcare and manufacturing applications. Such a lack of data has imposed great challenges for degradation modeling and prognostics. To tackle this problem, we propose a collaborative degradation modeling method that can effectively fuse degradation signals of multiple entities that collectively form a network.

■ MB38

Hilton- Union Sq 18

Cognition and Positioning

Cluster: Strategy Science

Invited Session

Chair: Dan Levinthal, University of Pennsylvania, Wharton School, Philadelphia, PA, United States of America, dlev@wharton.upenn.edu

1 - Cognition and the Resource-Based View of the Firm

Felipe Csaszar, Ross School of Business, U. of Michigan, 701 Tappan Ave #R4336, Ann Arbor, MI, 48104, United States of America, fcsaszar@umich.edu

This paper provides a psychological micro-foundation for the RBV by developing a behaviorally plausible model of how resources are assessed by managers and how, once acquired, resources affect firm production and value. The model sheds light on the question of under what conditions, strategies based on acquiring resources are more likely to create a sustainable competitive advantage. The model also helps to address some of the definitional problems of the RBV raised by Priem and Butler (2001).

2 - Strategic Foresight

Giovanni Gavetti, Dartmouth College, Tuck Business School, United States of America, Giovanni.Gavetti@tuck.dartmouth.edu

This presentation will focus on the concept of strategic foresight. It will use an intellectual historical perspective to interpret the current debate and shed some light on future avenues of research.

3 - Making Sense of Sound: The Technological and Cultural Evolution of Synthesizers

Mary Tripsas, Boston College, Carroll School of Management, Boston, MA, United States of America, tripsas@bc.edu

We leverage the historical case of sound synthesis technologies to explore whether technologies that are deeply embedded in cultural tastes may, in fact, exhibit atypical trajectories. Based upon both qualitative and quantitative analyses of more than 30 years of advertisements that appeared in the field's leading trade magazine, we analyze how changing cultural tastes can shape both the framing and the capabilities of emerging and abandoned technologies.

4 - The Effect of Abductive Reasoning on Early-Stage Innovation Decisions

Dan Lovallo, University of Sydney, Sydney, Australia, dan.lovallo@sydnedy.edu.au

This study examines the effect of the form of logical reasoning on accepting a potentially innovative design concept. An experiment was conducted to simulate an uncertain environment characterized by incomplete information with members of a committee called upon to decide whether or not to invest in innovation-oriented new product concepts. Under an abductive reasoning frame manipulation, a form of logical reasoning that introduces hypotheses and theories to explain given facts, individuals were more likely to accept concepts whereas under deductive reasoning they were more likely to reject concepts. We recommend that to increase the likelihood of product concepts being accepted during design concept selection, decision makers should not treat concept selection as a decision problem alone but also as a design problem. They should employ innovative abduction to think creatively about new ways to frame a proposed concept as something else than what is presented and new working principles underpinning the proposed concept.

■ MB39

Hilton- Union Sq 19

Joint Session HAS/Analytics: Learning from Healthcare Data

Sponsor: Health Applications & Analytics Section

Sponsored Session

Chair: Donald Lee, Yale School of Management, 165 Whitney Ave, New Haven, CT, 06520, United States of America, donald.lee@yale.edu

1 - Identifying Impactable High-Risk Diabetes Patients

Margrét Bjarnadottir, University of Maryland, 4324 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu, David Anderson

Case management has been suggested as an option in fighting rising health care costs through coordinated care that advocates quality and cost effectiveness, but the evidence on the cost effectiveness is mixed. A key for cost-effectiveness is to identify not only high-cost patients, but impactable patients, that is patients where case management will both help the patient and the bottom line. We utilize modern data mining methods and upper bound methodologies to explore this problem.

2 - A Robust Approach to Designing Prostate Cancer Screening Strategies

John Silberholz, PhD Candidate, MIT, 77 Massachusetts Ave. E40-149, Cambridge, MA, 02139, United States of America, josilber@mit.edu, Dimitris Bertsimas

Prostate cancer is the most common non-skin cancer in US men, and many published mathematical models evaluate the effectiveness of screening strategies for the disease. In some instances the most effective screening strategy according to one model is evaluated as worse than not screening at all under a different model. Using robust and stochastic optimization, we identify screening strategies that are effective across multiple models, which provides evidence of the quality of these strategies.

3 - Stronger Instrumental Variables via Integer Programming for Healthcare Research

Jose Zubizarreta, Columbia University Business School, 3022 Broadway, Uris 417, New York, NY, 10027, United States of America, jz2313@columbia.edu

Weak instrumental variables constitute an important problem for estimation because confidence intervals do not have adequate coverage and because estimates are highly sensitive to biases from unmeasured confounders. Typically, the strength of an instrument is thought as given, but we present a new method that augments the strength of an instrument by solving an integer program. We use this method to estimate the effect of hospital length stay on readmissions of late-preterm babies in California.

■ MB40

Hilton- Union Sq 20

Payment Innovations in Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Christian Wernz, Virginia Tech, 205 Durham Hall, Blacksburg, VA 24061, United States of America, cwernz@vt.edu

Co-Chair: Hui Zhang, PhD Student, Virginia Tech, Blacksburg, VA, United States of America, corinnaz@vt.edu

1 - The Role of Provider Payment in the Primary and Secondary Prevention of Type 2 Diabetes

John Franklin, University of Southern California, 1136 1/2 N El Centro Ave #1, Los Angeles, CA, 90038, United States of America, jpfrankl@usc.edu

One way that alternative provider payment systems try to encourage higher quality and reduced costs in health care is through better facilitation of prevention-oriented programming at the clinic level. Yet to date there has been little analysis of the characteristics of these systems that actually encourage (or discourage) disease prevention. This paper uses a system dynamics model to examine the relationship between payment systems and prevention, using the example of type 2 diabetes.

2 - Impact of Pay for Performance Incentives on Primary Care Efficiency in the Military Health System

Lawrence Fulton, Rawls School of Business,, Texas Tech University, 703 Flint Ave, Lubbock, TX, 79410, United States of America, lf25@txstate.edu, Paul Griffin, Nathaniel Bastian

We determine the effectiveness of a pay-for-performance (P4P) incentive program at U.S. Army hospitals using DEA and regression models. We evaluate pre- (2001 to 2007) and post- (2007 to 2012) P4P program implementation on primary care efficiency. We also compare to the other branches of service not using P4P.

3 - Mitigating Specialty Provider Financial Risk in Prospective Bundled Payment Systems

Danny Hughes, Research Director, The Harvey L. Neiman Health Policy Institute, 1891 Preston White Drive, Reston, VA, 20191, United States of America, dhughes@neimanhpi.org, Nadia Bilal

Retrospective bundled payment models, which cover all medical services associated with an episode of care, are used with existing fee-for-service (FFS) payments and usually include stop loss provisions to manage financial risk. As payments shift beyond FFS to prospective bundled payments, the mechanisms and benchmarks for managing these stop loss provisions may no longer exist. Using simulation-based optimization models, we develop pricing strategies to mitigate provider risk.

4 - How Reimbursements and Incentives Affect Decisions in Radiology and Accountable Care Organizations

Hui Zhang, PhD Student, Virginia Tech, Blacksburg, United States of America, corinnaz@vt.edu, Christian Wernz, Danny Hughes, Anthony Slonim

The effect of new reimbursement structures and incentives on cost and quality of care are challenging to predict. To address this challenge, we apply multiscale decision theory to model the decisions of and the interdependencies between health care stakeholders, including payers, Accountable Care Organizations, physicians and radiologists, with a focus on imaging use and investment. We discuss the effect of incentives on agent decisions and the optimal distribution of incentives between agents.

■ MB41

Hilton- Union Sq 21

Patient-Centric Healthcare and Personalized Medicine

Sponsor: Health Applications

Sponsored Session

Chair: Abe Zeid, Northeastern University, 360 Huntington Ave, Boston, United States of America, zeid@coe.neu.edu

1 - Modeling, Analysis and Improvement of Lung Cancer Diagnostic Procedure

Shan Jiang, University of Wisconsin-Madison, 1513 University Avenue, Room 3235, Madison, WI, 53706, United States of America, sjiang44@wisc.edu, Nicholas Faris, Xinhua Yu, Feng Ju, Jingshan Li, Raymond Osarogiagbon

To improve the care delivery process of lung cancer, we developed both simulation and analytic models to study the diagnostic procedure for lung cancer care delivery. In addition to performance evaluation, such as mean care delivery time and its variability, bottleneck analysis method is proposed to identify the most critical steps that impede the whole care delivery process. Such methods provide a quantitative tool to improve care delivery process for lung cancer patients.

2 - Patient Relationship Management in Healthcare

Sanjeev Bordoloi, University of St Thomas, 1000 LaSalle Ave TMH 443, Minneapolis, United States of America, sbordoloi@stthomas.edu

Healthcare organizations are starting to place higher priority to patient satisfaction. Satisfaction is measured through patient surveys and understanding patient's perceptions. One area that hospitals have found challenging is their service offered over the phone. We observed the call center operations within a hospital with the goal to improve overall patient relationship.

3 - Theoretical Modeling and Empirical Analysis of Canadian Joint Replacement Surgery Waiting Time Data

Qu Qian, Assistant Professor, Shanghai University of Finance and Econo, School of International Business Adminis, 100 Wudong Road, Shanghai, China, qian.qu@mail.shufe.edu.cn, Anming Zhang, Hong Chen

We empirically analyze joint replacement surgery waiting time data of 9 Canadian provinces from 2005-2012. The empirical analysis reveals surgeon's management of patient waiting list. By comparing the waiting times before and after January 2008, we assess the effectiveness of the policy of setting a waiting time target for joint replacement surgeries. Based on these empirical results, we develop a theoretical model to further investigate patient's waiting time problem.

4 - Data-driven Healthcare Service Opportunities in Korea

Chie-Hyeon Lim, Postdoctoral researcher, Postech, Eng. Bldg. 4-316, 77 Cheongam-Ro, Nam-Gu, Pohang, Korea, Republic of, freechon@gmail.com, Ki-Hun Kim, Kwang-Jae Kim, Chi-Hyuck Jun, Sung-Hong Kang

The National Health Insurance Service (NHIS) of Korea has collected insurance and medical record data of nearly all the citizens since 2001. Development of a big-picture of healthcare service opportunities utilizing the NHIS database is of national interest. Such picture would serve as a map for the healthcare policy and service development. In this talk, we discuss how we identified 138 data-driven healthcare service opportunities and present the big-picture which encompasses the opportunities.

5 - Design and Operations for Online-Offline-Integrated Healthcare Networks Facilitators

Jiun-Yu Yu, Assistant Professor, National Tawain University, No. 1, Section 4, Roosevelt Road, Da-An, Taipei, Taiwan - ROC, jyyu@ntu.edu.tw

Healthcare Networks Facilitators (HNFs) are organizations or platforms that help their members, including patients, families, doctors, and nurses, actively interact with one another so that everyone involved in the process benefits. HNFs are expected to create innovative healthcare services that are unlikely to be delivered in the past. This study aims to investigate the design and operations for online-offline-integrated HNFs so that these expectations can be met.

■ MB42

Hilton- Union Sq 22

Using OR to Model Healthcare Policy

Sponsor: Health Applications

Sponsored Session

Chair: Michael Carter, Professor, University of Toronto, Mech & Ind Engineering, 5 King's College Rd., Toronto, ON, M5S 3G8, Canada, mike.carter@utoronto.ca

1 - Designing Optimal Policies for the Recruitment of Rural Health Professionals

Anna Graber, annagr26@gmail.com, Vedat Verter, Michael Carter

Rural areas worldwide experience shortages of health workforce. In Canada, government policies such as alternative models of care for rural areas, promotion of rural medicine programs, educational programs for future physicians and financial incentives were used in an attempt to improve the discrepancy in resources. We would like to determine which financial policies and education location alternatives are best in order to attract workforce to rural areas, considering professionals' preferences.

2 - Resource Allocation and Risk Analysis of Renal Dialysis Centres in Ontario

Mahsa Shateri, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, mahsa.shateri@gmail.com, Michael Carter

The number of facility-based hemodialysis patients increases about 3% every year in Ontario. Three alternative methodologies have been employed to develop a tool that enables these facilities to determine the nurse-to-patient ratio while considering the possible incidents requiring the dedication of a nurse's time to a patient due to treatment complications. This tool also takes into account different nurses and patients types.

3 - using Analytics to Manage and Improve Ontario's Chronic Care System

Ali Vahit Esensoy, Sr Manager, Strategic Analytics, Cancer Care Ontario, 505 University Avenue, Toronto, ON, M5G 1X3, Canada, AliVahit.Esensoy@cancercare.on.ca, Neal Kaw, Somayeh Sadat

We present highlights of the Strategic Analytics practice at Cancer Care Ontario, which assists the agency's programs in making planning decisions through analytic products that employ OR, statistics, and machine learning. After a summary of projects to date, we focus our work with the Ontario Renal Network in developing a 12-year dialysis capacity assessment model to inform planning considerations including dialysis station deployment and patient-based funding allocation.

■ MB43

Hilton- Union Sq 23

Quadratic Assignment Problems and Applications

Sponsor: Computing Society

Sponsored Session

Chair: Peter Hahn, 2127 Tryon Street, Philadelphia, PA, 19146, United States of America, hahn@seas.upenn.edu

1 - A Biased Random-key Genetic Algorithm for Facility Placement to Minimize Total Flow Cost

Mauricio Resende, AT&T Labs Research, 200 S. Laurel Avenue, Room A5-1F34, Middletown, NJ, 07748, United States of America, mgcr@research.att.com, José Goncalves

We seek to place N rectangular facilities with unequal area on a rectangular floor space of dimension L x W such that all facilities fit in the space with no overlap and the sum of pairwise products of given distances and flows between facilities is minimized. A biased random-key genetic algorithm is proposed for this problem.

2 - On Solving a Hard Quadratic 3-Dimensional Assignment Problem

Hans Mittelmann, Arizona State University, Box 871804, Tempe, United States of America, mittelma@asu.edu, Domenico Salvagnin

We address the exact solution of a very challenging (and previously unsolved) instance of the quadratic 3-dimensional assignment problem, arising in digital wireless communications. Using special cutting plane and orbital shrinking techniques we are able to solve the target instance with moderate computational effort (the equivalent of one week of computations on a standard PC).

3 - Solving QAP with the Reformulation and Linearization Technique on a Heterogenous Cluster

Alexandre Goncalves, IFRJ - Instituto Federal de Rio de Janeiro, Str Dr José Augusto P. dos Santos s/n, São Goncalo, 24425-004, Brazil, alexandre.domingues.2000@gmail.com, Lucia Drummond, Artur Pessoa

The application of the Reformulation Linearization Technique (RLT) to the QAP leads to a tight linear relaxation with huge dimensions. The level 3 RLT (RLT3) is prohibitive in conventional machines for large instances due to memory limitations. The RLT2 obtains bounds with lower quality then RLT3, but with lower memory. This work presents a proposal of a application to solve the QAP on a heterogeneous clusters composed by machines with CPUs and GPUs using a combined RL2/RL3 B&B algorithm

4 - Solvable QAP Instances via the Level-1 RLT

Lucas Waddell, Graduate Student, Clemson University, Martin Hall, Clemson, SC, 29634, United States of America, lwaddel@clemson.edu, Warren Adams

Due to the difficulty associated with solving the QAP, researchers have directed attention to identifying polynomially-solvable special cases. We show that the level-1 RLT form serves as a unifying entity for many such cases, in that the continuous relaxation yields an optimal binary solution. The key challenge is the identification of complementary primal and dual solutions for which the primal variables are binary. These results build upon our earlier contributions.

■ MB44

Hilton- Union Sq 24

Digital Content Distribution and Management

Sponsor: Information Systems

Sponsored Session

Chair: Hong Guo, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo@nd.edu

1 - PULL or PUSH? Website's Strategic Choice of Content Delivery Mechanism

Dan Ma, Singapore Management University, 80 Stamford Road, Singapore, Singapore, madan@smu.edu.sg

Websites can push online content to users through Really Simple Syndication feeds (RSS). I construct a model to study the impact of RSS use on users and websites and examine their adoption strategy. I find that RSS can increase or decrease website profit; in a competitive context, it can actually be a disadvantage. Moreover, in a sequential adoption setting, under certain conditions, a first-adopter disadvantage exists. Together, my findings suggest the complexity of RSS adoption strategy.

2 - Impact of Anti-piracy Effort on Software Firms' Competition and Profitability

Can Sun, School of Business, University of Alberta, Edmonton, Canada, can1@ualberta.ca, Yonghua Ji

Piracy is a big issue for software companies all over the world. We study a problem where high quality software faces competition from low quality one and also the one pirated from the high quality software. The use of pirated software can be reduced through anti-piracy measures which make the pirated version either less attractive or more costly to use. We find that different measures can have different (and sometimes surprising) implications on software firms' competition and profits.

3 - ISP Competition and Content Discrimination: Implications for Net Neutrality

Yu-Chen Yang, Assistant Professor, National Sun Yat-sen University, 70 Lienhai Rd.,, Kaohsiung, 80424, Taiwan - ROC, ycyang@mis.nsysu.edu.tw, Hong Guo, Arthur Lim, Subhajyoti Bandyopadhyay, Hsing Cheng

We investigate how competition between ISPs affects their ability to discriminate between content providers. We compare the potential packet discrimination outcomes under the duopoly versus monopoly ISP regimes within a game-theoretical framework, and find that the ISPs still have the incentive and ability to discriminate between content providers and extract payment from them for priority delivery. The findings have important implications for the ongoing net neutrality debate.

■ MB45

Hilton- Union Sq 25

Inspections and Improvement Initiatives in Supply Chains

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Enno Siemsen, UMN, Minneapolis, Minneapolis, United States of America, siems017@umn.edu

1 - The Quality Management Implications of Dormitory Housing in Chinese Manufacturing

Enno Siemsen, UMN, Minneapolis, Minneapolis, United States of America, siems017@umn.edu, Elliot Bendoly

Quality inspections at source sites are essential to make global supply chains work. The inspectors that perform such inspections in China are often housed in company dormitories. We use data from an electronics manufacturer in southern China to examine the implications such an arrangement has on quality levels in the plant. We further examine the influence of individual attributes and social rewards on inspector behavior.

2 - Monitoring the Monitors: How Social Factors Influence Supply Chain Auditors

Jodi Short, Professor, UC Hastings College of Law, 200 McAllister Street, San Francisco, CA, 94102, United States of America, shortj@uchastings.edu, Michael Toffel, Andrea Hugill

Supply chain auditors provide companies with strategic information about the practices of suppliers, yet little is known of what influences their ability to identify and report dangerous or illegal conduct at factories. We find that reporting practices are shaped auditors' experience, gender, and professional training; ongoing relationships between auditors and audited factories; and gender diversity on audit teams. Our study suggests strategies for designing more credible monitoring regimes.

3 - Promoting Change from the Outside: Implementation Delays in Environmental Improvement Projects

Suvrat Dhanorkar, PhD Candidate, University of Minnesota, 321 19th avenue south, minneapolis, MN, 55455, United States of America, dhano002@umn.edu, Enno Siemsen, Kevin Linderman

Although challenging, externally promoting change in firms is vital to operations, supply chains and public policy settings. Combining proprietary and public data from state-level environmental agencies, we examine the factors that affect implementation of environmental improvement projects. We examine how factors such as recommendation structure as well as ongoing external influences impact implementation delays.

4 - Learning and Forgetting in Supply Chains

Anupam Agrawal, UIUC, 363 Wohlers Hall, Champaign, Il, 61821-6255, United States of America, anupam@illinois.edu, Suresh Muthulingam

Using a primary longitudinal dataset, we investigate how the depreciation of organizational knowledge (organizational forgetting) affects vendor quality performance. We find that quality gains from process improvement initiatives depreciate while those from quality assurance initiatives do not, and this depreciation is lower for knowledge embedded in technology than for knowledge embedded in organizational routines or members.

■ MB46

Hilton- Lombard

Advances in Discrete Optimization

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Santanu Dey, Georgia Tech, 765 Ferst Drive, NW, Atlanta, United States of America, santanu.dey@isye.gatech.edu

1 - GMI/Split Cuts using Lattice Information

Karen Aardal, Professor, Delft University of Technology, Delft Institute of Applied Mathematics, Mekelweg 4, Delft, 2628 CD, Netherlands, k.i.aardal@tudelft.nl, Andrea Lodi, Andrea Tramontani, Laurence Wolsey, Fred Von Heymann

We consider a heuristic separation procedure for generating split cuts. The procedure is based on a lattice reformulation of single-row integer programs.

2 - Computational Experiments with Split Cuts Induced by Lattice Reformulation

Andrea Tramontani, CPLEX Optimization, IBM Italy, Via Martin Luther King 38/2, Bologna, 40132, Italy, andrea.tramontani@it.ibm.com, Andrea Lodi, Karen Aardal, Fred Von Heymann, Laurence Wolsey

We report on computational experiments with split cuts induced by lattice reformulation of single-row integer programs.

3 - Almost Symmetries in Graphs

Bernard Knueven, University of Tennessee, 504 John D. Tickle Building, 851 Neyland Drive, Knoxville, TN, 37996-2315, United States of America, bknueven@utk.edu, Jim Ostrowski, Sebastian Pokutta

This work addresses the following question. Given an arbitrary graph, G, and a budget, k, find a subgraph of G formed by removing at most k edges that contains the most symmetry. If such a subgraph contains non-trivial symmetries, we call the symmetries "almost symmetries". We discuss how to find such symmetries and the affect that these have on solving combinatorial optimization problems.

■ MB47

Hilton- Mason A

Computational Methods for Stochastic Optimization and Variational Problems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Farzad Yousefian, UIUC, Dept. of Industrial and System Eng, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, yousefi1@illinois.edu

1 - Adaptive Sampling in Stochastic Recursions for Optimization and Root Finding

Raghu Pasupathy, Associate Professor, Purdue University, Dept. of Statistics, West Lafayette, United States of America, pasupath@vt.edu

There has recently been much interest in solving simulation optimization and stochastic root finding problems using recursions obtained by replacing derivatives in Newton-type methods with their sampled counterparts. We present a sequential sampling strategy that adaptively determines the sample size within such recursions by trading-off (estimated) structural and sampling errors. We analyze the resulting convergence rates.

2 - Stochastic Compositional Gradient: Optimizing Compositions of Stochastic Functions

Mengdi Wang, Assistant Professor, Princeton University, 6124 Kaitlyn Ct, West Windsor, NJ, 08550, China, mengdiw@princeton.edu, Ethan Fang, Han Liu

Classical stochastic gradient methods are well suited for minimizing expected values. However, they do not apply to the minimization of a nonlinear function involving expected values, i.e., $\min_x f(E_w[g_w(x)])$. We propose a stochastic compositional gradient descent (SCGD) method that updates using sample subgradients and a extrapolation step. For smooth problems, the SCGD converges at a rate of $O(k^{-2/7})$ in the general case and $O(k^{-4/5})$ in the strongly convex case.

3 - Algorithms for Derivative-free Stochastic Search for Learning of Noisy, Expensive Functions

Yingfei Wang, Princeton University, 35 Olden Street, Princeton, NJ, 08540, United States of America, yingfei@cs.princeton.edu, Warren Powell

We have developed a modular, optimal learning testing environment (MOLTE) for testing learning/stochastic optimization algorithms on a wide range of offline and online problems. We conduct a thorough series of comparisons of pre-coded competitive policies from different communities on pre-coded problems including standard test functions and real-world applications. We address the experimental issues that have been overlooked such as the difficulty of tuning and the construction of priors.

4 - Optimal Robust Smoothing Extragradient Algorithms for Stochastic Variational Inequality Problems

Farzad Yousefian, UIUC, Dept. of Industrial and System Eng, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, yousefi1@illinois.edu, Angelia Nedich, Uday Shanbhag

We present two robust variants of extragradient algorithms for solving stochastic variational inequality problems. The first scheme employs an averaging technique. We show that using an appropriate choice for the weights, a suitably defined gap function attains the rate O(1/k^0.5). In the second scheme, under an assumption of weak-sharpness, we develop a recursive stepsize rule and we show almost-sure convergence and convergence in a mean-squared sense to the solution at the rate O(1/k).

■ MB48

Hilton- Mason B

Multistage Stochastic Optimization and Applications in Healthcare

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Oleg Shylo, Assistant Professor, University of Tennessee, 523 John D. Tickle Building, 851 Neyland Drive, Knoxville, TN, 37996, United States of America, oshylo@utk.edu

1 - Totally Unimodular Multistage Stochastic Programs

Ruichen Sun, PhD Student, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, rus19@pitt.edu, Oleg Shylo, Andrew Schaefer

We consider totally unimodular multistage stochastic programs, that is, multistage stochastic programs whose extensive-form constraint matrix is totally unimodular. Such stochastic programs may be solved as multistage stochastic linear programs, even if there are integrality restrictions. We establish several sufficient conditions to ensure a multistage stochastic program is totally unimodular, and provide examples that arise in practice.

2 - Integrating Proactive and Reactive Operating Room Management

Gabriel L. Zenarosa, PhD Student, University of Pittsburgh, 3700 O'Hara Street, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, glz5@pitt.edu, Andrew Schaefer, Oleg Prokopyev

The goal of this research is to provide approaches for the design of operating room (OR) schedules that are adaptable and flexible to unexpected events. We formulate, calibrate, and solve OR scheduling models under uncertainty. These models produce initial schedules that facilitate flexible reactions during the surgical day, including rescheduling. Outcomes include generalizable insights on the aspects of flexible OR schedules and applicable techniques for solving these difficult problems.

3 - Patient Scheduling under Uncertainty and Resource Constraint

Jeremy Castaing, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, jctg@umich.edu, Brian Denton, Amy Cohn

We develop a stochastic optimization that creates a patient appointment schedule aiming to reduce patient waiting times and total hours of operation of a Cancer Infusion Center. The resulting model is a large-scale integer programming model, intractable for large instances of the scheduling problem. We design an algorithm giving good approximations to the optimal solution and we validate the heuristic result using several bounds on the optimal objective.

■ MB49

Hilton- Powell A

Interdiction Models in Complex Networks

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Alexander Veremyev, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States of America, averemyev@ufl.edu

1 - Sequential Shortest Path Network Interdiction with Incomplete Information

Juan Borrero, University of Pittsburgh, 3700 O'Hara street, Pittsburgh, United States of America, jsb81@pitt.edu, Oleg Prokopyev, Denis Saure

We study sequential interdiction of evaders on a network when the interdictor has partial initial information about the network structure and costs. In each period, the interdictor removes up to k arcs from the network, after which an evader travels a shortest path. By observing the evaders' actions the interdictor learns about the network and adjusts its actions accordingly. We analyze a class of policies that remove a set of k-most vital arcs of the observed network, and assess its optimality.

2 - Stochastic Maximum Coverage Problem

Konstantin Pavlikov, Stochastic Maximum Coverage Problem, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611-6595, United States of America, kpavlikov@ufl.edu, Alexander Veremyev

The network maximum coverage problem under uncertainty is considered. In this problem, network vertices are assumed to cover their adjacent nodes with some probability, independently of each other. The emphasis is put on minimizing the risk of losing coverage in the presence of random failures of "covering" components. We formalize the stochastic coverage problem, formulate and further investigate the corresponding combinatorial optimization problems.

3 - On the Minimum Vertex Blocker Clique Problem

Foad Mahdavi Pajouh, University of Florida, 350 N Poquito Rd, Shalimar, Fl, 32579, United States of America, mahdavi@ufl.edu, Vladimir Boginski, Eduardo Pasiliao

Cliques are among the earliest concepts used to model cohesive clusters in graphs. A clique is a subset of vertices that induces a complete subgraph. Given an integer r>0, we consider the problem of removing a subset of vertices of minimum cardinality in a weighted undirected graph, such that the weight of any remaining clique is bounded above by r. A linear 0-1 programming formulation, polyhedral results, an exact algorithm for solving this problem, and its complexity will be presented.

■ MB50

Hilton- Powell B

Network Design in the Automotive Industry

Cluster: Network Design

Invited Session

Chair: Stefan Minner, Technische Universitat München, Arcisstr. 21, Munich, 80333, Germany, stefan.minner@tum.de

1 - Timing a Sequence of New Car Ramp-ups in Automotive Production Networks

Thomas Stäblein, TU München, Arcisstr. 21, München, 80333, Germany, thomas.staeblein@gmail.com, Annika Becker, Raik Stolletz

A quantitative model is developed to optimize the production technology installation and the ramp-up sequence for new cars. Additionally, phase-outs, platform development and the delivery to markets are considered. Based on real-world data from the premium car industry, we show first insights on the optimization of timing investments and ramp-ups with respect to cash-flows. We pay attention to decisions for multiple products with learning and technology know-how transfer among plants.

2 - Strategic Capacity Planning in Automotive Production Networks under Duties and Duty Drawbacks

Katharina Mariel, Daimler AG, HPC: E203, Stuttgart, 70546, Germany, katharina.mariel@daimler.com, Stefan Minner

High tariffs and complex customs procedures for automotive goods have a crucial impact on global production strategies. Motivated by real-world planning problems of an OEM, we develop a mixed-integer model that simultaneously considers strategic capacity adjustments and duties and drawbacks for multi-stage production processes. In a numerical case study the impact of duties and duty drawbacks on strategic capacity decisions is highlighted.

3 - Supply Network Design under Local Content and Exchange Rate Uncertainty

Stefan Minner, Technische Universität München, Arcisstr. 21, Munich, 80333, Germany, stefan.minner@tum.de

We present an analytical approach to design the optimal sourcing strategy and product configuration of an automotive supply chain under joint exchange rate and demand uncertainty. The model includes different legal constraints when determining the local content under different cost structures with fixed and variable costs.

■ MB51

Hilton- Sutter A

Optimization for Large-scale Data Analysis and Optimization

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: George Lan, Assistant Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, glan@ise.ufl.edu

1 - Accelerated First-Order Method for Convex Composite Optimization and the Applications in Image Analysis

Yuyuan Ouyang, Postdoctoral associate, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, United States of America, ouyang@ufl.edu

We present an accelerated scheme for solving a class of convex composite optimization problems and its application in image analysis. The proposed AL-ADMM method, namely accelerating linearized alternating direction method of multipliers, has accelerated rate of convergence in terms of its dependence on Lipschitz constant of the smooth component. A backtracking technique for searching Lipschitz constant is also proposed for practical performance.

2 - Optimal Randomized First-order Methods for Saddle Point Optimization

Cong Dang, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611, United States of America, congdd@ufl.edu, George Lan

We present novel randomized algorithms for solving saddle point problems whose dual feasible region is a direct product of many convex sets. Our algorithms can achieve the optimal O(1/N) rate of convergence by solving only one dual subproblem at each iteration. When applied to linearly constrained problems, they need to solve only one randomly selected subproblem per iteration instead of solving all as in the Alternating Direction Method of Multipliers.

3 - The Complexity and Optimal Algorithms for Convex Programming under Linear Optimization Oracle

Yi Zhou, Ph.D. Student, University of Florida, Industrial and Systems Engineering, Gainesville, United States of America, yizhou@ufl.edu, George Lan

We present new conditional gradient methods which possesses optimal complexity in terms of the number of call to the first-order oracle and linear optimization oracle.

4 - Extending the Scope of Uniformly Optimal Methods for General Nonlinear Programming

Saeed Ghadimi, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32603, United States of America, sghadimi@ufl.edu, George Lan, Hongchao Zhang

We develop a generic framework to extend uniformly optimal convex programming algorithms to general nonlinear programming. Without requiring any problem parameters, these algorithms achieve the best known complexity for nonconvex problems, and the optimal complexity for convex ones. In particular, for the first time in the literature, we show that the level-type algorithms can be used for solving nonconvex problems uniformly.

■ MB52

Hilton- Sutter B

Recent Progresses on Solving Markov Decision Processes

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Yinyu Ye, Professor, Stanford University, Huang 308, Stanford, CA, 94025, United States of America, yyye@stanford.edu

1 - Reduction of Average-cost Markov Decision Processes to Discounting under an Accessibility Condition

Eugene Feinberg, Distinguished Professor, Stony Brook University, Dept. of Applied Math. & Statistics, Stony Brook, NY, 11790, United States of America, eugene.feinberg@stonybrook.edu, Jefferson Huang

We present sufficient conditions under which an average-cost MDP with Borel state and action spaces can be reduced to a discounted problem. Our assumptions include the existence of a continuous solution to the optimality equation for an embedded stochastic longest-path problem. Our results have applications to the existence of stationary optimal policies for infinite-state MDPs and strongly polynomial bounds for policy iteration and linear programming algorithms for certain MDPs and games.

2 - A Linear Programming Approach to Constrained Nonstationary Markov Decision Processes

Ilbin Lee, PhD Student, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, ilbinlee@umich.edu, Marina Epelman, Edwin Romeijn, Robert L. Smith

We study infinite-horizon constrained nonstationary Markov decision processes with discounted cost criterion and finite state space. This problem can equivalently be formulated as a countably infinite linear program (CILP), a linear program with countably infinite number of variables and constraints. We provide a complete algebraic characterization of extreme points of the CILP formulation and illustrate the characterization for special cases. We also suggest ideas for a simplex-type algorithm.

3 - Algorithms for Fast-Mixing Markov Decision Processes

Ian Post, University of Waterloo, Department of Combinatorics and Optimiza, 200 University Ave West, Waterloo, ON, N2L 3G1, Canada, ipost@uwaterloo.ca

We give an algorithm for solving Markov decision processes that have the property that any policy converges in polynomial iterations to its stationary distribution, even if the discount factor is very close to 1.

4 - Dantzig's Pivoting Rule for Shortest Paths, Deterministic MDPs, and Minimum Cost-Time Ratio Cycles

Thomas Dueholm Hansen, Postdoc, Stanford University, 385 Curtner Avenue, Apt. N, Palo Alto, Ca, 94306, United States of America, tdh@cs.au.dk, Haim Kaplan, Uri Zwick

Post and Ye recently proved an upper bound on the number of iterations required by Dantzig's pivoting rule when solving deterministic Markov decision processes. We improve the bound by Post and Ye and a similar bound by Orlin for shortest paths. Furthermore, we show that as a consequence Dantzig's pivoting rule solves the minimum cost to time ratio cycle problem in strongly polynomial time.

■ MB53

Hilton- Taylor A

Mathematical and Statistical Analysis of High Frequency Tradings

Cluster: Optimization in Finance

Invited Session

Chair: Xin Guo, Coleman Fung Chair Professor, UC Berkeley, Dept of IEOR, berkeley, Ca, 94708, United States of America, xinguo@berkeley.edu

1 - Tools for Studying Relationship between Temperature Forecasts and Natural Gas Futures

John Wu, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley CA 94720, john kwu@lbl.gov

Natural gas is consumed by homes and businesses at a fairly steady rate, however the futures trading on natural gas is actually quite volatile. In this work, we employ a number of different tools to study the characteristics of the price fluctuation to understand its potential causes. In this process, we found two techniques to be particularly instructive: non-uniform fast Fourier transform (NUFFT) and co-integration. In this study, we find clear signature of automated trading. Furthermore, we find that the temperature forecast errors account for about half of the price variation. This observation underscores the importance of improving the accuracy of temperature forecast systems produced by earth system modeling efforts.

2 - Can Large Uninformed Selling Explain Oct. 1987 and 2010 Flash Crash?

Isaac(Yuan) Mao, Dept. IEOR, UC Berkeley, 4174 Etcheverry Hall, UC Berkeley, Berkeley, CA, United States of America, yuan.mao@berkeley.edu, Xin Guo, Terrence Hendershott

Our extension of Kyle's (1985) model predicts market-wide information effect have different impact on stocks. We can predict SP500 stock price change during the stock market crashes and recover the large uninformed selling empirically.

3 - Multi-stage Optimal Exposure Problem

Yuanyuan Chen, The Chinese University of Hong Kong, ERB 810A, CUHK, Shatin, N.T., Hong Kong, Hong Kong - PRC, yychen@se.cuhk.edu.hk, Duan Li, Xuefeng Gao

We study a multi-stage optimal exposure problem which a large buyer faces. The buyer needs to decide at each time t whether to submit limit order or hidden order, or both and how many for each. We identify certain market conditions under which the buyer would never use iceberg orders. We further present some findings on how the market parameters affect the choice made among limit, hidden and iceberg orders.

4 - High Frequency Limit Order Book Dynamics via Support Vector Machines

Alec Kercheval, Professor, Florida State University, 1017 Academic Way, Rm 208, Department of Mathematics, Tallahassee, FL, 3 2306-4510, United States of America, kercheva@math.fsu.edu, Yuan Zhang

To analyze high frequency electronic trading behavior, a machine learning framework using multi-class support vector machines is proposed to automate short term forecasting of order book events. Experiments with sample market data show the method can forecast mid-price movements and price spread crossings a short time into the future.

■ MB54

Hilton- Taylor B

Some Recent Topics in Financial Engineering

Sponsor: Financial Services Section

Sponsored Session

Chair: Tim Leung, Columbia University, 500 West 120th Street MC4704, New York, United States of America, tl2497@columbia.edu

1 - A Stochastic Model for Order Book and Price Dynamics

Xinyun Chen, Stony Brook University, Department of Applied Math and Stat, Stony Brook, NY, 11790, United States of America, xinyun.chen@stonybrook.edu, Jose Blanchet

We construct and study a continuous time model that incorporates the whole limit order book to inform the joint evolution of the spread and the price processes. The construction of the order book model is guided by empirical data. In particular, the model addresses the autocorrelation pattern of order flows. Under the multi-scale asymptotic regime suggested by empirical observations, we solve a jump-diffusion approximation for the spread-price process determined by the order book dynamics.

2 - Commodity Leveraged Exchange Traded Funds

Kevin Guo, Columbia University, 345 S.W. Mudd Building, 500 West 120th Street, New York, NY, 10027, United States of America, klg2138@columbia.edu, Tim Leung

We investigate the tracking errors of leveraged exchange traded funds (LETFs) based on commodity indices. We observe from empirical data the discrepancy of LETF and their reference indices returns. This leads us to define the tracking error associated with each LETF. We conclude that tracking errors can significantly deteriorate returns over the long run. Incorporating correlated tracking errors into LETF price dynamics, we examine the effectiveness of a some trading strategies.

3 - Static and Dynamic Trading Strategies for Leveraged ETF Portfolios

Zheng Wang, Columbia University, IEOR Department, Rm 315, SEAS, 500 West 120th Street, New York, NY, 10027, United States of America, zw2192@columbia.edu, Tim Leung

We discuss a number of ways to construct static and dynamic portfolios using liquidly traded leveraged ETFs. In order to model the portfolio value dynamics, it is crucial to account for the various leverage ratios, value erosion due to realized volatility, and expense fees. We examine the risk characteristics of these portfolio both analytically and empirically.

4 - Implied Volatility of Leveraged ETF Options: Consistency and Scaling

Tim Leung, Columbia University, 500 West 120th Street MC4704, New York, United States of America, tl2497@columbia.edu

The growth of the exchange-traded fund (ETF) industry has given rise to the trading of options written on ETFs and their leveraged counterparts (LETFs).We study the relationship between the ETF and LETF implied volatility surfaces under a general stochastic volatility framework. We derive analytic approximations for the implied volatilities and identify their dependence on the leverage ratio.

■ MB55

Hilton- Van Ness

Optimization for Dimension Reduction

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Genevera Allen, Rice University, 6100 Main St. MS - 138, Houston, TX, 77005, United States of America, gallen@rice.edu

1 - Sparse PCA via Fantope Projection and Selection

Vince Vu, Assistant Professor, Ohio State University, Department of Statistics, 1958 Neil Avenue, 404 Cockins Hall, Columbus, OH, 43210-1247, United States of America, vqv@stat.osu.edu

Sparse PCA is dimension reduction and variable selection technique for high-dimensional data. This talk will present a recently developed convex relaxation of sparse PCA based on the convex hull of rank-k projection matrices (the Fantope). The resulting semidefinite program (SDP) can be solved efficiently by alternating direction method of multipliers and has near-optimal statistical properties. Insight into sparsity and the structure of the SDP enable its application to massive datasets.

2 - Sparse and Smooth Principal Components Analysis

Genevera Allen, Rice University, 6100 Main St. MS - 138, Houston, TX, 77005, United States of America, gallen@rice.edu

We present an optimization framework to simultaneously achieve sparsity and smoothness in both the left and right singular vectors. This framework generalizes existing approaches to Sparse PCA and Functional PCA, providing a unified optimization framework for regularization in PCA. We also propose a scalable alternating algorithm, study its convergence guarantees, and demonstrate its effectiveness on simulated data and an EEG example.

3 - Exact Data Reduction for Big Data

Jieping Ye, Associate Professor, Arizona State University, Tempe, AZ, 85287, United States of America, jieping.ye@asu.edu

Recent technological innovations have enabled data collection of unprecedented size and complexity. As an emerging and powerful tool for analyzing massive collections of data, data reduction has attracted tremendous attentions in the past few years. In this talk, I will present some of our recent work on exact data reduction in that the final model constructed from the reduced data is identical to the original model constructed from the complete data.

■ MB56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Bringing Optimization to the Enterprise with AIMMS PRO

Deanne Zhang, Sr. AIMMS Optimization Specialist, AIMMS, Heidi.Fergerstrom@aimms.com

AIMMS PRO brings optimization to the enterprise. We will demonstrate how PRO, the web-based deployment platform, eliminates the IT and technical hurdles involved with deploying a solution throughout an organization so that companies can reap the benefits of optimization and analytics.

2 - Optimization Modeling Made Easy

Mark Wiley, VP Marketing, Lindo Systems Inc., 1415 North Dayton Street, Chicago, IL, 60642, United States of America, mwiley@lindo.com, Gautier Laude

Learn how easy it is to: • Build linear, nonlinear, quadratic, integer optimization models • Incorporate uncertainty, • Access data from Excel/databases • Embed a solver into your application. See a demonstration of the new releases of: • LINDO API - a callable solver engine • LINGO - an integrated modeling language and solvers • What's Best! - a large-scale solver for Excel.

■ MB64

Parc- Cyril Magnin I

Applied Probability for Smart Cities

Sponsor: Applied Probability Society

Sponsored Session

Chair: Robert Hampshire, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, hamp@andrew.cmu.edu

1 - Fork-join Queues in In-Network Function Computation

Samyukta Sethuraman, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, samyukta@tamu.edu, Natarajan Gautam

We consider a smart sensor network which measures data and transmits to a sink. The sink node is ultimately interested in a function of the measured values, e.g., the maximum, calculated in a distributed fashion. To efficiently perform this under stochastic conditions, we model the flow of information along predefined arborescences, as a fork-join queueing network. We obtain bounds on the performance under light and heavy traffic conditions, and thereby select the ideal set of arborescences.

2 - Congestion-Based Staffing Policy for Toll Booths

Katsunobu Sasanuma, PhD Candidate, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, katz@cmu.edu, Robert Hampshire, Alan Scheller-Wolf

We study a traffic management policy for facilities with toll booths, that efficiently utilizes limited resources by dynamically changing the staffing level depending on the queue length. Our objective is to know when we need to add more operators and when to withdraw extra operators. The policy of changing the number of operators depending on the queue size is discussed and analytical results of performance indicators are shown.

3 - Is the Curb 80% Full or 20% Empty? A Dynamic Parking Pricing Experiment in San Francisco

Robert Hampshire, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, hamp@andrew.cmu.edu

The city of San Francisco is undertaking a large-scale controlled parking pricing experiment. San Francisco has adopted a performance goal of 60-80% occupancy for its metered parking. The goal represents an heuristic performance measure intended to reduce double parking and cruising for parking, and improve the driver experience. We develop an empirical Erlang C formula, and evaluate the impacts of the first two years of the San Francisco program.

■ MB65

Parc- Cyril Magnin II

Fluid and Diffusion Approximations of Stochastic Systems

Sponsor: Applied Probability Society

Sponsored Session

Chair: John Hasenbein, University of Texas at Austin, Grad Program in OR/IE, Austin, United States of America, jhas@mail.utexas.edu

1 - Optimal Pricing and Capacity Sizing when Customers Abandon, Amy Ward, Chihoon Lee

We consider how to jointly set the price and capacity in order to maximize the steady-state expected profit in a GI/GI/1+GI queue with a high rate of prospective customer arrivals. We use the solution to an approximating diffusion control problem to provide a simple condition under which the optimal price and service rate are such that the system operates in heavy traffic. Then, we further use that solution to propose a price and service rate that we can prove is asymptotically optimal.

2 - Diffusion Approximations for Probabilistic Matching Systems

Hanyi Chen, PhD Candidate, The University of Edinburgh, School of Mathematics, JCMB King's Buildings, Edinburgh, EH9 3JZ, United Kingdom, H.Chen-29@sms.ed.ac.uk, Burak Buke

The internet portals which enable potential customers and suppliers to meet and match, e.g. employment and renting portals, dating and classified websites, have become increasingly popular in the last decade. In these systems, each supplier and customer pair matches probabilistically. We provide models for analyzing the user traffic in these systems. It can be shown that these systems are unstable if uncontrolled. We suggest fluid and diffusion limits to facilitate analysis of these systems.

3 - The Analysis of Provider Triage Systems in Emergency Rooms

Ozlem Yildiz, University of Rochester, Simon School of Business, 4-333 Simon Hall. Simon Graduate School, of Business, Universiy of Rochester, Rochester, NY, 14627, United States of America, ozlem.yildiz@Simon.Rochester.edu, Tolga Tezcan, Michael Kamali

We study when and how provider triage (PT) methods should be applied in an emergency room (ER) to maximize the economic contribution using multi-server fluid approximations. We show that PT should be applied when arrival rate to the ER must exceed a threshold, which is provided in closed-form. Testing the performance of our proposed solution using patient flow data from our partner ER via simulation, we show that it leads to near-optimal results.

4 - Dynamic Control of Collaborative Networks

Itai Gurvich, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu

We study collaboration and resource sharing in processing networks. We first characterize sufficient conditions on the network's collaboration architecture that guarantee that the static planning problem truly captures the capacity of the process. We then proceed to study control of synchronization under non-preemption. We find that synchronization of collaborating resource under non-preemption introduces fundamental and non-trivial tradeoffs between throughput and controllability.

■ MB66

Parc- Cyril Magnin III

Simulation and Computer Experiments

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Matthew Plumlee, Georgia Institute of Technology, Atlanta, GA, United States of America, mplumlee@gatech.edu

1 - Joint Modeling of Point and Integral Responses in Computer Experiments

C. F. Jeff Wu, Coca-Cola Chair in Engineering Statistics and Professor, Georgia Institute of Technology, 755 Ferst Dr, atlanta, United States of America, jeffwu@isye.gatech.edu, Heng Su, Rui Tuo

In some computer experiments, the quantity of interest may be the average value of the responses over a specific region. One example is the diffuse solar irradiance on a building façade. We extend the standard Gaussian process framework so that it can handle both point and integral data. We find that a closed-form expression can be derived, and the predictions on new points and regions can be obtained with high accuracy. An illustration is made with real data from the irradiance study.

2 - A New Measure in Global Sensitivity Analysis: Shapley Values of Input Parameters

Eunhye Song, Northwestern University, 2145 Sheridan Road, Technological Institute, C210, Evanston, Il, 60208, United States of America, eunhyesong2016@u.northwestern.edu, Barry Nelson, Jeremy Staum

Global sensitivity analysis captures the variation in the model response over the range of the input parameters whose uncertainty is represented by probability distributions. We propose a new global sensitivity measure derived from the concept of Shapley value in cooperative game theory and compare its properties to other variance-based global sensitivity measures. Gaussian process modeling is used to facilitate efficient computation of the sensitivity measure for complex models.

3 - Local Gaussian Process Approximation for Large Computer Experiments

Robert B. Gramacy, Associate Professor, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, rbgramacy@chicagobooth.edu, Daniel Apley, Jarad Niemi

By focusing expressly on desirable properties of the predictive equations, we derive a family of local sequential design schemes that dynamically define the support of a Gaussian process predictor based on a local subset of the data. Then we show how independent application of our local design strategy across the elements of a vast predictive grid facilitates a trivially parallel implementation.

4 - Sequential Algorithms for Generating Space-filling Designs with Unknown Constraints

Tirthankar Dasgupta, Associate Professor, Harvard University, 1 Oxford Street, 7th Floor, Harvard Statistics Department, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu, Li Zhu, Robert B. Gramacy

We explore sequential strategies for obtaining a space-filling design within a feasible sub-region of the design space, where the feasibility constraints are unknown. Two criteria that are based on minimizing the prediction errors from Gaussian Process models are proposed for iteratively selecting new design points.

■ MB67

Parc- Balboa

Industrial Data Analytics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Shiyu Zhou, Professor, University of Wisconsin-Madison, Department of Industrial Engineering, Madison, WI, 53706, United States of America, szhou@engr.wisc.edu

1 - Hierarchical Bayesian Kernel Models Applied to Event Data
Hiba Baroud, University of Oklahoma, 202 West Boyd St, Room 124, Norman, OK, 73019, United States of America, hbaroud@ou.edu, Kash Barker

We propose to use hierarchical Bayesian kernel methods to model count data and predict the number of occurrences of a particular event using historical data and component and event characteristics. The model is implemented using several data sets and compared to other count data models for validation purposes.

2 - Detecting Point Pattern of Multiple Line Segments using Hough Transformation
Yuhang Liu, Graduate Student, University of Wisconsin Madison, Department of Industrial Engineering, Madison, WI, 53711, United States of America, liu427@wisc.edu, Shiyu Zhou

Surface defects in manufacturing often exhibit particular spatial patterns. These patterns can help to identify the potential root causes. In this paper, we present a new method to detect the point patterns consisting of multiple line segments. The idea is to convert the point pattern detection problem into a simple point matching problem by using Hough Transformation. The proposed method is easy to implement and has a good performance. The algorithm and case studies are presented in the paper.

3 - Robust Parameter Design for Profile Quality Control
Lulu Bao, Tsinghua University, Department of Industrial Engineering, Tsinghua University, Beijing, 100084, China, baoll11@mails.tsinghua.edu.cn, Qiang Huang, Kaibo Wang

In certain manufacturing processes, product quality is characterized by spatial profiles. Such profiles are expected to meet specific shape requirements. This talk aims to improve profile quality using robust parameter design. A hierarchical model is built to reflect the spatial correlation the profile data has and linked with process variables. The performance of the proposed method is studied using a motivating example from nano-manufacturing.

4 - Reliability Optimization for Critical Components with Uncertain Component Reliability in the Design
Qianru Ge, Ph.D Candidate, Technology University of Eindhoven, Technology University of Eindhoven, Den, Eindhoven, 5612 AZ, Netherlands, q.ge@tue.nl, Geert-Jan Van Houtum, Ivo Adan, Hao Peng

We develop an optimization model to determine the reliability design of critical components in a system. Since the system is under a service contract, a penalty cost should be paid by the OEM when the total system down time exceeds a predetermined level, which complicates the evaluation of the life cycle costs. Furthermore, in the design phase for each critical component, all the possible designs are subject to uncertain component reliability. An efficient approximation method is proposed.

■ MB68

Parc- Davidson

Simulation Methodology Applications

Sponsor: Simulation

Sponsored Session

Chair: Seong-Hee Kim, Associate Professor, Georgia Institute of Technology, Atlanta, GA, 30332, United States of America, skim@isye.gatech.edu

1 - Sampling from Manifolds without Derivatives
Enlu Zhou, Georgia Institute of technology, 755 Ferst Drive, NW, Atlanta, GA, 30319, United States of America, enlu.zhou@isye.gatech.edu, Chang-han Rhee

We introduce an algorithm that generates samples from a manifold, based only on the ability to evaluate the mapping defined by the parametrization of the manifold. In particular, we do not assume the ability to evaluate the derivatives of the mapping. Our approach is useful when the manifold is analytically intractable and highly nonlinear—-for example, in studying complex regulatory networks in systems biology where the mapping is typically defined by the solution of a system of ODEs.

2 - A Simulation Based Optimization Model for Workforce Scheduling in Call Centers
Amr Eltawil, Acting chairperson, Industrial Engineering and Systems Management, Egypt-Japan University of Science and Technology, 179 New Borg El-Arab City,Alexandria,Egy, Alexandria, 21934, Egypt, eltawil@ejust.edu.eg, Aya Seada

One of the key metrics used in evaluating call centers performance is the service level (SL).The SL is the percentage of incoming calls an agent can answer within a specified time. In this paper, we present a case study of using discrete event simulation for workforce scheduling in the largest home appliances company in Egypt. The model considers many factors that cannot be handled by the current workforce planning process that relies on using Erlang-C method.

3 - Simulating High Speed and Rate-Based Systems
David Krahl, Imagine That, Inc., 6830 Via Del Oro, Suite 230, San Jose, CA, 95119, United States of America, davek@extendsim.com, Cecile Pieper

Systems that process material at high speed or continuously are common. These include pulp and paper, manufacturing, petrochemical, and mining. These kinds of systems typically pose unique challenges for simulation modelers. This session will discuss various simulation modeling technologies including discrete event, continuous, and discrete rate. Real-world examples will be presented to illustrate these concepts.

4 - Building Metamodels for Cycle Time Quantiles in Manufacturing Systems
Demet Batur, Assistant Professor, University of Nebraska, CBA 209, Lincoln, NE, United States of America, dbatur@unl.edu, Jennifer Bekki

We present a procedure for building metamodels from discrete-event simulation models of manufacturing systems. The performance measure of interest is the quantiles of the cycle time distribution while the independent variables are controllable aspects of the production system itself such as arrival rate, service time, setup time, loading/unloading time, etc. Experimental results will be presented on a prototype simulation model of a semiconductor manufacturing system.

5 - Impact of Sensor Measurement Errors in Sensor Positioning in Water Quality Monitoring Networks
Chuljin Park, Assistant Professor, Hangyang University, Engineering Center #706-2, 222 Wangsimni-ro Seongdong-gu, Seoul, 133-791, Korea, Republic of, parkcj@hanyang.ac.kr, Seong-Hee Kim, Jisu Park, Mustafa Aral, Yongsoon Eun

We study the impact of sensor measurement errors in the problem of determining sensor locations in water quality monitoring networks. We develop a probabilistic model for sensor measurement errors and find sensor locations that minimize the expected time until spill detection subject to the reliability of detecting a spill is greater than a pre-specified threshold. Randomness in a contaminant spill and rain events is considered with various levels of bias and variability in sensor measurements.

■ MB69

Parc- Fillmore

Models for Electric Vehicle Charging Infrastructure Network

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Yongxi Huang, Assistant Professor, Clemson University, 314 Lowry Hall, Clemson University, Clemson, SC, United States of America, yxhuang@clemson.edu

1 - Optimal Electric Vehicle Charger Placement Problem: A Time-of-Day Parking Activity Based Approach
Jing Dong, Assistant Professor, Iowa State University, 350 Town Engineering Building, Ames, IA, 50011, United States of America, jingdong@iastate.edu, Changzheng Liu

This study optimizes the electric vehicle charger placement to minimize the unmet charging demand. The spatial and temporal distributed charging demands are derived from parking activities of GPS-tracked vehicles. A mixed integer programming approach is developed to solve the proposed problem.

2 - Concurrent Electric Vehicle Fleet Sizing and Charging Station Network Design

Scott Mason, Professor and Endowed Chair, Clemson University, 124 Freeman Hall, Clemson, SC, 29631, United States of America, mason@clemson.edu, Yongxi Huang, Navid Matin Moghaddam

We present a model for the capacitated electric vehicle routing problem that focuses on both fleet sizing and network design decisions simultaneously. We focus on determining the required routing for each electric vehicle, including required driving, waiting, and charging times, such that all customer demands are satisfied within required time windows. Any feasible solution must not violate vehicle capacity constraints, maximum range limitations, or customer-required delivery requirements.

3 - Life Cycle Analysis of Electric Vehicles using a Detailed Optimization Model of the Electricity Grid

Allison Weis, PhD Student, Carnegie Mellon, EPP Baker Hall 129, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, aeweis@andrew.cmu.edu, Paulina Jaramillo, Jeremy Michalek

The potential environmental benefit of electric vehicles over conventional vehicles depends heavily on the emissions resulting from charging the electric vehicles. In this work we use a MILP model of optimal power plant dispatch and unit commitment to characterize the criteria air pollutant and greenhouse gas emissions caused by charging. We combine these results with the emissions from other electric vehicle life cycle stages and compare them to life cycle emissions for conventional vehicles.

4 - A Dynamic Location Model for Electric Vehicle Charging Corridor

Shengyin Li, Graduate student, Clemson University, 139S Lowry Hall, Clemson University, Clemson, SC, 29634, United States of America, shengyl@clemson.edu, Yongxi Huang

We develop a dynamic flow-based location model for optimally deploying public electric vehicle charging stations on a transportation network to meet demand increases in a sequential manner. Mixed integer programming models were formulated to minimize the total system cost over planning horizon, considering realistic scenarios of relocations. We demonstrated the models using a South Carolina case study with probabilistic analysis based future demand changes on a geographic resolution.

■ MB70

Parc- Hearst

Using Optimization for Wildfire Preparation and Mitigation

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Hugh Medal, Assistant Professor, Mississippi State University, 260F McCain Hall, Mississippi State, MS, 39762, United States of America, hugh.medal@msstate.edu

1 - Analyzing the Vulnerability of Landscapes to Pyro-terror Attacks: A Network Interdiction Approach

Eghbal Rashidi, Mississippi State University, 340C McCain Hall, Starkville, MS, 39759, United States of America, er442@msstate.edu, Hugh Medal

We study the potential impact of a pyro-terrorism attack on a landscape. A mathematical programming model is developed from a terrorist's point-of-view to optimally locate ignition points and maximize the damage caused by the fire. Considering fuels treatment as a strategy to reduce the loss due to fire, we also model a Stackelberg game in which a fire manager finds optimal locations for fuel treatments, and terrorists locate ignition points to maximize the damage.

2 - Forest and Wild Land Fire Management Resource Sharing

David Martell, Professor, University of Toronto, 33 Willcocks Street, Toronto, ON, M5S 3B3, Canada, david.martell@utoronto.ca, Bernardo Pagnoncelli, Cameron Buttazzoni, Adriana Piazza

Each year forest fire managers must decide what resources (e.g., airtankers and fire fighters) to acquire subject to uncertainty concerning when and where the fires might occur. Many have developed inter-agency resource sharing agreements that enhance their ability to cope with elevated fire loads. We developed a simulated multi-agency fire management system and used it to explore how specific deterministic and stochastic resource sharing models would perform in such planning environments.

3 - Arson Wildfire Damage Reductions through Displacement and Deterrence

Jeffrey Prestemon, Research Forester, USDA Forest Service, Southern Research Station, Forestry Sciences Laboratory, PO Box 12254, RTP, NC, 27709, United States of America, jprestemon@fs.fed.us, David Butry, Douglas Thomas

Little is known about how law enforcement efforts reduce arson wildfire counts, although studies confirm its effectiveness. Using temporally autoregressive arson wildfire production functions estimated for tribal lands in the U.S., we examine how law enforcement might temporally displace arson fires, reducing their ignition success and fire spread potential, yielding positive net benefits for landowners or society.

■ MB71

Parc - Lombard

Procurement and Auction Markets

Cluster: Auctions

Invited Session

Chair: Gabriel Weintraub, Columbia Business School, gyw2105@columbia.edu

1 - Entrant Cost Uncertainty in Procurement Auctions: Theory and Experiments

Izak Duenyas, Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI, 48109, United States of America, duenyas@umich.edu, Damian Beil, Brendan See, Stephen Leider

Although an incumbent supplier may know her cost to produce an item, an entrant supplier is usually less informed. We model this scenario and allow the entrant to learn additional information at a cost. The buyer can influence the learning cost. We study whether the entrant will learn prior to the auction or delay learning and make a less-informed bid. We derive theoretical results which we then test in the lab.

2 - Mechanism Design for Procurement with Differentiated Products Demand Systems

Daniela Saban, Columbia University, Uris Hall, 4I, New York, United States of America, dhs2131@columbia.edu, Gabriel Weintraub

We study the problem faced by a buyer who uses an auction to select an assortment and unit prices from a set of suppliers with private costs offering differentiated products. Once the assortment and prices are fixed, consumers can choose their most preferred product from this set. We use a mechanism design approach to optimize the trade-off between variety and price competition when maximizing consumer surplus. We use these results to analyze the performance of simple and practical mechanisms.

3 - Efficient Iterative Auctions for Multi-Featured Items: A Network Flow Approach

Sasa Pekec, Duke University, Durham, NC, United States of America pekec@duke.edu, Ozan Candogan

We focus on a setting in which every item is described by a given set of features. Bidders' values for bundles are the sum of individual feature valuation functions (with decreasing marginals). We determine (hypothetical) allocations of features, and link them to allocations of (actual) items via a network flow formulation. Using this formulation, we reveal a new class of valuations for which a Walrasian equilibrium exists, and construct an efficient iterative auction for multi-featured items.

4 - Optimizing Prices in Descending Clock Auctions

Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, sandholm@cs.cmu.edu, Tri-Dung Nguyen

In a descending clock auction (DCA), bidder-specific prices are decremented during the auction. In each round, a bidder can accept or decline his offer. DCAs have been proposed for sourcing spectrum from incumbents in the FCC's imminent incentive auctions. We present the first techniques for determining the prices to offer the bidders in each round: a percentile-based approach and an optimization-based approach. We provide theory and experiments for homogeneous items and for incentive auctions.

■ MB72

Parc- Stockton

Assorted Topics in Distributed Energy Generation

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Alexandra M. Newman, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Generating Load Profiles to Reduce Power use in a Forward Operating Base

Gavin Goodall, PhD Student, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, ggoodall@mines.edu

We present the methodology behind creating power demand profiles for forward operating bases(FOBs) based on five input parameters: latitude, longitude, number of people, mission type and duration of operations, for use in the design and dispatch strategy of renewable energy technologies at FOBs. Additionally, we demonstrate how to reduce the power consumption of the FOB by improving the configuration of heating and cooling units, lighting, and other power draws within facilities on the base.

2 - Solution Quality and Jackknife Estimators in Large Scale Hydroelectric Scheduling

A. Rodrigo de Queiroz, Professor, Federal University of Itajuba, Av. BPS, 1303, bairro Pinheirinho, Itajuba, MG, 37500-903, Brazil, ar_queiroz@yahoo.com.br, David Morton

In stochastic programs the assessment of solution quality is vital, especially when the size of the problem is too large to be solved to optimality. We model a hydroelectric scheduling problem as a large-scale multi-stage stochastic linear program. We solve this problem via a sampling-based decomposition algorithm. We use jackknife estimators to reduce bias when estimating the optimal value of the stochastic program.

3 - Quantifying the Net Value of Electric Power Generation Technologies in a Capacity Expansion Model

Kelly Eurek, National Renewable Energy Lab, Golden, CO, 80401, United States of America, kelly.eurek@nrel.gov

The Regional Energy Deployment System (ReEDS) is a linear programming model designed to explore the evolution of the electric sector infrastructure under a variety of economic, technology, and policy assumptions. Using the ReEDS model, we develop a method for quantifying the net value that new generation capacity provides to the reliable balancing of supply and demand resources. The net value can be an alternative metric for technology competitiveness, more useful than the ever-present LCOE.

4 - Optimal Power Generation Expansion Planning with Learning Consideration

Soheil Shayegh, Georgia Institute of Technology, North Ave NW, Atlanta, GA, 30332, United States of America, soheilsh@gatech.edu, Valerie Thomas

We introduce a novel optimization approach to the global power generation expansion planning problem. It incorporates an endogenous learning mechanism to update the construction cost and emissions as a function of operating generation for each technology. We include an energy balance system to translate the emissions into the change in temperature. The optimization was performed with two objective functions with or without considering the learning effect and the optimal solutions were compared.

■ MB73

Parc- Mission I

Uncertainty in Climate Policy Modeling

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Robert Barron, University of Massacusetts, 160 Governor's Drive, Room 219, Amherst, MA, 01003, United States of America, barron@ecs.umass.edu

Co-Chair: Erin Baker, University of Massachussetts, Amherst, MA, edbaker@ecs.umass.edu

1 - Grid Integration Cost Assumptions and the Optimal Electricity Supply Technology R&D Portfolio

Robert Barron, University of Massacusetts, 160 Governor's Drive, Room 219, Amherst, MA, 01003, United States of America, barron@ecs.umass.edu, Erin Baker, Noubara Djimadoumbaye

Many low carbon energy technologies are non-dispatchable, which imposes additional costs when these technologies are connected to the grid. This work examines the impact of assumptions about grid integration costs on the optimal R&D portfolio for minimizing the cost of climate change. Absent a budget constraint the optimal R&D portfolio is affected by grid integration cost assumptions, but given a budget constraint grid integration cost assumptions have little impact.

2 - Optimal Climate Policy under Uncertainty: Modeling Catastrophes with Stochastic Control

Delavane Turner, PhD Candidate, Stanford University, Huang Engineering Center, Stanford, CA, 94305, United States of America, delavane@stanford.edu

Greenhouse gas policies balance the costs of reducing emissions and the benefits of avoided climate change. This paper explores climate impacts from sea level rise in the face of an uncertain and potentially irreversible catastrophe. A benchmark integrated assessment model is reformulated with stochastic control to investigate whether precautionary action to reduce the threat of polar ice-sheet collapse is warranted. This work provides insight into managing downside risks of climate change.

3 - Minimizing Water Requirements for Electricity Generation in Water Scarce Areas

Erica Stults, Worcester Polytechnic Institute, 100 Institute Rd, ME Department, Worcester, Ma, 01609, United States of America, estults@wpi.edu, John Bergendahl, Andrew Trapp, Isa Bar-On

Thermoelectric power generation uses approximately 50% of the water withdrawn in the US. We explore the replacement of existing power generation plants by alternative technologies, and its effect on water use. We show how the replacement of traditional thermoelectric generation with renewable solar and wind technologies can reduce future water demands for power generation. A case study replacing a large generation plant in Texas demonstrates a significant decrease in water requirements.

4 - Stochastic Modeling of Energy Technology Portfolios

Ekundayo Shittu, The George Washington University, 1776 G St. NW, Washington, DC, 20052, United States of America, eshittu@email.gwu.edu, Ilka Deluque

In the context of climate change, we present models of energy technology choices and capacity additions under sequential and multiple uncertainties. The investment decisions that firms make on their energy technology portfolios are shaped by uncertainties in demand, technological success or learning and regulatory policy. We unpack the impacts of these layers of uncertainties to indicate that the influence of uncertainty on a firm's spending has different, and sometimes intriguing, outcomes.

■ MB74

Parc- Mission II

Existing Challenges in Non-convex Electricity Markets

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Kory Hedman, Assistant Professor, Arizona State University, PO Box 875706, GWC 206 School of ECEE, Tempe, AZ, 85287-5706, United States of America, Kory.Hedman@asu.edu

1 - System Operator Modifications to Electricity Market Solutions

Mostafa Sahraei-Ardakani, Post Doctoral Scholar, Arizona State University, 519 ERC Building, Tempe, United States of America, mostafa@asu.edu, Kory Hedman

ISOs play the role of the invisible hand in electricity markets with the objective to maximize social welfare. Due to the size and complexities of these non-convex markets, ISOs make many approximations to obtain a solution within a reasonable timeframe. This presentation discusses ISO practices that involve adjustments to the market solution as well as the practice to choose market solutions that may have lower uplift payments, which may coincide with solutions that have less social welfare.

2 - Non-convexities in Electricity Markets: Theoretical and Practical Implications

Alex Papalexopoulos, Dr, President and CEO, ECCO International, Inc., 268 Bush Street, Suite 3633, San Francisco, CA, 94104, United States of America, alexp@eccointl.com, Panagiotis Andrianesis, George Liberopoulos

In centralized day-ahead electricity markets with marginal pricing, unit commitment costs and capacity constraints give rise to non-convexities which may result in losses to some of the participating generating units. We provide both theoretical and practical implications for several mechanisms developed to address the issue of non-convexities, and compare their performance and incentive compatibility.

3 - Challenges in Electricity Markets
Richard O'Neill, Federal Energy Regulatory Commission, 888 First Street NE, Washington, DC, United States of America, richard.oneill@ferc.gov

In ISOs, complexity and transparency can co-exist. The ISO markets contain the necessary complexity to solve the complex operations problems. Financial market exists for those who want simplicity. The presentation will address the challenges in electricity markets including pricing in non-convex markets, stochastic issues, ancillary service markets, uplift or multi-part pricing, and ramp products.

4 - Challenges for Balancing Area Coordination Considering High Wind Penetration
Robin Broder Hytowitz, PhD Student, Johns Hopkins University, 3400 North Charles Street, Ames Hall 313, Baltimore, MD, 21218, United States of America, hytowitz@jhu.edu, Ozge Ozdemir, Ben Hobbs

In order to manage variability in wind generation, balancing area consolidation has been proposed. With an increase in network size, challenges arise in incorporating complexities into system operations and solving to optimality, so the putative efficiency improvements might not be realized. These impacts are assessed with day-ahead and real-time models that consider variability as well as uncertainty through deterministic, stochastic, and trade models, with an example using the COMPETES model.

■ MB75

Parc- Mission III

Simulation and Optimization II

Contributed Session

Chair: Suzanne Marcotte, Associated professor, ESG-UQAM, Dept Management and technology, P.O. Box 8888, Downtown Station, Montreal, Qc, H3C3P8, Canada, Suzanne.Marcotte@cirrelt.ca

1 - Robustness of Capacity Markets – A Stochastic Capacity Expansion Model Applied to the GB Case
Daniel Hach, PhD Student in OR, WHU - Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, daniel.hach@whu.edu, Stefan Spinler

Electricity capacity markets are currently discussed in several countries worldwide – e.g. the U.K. and Texas. We quantitatively assess the effect of different design options on the electricity market. Using a long term stochastic electricity capacity investment model we compare the impact of these design options regarding cost, supply adequacy, and sustainability. Our model includes stochastic conventional plant outages and a robustness framework to reflect uncertain policy changes.

2 - A Chance-Constrained Optimization Model of Urban Land-use Allocation under Seismic Hazard
Chih-Hao Wang, Assistant Professor, California State University Fresno, 4691 Barrington Club Dr, COLUMBUS, OH, 43220, United States of America, cwang@csufresno.edu, Jean-Michel Guldmann

Seismic damages result from interactions between seismic hazards (ground motion/failure) and urban vulnerabilities (land-use pattern). A seismic damage model is statistically estimated with simulated data for Taichung, Taiwan, and is next incorporated into a chance-constrained optimization model allocating future land uses to city districts. This model maximizes the total economic benefits of future land development subject to chance constraints for maximum seismic damages in each district.

3 - Simulating Late Order Management Policies for Proactive Order Consolidation
Suzanne Marcotte, Associated professor, ESG-UQAM, Dept Management and technology, P.O. Box 8888, Downtown Station, Montreal, Qc, H3C3P8, Canada, Suzanne.Marcotte@cirrelt.ca, Walter Rei, Olivier D. Gadoury, Teodor Gabriel Crainic

In the context of global sourcing, Proactive Order Consolidation (POC) is an efficient strategy to perform shipments. However, giving uncertainty in sourcing, one of the main challenges is the management of late orders. In this study, we propose series of operational policies to manage the order delays in the context of organizing shipments. To evaluate these policies, we develop a simulation framework that formulates the general global sourcing process.

4 - Improvement of Work Process Performance with Task Assignments and Mental Workload Balancing
Cansu Kandemir, Ph.D. Candidate, Old Dominion University, 5115 Hampton Blvd., Norfolk, VA, 23529, United States of America, ckandemi@odu.edu, Holly Handley

This research aims to propose a simulation optimization model to evaluate the potential improvements in organizations for performance of work processes. The model created for this study will serve as a test-bed to evaluate different hypotheses on the optimal method to assign employees to tasks based on credentials, while still maintaining a workload balance among employees. The outcome of the study will provide guidance on identifying the region where both goals can be met successfully.

5 - A Reliability Based Approach to Supplier Selection
Layek Abdel-Malek, New Jersey Institute of Technology, University Heights Newark, Newark, 07102, United States of America, layek.abdel-malek@njit.edu, Marta Rinaldi, Eleonora Bottani, Roberto Montanari

A comparison between two scenarios is presented where a company should choose between two policies. The first is to retain one supplier with limited reliability and suffers possible stock out and the second is to have a backup supplier to make up for shortages in case they occur. The comparison aims at assessing the economic profitability of the two scenarios based on the operating conditions. The results of this comparison should provide companies with a tool in design this supply chains

■ MB76

Parc- Embarcadero

Making Operations Research Deliver

Sponsor: The Practice Track

Sponsored Session

Chair: Jack Levis, Director of Process Management, UPS, JLevis@ups.com

1 - Forget the Drones: The Making of the UPS ORION Project
Jack Levis, Director of Process Management, UPS, JLevis@ups.com

To manage the ever increasing complexity of its delivery operations, UPS embarked on an ambitious mission in 1999 to streamline and automate its delivery route planning process. ORION (On-Road Integrated Optimization and Navigation) is the result of this decades long quest. Considered to be the largest operations research project in the world, ORION uses an array of technologies and advanced algorithms, to provide the UPS drivers with optimized routes.

■ MB77

Parc- Market Street

Joint Session Analytics/CPMS: The Whys Hows and Whats of Analytics Certification

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Polly Mitchell-Guthrie, Sr. Manager, Advanced Analytics Customer Liaison, SAS, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com

1 - Why Should you Become a Certified Analytics Professional?
Elizabeth Nielsen, Quintiles, 4820 Emperor Boulevard, Durham, NC, 27703, United States of America, Elizabeth.Nielsen@quintiles.com

Being a Certified Analytics Professional can positively impact your career since it is an independent assessment of knowledge and understanding of business analytics. It can be used as a marketing tool with your customers to show that you take analytics seriously. If you're looking for a new opportunity using analytics, the CAP designation gives your prospective employer an unbiased verification of your qualifications. CAP is the gold standard for the business analytics field.

2 - CAP Exam Prep Tips
Matthew Windham, Director of Analytics, NTELX Inc., 1945 Old Gallows Road, Suite 700, Vienna, VA, 22182, United States of America, mwindham@ntelx.com

How does one effectively prepare for the exam? While each individual is different, with their own learning styles, this session is meant to provide attendees with insights on preparation techniques taken by those who have already passed the exam. The variety of approaches discussed should provide the audience with ample options to consider for their own preparation efforts. Since this is a panel discuss event, audience participation is encouraged.

3 - Gaining the Analytics Advantage through Professional Certification of your Employees
Freeman Marvin, Executive Principal, Innovative Decisions, Inc., 8230 Old Courthouse Road, Suite 460, Vienna, VA, 22182, United States of America, ffmarvin@innovativedecisions.com

The INFORMS Certified Analytics Professional program has obvious benefits to the individual analysts who earn a certificate. What you may not realize are the many benefits to your company, agency, or organization of having employees who are CAP certified. Learn the five advantages that your CAP certified employees can give you over your competition or in the accomplishment if your mission.

4 - From OR Credentialing to Analytics Certification: A Five-Plus Year Journey
Scott Nestler, Chair, Analytics Certification Board, 8419 Riverside Rd, Alexandria, VA, 22308, United States of America, acb@informs.org

In 2008, at the Military Operations Research Society Symposium in New London, CT I heard a short talk about a proposed credentialing program for OR practitioners that caused me to ask, "how can I get involved?" Six years and hundreds of meetings later, I serve as the Chair of the Analytics Certification Board. This talk will provide historical anecdotes about the development of the Certified Analytics Professional (CAP) program, and my thoughts on why it is a worthy venture for INFORMS.

■ MB78

Parc- Mason

Big Data Industry Applications

Sponsor: Analytics

Sponsored Session

Chair: Grace Lin, VP & Director General, Advanced Research Institute, Institute for Information Industry, Taipei, Taiwan, gracelin.ny@gmail.com

Co-Chair: Ya-Hui Chan, Manager, Big Data Analytics, Advanced Research Institute (ARI), Institute for Information Industry (III), Taipei, Taiwan, yhchan@iii.org.tw

1 - Problems and Solutions to Throughput Modeling and Predictive Maintenance for Semi-conductor Packaging
Raymond Yu, Big Data Analytics, Advanced Research Institute (ARI), Institute for Information Industry (III), fishyu@iii.org.tw, Ming-Chen Shen, Grace Lin, Roger Gung, Paul Chou

This paper introduces two problems, solutions, and experimental results in semiconductor packaging: throughput modeling and predictive maintenance. Throughput modeling is about predicting throughput incorporating statistical models and/or data mining techniques by exploring vast amounts of historical data for product/tool specifications and their corresponding throughputs. Predictive maintenance is designed to incorporate throughput models and real-time performance measures that predict failures and performance degradations in order to optimize maintenance policies.

2 - Smart Tourism and Big Data Analytics
Grace Lin, VP & Director General, Advanced Research Institute, Institute for Information Industry, Taipei, Taiwan, gracelin.ny@gmail.com, Tim Lin, Jesse Shih, Ko-Yang Wang

In this talk, a Smart Tourism Initiative that was designed to provide tourists with high quality services, and deeper and more authentic experiences using big data analytics - before, during and after their trips will be presented. Key features include real-time, interactive, heterogeneous tourism information integration and Smart Matching, and O2O personalized SoLoMo-Based Services and Social media connectivity. Some pilot results and next steps will also be discussed.

3 - Analytics in the Cloud
Ko-Yang Wang, Executive Vice President, Institute for Information Industry, kyw@iii.org.tw

The emerging Information and big data analytics technologies are changing the way decisions are made everywhere. In this talk, Dr. Wang will discuss trends in IT, from Service-oriented Architecture, Business Process Management, Smart System Services and Cloud, to SoLoMo, APP and API Economy. The opportunities in leveraging emerging Information Technology for better decision-making will also be discussed.

■ MB79

Parc- Powell I

Decision Analysis in Organizations

Sponsor: Decision Analysis

Sponsored Session

Chair: Robert Bordley, Booz Allen Hamilton, 101 West Big Beaver, Troy, MI, 48085, United States of America

1 - Appreciating Decision Quality … Learning from our Mistakes
Vince Barabba, Chairman, Market Insight Corporation, 308 Cherry Ave, Capitola, Ca, 95010, United States of America, vbarabba@sbcglobal.net

The presentation will illustrate how General Motors improved its enterprise decision making by incorporating the thinking pricess underlying Ron Howard and Howard Raiffa's pioneering efforts. Although the decision process is no longer operating as an enterprise-wide process, some of the key components are still being used within the company. The presentation will focus on the successful impact of the fully integrated system on General Motors between 1985 and 2005.

2 - Which Came First? DA Practice or DA Research?
Jeffrey Keisler, Professor, Univ. of Massachusetts, Boston, 100 Morrissey Blvd, Boston, Ma, 02125, United States of America, jeff.keisler@umb.edu

In decision analysis, research has informed practice and practice has informed research, benefiting the field overall. Important examples from the literature demonstrate this. From reviewing these examples and reflecting on personal experience, I will suggest principles for how we can consciously manage research-practice interactions to continue to make progress.

3 - How to Dispose of California's Defunct Offshore Oil Platforms?
Max Henrion, CEO, Lumina Decision Systems, 26010 Highland Way, Los Gatos, Ca, 95033, United States of America, henrion@lumina.com, Brock Bernstein

The 27 oil platforms off California's coast are reaching the end of their productive lives. Should they be removed at great cost to the oil companies? Or should they be left their with their rich marine ecosystems? An interdisciplinary team created a decision analysis tool with Analytica to help the initially conflicted decision makers find a solution satisfying almost everyone.

4 - Session Summary
Robert Bordley, Booz Allen Hamilton, 525 Choice Court, Troy, MI, 48085, United States of America, rbordley@umich.edu

Decision analysis at General Motors took several forms: (1) the Dialogue Decision Process,(2) Cost Driver Analysis based on Henrion's sophisticated influence diagram software, and (3) Technology Portfolio Mgt —- for which Jeff Keisler, former President of this Society, has recently received a best publication award. Vince Barabba's leadership across these efforts during GM's Golden Age of Decision Analysis highlights DA's value in facilitating enriched cross-functional dialogues.

■ MB80

Parc- Powell II

Value of Information Analysis: Theory and Applications

Sponsor: Decision Analysis

Sponsored Session

Chair: Matthew Bates, Research Environmental Engineer, US Army Corps of Engineers, 696 Virginia Rd, Concord, MA, 01742, United States of America, Matthew.E.Bates@usace.army.mil

1 - Value of Sequential or Static Information in Models with Statistical Dependence
Jo Eidsvik, Professor, Department of Mathematical Sciences, Norwegian University of Science and Technology,, NTNU, NO-7491, Trondheim, Norway, joeid@math.ntnu.no, Gabriele Martinelli, Debarun Bhattacharjya

We describe static and sequential information gathering in multivariate and spatial decision making problems when there is statistical dependence. Value of information analysis is used to compare the static and sequential testing options for a Gaussian portfolio example and a Bayesian network model for petroleum prospects.

2 - Entropy Based Methodology for Valuation of Uncertainty Reduction
Adam Fleischhacker, Assistant Professor of Operations Management, University of Delaware, 222 Alfred Lerner Hall, Newark, DE, 19716, United States of America, ajf@udel.edu, Pak-Wing Fok

We propose a distribution-free entropy-based methodology to calculate the expected value of uncertainty reduction efforts without requiring sampled observations of demand or a priori assumptions regarding the underlying demand distribution. We leverage our results to answer an often overlooked question in demand management: "Is there value in further reducing my demand uncertainty or do I act on my currently available information?""

3 - Prioritizing of Research to Improve Environmental Remediation Decisions
Matthew Bates, Research Environmental Engineer, US Army Corps of Engineers, 696 Virginia Rd, Concord, MA, 01742, United States of America, Matthew.E.Bates@usace.army.mil, Magnus Sparrevik, Igor Linkov, Jeffrey Keisler

Environmental remediation projects are often characterized by high degrees of complexity and uncertainty that make selection of optimal management alternatives difficult, especially when tradeoffs are needed across multiple domains. We apply Value of Information analysis to selection of remediation alternatives for the contaminated sediments of the Grenland Fjord, Norway, based on tradeoffs across uncertain environmental impact, human health risk, societal benefit, and monetary cost objectives.

4 - Putting Qualitative Data to Work: The Other Half of the Data Puzzle
McCall Baldwin, Baldwin Advisory Services, United States of America, mbaldwin@baldwinadvisory.com

In order to further reduce uncertainty in the decision-making process, we need to incorporate both quantitative and qualitative aspects of data. This paper demonstrates methods of identifying, implementing and integrating both quantitative and qualitative aspects of data. The result is a comprehensive approach to data deployment that further reduces uncertainty surrounding the decision-making process. With a reduction in uncertainty comes an improvement in the value of decisions.

■ MB81

Parc- Divisadero

Joint Session Data/AI/HAS: Big Data Analytics and Smart Health I

Sponsor: Data Mining, Artificial Intelligence, & Healthcare

Sponsored Session

Chair: Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com

1 - Blood Donation Tailoring Problem to Improve Blood Supply Management
Guven Kaya, Ph.D. Student, Industrial Engineering-University of Houston, E222 Engineering Building 2, Houston, TX, 77204, United States of America, gkaya@central.uh.edu, Ali Ekici

Blood donation tailoring is to identify blood donation types and collect blood products. Donors perform donation types that provide blood products to patients, having collection/inventory/spoilage costs. We collect data about donation types with demand, cost, time, eligibility percentages, compatibility from blood banks. We develop MIP models to find collected/spoiled/carried blood product amount on single and multi-period settings. We provide results based on data from blood donation centers.

2 - Heterogeneous Postsurgical Data Analytics for Effective Healthcare Services
Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

The rapid advancements of healthcare information technology, biomedical sensors, and computing power have resulted in data-rich environments in hospitals. With massive healthcare recordings readily available, it becomes a challenge for physicians to improve the prediction of postsurgical complications. This paper presents our recent efforts to develop new decision-support methods and tools of heterogeneous postsurgical informatics.

3 - Quantitative Approach for Surgical Task Recognition
Mahtab Jahanbani Fard, Wayne State University, Detroit, United States of America, mahtab.jahanbanifard@wayne.edu, R. Darin Ellis

Recognition of surgical procedure from different granularity level becomes one of the recent interests of researchers. Due to the stochastic description of the physical environment, modeling surgical assessment systems should incorporate with higher level modeling such as HMM which known to be more robust and accurate classifiers. In this study we review existing models and introduce a new model to recognize surgical task using HMM.

4 - Analyze Patient Flow of Appointment System with Blocking by Semi-Markov Model
Jie Song, Peking University/Department of Industrial and Management Engineering, Room512,Founder Building,No.298, Chengfu Road, Haidian, Beijing, HD, 100871, China, songjie@coe.pku.edu.cn, Yu Li, Yaqing Bai

This paper develops a novel method to manage patients' access to its appointment intervals and slots that explicitly takes into account the Key Resource Appointment System(KRAS) in China. A short-run booking window KRAS with blocking and batch transfer has been formulated as a semi-Markov model. Along with the parameters approximation and recursion, we get the close form that can quantitatively estimate the patient indirect waiting time and the system blockages.

■ MB82

Parc- Haight

Multiple Criteria Decision Making Applications

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Murat Köksalan, Middle East Technical University, IE Dept., METU, Ankara, Turkey, koksalan@metu.edu.tr

1 - Bi-Objective Energy and Environmental Policy Research
Sahan Yildiz, Research Assistant, Middle East Technical University, IE Dept. METU, ANKARA, 06530, ysahan@metu.edu.tr, Murat Köksalan, Ebru Voyvoda

We design a bi-objective decision support system for energy policy decisions. We consider maximizing total consumption and minimizing greenhouse gas emissions as objectives and explore the efficient frontier. We also investigate robust policies against external energy price changes.

2 - Finding Preferred Points for Multi-objective Integer Programs
Banu Lokman, Middle East Technical University, Department of Industrial Engineering, Ankara, Turkey, banulokman@gmail.com, Murat Köksalan

We approximate the nondominated set with a hypersurface and identify a preferred point interacting with the decision maker. We then define a small preferred region around the identified point and generate the nondominated points in that region. Computations show that preferred points are generated with little cognitive and computational effort.

3 - Generating Representative Subsets of Nondominated Solutions in Multi-objective Integer Programming
Gokhan Ceyhan, Middle East Technical University, Department of Industrial Engineering, Ankara, 06800, Turkey, gceyhan@metu.edu.tr, Murat Köksalan, Banu Lokman

Generating all nondominated solutions of a multi-objective integer program is neither practical nor useful. The computational burden could be prohibitive and the resulting set could be huge. We develop algorithms to generate a small representative subset of nondominated solutions and we present computational results.

4 - A Probabilistic Approach to Multiple Criteria Sorting
Sinem Mutlu, Middle East Technical University, Department of Industrial Engineering, Ankara, 06800, Turkey, sinemmutlu01@gmail.com, Murat Köksalan, Yasemin Serin

We address the problem of placing alternatives evaluated in multiple criteria into preference-ordered classes. Either the decision maker directly places an alternative or the approach places when the probability of misclassification is below a specified threshold. We demonstrate that the approach works well.

■ MB83

Parc- Sutro

Optimization Models in Data Mining

Sponsor: Data Mining

Sponsored Session

Chair: Petros Xanthopoulos, University of Central Florida, 12800 Pegasus Dr., Orlando, United States of America, petrosx@ucf.edu

1 - Data-driven Analytic Tools for Studying Brain Concussion During Sports
Ioannis Pappas, PhD Student, University of Florida, 3751 SW 20th Avenue, Apt 22, Gainesville, FL, 32607, United States of America, ioannis.p.pappas@ufl.edu, Panos Pardalos

We conduct analysis of EEG readings that were retrieved during a unique live recording of High School athletes playing football in practice. We identified excerpts of EEG before and after a concussion incident that took place during practice. We depict signal interdependencies by quantifying signal correlations using graph theory. We use linear and non linear measures in order to explain the causality of the differences between the EEG before and after the concussion.

2 - Sparse Mixed-Membership Matrix Factorization via Mixed-Integer Programming
Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01602, United States of America, atrapp@wpi.edu, Patrick Flaherty

We consider regularized mixed-membership matrix factorization, where one factor matrix can have a limited number of non-zero entries, and the other has simplex constraints. This provides a mixed-membership representation for each column of the original matrix with sparse mixing components. We transform the original and NP-hard biconvex optimization problem into a mixed-integer linear program, and show that reasonable-size problems can be solved via a sequential refinement approach.

3 - A Robust Consensus Unsupervised Framework for Time Series Clustering

Siavash Haghtalab, University of Central Florida, 1341-North Gate Circle, Apt 105B, Oviedo, Fl, 32765, United States of America, s.haghtalab@gmail.com

Network clustering is an important task for many Manufacturing tasks. Unfortunately different clustering algorithms might give different clustering results for the same data. In unsupervised learning since we do not have any prior information on the data, we do not have any information on how to choose a best fitted algorithm. In this work we will purpose a robust unsupervised framework to show how much the results and robustness of a clustering can be improved even by using bad clustering.

4 - Constraint Subspace Classification Algorithm for High Dimensional Datasets

Orestis Panagopoulos, Graduate Assistant, University of Central Florida, 2220 SW 34th Street, Apt.315, Gainesville, FL, 32608, United States of America, ore.pan@hotmail.com, Panos Pardalos, Vijay Pappu

In this work, we propose the extended binary classification method Constrained Subspace Classifier (CSC). CSC optimizes Local Subspace Classifier (LSC) by accounting for the relative angle between the subspaces and utilizing the projection metric. An efficient alternate optimization technique is also proposed. Simulations demonstrate that the method improves the accuracy of LSC, showing the significance of considering the relative angle between subspaces while approximating the classes.

Monday, 12:30pm – 2:30pm

Hilton Grand Ballroom A-B

Cluster: Interactive Session

Invited Session

Chair: Anna Nagurney, University of Massachusetts-Amherst, Amherst, MA, United States of America, nagurney@isenberg.umass.edu

1 - Operating Room Allocation for Overtime Control with Chance Constraints

Zheng Zhang, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, United States of America, zhazheng@umich.edu, Brian Denton, Xiaolan Xie

This study considers operating room (OR) allocation problems with multiple ORs and random service time. We present a new stochastic programming formulation for surgery planning that guarantees a given proportion of ORs close punctually. We show this can reduce cost and achieve a more equitable balance of overtime for nursing staff. Decisions include a combination of surgery allocation decisions prior to the start of the day and dynamic reallocation decisions throughout the day.

2 - Online Robotic Parameter Optimization for High Precision Manufacturing via Analytic Hierarchy Process

Binbin Li, Texas State University, 1014 Sagewood Trail, San Marcos, TX, 78666, United States of America, b_l77@txstate.edu, Heping Chen, Tongdan Jin

High precision robots are widely used in automobile assembly, remote surgery, and aerospace industry. We propose a Gaussian Process Regression (GPR) model to establish the relation between process parameters and robotic performance including First Time Through and cycle time. Analytic hierarchy process is employed to search for the best covariance function. Experimental data show that GPR outperforms design-of-experiment and meta-heuristics in terms of global optimality and computational time.

3 - Risk Assessment and Mitigation for Food Supply Chains

Yanling Chang, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, changyanling@gmail.com, Brian Kues, Alan Erera, Chelsea White

We propose a dynamic risk analysis method to evaluate and mitigate the risks to food supply chains posed by intelligent and adaptive adversaries. We justify the value of our model by comparison to the traditional risk analysis approach. Finally, we determine the value of the defender's information about the attacker.

4 - Optimization, Discrete-event Simulation and Game Theory to Redesign Hazardous Materials' Logistics

Diana Ramirez, CSO, FCIMEC, Carrera 53 No.74-86 Of. 402, Barranquilla, Colombia, dramirez@fcimec.org, Luis Ramirez, Linda Bendavid, Nilson Herazo, Santiago Nieto, Miguel Jimenez, Lauren Castro, Jairo Montoya

This work integrates Game Theory, Meta-heuristic Optimization and Computer Simulation to solve a real-life location-routing problem found in bulk liquids and hazardous materials' transport. The models search for optimal transport network configuration in order to minimize environmental impacts while improving economic performance. A DSS is developed in which stochastic travel times are considered for daily truck operation.

5 - Equilibrium and Optimal Location of Retail Stores Competing with Mail Order Business

Masaaki Ozawa, Keio University, 5-29-4 Hiyoshi, Kohoku-ku, Yokohama, Japan, ozawa0130@gmail.com

We present a competitive location model in a one-dimensional city model with two competing retail stores and one mail order business. Consumers' choice of store is modeled by the production constraint spatial interaction models. We investigate the characteristics of the equilibrium and optimal location for two stores using different parameter settings: attraction and decay parameter. As the attraction of the mail order business increases, the two retail stores move to two separate locations.

6 - Optimal Inventory Mirroring via Linear Integer Programming

Zhiwei (Tony) Qin, Data Scientist, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, tqin@walmartlabs.com, Jagtej Bewli, Mohan Akella

Inventory mirroring concerns with problem of deciding how many warehouses in the fulfillment network an SKU should be stocked. In the context of online retailing, strategic inventory mirroring allows the retailer to reduce overall delivery and fulfillment costs. In this poster, we propose a practical methodology to approximately solve the optimal inventory mirroring problem, by formulating the problem as a binary integer programming problem.

7 - Seasonal Transmission Switching to Reducing the Cost of Electricity

Masood Jabarnejad, Instructor and PhD Student, Auburn University, 333 East Magnolia Ave., Auburn, AL, 36830, United States of America, masood@auburn.edu, Jorge Valenzuela

Electricity generation infrastructure has a critical role in any country's economy and national security. The more efficient these infrastructures are, the cheaper service and better reliability they can offer to the society. We propose to use and integrate seasonal transmission switching with dynamic thermal rating system to reduce the electric generation costs, save money for the companies and offer cheaper service to the customers.

8 - Value-chain Optimization for Complex Chemical Production Processes

Patrick Briest, McKinsey & Co., Kennedydamm 24, Düsseldorf, 40476, Germany, patrick_briest@mckinsey.com, Isabelle Patouillaud, Valerio Dilda

We propose a novel production planning approach for the chemicals industry centered around an end-to-end optimization model covering the full length of the value chain, from procurement over production to sales. Our model incorporates cost/price curves for raw materials and finished goods and a MIP production model detailed enough to mimic physical plant behavior across all possible production scenarios. We present results based on a first real-life application with a global chemicals company.

9 - Integrating Uncertain Data in Disaster Relief Facility Location

Bin Li, University of Arkansas, Bell Engineering Building 4110, Fayetteville, AR, 72703, United States of America, binli@email.uark.edu, Ashlea Milburn

A multi-objective formulation of the minimax regret for the facility location problem that allows decision makers to open an efficient number of facilities when there is demand uncertainty. The problem is motivated by the recent need of integrating social data from multiple sources in order to make optimal decisions. CPLEX is used for solving three different optimization problems based on three different facility location strategies.

10 - Social Media Usage in Static Disaster Relief Routing Plans

Emre Kirac, PhD Candidate, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ekirac@uark.edu, Ashlea Milburn, Clarence Wardell III

Precise information about the affected people is required so as to perform a quick response in disaster relief. Traditionally, on-the-ground assessment teams collect this information, but it takes some time. Social media can provide additional information about needs in less time, but such needs are not verified. This research evaluates the tradeoff associated with considering unverified information in disaster relief planning. These approaches are compared across a variety of demand scenarios.

11 - Intellectual Map of Information Systems

Mohammadmahdi Moqri, University of Florida, Gainesville, FL, 32611 United States of America, moqri.mo@gmail.com

We improve and redefine the Invisible Networks of Knowledge models as a social network and use it to map the intellectual structure of the field of Management Information Systems. The results help us observe how the field has been evolving and identify the core and emerging areas of research.

12 - The Art of Revenue Management: Optimizing by the LoS in Airport Carparks

Andreas Papayiannis, University of Manchester, School of Mathematics, Manchester, United Kingdom, Andreas.Papayiannis@manchester.ac.uk, Paul Johnson

We investigate the revenue management (RM) problem encountered in airport carparks, where spaces are sold in advance online. Currently, most RM practices in this sector are simple adjustments of those developed for hotels, exploiting the strong similarities of the two industries. However, unlike in hotels where the day of the week strongly affects the price of a room, a distinct setting appears where the daily price of a parking space depends heavily on the length-of-stay (LoS) of the booking. A continuous-time formulation leads to a HJB-type PDE model; by optimizing over the LoS, the PDE is solved to generate the dynamic table of expected marginal values required for bid-price control.

13 - Exploring Scheduling Changes in Clinic Rotations of a Medical Residency Program

Akshit Agarwal, Rochester Institute of Technology, Rochester, NY, 14623, United States of America, aa9425@rit.edu, Ruben Proano

Resident rotational programs require residents to have a one week outpatient clinic assignment every month. We explore the implications of having two consecutive weeks of clinic rotation every two months. We use discrete optimization to generate rotational schedules, and we explore combined metrics to assess the quality of this policy change.

14 - Freeway Reliability Scenario Generation: A Hybrid Approach

SeyedBehzad Aghdashi, NC State University, 803 Essex Forest Dr, Cary, NC, 27518, United States of America, behzad_aghdashi@ncsu.edu

The main objective of the proposed Scenario Generation approach is to increase the quality of each scenario, making it more representative of the expected congestion patterns on the freeway. The proposed approach uses three core mathematical schemes: a) a deterministic mathematical model b) a Monte Carlo simulation, and c) an optimization.

15 - Assessment of Capacity and Stability in National Sustainable Transportation

Hamed Ahangari, PhD Candidate, University of Connecticut, 1 Northwood Rd, Storrs, CT, 06268, United States of America, hamed.ahangari@uconn.edu, Carol Atkinson-Palombo, Norman Garrick

In last three decades, transportation system was faced with sustainability concerns but few efforts have been made to develop national sustainable transportation index-NTSI. This research use a nested approach to estimate NTSI by 19 environmental, social, and economic indicators in 30 developed countries. We also suggest and measure two new dimensions to assess sustainable systems: capacity and stability. Results offer a three dimensions clustering model to classify different countries.

16 - A Multi-criteria Approach to Maritime Search and Rescue Location Analysis

Amin Akbari, PhD Student, Dalhousie University/ Industrial Engineering Department, 5269 Morris Street/ PO Box 15000, Room R1-203, Halifax, NS, B3H 4R2, Canada, amin.akbari@dal.ca, H.A Eiselt, Ronald Pelot

This study's aim is to analyze the optimal location-allocation of maritime search & rescue resources by applying customized versions of the maximal covering and p-median problems. The optimal solutions of these two models are compared in terms of three decision criteria: (1) coverage; (2) mean access time; and (3) service equity. The results show a significant increase in resource utilization based on coverage and response time criteria for the model solutions compared to the current situation.

17 - Tournament Scheduling for Recreational Leagues

Athena Alimirzaei, Clinical Assistant Professor, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, athena.alimirzaei@utdallas.edu

There are many thousands of recreational sports leagues worldwide for both youth and adults of all ages. The recreational league scheduling problem is to assign matches in a given league to the resources allocated to that league. This work is motivated by the scheduling problem faced by the local company AllPlayers.com. A goal programming model has been developed to generate sports schedules on-line with various goals and restrictions.

18 - A Novel, Simple Interpretation of Nesterov's Method as a Combination of Gradient and Mirror Descent

Zeyuan Allen-Zhu, MIT, 32 Vassar St, Rm 32-G636, Cambridge, MA, 02139, United States of America, zeyuan@csail.mit.edu, Lorenzo Orecchia

Almost all first-order methods rely on two types of algorithmic steps: gradient-descent and mirror-descent steps. We obtain a simple interpretation of Nesterov's accelerated gradient method by expressing it as a natural coupling of the two types of steps. This interpretation has facilitated some recent breakthroughs (of the same authors) in approximately solving packing and covering LPs in nearly-linear time.

19 - Admission Batches to Minimize Internal Shuffles in a Centralized or Decentralized Hospital

Bruno Alves Maciel, Rochester Institute of Technology, 979 Nathaniel Rochester Hall, Rochester, NY, United States of America, ba8641@rit.edu, Ruben Proano, Richard Latham

We analyze the impact of a batched bed assignment process on the number of internal movements in several hospital units. The process can be applied under a centralized or decentralized admission policy, varying the amount of time between batch admissions while trying to minimize the number of internal movements. Our preliminary results show that under a centralized policy the need for internal movements can be completely eliminated.

20 - Evaluating and Testing Contemporary Snow Removal Routing Models under Ongoing Weather Conditions

Nathan Arrowsmith, RIT, 298 Pennels Dr, Rochester, NY, 14626, United States of America, nea4305@rit,edu

Snow removal route scheduling is a major component of winter weather planning. Recent approaches have focused on plowing all streets as quickly as possible and have demonstrated notable reductions in deadheading. These approaches however have largely ignored the impact of ongoing snow accumulation in the decision making process. By considering weather and traffic behavior, these methods can be evaluated for their efficacy during snow events. An accumulation-aware model is also under evaluation.

21 - The Effect of Urban Form and Location in Consumer Satisfaction

Homa Atef Yekta, Sharif University of Technology, Azadi St., Tehran, Iran, homa.atefyekta@gmail.com, Hamed Ahangari

Determinant of consumer satisfaction includes series of endogenous and exogenous factors. This research hypothesizes that urban form and business location are exogenously contributing in consumer satisfaction. We use online rating as the proxy of satisfactions. For location and urban variables we consider parking number, walkability score, network scale, and network density. The findings show that there is a strong statistical relation between urban form and consumer satisfaction.

22 - Efficiency Initiatives in Catalyst Production Lines the Use of Simulation as a Tool to Support Energy

Alexandre Augusto Massote, Professor, FEI University, Campus of S„o Bernardo, S„o Bernardo do Campo, Brazil, massote@fei.edu.br

This work includes the energy efficiency variables within the context of manufacturing systems and the aims are: to emphasize the importance of planning the production including variables related to energy; to use the simulation for improving the efficiency of the energy into industries; to investigate the opportunities of saving energy.

23 - Analyzing Tweets to Inform a Model of Patient Choice, Arrival Rates and Wait in Emergency Rooms

Barry Barrios, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, barriosb@vt.edu, Ekkehart Beck

Patients tweet about their experience in emergency departments (EDs). We show how these relate to observed arrival and waiting time patterns seen in US EDs. Using these data we develop a model to study the effect of patient tweets on patient choice of ED, arrival rates and waiting times.

24 - The Care Life Cycle: Linking Health and Social Care for an Ageing Population

Sally Brailsford, Professor of Management Science, University of Southampton, School of Management, Southampton, United Kingdom, s.c.brailsford@soton.ac.uk

The Care Life Cycle is a five-year multidisciplinary research program funded by the UK EPSRC. Its aim is to apply "complexity science" methods to study the links between supply and demand for health and social care in an ageing population. We have developed a suite of linked simulation models, including an agent-based model of family formation, a system dynamics model of social care provision, and a hybrid DES-SD-ABS model for the eye condition age-related macular degeneration.

25 - Managing Stakeholder Voices for the Development of a Novel Rehabilitation Device for Upper Limbs Rehabilitation

Aline Marian Callegaro, Universidade Federal do Rio Grande, Porto Alegre, 90035190, Brazil, nimacall@gmail.com, Amanda SÛria Buss, Carla Schwengbe ten Caten, M·rcia Elisa Soares Echeveste, Raffaela Leane Zenni Tanure

The development of new technologies for the health area must take into consideration customer requirements from different stakeholders of the product value chain. This study aims in managing requirements from different stakeholders to develop a novel rehabilitation device for upper limbs rehabilitation. The Customer Value Chain Analysis (CVCA) tool was used to identify stakeholders and the Quality Function Deployment (QFD) tool to analyze and prioritize the requirements. Study results are described according the engineering requirement process: elicitation, analysis, and documentation. The results of this new approach of managing requirements report technology inputs for the development process of new medical devices.

26 - Modeling and Assessing Health Care Services Utilization in Hospital Readmission for Cancer Patients

Hanqing Cao, Senior Scientist, Philips Research North America, 345 Scarborough Rd, Briarcliff Manor, NY, 10510, United States of America, hanqing.cao@philips.com, Usha Raghavan, Yugang Jia

Healthcare services utilization data have not been previously employed to assess the readmission risk for cancer patients, while both are at the high priority of US government aiming to cutting cost. We developed models to investigate the relationship between health care services utilizations with unplanned 30-day hospital readmission. A number of interesting insights were generated from healthcare services utilization and unplanned hospital readmissions for cancer patients.

27 - Literature Review of Mathematical and Simulation Models for School Closures in Pandemic Influenza

Yao-Hsuan Chen, CDC, 1600 Clifton Rd, Atlanta, GA, 30333, United States of America, xhj1@cdc.gov, Amra Uzicanin, Karen Wong, Hongjiang Gao

We reviewed assumptions, structures, parameters, and results of published models that evaluated effects of school closures implemented to mitigate impact of an influenza pandemic. Out of 1587 papers identified in the initial search in PubMed, 39 met inclusion criteria for further review. Despite great variety in model specifications, published models found school closures to be effective in mitigating a pandemic influenza outbreak when implemented quickly and for sufficient duration.

28 - Eliciting and Combining Expert Opinion ñ An Overview and Comparison of Methods

Mutsa Chinyamakobvu, Masters Student, Rhodes University, P.O. Box 94, Grahamstown, EC, 6140, South Africa, m.chinyamakobvu@ru.ac.za, Isabelle Garisch

This paper is an overview and comparison of the elicitation and combination methods available for Expert Judgement Analysis. These include the traditional committee method, the Delphi method, the paired comparisons method, the negative exponential model, the classical model, the histogram technique, using the Dirichlet distribution and the employment of overfitting. The supra Bayes approach, and combining the opinions of experts given as confidence levels, are also considered.

29 - Design of Fuel Supply Chain for Power Plants: A Hybrid Stochastic and Robust Optimization Approach

Anna Danandeh, University of South Florida, 4202 E Fowler Ave, Tampa, FL, United States of America, annadanandeh@mail.usf.edu, Bo Zeng

42 percent of the US electricity power is generated from burning coal, whose quality variations may cause violations of EPA regulations. In this project, we develop a stochastic-robust hybrid multi-stage and multi-generator optimization model in which the demand randomness is described by a set of scenarios and the concept of uncertainty set is adopted to bound quality variations.

30 - NP-Hardness Proof for the Maintenance Scheduling for Modular Systems Problem

Tamar Cohen, Technion Israeli Institute of Technology, 11 Hagalil St., Gival Ela, Israel, tamar.cg@gmail.com, Liron Yedidsion

The Maintenance Scheduling for Modular Systems problem consists of a tree of components with respective cycle limits. The cycle limit for each component specifies the time interval in which it must be repaired. In order to reach a component in the tree its predecessor module must also be disassembled. The goal is to find a periodic replacement policy that minimizes the cost associated with component maintenance and module disassembly. In this paper we provide a proof that the problem is NP-hard.

31 - A Scenario-based Approach to Inventory Routing Problem

Vinayak Dinesh, RIT, 6000 Reynolds Drive, Rochester, NY, 14623, United States of America, vxd9920@rit.edu, Scott Grasman

Inventory routing problems (IRPs) that integrate inventory & routing problems can be considered a shift towards centralized thinking, influenced by practices like VMIs. This research tries to solve an IRP using a scenario based approach, considering uncertain demands. Furthermore the number of scenarios has been reduced by grouping retail centers showing similar demands with techniques like K-means clustering. As per our knowledge this is the first attempt at solving IRPs using this approach.

32 - Optimal Sampling Times for a Partially-observable Growing Population

Ali Eshragh, Lecturer/Researcher in Statistics and Optimization, The University of Newcastle, School of Mathematical and Physical Science, Callaghan, NS, 2308, Australia, Ali.Eshragh@newcastle.edu.au

Our goal is to estimate the rate of growth of a population governed by a simple birth process. We may choose (n) time points at which to count the number of individuals present, but due to detection difficulties, we are able only to observe each individual with fixed probability (p). We discuss the optimal times at which to make our (n) observations in order to maximize the Fisher Information for the rate of growth and support our theoretical results by numerical experiments.

33 - Model-based Simulation Systems for Adaptive Training in Time-critical Decision Making

Kushal Abhyankar, Wright State University, Dayton, OH, United States of America, kushal.abhyankar@wright.edu, Subhashini Ganapathy

The main goal of education and training is to provide capabilities that can help humans improve performance and accelerate decision-making. Advances in mobile computing (e.g., sensor technology, context aware computing, and cloud computing) allow for the design of systems that goes beyond the traditional methods of simulation training to support adaptive learning. The focus of this paper will be to present a human performance model for disaster response through sensor-based information.

34 - Textbooks for Responsible Data Analysis in Excel

Nathan Garrett, Woodbury University, 7500 Glenoaks Blvd., Burbank, CA, 91510, United States of America, nathan.garrett@woodbury.edu

With 27 million users, Excel is the most common data analysis software. However, audits show that almost all complex spreadsheets have errors. This project examines textbooks to understand why; are we teaching responsible data analysis? These textbooks are compared against spreadsheet development best practices. The results show a wide range of approaches, and that none of the ten books fully covers both the features and methodologies needed to create well-rounded Excel data analysts.

35 - Scheduling Multiple Parallel Machines with Capacity Constraints

Lai Wei, University of Michigan, Ross School of Business, Ann Arbor, MI, United States of America, laiwi@umich.edu, Dongdong Ge, Simai He

This work studies the problem of scheduling n independent jobs on p identical machines, with a limit on the number of jobs (q) that can be assigned to each machine. The goal is to minimize the total weighted completion time of the jobs. We consider both its deterministic case and the 2-≠stage stochastic optimization model and provide constant approximation algorithms for both problems.

36 - Total Value-of-ownership Model for Analyzing the Economics of a Fleet of Electric Vehicles

Thomas Goerzen, PhD Student, University of Paderborn, Warburger Strafle 100, Paderborn, Germany, Thomas.Goerzen@wiwi.uni-paderborn.de

We present a total value of ownership model to analyze the economics of a commercial fleet of electric vehicles. In comparison to existing models, we consider a significantly larger number of different cost and value parameters. Thereby we provide a better insight into the economic potential of electrified car fleets.

37 - Maximizing Sandfly Mortality for Controlling Kala-Azar Transmission in India

Kaushik Gorahava, Senior Quality Engineer, Verotech Solutions, LLC, 6189 NW 72nd Way, Parkland, FL, 33067, United States of America, kgorahava@gmail.com

Leishmaniasis is a family of human infectious diseases spread by the bite of sandflies. The Indian state of Bihar has the highest Leishmaniasis mortality rate in the world. Currently in Bihar, DDT (for controlling Leishmaniasis) is distributed only according to human population size. Is this process of insecticide distribution optimal? In this research, we explore this question by using models which optimize sandfly mortality rate under limited budget scenario.

38 - Demand Substitution in a Dual Sourcing Problem

Mustafa Hekimoglu, PhD Student, Erasmus University, Postbus 1738, Rotterdam, 3000 DR, Netherlands, hekimoglu@ese.eur.nl, Alan Scheller-Wolf

We consider quality difference between products from two suppliers. A natural outcome of this quality difference is demand substitution between products from two suppliers. We prove that the cost function for this model is pseudoconvex, which indicates the optimality of dual index policy under a mild sufficient condition. Also, a heuristic policy is developed by exploiting the myopic cost function. Extensive numerical tests show the heuristic deviates 7% from the optimal cost.

39 - Optimized Surveillance for Mosquito-borne Infections in Louisiana

Alexander Gutfraind, University of Illinois at Chicago, 1603 W. Taylor Street Rm. 834, MC 923, Chicago, IL, 60612, United States of America, agutfraind.research@gmail.com, Justin Davis, Krishna Patel, Lauren Meyers

Mosquito-borne infections, such as the West Nile Virus, cause millions of infections every year around the globe and in the USA. Infection control requires monitoring of the mosquito vectors. Here we report on one of the first applications of OR methods to this problem. Based on multiple years of data from St. Tammany Parish, LA we developed a spatial statistical model for the surveillance network. Using the model we optimized the efficiency and sensitivity of the surveillance schedule.

40 - Failure at the Top: How Power Undermines Collaborative Performance

John Hildreth, UC Berkeley, 2220 Piedmont Avenue, Berkeley, CA, United States of America, angus@berkeley.edu, Cameron Anderson

How does leaders' power affect their ability to work with other leaders? Laboratory experiments and field studies of executives found that groups of high power individuals performed worse than other groups: High power individuals were less creative when working together in groups and less able to reach agreement on difficult negotiation tasks because these groups engaged in more status conflict, were less focused on their tasks, and shared task information less effectively with each other.

41 - Departure Process in Heavily-loaded Service Systems with General Service Times

Junfei Huang, Assistant Professor, The Chinese University of Hong Kong, No.12, Chak Cheung Street, Shatin, N.T., Hong Kong - PRC, junfeih@cuhk.edu.hk

We derive an approximation for departure process in heavily-loaded service systems with general service time distributions. The results is based on some comparison results between loss systems and systems with buffers.

42 - Impact of Operational Drivers on Repurchase Intention in E-fulfilment

Nikunj Jain, Indian Institute of Management Indore, Rau-Pithampur Road, Prabhand Shikhar, Indore, MP, 453331, India, f11nikunjk@iimidr.ac.in

This study empirically examines the relationship between repurchase intention of customers and order procurement, order fulfilment and reverse service exchanges processes in an online retail environment. After controlling for customers' preferential brands, partial least squares structural equation modelling(PLS-SEM)analysis shows that operational drivers(ease of return,product information,product availability and condition of product on arrival)significantly affect repurchase intention.

43 - Towards Zero-carbon Manufacturing Operation: An Advanced Analytics Decision

Tongdan Jin, Associate Professor, Texas State University, 601 university Drive, San Marcos, TX, 78666, United States of America, tj17@txstate.edu, Victor Santana-Viera, Binbin Li, Heping Chen, Jesus Jimenez

This research performs a feasibility analysis on operating large manufacturing facilities under one hundred renewables penetration. We integrate wind turbines and concentrated photovoltaics into large enterprise systems to achieve zero carbon emissions goal. Our numerical experiments show that 100% renewable energy penetration is virtually affordable to any manufacturing facility in the world.

44 - New Branching Rules for Integer Programming using Strong Branching and Sampling

Ezgi Karabulut, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, ezgi.karabulut@gatech.edu, Pierre Le Bodic, George Nemhauser

In this research, we aim to utilize a sampling approach in branch-and-bound trees. For that purpose, we incorporate sampling and strong branching with multiple levels. The first round of experiments on multicommodity network flow problems with fixed charge yield promising results for optimality gap in fixed amount of time.

45 - Iterative Simulation-optimization Algorithm for the Ambulance Location Problem

Sun Hoon Kim, Yonsei University, Korea, Seoul, Korea, Republic of, misia789@hanmail.net, Kee Yong Shin, Hyuk Lee, Cheng Yu Hwang, Young Hoon Lee

This study suggests an iterative simulation optimization algorithm for an ambulance location problem to minimize the number of vehicles while achieving required reliability level. An optimization model in the suggested model provides information regarding location of ambulances, the simulation model is used to validate the solution and interaction parameters are updated based on the simulation results. The computational experiments show that the suggested model outperforms existing algorithms.

46 - A Gage R&R Study in a Healthcare Setting

Russell Krenek, Clemson University, 129 Freeman Hall, Clemson, SC, 29634-0920, United States of America, rkrenek@g.clemson.edu, Shannon Harris, George Helmrich, Joel Greenstein, Byung Rae Cho

Despite being paramount to healthcare quality improvement initiatives, Gage Repeatability and Reproducibility studies in a hospital setting are rarely studied in the literature. This poster discusses a Gage R&R experiment in a hospital setting by developing various aspects of the quality of measurement associated with medical devices and processes to identify what part of measurement variability is affected by repeatability and reproducibility. A strategy for collecting data is also presented.

47 - Demand Forecasting by Factorization Machines in Fashion Industry

Chongshou Li, Phd Candidate, Department of Management Sciences, City University of Hong Kong, To Yuen Building - 2802, Tat Chee Avenue, Kowloon,Hong Kong, Hong Kong - PRC, chongshli2-c@my.cityu.edu.hk, Andrew Lim, Brenda Cheang

Demand forecasting is a challenging problem because demands for fashion products are highly affected by season, region and short life cycle. Factorization Machines (FMs) have recently been proposed as generic predictors and solved such problems in many areas. In this study, a novel model based on FMs is proposed for fashion products demand forecasting based on sixteen months of sales data from a multinational fashion retailer. Experimental results show that our approach produces good results.

48 - Optimal Pairing of Single and Multi-occupancy Rooms in a Centralized or Decentralized Hospital

Richard Latham, RIT, 6000 Reynolds Dr., Box 509, Rochester, 14623, United States of America, rel5224@rit.edu, Ruben Proano, Bruno Alves Maciel

The study uses a response surface design with a Monte Carlo simulation experiment to determine the best room configuration for a hospital interested in reducing the number of internal shuffles. These shuffles result from the need to implement isolation requirements to control healthcare-acquired infections in multi-occupancy rooms. The model determines the optimal pairing of single and multi-occupancy rooms in each unit when using a decentralized or centralized scheduling methodology.

49 - A Multilevel Proximal Algorithm for Large Scale Composite Convex Optimization

Duy Luong, Dr, Imperial College London, South Kensington, London, SW7 2AZ, United Kingdom, vu.luong@imperial.ac.uk

Composite convex optimization models consist of the minimization of the sum of a smooth convex function and a non-smooth convex function. Such models arise in many applications where, in addition to the composite nature of the objective function, a hierarchy of models is readily available. We propose a novel method to take advantage of the hierarchy of models for computing the search directions. We establish the global convergence and compare with two popular algorithms (ISTA and FISTA).

50 - Improving Model Inference from FRAP Data – An Example from the Drosophila Wing Disc

Lin Lin, University of Minnesota, Twin Cities, 1618 Eustis St., Saint Paul, MN, 55108, United States of America, linlinbme2009@gmail.com

Fluorescence recovery after photobleaching (FRAP) is used to obtain quantitative information about diffusion and binding kinetics by fitting the experimental data to a mathematical model. However, when the system involves the complex interaction of transport and reaction steps, the question arises as to what level the system should be modeled and how one is to estimate the parameters. I will propose a theoretical approach to investigate these questions and to improve parameter estimation.

51 - Allocating Linear Rescheduling Cost with Machine Unavailability

Zhixin Liu, University of Michigan - Dearborn, 19000 Hubbard Dr, Dearborn, MI, 48126, United States of America, zhixin@umich.edu, Liang Lu, Xiangtong Qi

We study a rescheduling problem faced by multiple jobs owners, where jobs need to be rescheduled to minimize the total weighed completion time, when the machine becomes unavailable for a period of time and the initial optimal schedule becomes infeasible. We provide a simple closed form core allocation of the total cost saving for all the jobs, and also provide the Shapley value of the game in a computable form.

52 - Stochastic Modeling and Optimization of Biomanufacturing Operations

Tugce Martagan, University of Wisconsin-Madison, 4701 Sheboygan Ave Apt 302, Madison, WI, United States of America, martagan@wisc.edu, Ananth Krishnamurthy

We consider the manufacturing of custom-made proteins. We first develop reliability models and condition-based control policies for fermentation systems. Next, we investigate optimal protein purification strategies via dynamic programming to minimize costs. We collaborate with several local biomanufacturing companies to validate our models and implement our findings.

53 - Measuring Near Real-time Harm in the Hospital using Electronic Health Records (EHR)

Seyed Mani Marashi, PhD Student, Wayne State University, 4815 Fourth Street, Detroit, MI, 48202, United States of America, ez6964@wayne.edu, Jack Jordan, Kenneth Chelst

Harm occurs when a patient develops a new medical problem in a hospital. It is historically measured using billing data that lags the actual harm by weeks and also has accuracy issues. We used electronic health records to achieve better and faster measurement using cases of venous thromboembolism.

54 - Mathematical Analysis of Fireworks Displays with Respect to Solid Angles

Yohei Okimura, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, 223-8522, Japan, youhei.o@a7.keio.jp, Yudai Honma, Takamori Ukai, Osamu Kurita

Fireworks displays are typical features of Japanese summer. We propose a mathematical model to evaluate the optimal viewing points for fireworks displays based on computational geometry algorithms. We calculate the solid angles of actual fireworks displays with respect to the shielding by millions of existing buildings in Tokyo metropolitan area.

55 - Evaluating Algorithms for Processing Nuclear Detection Sensor Data

Christie Nelson, Rutgers University, 23A Norwood Ct, Princeton, NJ, 08540, United States of America, christie.l.nelson.phd@gmail.com, William M. Pottenger, Fred Roberts, Paul Kantor

Many nuclear detection algorithms have been developed for scanning vehicles for threats and must be evaluated fairly. An approach is to conduct experiments with simulated data using sensor data as input, with a goal to find experimental configurations revealing meaningful differences between algorithms. Combinatorial Experimental Design provides a set of configurations which cover all levels and pairs of levels of important variables; these must be reviewed and valued by subject matter experts.

56 - Exact and Heuristic Anytime Algorithms for Solving the Knapsack Problem

Diego Mesquita, University of Alberta, 2-32 Athabasca Hall, Edmonton, AB, T6G2E8, Canada, parentep@ualberta.ca

In 1997, Richard E. Korf presented an approach for solving Combinatorial Optimization problems which has been successfully applied to problems such as Number Partitioning and Bin Packing. In this work we apply it to the Knapsack Problem and provide a critique of Korf's method.

57 - Group Buying: Retail Stores' Performance and Implications

Qijun Qiu, The University of Hong Kong, RM 723, 7/F, K.K. Leung Building, Pokfulam RD., Hong Kong, Hong Kong - PRC, angieq@connect.hku.hk, Benjamin Yen

We study a new promotion strategy, Group Buying (GB), in which consumers enjoy a price discount by forming a group. We build monopoly and competition models to examine if and how store offers GB in a sustainable manner. We find that store's decision depends on the market pattern and its regular pricing policy, while it still can manage to secure a reasonable profit. Further, store competition affects the equilibrium in a quite dramatic way. All these explain the prevalence of GB worldwide.

58 - Credit Card Holders Behavioral Modeling: Multistage Regression Approach

Denys Osipenko, Doctoral Researcher, University of Edinburgh Business School, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, denis.osipenko@gmail.com, Johnathan Crook

Because of the variety of the card holders' behaviour patterns and income sources each consumer account can move to different states. The key question is which approach gives more accurate results: multinomial logistic regression or multistage decision tree with binary logistic regressions. This paper investigates the approaches to credit cards profitability estimation at account level based on multistates conditional probability.

59 - AI-AFTER: Identifying the Right Goal of Forecast Combination

Craig Rolling, Assistant Professor, Lundquist College of Business, 1208 University of Oregon, Eugene, OR, 97403, United States of America, crolling@uoregon.edu

There are two potential goals of forecast combination: combining for adaptation or combining for improvement. It is important to know which goal is more appropriate for a given analysis so that a suitable combination method may be used. AI-AFTER first determines the appropriate goal of forecast combination, then combines the forecasts to achieve the proper goal. As a result of this approach, the combined forecasts from AI-AFTER perform well in both adaptation and improvement scenarios.

60 - Modeling Red and Yellow Alert Durations for Ambulance Systems as Partial Busy Periods

Amir Rastpour, University of Alberta, Edmonton, AB, Canada, rastpour@ualberta.ca

Ambulance system Red and Yellow alerts are time periods during which all or most ambulances are busy, respectively. Modeling such systems as Erlang loss systems, we obtain the first moment of alert period duration, and show that our results are consistent with empirical data from Calgary. We also obtain alert duration Laplace Transform and higher moments when the service time distribution is general. We study the impact on alert duration of increasing the number or service speed of ambulances.

61 - Development of Control Models for the Planning of Sustainable Transportation Systems

Alexander Paz, University of Nevada, PO BOX 454015, Las Vegas, NE, 89154, United States of America, apaz@unlv.edu, Pushkin Kachroo, Pankaj Maheshwari

The proposed research envisages how to incorporate sustainability considerations into the transportation planning process. A dynamic model for planning and development of sustainable transportation systems is presented. A system of three nonlinear differential equations is used to represent the dynamics of three states; namely Transportation, Activity, and Environmental systems. A policy scenario considering investment in energy efficient technologies and its effects is discussed.

62 - The Behavior of Government Subsidies to Low-carbon Products and Social Welfare Analysis

Jie Ren, University of Science and Technology of China, School of Management, 96 Jinzhai Road, Hefei, 230026, China, ahrj@mail.ustc.edu.cn

We study the effect of government subsidies to individual consumers, manufacturers or both subsidized by using three modes of game between government and enterprises. In order to provide a support for the government to make scientific subsidies decisions and for the manufacturers and consumers to make good decisions in the context of government subsidies, we analysis the impact of different government subsidies modes on the manufacturer's revenue, consumer surplus and social welfare.

63 - A Defender-Attacker-Defender Model for Railway Infrastructure

Hassan Sarhadi, PhD Student, Memorial University of Newfoundland, 57 Allandale Road, PO BOX 534, St.John's, NL, A1B 3S7, Canada, hassan.sarhadi@mun.ca, David Tulett, Manish Verma

Owners of railway facilities need to defend their assets, particularly railyards, against attack by terrorists. We use a Defender-Attacker-Defender framework to model this problem. The resulting mathematical formulation is very complex, but we are able to solve the problem optimally for a small number of protected/interdicted terminals.

64 - Buyer-supplier Relationship: The Impact of Service Logistics Level in Customer Satisfaction and Loyalty

Mauro Sampaio, FEI University, Campus of S„o Bernardo, S„o Bernardo do Campo, 09850-901, Brazil, msampaio@fei.edu.br

The objective of this research is to demonstrate the impact of logistics service on customer satisfaction and, consequently, on their loyalty. Empirical evidence is provided on the relationship between operational and relational performance, satisfaction, affective commitment, purchasing behavior and loyalty of buyers from the Brazilian industry.

65 - Using Big Data Analytic to Eliminate Empty Miles in Logistics

Haibo Wang, Texas A&M International University, 5201 University Blvd, Laredo, TX, 78041, United States of America, hwang@tamiu.edu, Wei Wang, Jun Huang, Wei Ning

This study presents a framework using information system based on big data analytic and cloud computing to eliminate empty miles to improve the efficiency of logistics. First, data and text mining tools are used to extract valuable information automatically for input, then a mathematical programming model is proposed to solve the problem of matching shipments with carriers in term of time and cost. The customer retention and dynamic pricing schedule are also implemented in the proposed system.

66 - Discounting over Subjective Time: One Step Towards a Unified Theory of Intertemporal Choice

Yitong Wang, Lecturer, University of Technology, Sydney, Cnr Quay Street and Ultimo Road, Haymarket NSW, NS, 2000, Australia, yitongwang@uts.edu.au, L. Robin Wang, Liangyan Wang

Discounted utility theory has been regarded as the normative theory when modelling inter-temporal choice. However, existing research suggests people in general don't obey discounted utility theory as their discount rates are context dependent. This paper incorporates decision makers' time perception into discounted utility model and finds relatively constant discount rates over subjective time. Our finding helps in developing a unified theory for inter-temporal decision making.

67 - Dynamic Optimal Inflow Control with Queues for Minimal Evacuation Time in a Tsunami Inundated Area

Junji Urata, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, 1138656, Japan, urata@bin.t.u-tokyo.ac.jp, Eiji Hato

The optimal control is needed to prevent a traffic congestion for evacuation in a tsunami inundated area. This paper proposes a dynamic inflow control model on intersections and aims to minimize the evacuation time. This model treats the flow conservation, the FIFO and the physical queues in a many-to-one network. The Pontryagin's maximum principle is applied to get the earliest evacuation time. The dynamic optimization is formulated by the constrained conditions of DTA.

68 - Operations Research for Functional Neuroimaging
Svetlana Soloveva, PhD Student, Rutgers University, 617 Bowser Road, Piscataway, NJ, 08854, United States of America, svetsolo@rutgers.edu, Dimitris Metaxas

Our goal is to identify disease related features and common features of a healthy brain through characterization of changes in connectivity of functional networks. Our neuroimaging data is recorded with MEG and MRI. We solve inverse electromagnetic problem for realistic head models to localize sources of activity in the brain. Measures of functional similarity are used for network analysis.

69 - WLC-based Process Plan Decision and its Heuristic Approaches
Boxuan Zhao, Xi'an Jiaotong University, Xi'an, China, zbx.1067@stu.xjtu.edu.cn, Kun Chen, Jianmin Gao

This paper investigates WLC-based process plan decision which is a real-time dynamic and closed loop decision-making method for process planning, and derives nine heuristic approaches. The simulation results in the general job shop show the strategies considering order features outperform those considering shop status. The processing-time-related strategies perform best and present a good robustness as the workload control is relaxed. The locations of focused stations affect their performances.

70 - Common Pitfalls in "Common Practice"
Channing (Chang) Yan, Senior Consultant, Decision Strategies, Inc., Houston, TX, 77042, United States of America, cyan@decisionstrategies.com

Traditionally drilling time and cost have always been estimated deterministically. A typical approach is to develop an approximate average and then add enough contingency until we feel comfortable with the number. Few people realize the danger of this practice, and most consider it to be "conservative"; hence it is all "good". This paper challenges the convention and demonstrates what has always been done in the past is not necessarily always right or a best practice. It points out several common pitfalls in our common practice as well as challenges in influencing people with a new way of thinking.

71 - Modeling Brand Correlation through Iterative Sparsity Search
Qiong Zhang, Virginia Commonwealth University, 1015 Floyd Avenue Richmond, VA 23284-308, Richmond, va, 23294, United States of America, zhangqiong1985@gmail.com

We propose a novel statistical approach to estimate the covariance structure of multiple brands in grocery stores. The method can also be used for predicting brand performances in unexplored markets.

72 - A Simulated-based Approach for ED Patient Throughput and Med/surg Unit Workforce Optimization
Jingyu Zhang, Philips Research North America, 345 Scarborough Rd, Briarcliff Manor, NY, 10510, United States of America, jingyu.zhang@philips.com, Xiang Zhong, Zhichao Shu, Therese Fitzpatrick

Many hospitals in the US face serious patient throughput problems especially in their emergency department (ED). While new patients wait long time for ED beds, ED beds are still occupied by those patients who should have moved to other general med/surg units. A root cause is the workforce utilization problem in those general units. We developed a simulation-based approach to improve ED patient throughput and optimize med/surg unit workforce simultaneously.

73 - Modified Cell Transmission Model for Traffic Signal Control Optimization
Hao Yu, Southeast University, 2 Sipailou, Nanjing, 210096, China, seudarwin@gmail.com

The traffic signal timing optimization problem is formulated based on a modified cell transmission model. The node model of the new CTM is enhanced to capture complex traffic signal control strategies. Detailed model structure is proposed, as well as some numerical studies. It shows that the new model is able to simulate different traffic signal control strategies, with quite low additional computation."

Monday, 1:30pm - 3:00pm

■ MC01

Hilton- Golden Gate 6

Sensors and Weapons

Sponsor: Military Applications Society

Sponsored Session

Chair: Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Optimizing Sensor Placement to Maintain Coverage and Connectivity Following Perturbations
Andrew Romich, Sandia National Laboratories, 7011 East Avenue, MS 9154, Livermore, CA, United States of America, aromich@sandia.gov, George Lan, J. Cole Smith

We consider a sensor placement problem in which the sensors must maintain coverage of a set of adversarial locations. Maximum intra-sensor communication, as determined by a function of distance between sensors, is desired. Complicating the sensor location problem are uncertainties related to final sensor positions due to unintended movement, e.g., due to air or water currents to which the sensors may be subjected.

2 - Optimal Positioning of Active Multistatic Sensors for Point Coverage Applications
Emily Craparo, Naval Postgraduate School, 1411 Cunningham Road, GL-238, Monterey, CA, 93943, United States of America, emcrapar@nps.edu, Mumtaz Karatas

We study the problem of optimally positioning active multistatic sonar sources for a point coverage application where all receivers and targets are stationary. We formulate exact and approximation algorithms for optimally placing sources under a various sensor models, and we extend these models to account for unreliable sensors.

3 - Approximate Dynamic Programming for the Dynamic Weapon Target Assignment Problem
Carl Parson, Air Force Institute of Technology, 2950 Hobson Way, Wright-Patterson AFB, OH, 45433, United States of America, carl.parson.ctr@afit.edu, Darryl Ahner

As the sophistication of air defense systems increases, traditional weapon's employment strategies no longer suffice. In many practical examples, weapon's effectiveness may not necessarily be independently multiplicative. This research formulates the dynamic weapon-target assignment problem with conditional weapons effectiveness and solves it using dynamic programming. A small example is solved exactly prior to presenting approximation methods to help mitigate the curse of dimensionality.

4 - Maritime Anomaly Detection
Cleber Almeida De Oliveira, Fundaç„o EZUTE, Rua do RÛcio, 313 - 11∫ andar, Sao Paulo, 04552-000, Brazil, oacleber@gmail.com

The challenge in this research is to determine the location of dependent sources for data collection in oil rig areas and to specify an effective information exploitation system for maritime situation awareness that reduces the operator's workload to detect maritime anomalies and allow a comprehensive association between anomalies and scenarios of interest so that follow-on decisions may be better rationalized.

■ MC02

Hilton- Golden Gate 7

Rx for Patent Fatigue in Innovation Research: New Data, New Causal Methods, and New Results

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Lee Fleming, UC Berkeley, 330 Blum Hall, Berkeley, CA, 94720, United States of America, lfleming@berkeley.edu

1 - What Does the Patent Allowance Rate Tell us About Examination Standards?

Alan Marco, Acting Chief Economist, U.S. Patent and Trademark Office, 600 Dulany St. MDE 2D39, Alexandria, VA, 22314, United States of America, Alan.Marco@uspto.gov, Micharl Carley, Deepak Hegde

Patents play a key role in companies' innovation strategies: this study analyzes factors that affect patent examination outcomes at the US Patent & Trademark Office (PTO). Controlling for application characteristics and stocks of pending applications, we find little evidence to support claims of widely varying quality. Apart from offering implications for patent policy makers, our study also contributes a novel methodology to estimate the effect of covariates on patent allowance and abandonment.

2 - Do Inventors Value Secrecy in Patenting? Evidence from the American Inventor's Protection Act of 1999

Stuart J. H. Graham, Georgia Institute of Technology, Atlanta GA, United States of America, stuart.graham@scheller.gatech.edu, Deepak Hegde

This study examines the revealed preferences of inventors towards secrecy in patenting by analyzing their disclosure choices before and after the enactment of the American Inventor's Protection Act (AIPA) of 1999. We find that about 7.5% of U.S. patent applications use AIPA's provisions to keep their inventions secret before patent grant. Small U.S. inventors, in particular, are more likely than large corporations to prefer disclosure over secrecy for their most important inventions. Our findings question the conventional wisdom — which seems to have shaped important policy — that the disclosure of patent applications harms U.S. invention by increasing the risk of imitation for small inventors.

3 - Friendly Boards and Innovation

Lee Fleming, UC Berkeley, 330 Blum Hall, Berkeley CA 94720, United States of America, lfleming@berkeley.edu, Benjamin Balsmeier, Gustavo Manso

We develop a model and present supporting evidence for how friendly boards influence the innovative search strategies of a firm. Shareholders hire a manager to run a firm for two periods. To supervise the manager, shareholders appoint a board of directors. In each period, the manager reports to the board of directors, proposing a strategy, which the board decides whether or not to approve. Riskier and "explorative" search strategies are more likely with friendlier boards. Empirical identification relies on regulatory changes that caused shareholders to appoint a majority of independent directors. We find that firms with friendly boards are more likely to explore less crowded and newer and new-to-the firm technologies and to hire younger and new-to-the firm inventors. Firms with less friendly boards tend to patent more and get more citations to their patents, though these effects are strongly mediated by an increase in claims and insignificant in the tales of the citation distributions (completely failed and breakthrough inventions are less influenced by the friendliness of the board).

4 - Patents and Cumulative Innovation: Causal Evidence from the Courts

Alberto Galasso, University of Toronto, Toronto, ON, Canada, alberto.galasso@rotman.utoronto.ca

This paper studies the causal effect of removing patent protection through court invalidation on subsequent research related to the focal patent, as measured by later citations. We exploit random allocation of judges at the U.S. Court of Appeal for the Federal Circuit to control for the endogeneity of patent invalidation. We find that patent invalidation leads to a 50 percent increase in citations to the focal patent but the impact is highly heterogeneous.

■ MC03

Hilton- Golden Gate 7

Data-Driven Analysis in eBusiness

Sponsor: eBusiness

Sponsored Session

Chair: Hong Guo, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo@nd.edu

1 - Large Scale Network Analysis for Online Social Brand Advertising

Kunpeng Zhang, Assistant Professor, University of Illinois at Chicago, 601 S Morgan St., Chicago, IL, 60607, United States of America, kzhang6@uic.edu

This paper proposes an audience selection framework for on-line brand advertising based on user historical activities on social media platforms. It builds implicit brand-to-brand networks and analyzes their structural properties. We propose hierarchical community detection, distributed influential brand identification, and sentiment analysis to find target users. The experiments conducted on Facebook data show that our framework can obtain performance improvement compared to baselines.

2 - Text Mining for Marketing Importance: Decomposing Firm Value

Brent Kitchens, University of Florida, 4046 NW 60th Ave, Gainesville, FL, 32653, United States of America, brent.kitchens@warrington.ufl.edu, Debanjan Mitra, Joseph Johnson, Praveen Pathak

We use a novel text mining technique to extract firm marketing news. This enables us to address a longstanding big picture question raised by marketing scholars – is marketing losing its importance? We compare marketing news to firm abnormal returns and find that marketing is important to investors. Moreover, we find no sustained diminishing trends in marketing's importance, but rather that this importance is counter-cyclical – decreasing with macroeconomic growth and increasing with adversity.

3 - Bidding Behavior in Sealed-bid Construction Contracts: An Empirical Study

Gulver Karamemis, University of Florida, Warrington College of Business Administr, Gainesville, United States of America, gkaramemis@ufl.edu, Anand Paul

We uncover patterns of bidding behavior in sealed bid contracting in the construction industry in a large US state by analyzing longitudinal data spanning several years, and across a wide range of construction projects. We compare and contrast our findings with predictions from contract theory.

4 - Hierarchical SVMs for Personal Event Detection in Social Networking Sites

Shengli Li, Xi'an Jiaotong University, Xianning West Road 28, Xi'an, China, lishengli@mail.xjtu.edu.cn, Hong Guo, Haldun Aytug, Praveen Pathak

Users announce and discuss their personal events with their friends on the social networking sites.This paper models personal event detection in social networking sites as a classification problem and proposes a hierarchical SVM model to capture the unique nested structure of social networking data.Using a large-scale real-life dataset, we test the performance of the proposed hierarchical SVMs and compare it to other existing methods.

■ MC04

Hilton- Continental 1

New Topics in Supply Chain Network and Design

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Yehua Wei, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yehua.wei@duke.edu

1 - Designing Flexible Systems

Andre Calmon, Assistant Professor, INSEAD, Boulevard de Constance, Fontainebleau, France, acalmon@mit.edu, Dragos Florin Ciocan

We propose a novel theoretical framework for flexibility in supply chains and service systems. Using this framework, we develop tools aimed at guiding the design of large scale flexible systems. In addition, we apply this approach to the design and analysis of an on-line resource allocation scheme. Finally, we illustrate our results through numerical experiments.

2 - Managing Disruptions with Uncertain Duration in Supply Chain Networks

Peter Y. Zhang, Massachusetts Institute of Technology, 77 Mass Ave., Cambridge, 02139, United States of America, pyzhang@MIT.EDU, William Schmidt, David Simchi-Levi, Yehua Wei

Firms with complex supply chains are exposed to a variety of risks, including low-probability / high-impact events that can completely halt the production of supplier sites for an extended duration. We use a linear optimization model to quantify the performance impact of disruptions, and identify inventory / flow decisions that minimize such impact. We also develop a Pareto robust strategy to identify dominant solutions if the disruption duration is uncertain.

3 - Competition in Supply Chain Networks in the Presence of Disruption Risk

Ozan Candogan, Fuqua School of Business, Duke University, Durham, NC, 27708, United States of America, ozan.candogan@duke.edu, Kostas Bimpikis, Shayan Ehsani

This paper considers multi-tier supply chains in the presence of disruption risk. A network structure determines the set of potential supply relationships and the extent of competition among firms in a given tier. We provide a characterization of the equilibrium of the strategic interaction between the firms, which highlights the interplay between the network structure and the resulting prices, production quantities, and profits associated with each of the firms.

4 - Approximation Algorithms for Perishable Inventory Systems with Setup Cost

Huanan Zhang, University of Michigan, 2797 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, zhanghn@umich.edu, Xiuli Chao, Cong Shi

This work studies perishable inventory systems with setup costs. Little is known about the structures of optimal policies for such systems in the literature. The design and computation of an effective heuristic policy has been an open challenge. We describe the first computationally efficient policy that admits a worst-case performance guarantee between 3 and 4 under a large class of correlated demand processes.

■ MC05

Hilton- Continental 2

MSOM Student Paper Competition Finalists

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Goker Aydin, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

Co-Chair: Guillaume Roels, UCLA, 110 Westwood Plaza, B511, Los Angeles, CA, 90066, United States of America, guillaume.roels@anderson.ucla.edu

Co-Chair: Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

1 - 2014 MSOM Student Paper Competition Finalists

Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

The MSOM Student Paper Competition is awarded annually by the Manufacturing & Service Operations Management Society at the INFORMS Annual Meeting for papers judged to be the best in the field of operations management.

■ MC06

Hilton- Continental 3

Operations and Marketing Interface

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ozge Sahin, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21231, United States of America, ozge.sahin@jhu.edu

1 - Pricing of Conditional Upgrades in the Presence of Strategic Consumers

Yao Cui, PhD Candidate, University of Michigan, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, cuiyao@umich.edu, Izak Duenyas, Ozge Sahin

We study a conditional upgrade strategy that has recently become common in travel industry. A consumer can accept an upgrade offer after making a reservation and pay the fee to upgrade at check-in if the high-quality product type is still available. Consumers decide which product type to book and whether to accept an upgrade offer based on the anticipated upgrade probability. We characterize the firm's optimal upgrade pricing strategy and identify multiple benefits of conditional upgrades.

2 - B2B Pricing Optimization for Resellers

Ozden Engin Cakici, American University, Washington, DC, cakici@american.edu, Itir Karaesmen

In electronics, health care, and retail industries, it is common for surplus inventory, returned merchandise, used goods, or waste to be sold to resellers. A reseller (or broker) matches the demand for such goods with the supply. The resellers operational decisions include how much to bid for the supply and how to allocate the supply among its existing customers. We show how a reseller's problem can be formulated as a two-stage stochastic model and how the optimal solution can be obtained.

3 - Consumer Choice Models with Endogenous Network Effects

Ruxian Wang, Assistant Professor, Johns Hopkins Carey Business School, 100 International Dr, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu, Zizhuo Wang

Network externality arises when product utility not only depends on attribute valuations, but also the number of users. We propose and analyze a new class of choice models by taking into account the endogenous network effects. We show the optimality of a new class of assortments, called a quasi-revenue-ordered assortment, consisting of a revenue-ordered assortment plus one item. Empirical results by using a new iteration-based estimation method show that our model is statistically significant.

4 - Personal Selling in an Emerging Market

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, dai@jhu.edu, Jian Ni

We develop a principal-agent type model to study how a multinational manufacturer constructs its personal-selling networks when entering an emerging market. Under information asymmetry and product/cost differentiation, we show that a strong regulatory environment may facilitate the entry of the multinational manufacturer. Our paper helps explain asymmetric distribution structures empirically observed in emerging markets.

■ MC07

Hilton- Continental 4

Cloud Computing for Optimization

Cluster: Tutorials

Invited Session

Chair: Jeff Linderoth, Professor, University of Wisconsin-Madison, United States of America, linderoth@wisc.edu

1 - Cloud Computing for Optimization

Jeff Linderoth, Professor, University of Wisconsin-Madison, United States of America, linderoth@wisc.edu

I will describe experiences with using ubiquitous, convenient, on-demand, shared computing resources to solve large-scale optimization problems. In olden days, these computing resources were known as a "metacomputer." In the early 2000's, the name changed to the "computational grid," and now using computing resources in this way is known as "cloud computing." I will also survey the landscape of cloud computing and its use and potential for Operations Research and Optimization.

■ MC08

Hilton- Continental 5

George Dantzig's Continuing Impact on Advances in Optimization

Cluster: Celebrating George B. Dantzig's 100th Birthday and His Influence on MS/OR

Invited Session

Chair: Robert Freund, Professor, MIT, Sloan School of Management, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, rfreund@mit.edu

1 - How Good is the Simplex Method, Continued?
Ilan Adler, UC Berkeley, Berkeley CA, United States of America adler@ieor.berkeley.edu

Ever since G.B. Dantzig introduced the Simplex method in 1947, it has become a phenomenally successful tool for solving real world problems. However, for almost as long, researchers have been working intensely to develop a theory to explain its success. We will trace the practical success of the method as well as the underlying theoretical developments, highlighting Dantzigπs continuing impact.

2 - About George B. Dantzig's Homework
Roger Wets, Research Professor, University of California, Davis, Department of Mathematics, Davis, 95616, United States of America, rjbwets@ucdavis.edu

A famous anecdote about G. Dantzigπs student-time experience was that he arrived late for a class taught by his advisor, Jerzy Neyman, and he found on the blackboard a couple of questions. Surmising that these must be homework questions, he turned in his `solution' and was surprised to learn that these where actually open questions related to the famous Neyman and Pearson lemma.

3 - Efficiency of the Simplex and Policy Iteration Methods for Markov Decision Processes
Yinyu Ye, Professor, Stanford University, Huang 308, Stanford, CA, 94025, United States of America, yyye@stanford.edu

We prove that the simplex method with the most-negative-reduced-cost pivoting rule is a strongly polynomial-time algorithm for solving discounted Markov decision processes (MDP) of any fixed discount factor. This is surprising since almost all such results on the simplex method are negative, while in practice it is widely successful. We also present a result to show that the simplex method is strongly polynomial for solving deterministic MDPs regardless of discount factors.

■ MC09

Hilton- Continental 6

Appointment Scheduling Models

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Sarang Deo, Assistant Professor, Indian School of Business, Hyderabad, 500032, India, sarang_deo@isb.edu

1 - Dynamic Patient Scheduling For a Multi-Appointment Health Care Program
Adam Diamant, Adam.Diamant09@Rotman.Utoronto.Ca, Joseph Milner, Fayez Quereshy

We formulate a Markov Decision Process to dynamically schedule patients to appointments in a pre-surgical health care setting. Patients have a series of appointments, undergoing multiple assessments prior to being eligible for surgery. There are a significant numbers of no-shows. We use approximate dynamic programming to develop several heuristic policies and compare them via simulation. We apply our results to a dataset collected from a bariatric surgery clinic at a large hospital in Toronto.

2 - Combining the Advanced and Appointment Scheduling Problems
Jonathan Patrick, Associate Professor, University of Ottawa, 55 Laurier Avenue, Ottawa, ON, K2G 3A6, Canada, patrick@telfer.uottawa.ca, Antoine Sauré, Mehmet Begen

Appointment scheduling and advanced scheduling have generally been addressed as two separate problems despite being highly dependent on each other. We present work in which we attempt to join these two problems together by taking advantage of past work by the authors on both problems.

3 - Stochastic Scheduling for Chronic Care
Armagan Bayram, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, abayram@northwestern.edu, Seyed Iravani, Karen Smilowitz, Sarang Deo

We present a study motivated by an ongoing collaboration with a mobile asthma care provider. Our study focuses on appointment allocation rules by considering stochastic nature of the problem. Using actual data and integrating it into a stochastic dynamic framework, we identify some results on optimal appointment allocation rules.

■ MC10

Hilton- Continental 7

New Advancements in Classic Inventory Problems

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Li Chen, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, li.chen@duke.edu

Co-Chair: Jing-Sheng Song, Professor, Duke University, 100 Fuqua Drive, Durham, United States of America

1 - Serial Inventory Systems with Markov-Modulated Demand: Derivative Analysis, Solution Bounds, Insight
Yue Zhang, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yueyue.zhang@duke.edu, Li Chen, Jing-Sheng Song

We derive bounds for the optimal policies for serial inventory systems with markov-modulated demand (MMD). Our bounds generalize the existing newsvendor bounds for serial systems with stationary demand. We further prove that the relative errors between our bounds and the optimal solutions converge to zero as the lead time increases, with the rate of convergence being square root of the lead time.

2 - Conveying Demand Information in Serial Supply Chains with Capacity Limits
Rodney Parker, The University of Chicago, Booth School of Business, Chicago, IL, 60637, United States of America, rodney.parker@chicagobooth.edu, Roman Kapuscinski

We construct two mechanisms to manage inventory in serial multi-echelon systems subject to production capacity limits which utilize local knowledge only. We demonstrate that these mechanisms (which differ based on timing assumptions) can replicate the known optimal and equilibrium policies. That is, sufficient information about the market demand is conveyed through the orders only. Also, a strong relationship between the mechanisms is demonstrated for channels of differing lengths.

3 - Optimal Policies for Assembly Systems: Completing Rosling's Characterization
Alp Muharremoglu, Associate Professor, University of Texas at Dallas, Richardson, TX, United States of America, alp@utdallas.edu, Shaokuan Chen

We study an assembly system, the model studied in Rosling (1989), one of the classical papers in inventory theory. Rosling characterized the optimal policy as a balanced echelon base stock policy, assuming that the initial state of the system possesses a "long-run balance" property. We characterize the optimal policy starting with any arbitrary initial state. The optimal policy is essentially a balanced echelon base stock policy, but with dynamically evolving echelon base stock levels.

4 - Measuring the Bullwhip Effect with Material Flow Data: Biases and Remedies
Wei Luo, IESE Business School, Av. Pearson 21, Barcelona, Spain, wluo@iese.edu, Li Chen, Kevin Shang

This paper concerns the accuracy of estimating bullwhip effect with material flow data in serial supply chains. We derive conditions under which overestimation occurs and characterize four driving factors: stocking level, lead time, supply chain location, and demand correlation. We also provide simple remedies to correct such biases based on the sample autocovariances of the sales and shipment data.

■ MC11

Hilton- Continental 8

Incentives for Socially-beneficial Goods

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Terry Taylor, Associate Professor, U.C. Berkeley, Haas School of Business, 2220 Piedmont Ave., Berkeley, CA, 94720, United States of America, taylor@haas.berkeley.edu

Co-Chair: Wenqiang Xiao, NYU, 44 W 4th St, New York, United States of America, wxiao@stern.nyu.edu

1 - Demand vs. Supply-side Investment in Humanitarian Operations

Karthik Natarajan, Carlson School of Management, 321 19th Ave South, minneapolis, MN, 55454, United States of America, knataraj@umn.edu, Jayashankar Swaminathan

Both supply- and demand-side constraints impact program coverage in humanitarian settings. We study the problem of identifying the optimal mix of supply- and demand-side investments in a budget-constrained environment and offer insights into the impact of supply- and demand-side parameters on the investment mix. We also consider a decentralized setting where demand mobilization activities are contracted to a third party and identify coordinating performance-based contracts.

2 - Subsidizing New Technology with a Strategic Supplier: Commitment vs. Flexibility

Ruben Lobel, University of Pennsylvania, 3730 Walnut St, JMHH - suite 500, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu, Jonathan Chemama, Maxime Cohen, Georgia Perakis

We study how policy adjustments in subsidy programs (e.g. solar panels) interact with production decisions. We model the interaction between a government and an industry player in a two-period game setting under uncertain demand. We show how the timing of decisions will affect the cost of the subsidy program. In particular, we show that when the government commits to a fixed policy, it spends less on the subsidy program because it signals the supplier to produce more in the earlier stage.

3 - Fleet Management Coordination in Decentralized Humanitarian Operations

Sameer Hasija, Assistant Professor of Technology and Operations Management, INSEAD, 1 Ayer Rajah Avenue, Singapore, Si, 138676, Singapore, Sameer.Hasija@insead.edu, Alfonso Pedraza-Martinez, Luk Van Wassenhove

We study incentive alignment for the coordination of operations in humanitarian settings. The incentive alignment issue is complex because traditional instruments based on financial rewards and penalties are not considered to be viable options. This problem is further complicated by information asymmetry in the system due to the dispersed geographical locations of the parties. We design a novel mechanism based on an operational lever to coordinate incentives in this setting.

4 - Donor Product-Subsidies: Implications of Consumer Awareness and Profit-maximizing Intermediaries

Wenqiang Xiao, NYU, 44 W 4th St, New York, United States of America, wxiao@stern.nyu.edu, Terry Taylor

In the developing world, consumption of socially-desirable products (e.g., recommended malaria drugs) depends on consumers' awareness of their benefits and prevailing prices. This paper studies how the consumer awareness level and the presence of profit-maximizing intermediaries in the distribution channel influences how donors should design subsidies for such products.

■ MC12

Hilton- Continental 9

Green Business Models and Strategies

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Ioannis Bellos, Assistant Professor, George Mason University, 4400 University Drive, MS 5F4, Fairfax, VA, 22030, United States of America, ibellos@gmu.edu

1 - Bike Share: Accessibility and Availability Tradeoff

Ashish Kabra, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Ashish.Kabra@insead.edu, Karan Girotra

We study bike-share systems as implemented in large cities such as Paris, London, New York. We develop a structural empirical model that captures the elasticity of user demand w.r.t. distance to a station as well as long-term and short-term effects of service level. We find that station designs denser than the current designs can increase ridership by as much as 9% in Velib'.

2 - Measuring Consumer Willingness-to-Pay for Socially Responsible Products

Leon Valdes, PhD Student, Massachusestts Institute of Technology, Sloan School of Management, Boston, MA, 02142, United States of America, lvaldes@mit.edu, Tim Kraft, Karen Zheng

We study consumers' Willingness-to-Pay (WTP) for socially responsible products via an incentivized human-subject experiment. We are interested in how WTP is impacted by: (i) the effort a company exerts toward ensuring socially responsible practices within its supply chain; and (ii) the precision of the information the company presents to consumers. To better understand the motives behind consumers' decisions, we also examine the role reciprocity plays in determining consumers' WTP.

3 - Leasing vs. Selling and Product Modularity

Atalay Atasu, Associate Professor, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, atalay.atasu@scheller.gatech.edu, Vishal Agrawal, Sezer Ülkü

We analyze the interactions between lease-sell and product architecture (i.e., modular versus integral product design) choices of a firm. One would expect that leasing and modular product architectures would be complementary when jointly exercised. However, this combination is rarely observed in practice, with a few exceptions such as Xerox. In this paper, we investigate the drivers of this discrepancy.

4 - Toward Mass Adoption of Electric Vehicles: Impact of the Range and Resale Anxieties

Ying Rong, Assistant Professor, Shanghai Jiao Tong University, No. 535 Fahua Road, Shanghai, 200052, China, yrong@sjtu.edu.cn, Michael Lim, Ho-Yin Mak

We study the impact of two major barriers to mass adoption of electric vehicles (EVs), range and resale anxieties, on prevalent business models in the market. We find that the combinations of battery owning/leasing with enhanced charging service typically yield the best societal outcome. To induce the private sector to employ such business models, policymakers should carefully rebalance the surplus from consumers to the firm through proper policies.

■ MC14

Imperial B

Best Practices in Reviewing Papers

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01602, United States of America, atrapp@wpi.edu

Co-Chair: Ozgun Caliskan Demirag, Penn State Erie, 5101 Jordan Road Burke 259, Erie, PA, 16563, United States of America, ozc1@psu.edu

1 - Best Practices in Reviewing Papers

Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01602, United States of America, atrapp@wpi.edu, Ozgun Caliskan Demirag, Haresh Gurnani, Kim Needy, Ted Ralphs, J. Cole Smith

This panel discussion will focus on the best practices in reviewing scholarly articles. Panelists from different areas of OR/MS will discuss various aspects of the peer review process, including but not limited to: how to perform a constructive review, what makes a good referee report, how to respond to referees' comments, and tips for success. With live Q&A, the panel aims to help academics and research-active industry professionals alike to improve their paper-reviewing skills.

■ MC15

Hilton- Exec. Boardroom

Banking and Manufacturing Applications

Cluster: Data Envelopment Analysis

Invited Session

Chair: Kankana Mukherjee, Associate Professor, Babson College, Economics Division, 231 Forest Street, Babson Park, MA, 02457, United States of America, kmukherjee@babson.edu

1 - Operational Efficiency of Bank Branches: Evidence from Indian Banking

Kankana Mukherjee, Associate Professor, Babson College, Economics Division, 231 Forest Street, Babson Park, MA, 02457, United States of America, kmukherjee@babson.edu, Abhiman Das, Subhash Ray

In this study, we examine the efficiency of branches located in the main metropolitan Indian cities of a major Indian bank with national presence. We utilize Data Envelopment Analysis to analyze data for the year 2007. We conceptualize the role of bank branches along the production approach and estimate a non-radial input-oriented Russell type measure of efficiency with a special focus on labor use.

2 - Variable Selection Techniques for DEA – An Empirical Case from a Retail Bank

Juha Eskelinen, Dr., Aalto University, School of Business, P.O.Box 21220, 00076 Aalto, Helsinki, Finland, juha.p.eskelinen@aalto.fi

If there are too few units compared to inputs and outputs, the nonparametric efficiency evaluation suffers from lack of discrimination. Various statistical techniques have been proposed to support the variable selection. The variable reduction procedure of Jenkins and Anderson (2003) and the efficiency contribution measure (Pastor, Ruiz, and Sirvent, 2002) were compared in a retail bank context. They led to different interpretations of the performance complementing each other.

3 - Overcoming the Shortcomings of Energy Intensity Index: An Application on Japanese and Chinese Manufacturing Industries

Osman Zaim, Dean, Faculty of Economics Administrative and Social Sciences, Kadir Has University, Central Campus, Kadir Has Cad. Cibali, Istanbul, 34083, Turkey, osman.zaim@khas.edu.tr

In multilateral comparisons of environmental performance over time, energy intensity measures especially "real" energy intensity computed by index decomposition approach is one of the most commonly used measure. While its intuitiveness and computational ease make this index an attractive one, its time series properties create considerable challenges in performing informative and fair comparisons among the energy efficiency levels of units considered. The theoretical part of this paper shows how one can overcome the shortcomings of the energy intensity measure by constructing a new energy index using directional technology distance functions. The new index constructed in this study not only overcomes the shortcomings of the energy intensity measures but also satisfies the axiomatic properties of index numbers that are laid down by Fisher. An empirical application on Japanese and Chinese manufacturing industries further complements existing studies.

■ MC16

Hilton- Franciscan A

Mitigating Supply Risk

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Sammi Yu Tang, Assistant Professor, University of Miami, 5250 University Drive, Coral Gables, FL, 33146, United States of America, ytang@miami.edu

1 - Does Punishment Work? On the Value of Buyer's Commitment in Supplier's Dynamic Improvement

Morteza Pourakbar, Rotterdam School of Management, Erasmus University, BurgMeester Oudlaan 50, 3000 DR, Rotterdam, Netherlands, mpourakbar@rsm.nl, Mehmet Gumus, Saied Samiedaluie, Mohammad Nikoofal

There are evidences suggesting that the stability in buyer-supplier relationship influences supplier commitment to improve its reliability. We develop models allowing the supplier to improve its reliability through offering punishment and commitment contracts. Our analysis reveals that punishment contract is more effective in incentivizing supplier to improve its reliability.

2 - Quality in Downstream Supply Chain Encroachment

Xiaoyang Long, HKUST, LSK Building, Clear Water bay, Kowloon, Hong Kong - PRC, xlongaa@ust.hk, Albert Ha, Javad Nasiry

We incorporate quality as an operational consideration in downstream supply chain encroachment decision by a manufacturer. We show that the retailer is always worse off if the manufacturer determines the quality of the product to sell through the two channels. Further, in contrast to conventional understanding, we show that product differentiation is not always in the best interest of the retailer and this practice can negatively affect the retailer.

3 - Operational Strategies under Consumer-Driven Bankruptcy

Michelle Xiao Wu, University of Chicago, wuxiao.nw@gmail.com, John Birge, Rodney Parker, S. Alex Yang

Financially distressed retailers are often forced to run liquidation sales. Traditional and social media enable consumers to be better informed of these sale opportunities and time their purchases strategically. We show that strategic waiting in anticipation of a potential liquidation sale can exacerbate a firm's current financial distress significantly.

4 - Farm-yield Management When the Production Rate is Yield Dependent

Kwan Eng Wee, Singapore Management University, 50 Stamford Road #04-01, Singapore, 178899, Singapore, kewee@smu.edu.sg, Onur Boyabatli

This paper analyzes the impact of farm-yield uncertainty when the unit production rate is yield dependent. We model a firm that procures an input through a contract in advance of the selling season; and through the open market on the day in a single period so as to maximize its expected profit. We investigate the impact of yield uncertainty on the optimal contract volume and the profitability of the firm, and underline the role of yield-dependent production rate on our results.

5 - Production Chain Disruption: Inventory and Interruption Insurance

Sammi Yu Tang, Assistant Professor, University of Miami, 5250 University Drive, Coral Gables, FL, 33146, United States of America, ytang@miami.edu, Lingxiu Dong, Brian Tomlin

We analytically explore the use of BI insurance and inventory to mitigate disruption risk in a multi-stage production chain. We characterize the firm's optimal insurance policy-the deductible and coverage limit-and the optimal inventory level at each stage. We examine the interaction between insurance and inventory investments.

■ MC17

Hilton- Franciscan B

Pricing and Strategic Behavior in Queueing Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Philipp AfËche, Rotman School of Management; University of Toronto, 105 St.George Street, Toronto, Canada, Philipp.Afeche@Rotman.Utoronto.Ca

1 - Paying More to Get it Faster: When Should it be Considered?

Tava Olsen, Professor, University of Auckland, 12 Grafton Road, Auckland, New Zealand, t.olsen@auckland.ac.nz, Riccardo Mogre

In this study, we identify efficient expediting policies, explicitly quantifying the cost reduction ensuing from the use of expediting. We also investigate the relationship between expediting and the ability to offer express orders, shedding new light on how expediting policies could be strategic for companies. Finally, we consider the interaction of such policies with the offering of super-saver discounts and how this interaction affects a company's revenues and costs.

2 - Revenue Maximization for Cloud Computing Services

Cinar Kilcioglu, Columbia Business School, ckilcioglu16@gsb.columbia.edu, Costis Maglaras

We study a stylized model of revenue maximization for cloud computing services. We analyze price data traces from the biggest cloud service provider, Amazon, providing some possible explanation for price spikes based on intuitive asymptotic analysis arguments in systems with large capacity and large market potential. We study the service provider's revenue maximization problem in an infinite capacity system and in a market with heterogeneous customers.

3 - Signaling Quality via Price or Wait Time?
Laurens Debo, Associate Professor, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu, Uday Rajan, Senthil Veeraraghavan

When the quality of a capacitated service is not known to a fraction of the potential market, not only the price, but, also congestion (wait time) can signal high quality. Ex ante, it is not clear whether short or long wait times are signals of high quality. We study this question via the analysis of a queuing-game theoretic model. We find that the degree of convexity of the cost of capacity is a main determinant of the direction of distortion of a firm's waiting time to signal quality.

4 - Rational Abandonment from Priority Queues: Equilibrium Strategy and Pricing Implications
Vahid Sarhangian, Rotman School of Management; University of Toronto, 105 St.George Street, Toronto, ON, Canada, vahid.sarhangian11@rotman.utoronto.ca, Philipp AfËche

The literature on the economics of queues predominantly focuses on the queue-joining decisions of customers and ignores subsequent abandonment decisions. Such abandonment behavior is particularly important in priority queues, which are quite prevalent in practice. We study the equilibrium joining and abandonment behavior of utility-maximizing customers in the context of an observable two-class priority queue and identify novel pricing implications.

■ MC18

Hilton- Franciscan C

Practice-driven Revenue Management I

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: So Yeon Chun, Assistant Professor, McDonough School of Business, Georgetown University, 3700 O St NW, Washington, United States of America, sc1286@georgetown.edu

1 - Dynamic Management of Loyalty Programs
Dan Iancu, Stanford Graduate School of Business, 655 Knight Way, Stanford, United States of America, daniancu@stanford.edu, So Yeon Chun, Nikos Trichakis

We formulate a model that can guide the dynamic management of loyalty and reward programs. Our model touches on several important considerations that arise in practice, including accounting, financial and marketing functions, and discusses how these influence and are influenced by revenue management.

2 - Understanding Markdown Recommendations Overriding
Felipe Caro, Associate Professor, UCLA Anderson School of Management, fcaro@anderson.ucla.edu

Since 2008, Zara has been using a model-based process to support its markdown decisions during clearance sales. We study the adoption of the tool by the country managers and analyze the impact that key user interface modifications have had on pricing decisions.

3 - Personalized Bundle Recommendations: A Data-Driven Online Sales Approach
Anna Michelle Papush, Massachussetts Institute of Technology, Cambridge, MA, United States of America, apapush@mit.edu, Pavithra Harsha, Georgia Perakis

With the continuously growing trend in online shopping and sales, the development of a more sophisticated product recommendation system can provide the necessary competitive edge for any Internet retailer. By considering this problem from a new angle, this work presents a model that combines both diverse recommendations and personalized pricing based on a consumer's purchase history and inventory at risk of being marked down.

4 - Strategic Consumers, Revenue Management and the Design of Loyalty Programs
So Yeon Chun, Assistant Professor, McDonough School of Business, Georgetown University, 3700 O St NW, Washington, United States of America, sc1286@georgetown.edu, Anton Ovchinnikov

We study an interaction between revenue management and premium-status (e.g., Gold) loyalty program, and the role of strategic consumers. We compare volume-based and spending-based designs and show that when coordinated with revenue management, how the loyalty program allows the firm to benefit from the behavior of strategic consumers who would fly/spend more in order to qualify for the premium-status.

■ MC19

Hilton- Franciscan D

New Applications in Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Mehmet Sekip Altug, Assistant Professor, George Washington University, School of Business, Washington, DC, 20052, United States of America, maltug@gwu.edu

1 - Quality and Pricing Decisions when Consumers Perceive Recycled Content Differently
Monire Jalili, PhD Student, University of Oregon, 1208 University of Oregon, Eugene, OR, 97405, United States of America, mjalili@uoregon.edu, Tolga Aydinliyim, Nagesh Murthy

We consider a monopolist selling ordinary and green product variants to consumers whose differential (dis)utility vary by consumer type, and is a function of the firm's quality decision (i.e., the amount of recycled content.) We discuss how the optimal quality and pricing decisions drive demand and profit.

2 - Loss Aversion and the Uniform Pricing Puzzle
Javad Nasiry, Assistant Professor, HKUST, LSK Building, HKUST, Hong Kong, Hong Kong - PRC, nasiry@ust.hk, Pascal Courty

We develop a behavioral model based on loss aversion to explain why a monopolist may sell high quality products at the same price as low quality ones despite the fact that quality is perfectly observable and that there are no obvious costs of adjusting prices.

3 - A Behavioral Study of Capacity Allocation in Revenue Management
Bahriye Cesaret, PhD Student, The University of Texas at Dallas, 800 West Campbell Road SM 30, Richardson, TX, 75080, United States of America, bahriye.cesaret@utdallas.edu, Elena Katok

We present a set of laboratory experiments that investigate how human subjects solve the two-class capacity allocation revenue management problem. We study the problem with ordered and unordered arrival, as well as a simplified version - making an upfront decision at the beginning of the selling season. We find that making decisions up-front improves (resp., does not hurt) performance in the ordered (resp., unordered) arrivals case. We also identify several behavioral regularities.

4 - The Impact of Endogenous Secondary Markets on Retailer's Profitability
Mehmet Sekip Altug, Assistant Professor, George Washington University, School of Business, Washington, DC, 20052, United States of America, maltug@gwu.edu, Garrett van Ryzin

One of the main assumptions in the newsvendor model is that the salvage value is exogenous and that retailers can sell their excess stock at this fixed salvage value. However, in retailing, the salvage value of excess stock is mostly determined endogenously in secondary markets by firms and that raises several interesting questions such as the value of consolidated vs. firm-specific secondary markets. We analyze these questions using a stylized model with an endogenous secondary market.

■ MC20

Hilton- Yosemite A

Joint Session Analytics/CPMS: Business Analytics in Higher Education Industry

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Roger Gung, Sr. Manager of Business Analytics and Optimization, University of Phoenix, 4025 S Riverpoint Parkway, Phoenix, AZ, 85040, United States of America, roger.gung@phoenix.edu

1 - Marketing Mix Optimization
Roger Gung, Sr. Manager of Business Analytics and Optimization, University of Phoenix, 4025 S Riverpoint Parkway, Phoenix, AZ, 85040, United States of America, roger.gung@phoenix.edu, Hussain Khaleeli, Suxing Zeng, Jason Holechek

Marketing spend allocation drives the volume of new marketing inquiries (NMI) and enrollments. Two-stage non-linear regression models were built to formulate NMI channels with respect to marketing spends which were defined as either endogenous, exogenous or instrument variables. The optimization model was formed by aggregating all NMI channels' regression models into one objective function. The optimal spend allocation was then derived from the model every quarter to guide marketing strategies.

2 - New Degree Enrollments Forecasting Model
Yun Ouyang, Operations Research Scientist, University of Phoenix, 4025 S Riverpoint Parkway, Phoenix, AZ, 85040, United States of America, yun.ouyang@phoenix.edu, Roger Gung, Suxing Zeng

New Degree Enrollments forecasting has been one of the keys for revenue management in higher education industry. We developed semi-parametric regression-based survival models to forecast enrollments for given market inquiries and registrations. We applied time-dependent variables to handle holidays and breaks where enrollments are pushed to the subsequent weeks. We compared K-M plot and fitted curve to check in-sample performance and performed holdout test to evaluate out-sample performance.

3 - Lifetime Value Modeling
Suxing Zeng, Operations Research Scientist, University of Phoenix, 4025 S Riverpoint Pkwy, Phoenix, AZ, 85040, United States of America, suxing.zeng@phoenix.edu, Roger Gung, Jason Holechek

Existing students' lifetime value has been one of the keys for revenue management in higher education industry. We developed semi-parametric regression-based survival models to estimate each student's expected lifespan, starting from the Degree Enrollments. We applied the results to profile students by attributes, and identified successful students and value propositions for the University.

4 - Analytics Framework for Higher Education
Grace Lin, VP, Advanced Research Institute, Institute for Information Industry, No. 133, Section 4, Minsheng East Road, Taipei, 105, Taiwan - ROC, gracelin@iii.org.tw

We present an end-to-end anlytics framework for higher education industry that covers solution methods with using big data for the management on enrollments, learning platform, academic performance and institutional finance.

■ MC21

Hilton- Union Sq 1

Freight Fleets Logistics and Management

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Ilke Bakir, PhD Student, Milton H. Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA, United States of America, ilkebakir@gatech.edu

1 - Third Party Logistics Planning and Production Scheduling Integration
Farshid Azadian, Assistant Professor, Embry Riddle Aeronautical University, College of Business, 600 S Clyde Morris Blvd., Daytona Beach, FL, 32114, United States of America, azadianf@erau.edu, Ratna Babu Chinnam, Alper Murat

We address the operational problem of a make-to-order contract manufacturer that seeks to integrate production scheduling and transportation planning under commit-to-delivery model. The manufacturer produces customer orders on unrelated parallel processors, accounting for release dates and sequence dependent setup times. Set of shipping options with different costs and transit times is available for order delivery. The objective is to minimize total cost, including delivery tardiness penalties.

2 - Stochastic Auto-Carrier Loading Problem
Benita Mordi, PhD Student, Texas A&M University, College Station, TX, United States of America, bmordi@tamu.edu, Saravanan Venkatachalam, Lewis Ntaimo

This talk presents the tactical planning regarding the number and type of auto-carriers required under uncertainty in the demand of vehicles. This auto-carrier loading problem considers actual dimensions of the vehicles, regulations on total height of the auto-carriers and maximum weight of the axles, and safety requirements. The problem is modeled using two-stage stochastic integer programming and preliminary results using real data are presented.

3 - Outbound Logistics Optimization Coordinating Production-Distribution and Vehicle Routing Decisions
Gopalakrishnan Easwaran, United States of America, geaswaran@stmarytx.edu, Halit Uster

We consider an integrated approach to coordinate aggregate level production-distribution planning and operational level weekly vehicle route planning for outbound trucks from a production facility. We present a heuristic framework with production/inventory, vehicle routing, and multi-objective shipment splitting modules as well as computational results and analysis illustrating efficiency of the approach.

4 - Greening the Fleet with Alternative Fuel Long-Haul Trucks
Ilke Bakir, PhD Student, Milton H. Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA, United States of America, ilkebakir@gatech.edu

Recent increase in environmental concerns and petroleum prices initiated effort for transitioning to alternative fuel long-haul trucks. But fleet replacement planning under strict operational requirements remains a challenge. We present a fleet replacement model for greening the fleet while maintaining feasible operations, and propose a decomposition-based solution approach that provides economically justifiable replacement plans for the transition from a petroleum-fueled fleet to a greener one.

■ MC22

Hilton- Union Sq 2

Application of Machine Learning in Transportation

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Mahdieh Allahviranloo, PhD Candidate, University of California Irvine, 4000 Anteater Instruction and Research B, Irvine, CA, 92697, United States of America, mallahvi@uci.edu

1 - Proactive Vehicle Routing with Inferred Demand to Solve the Bike Sharing Rebalancing Problem
Robert Regue, PhD Candidate, University of California Irvine, 4000 Anteater Instruction and Research B, Irvine, CA, 92697, United States of America, rreguegr@uci.edu

We use gradient boosting machines as a forecasting technique to feed a dynamic routing problem to rebalance a bike sharing system. The use of anticipated demands turns it into a proactive rather than responsive approach and increases system level of service and customer satisfaction.

2 - Closed-Loop Optimal Traffic Control using Reinforcement Learning: Traffic Signal and Ramp Control
Baher Abdulhai, Professor, Department of Civil Engineering, University of Toronto, 35 St. George St., #105, Toronto, ON, M5S 1A4, Canada, baher.abdulhai@utoronto.ca, Samah El-Tantawy, Kasra Rezaee

Optimal traffic control is the most environmentally sustainable and plausible solution to the today's traffic system's extensive congestion. We present a decentralized approach to optimal Ramp Metering, to control the entrance flow to freeways, and Adaptive Traffic Signal Control, to control the flow on surface streets, based on Reinforcement Learning and Game Theory. Evaluations of the methods using a high fidelity computer model of Downtown Toronto resulted in significant travel time savings.

3 - Data Mining Application to Infer Individuals' Activity Type, Socio-economic Attributes By GPS Data
Mahdieh Allahviranloo, PhD Candidate, University of California Irvine, 4000 Anteater Instruction and Research B, Irvine, CA, 92697, United States of America, mallahvi@uci.edu

Using boosting techniques we predict activity types and their sequence given only spatial-temporal data for southern California. Activity patterns are clustered to study the statistical distributions of socio-demographic characteristics for further pattern inferences. We compare the predicted spatial-temporal distribution of activities in the network with the observed pattern in TransCad. The methodology can be used to mine large amount of historical location data generated by smart devices.

■ MC23

Hilton- Union Sq 3

Multimodal Transportation

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Irina Benedy, birina@purdue.edu

1 - Scenario-based Dynamic Model of Investment Decision Process for Multimodal Freight Facilities Under Stochastic Demand
Irina Benedy, birina@purdue.edu, Srinivas Peeta, Hong Zheng, Ananth Iyer, Yuntao Guo

Shift in world trade patterns and changes in the U.S. import/export commodity flows leads to demand uncertainty for multimodal freight facilities. This issue leads to an investment decision problem both for construction of new facilities and upgradation of existing ones. We use a dynamic model to formulate the investment decision process and investigate policy insights under various sources of perturbation.

2 - Integrated Intermodal Network Design Considering Non-linear Transportation Costs
Mohammad Ghane-Ezabadi, Graduate Research Assistant, Oregon State University, 204 Rogers Hall, Corvallis, OR, 97321, United States of America, ghaneezm@onid.oregonstate.edu, Hector A. Vergara

Logistics network topology has a significant effect on decisions at the tactical and operational levels in intermodal transportation systems. In this research study, decisions on route and mode selection are integrated within the mathematical formulation of the hub location problem to improve the performance of the intermodal transportation system as a whole. A heuristic that takes advantage of both genetic algorithms and the shortest path algorithm is applied to solve several instances of this problem in reasonable times. Heuristic solutions are compared to optimal solutions in small instances to evaluate the performance of the proposed solution method.

3 - Impact of ETA on the Capacity Utilization of the Actors in the MTC - A Simulation Based Approach
Fabian Walter, Chair of Management and Logistics, Technische Universität Darmstadt, Hochschulstr. 1, Darmstadt, D-64289, Germany, walter@bwl.tu-darmstadt.de, Ralf Elbert

In maritime transport chains (MTC) each actor needs to improve his capacity utilization. For the intermodal operator (IO) no containerized estimated time of arrival (ETA) exists. With increasing container vessel capacity, for IO decision on container disposition, this inter-related data have great influence. We gathered 261,361 real container based data. The results of a monte carlo simulation show, that based on ETA information IO can significantly improve the utilization of container wagons.

4 - Shipper Attitudes for Container Transportation on the North Sea Route
Irina Benedy, birina@purdue.edu, Srinivas Peeta

This study seeks to explore opportunities and barriers for freight shippers to use the North Sea Route. A stated preference survey is conducted for freight shippers in East Asia and Europe. Econometric models are used to investigate the attitudes towards the usage of the North Sea Route, and identify key factors which influence them.

■ MC24

Hilton- Union Sq 4

Network Science and Transportation

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Alireza Khani, Postdoctoral Fellow, University of Texas at Austin, 1616 Guadalupe St, Suite 4.202, Austin, TX, 78701, United States of America, akhani@utexas.edu

1 - An Efficient Algorithm for Solving Reliable Shortest Path Problem
Alireza Khani, Postdoctoral Fellow, University of Texas at Austin, 1616 Guadalupe St, Suite 4.202, Austin, TX, 78701, United States of America, akhani@utexas.edu, Stephen Boyles

The efficient frontier for the solution of path problem with minimum Mean and Std. Deviation (P1) is shown to be similar to those of path problem with minimum Mean and Variance (P2). An algorithm is developed to efficiently search in the P2 frontier and find the optimal solution for P1.

2 - An Algorithm for Non-additive Shortest Path Problem
Mehrdad Shahabi, mshahabi@mix.wvu.edu, Avinash Unnikrishnan, Stephen Boyles

An outer approximation algorithm has been customized for solving the multi-attribute non-additive shortest path problem. Theoretically, outer-approximation is capable of providing the exact global solution for problems with convex travel cost functions. Numerical experiments based on different utility functions show the promising performance of the outer-approximation in handling large size problems.

3 - Measures of Travel Time Variability of Emergency Vehicles on Arterials
Qing He, University at Buffalo (SUNY), 225 Ketter Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu, Zhenhua Zhang, Jizhan Gou, Xiaoling Li

Travel time is very critical for emergency vehicle (EV) operations. This study obtains 2.5 year EV travel time data in North Virginia using preemption records at the signalized intersections. A utility-based model is proposed to measure the travel time reliability of the road links and several assumptions are made and validated.

4 - A Double-queue Model and Its Applications in Dynamic Network Modeling
Xuegang (Jeff) Ban, Associate Professor, RPI, 110 8th Street, Room JEC 4034, Troy, NY, 12180, United States of America, banx@rpi.edu, Rui Ma

A double-queue model was recently introduced in the literature to model traffic flow dynamics of a network link. The model captures realistic congestion effects such as queue spillbacks in a simplified mathematical framework. Some theoretical and numerical results of the model are presented. Applications of the model in dynamic network modeling problems are also discussed.

■ MC25

Hilton- Union Sq 5

Recent Advances in Day to Day Traffic Assignment

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Xiaozheng He, NEXTRANS, 3000 Kent Ave, West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu

1 - A Marginal Utility Day-to-Day Traffic Assignment Model
Xiaozheng He, NEXTRANS, 3000 Kent Ave, West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu, Srinivas Peeta

Inspired by the marginal decision rule in economics, this study proposes a conceptual shift in the definition of rationality in the modeling of day-to-day traffic evolution. A new marginal utility day-to-day traffic evolution model is developed by additionally introducing the notion of marginal cost rather than just the notion of marginal benefit considered in classical day-to-day traffic evolution models. Theoretical properties of the proposed model are rigorously analyzed.

2 - Day-to-Day Dynamics in a Traffic Network under Bounded Rationality
Srinivas Peeta, Professor, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47907, United States of America, peeta@purdue.edu, Amit Kumar, Xiaozheng He

We develop a dynamical system based model to represent the evolution of path flows resulting from the day-to-day dynamics in traffic disequilibrium under static demand. The proposed model is based on the proportional-switch adjustment process under the assumption of bounded rationality. The solution methodology is discussed and computational results are presented for a study network.

3 - Approximation Methods for a Link-based Day-to-Day Traffic Assignment Model
Jian Wang, Ph.D student, Purdue University, 3000 Kent Ave, West Lafayette, IN, 47906, United States of America, wang2084@purdue.edu, Xiaozheng He, Srinivas Peeta

Seeking to reduce the high computational cost for analyzing traffic evolutionary characteristics, this study proposes four sensitivity-analysis-based approximation approaches for a link-based day-to-day traffic assignment model. Sufficient conditions for applying these four approaches are identified. Numerical examples show that they can approximate well the link flow evolutionary trajectory when the sufficient conditions are satisfied.

■ MC26

Hilton- Union Sq 6

New Directions in Location Research

Sponsor: Location Analysis

Sponsored Session

Chair: Dmitry Krass, Professor, Rotman School of Management, Univ. of Toronto, 105 St. George St., Toronto, ON, M5S 3E6, Canada, krass@rotman.utoronto.ca

1 - Discrete Budget Allocation in Competitive Facility Location
Tammy Drezner, California State University, Fullerton, CA, United States of America, tdrezner@fullerton.edu, Zvi Drezner

The competitive location problem using the gravity model with a limited budget constraint to improve the attractiveness of existing facilities and locating new ones is considered. The problem is optimally solved by assigning budgets which are multiples of a basic budget unit such as multiples of 0.1% of the available budget.

2 - Dynamic Long-Term Planning of Ambulance Locations and Assignments
Oleksandr Shlakhter, Senior Researcher, Alberta Health Services, 10030-107 Street, Edmonton, AB, T5J 3E4, Canada, alex.shlakhter@rotman.utoronto.ca, Dmitry Krass

In this paper we analyze Emergence Medical Services (EMS) with stochastic dynamic demand. We present new perspectives on the problem of long-term planning of emergency medical services, including station locations and ambulance assignments. The problem is formulated as multi-period location/queueing model with two non-preemptive priority classes of events (calls), with each class consisting of two types of events: events which require transport to a hospital and events without transport.

3 - Competitive Location Models and Comparison Shopping
Vladimir Marianov, Professor. Department of Electrical Engineering., Pontificia Universidad CatÛlica de Chile, Av. Vicuña Mackenna 4860. Macul., Santiago, 7820436, Chile, marianov@ing.puc.cl, HA Eiselt

Customers searching for a product require comparing at least two varieties sold by different competing facilities before purchasing. A new firm enters the market and competes with the existing firms. A mathematical optimization model is formulated that maximizes the market share of a new firm that enters the market.

4 - A Competitive Location Model with Multipurpose Shopping
HA Eiselt, professor, University of New Brunswick, Fredericton, NB, Canada, haeiselt@unb.ca, Vladimir Marianov

In contrast to traditional competitive location models, customers in our model purchase two goods at existing firms. A new firm then enters the market and competes with one of the existing firms. We formulate a mathematical optimization problem that maximizes the market share of the new firm.

■ MC27

Hilton- Union Sq 7

Models for Fleet Management and Scheduling

Sponsor: Railway Applications

Sponsored Session

Chair: Xuesong Zhou, Associate Professor, Arizona State University, School of Sustainable Engineering and th, Tempe, AZ, United States of America, xzhou74@asu.edu

1 - An Integrated Model for Train Timetabling and Platforming in High Density Double Track Corridor
Mahendra Birhade, Nanyang Business School, Nanyang Technological University, Singapore, Singapore, Mahendra1@e.ntu.edu.sg, Rohit Bhatnagar, S Viswanathan

This paper is motivated by the train scheduling problem in high density, double track corridors. We develop a novel MIP formulation of the Integrated Train Timetabling and Platforming Problem(ITTPP). Unlike existing literature that treats Train Timetabling and Train Platforming as distinct problems, our ITTPP formulation directly generates feasible timetables. We develop two heuristic algorithms that provide close to optimal solutions for real problem sets from Indian Railways.

2 - Fleet Management in Rail Transport: Petroleum Rakes in Indian Railways
Vishal Rewari, MTech Student, IIT Bombay, IEOR Department, Roll Number- 123190002, Mumbai, MH, 400076, India, rewari.vishal@gmail.com, Raja Gopalakrishnan, Narayan Rangaraj

This paper presents a decision-support model for assignment of petroleum rakes using MILP for firm demands and a predictive method for deciding the direction of empty rake repositioning for meeting expected demands. It minimizes empty rake running while maintaining service levels for the industry taking into consideration the maintenance and rake-product compatibility constraints. It also attempts to answer long-term issues of investments in rakes and capacity of maintenance depots.

3 - Efficient Scheduling Operations for Dedicated Freight Corridors Corporation of India Ltd (DFCCIL)
Nomesh Bolia, Dr, IIT Delhi, Dept of Mechanical Egineering, IIT Delhi, New Delhi, 110016, India, nomesh@mech.iitd.ac.in, Amit Upadhyay

Empty car allocation, train formation and train scheduling are complex optimization problems for large railroads. Motivated by Indian dedicated freight corridors (DFC), an integer programming formulation of the dynamic problem of empty car allocation and train scheduling is developed by considering the unique characteristics of the DFC. A constructive heuristic is proposed as the solution method. Computational experiments show that the heuristic can provide high quality solution in a short time.

4 - Design of a Railway Network Resiliency Model
Carl Van Dyke, Managing Director, TransNetOpt, 6 Snowbird Ct, West Windsor, NJ, 08550, United States of America, carl@cvdzone.com

Railroads are complex, network enterprises, where disruptions such as the closure of a line due to flooding can cause ripple effects that impact many other parts of the network. The objective of this discussion is to provide a practical approach to modeling railroad networks that can be used to assess the impact of network disruptions to rail lines and yards, including the potential reroutes of traffic, and limitations on network throughput due to reduced network capacity.

■ MC28

Hilton- Union Sq 8

Airline Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Jon Dunsdon, Chief Technology Officer, Taleris, 2623 Camino Ramon Suite 500, San Ramon, CA, 94583, United States of America, jon.dunsdon@taleris.com

1 - Flight Trajectory Optimization
Srinivas Bollapragada, Chief Scientist, GE Global Research, One Research Circle, Niskayuna, NY, 12309, United States of America, bollapragada@research.ge.com

We developed and implemented a novel algorithm to control the trajectory of an aircraft flight to reduce the costs it incurs. Our algorithm computes the values for the parameters to be entered into the aircraft's flight management system to minimize the fuel and schedule-adherence costs incurred on the flight. We implemented it in a prototype software system that is currently in use at GE Aviation Services.

2 - Fast & Furious with Feedback: The Machine for Next-Gen Airline Operations Optimization
Julian Loren, Senior Product Manager, GE Software, 2623 Camino Ramon, San Ramon, CA, 94583, United States of America, loren@ge.com

In complex, regulated, and competitive environments, we increase return on operations by finding better solutions that consider a growing number of factors in a shrinking period of time. We chase Operational Excellence down a path of increasing pressure and constraint. In this paper, we explore pressures related to decision support at scale and approaches to alleviate them—the motivations driving our development of a fast & furious operations optimization machine with feedback mechanisms.

3 - From Reactive to Proactive: Changing the Recovery Paradigm
Jon Petersen, Operations Research Scientist, Taleris, petersej@taleris.com

While industry practitioners and academics have made advancements in managing operations under irregularity, the prevailing assumption is that decisions are made reactively only after the disruption has been revealed. By mining over a vast field of aircraft sensor data, we introduce the ability to predict aircraft failure before it occurs allowing an airline to proactively manage its operations. We discuss how optimization is used in concert with big data and show the benefit of prediction.

4 - Anomaly Detection and Prognostics for Air-Conditioning System of Commercial Aircraft
Kyungjin Moon, Analytics Engineer, Taleris, 400 W 15th St., Suite 1000, Austin, TX, 78701, United States of America, Kyungjin.Moon@taleris.com

This paper describes Taleris' on-going anomaly detection and prognostics development for the air-conditioning (AC) system of commercial aircraft. In order to detect temporal anomalous patterns of the system behavior, data-driven static models are generated to represent nominal states of the system using Quick Access Recorder (QAR) data. Then these models are used to determine the possible anomalous deviations of the system from their estimated nominal states.

■ MC29

Hilton- Union Sq 9

Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice

Cluster: Daniel H. Wagner Prize for Excellence in Operations Research Practice & CPMS, The Practice Section

Invited Session

Chair: C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

1 - Daniel H. Wagner Prize

C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

The competition for the 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in six finalists, who submitted papers to the judging committee and who will present their results in three sessions . In this keynote, the winner of the competition will be announced and the authors will give a reprise of the winning presentation.

2 - Identifying Risks and Mitigating Disruptions in the Automotive Supply Chain

Don Zhang, Technical Expert, Research & Advanced Engineering, Ford Motor Company, Dearborn, MI, United States of America, xzhang35@ford.com, William Schmidt, David Simchi-Levi, Yehua Wei, Michael Sanders, Oleg Gusikhin, Yao Ge, Keith Combs, Peter Y. Zhang

Firms are exposed to a variety of low probability / high impact risks which may disrupt their operations and supply chains. These risks are difficult to predict and quantify, and therefore difficult to manage. As a result, managers may deploy countermeasures sub-optimally, leaving their firms exposed to some risks while wasting resources to mitigate other risks that would not cause significant damage. In a three-year research engagement with Ford Motor Company, we address this practical need by developing a novel risk exposure model that assesses the impact of a disruption originating anywhere in the firm's supply chain. Our approach defers the need to estimate the probability associated with any specific disruption risk until after the company learns how the realization of such a disruption will impair its operations. As a result, the company can make more informed decisions about where to focus its limited risk management resources. We demonstrate how Ford has applied this model to identify previously unrecognized risk exposures, evaluate pre-disruption risk mitigation actions, and develop optimal post-disruption contingency plans, including circumstances in which the duration of the disruption is unknown.

3 - Statistical and Optimization Techniques for Laundry Portfolio Optimization at P&G

Ivan Oliveira, SAS, 100 SAS Campus Dr, Raleigh, United States of America, ivan.oliveira@sas.com, Kevin Miller, Kevin Norwood, Ming Zhao, Nats Esquejo, Rob Pratt

The Procter & Gamble (P&G) Fabric Care business oversees a broad portfolio of products, including household brands such as Tide, Dash, and Gain. We describe a novel analytical framework that uses visual statistical tools and advanced mathematical programming methods, helping P&G determine ingredient levels and product and process architecture to create some of the world's best laundry products. This framework has provided targeted consumer benefits while enabling cost savings in the order of millions of dollars.

4 - Gerrymandering for Justice: Redistricting U.S. Liver Allocation

Sommer Gentry, Associate Professor, United States Naval Academy, 572-C Holloway Road, Mailstop 9E, Annapolis MD 21402, United States of America, gentry@usna.edu, Eric K.H. Chow, Allan Massie, Dorry Segev

U.S. policy sequesters livers from deceased donors within arbitrary geographic zones, frustrating the intent of offering livers according to medical urgency. We used a zero-one integer program to partition the U.S. into districts that minimize disparity in access to livers. Redistricting liver allocation would save hundreds of lives and make transplantation more equitable. Our redistricting concept garnered unprecedented unanimous support in the Liver Committee that manages allocation policy.

■ MC30

Hilton- Union Sq 10

Uncertainty and Cooperation

Cluster: Scheduling and Project Management

Invited Session

Chair: Nicholas G. Hall, The Ohio State University, 2100 Neil Avenue, Columbus, OH, United States of America, hall.33@osu.edu

1 - Cooperation and Contract Design in Project Management with Outsourcing

Xiaoqiang Cai, Professor, The Chinese University of Hong Kong, Dept of Systems Engineering, Shatin, NT, Hong Kong, Hong Kong - PRC, xqcai@se.cuhk.edu.hk, Nicholas G. Hall, Feng Zhang

We consider a project management problem where the prime contractor outsources tasks to a set of subcontractors, which involves (i) coordination among the subcontractors; and (ii) contract design by the prime contractor, to incentivize the subcontractors. We study the two issues by a cooperative game and a principal-agent model, respectively.

2 - Minimizing Value-at-Risk in Single-Machine Scheduling

Kerem Bulbul, Assoc. Professor, Sabanci University, Sabanci University, Orhanli, Tuzla, Istanbul, 34956, Turkey, bulbul@sabanciuniv.edu, Semih Atakan, Nilay Noyan

We consider single-machine scheduling problems with uncertain parameters. We impose a probabilistic constraint on the random outcome and introduce a generic risk-averse stochastic programming model with the objective of finding a non-preemptive static job sequence that minimizes the value-at-risk of the random outcome. Our solution approach relies on Lagrangian relaxation-based scenario decomposition with numerical results that demonstrate its efficacy and the value of the proposed model.

■ MC31

Hilton- Union Sq 11

Service Queues

Sponsor: Service Science

Sponsored Session

Chair: Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu

1 - Service Outsourcing with Strategic Collaboration of Competing Servers

Ying Xu, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, yingx1@andrew.cmu.edu

This paper studies a client who outsources service tasks to two service providers. Previous work mainly focused on how to incentivize or utilize capacity investments of the servers. We extend the literature by incorporating the option of strategic collaboration between servers. Collaboration reduces waiting but dampens capacity competition, so its impact on the client is unclear. This paper studies how the client could affect the degree of collaboration via demand allocation and SLA requirements.

2 - Value-driven Load Balancing

Sherwin Doroudi, Tepper School of Business; Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, sdoroudi@andrew.cmu.edu, Esa Hyytia, Mor Harchol-Balter

To date, the study of dispatching in server farms with Processor-Sharing servers has focused on response time, where all jobs are assumed to be equally delay sensitive. Our work departs from this assumption: we model each arrival as having a randomly distributed value, independent of its size. The correct metric is no longer response time, but rather, value-weighted response time. We propose new dispatching policies and deduce many unexpected results regarding dispatching with this metric.

3 - Non-asymptotic and Asymptotic Analysis for Extended Erlang A Models

Katsunobu Sasanuma, PhD Candidate, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, katz@cmu.edu, Robert Hampshire, Alan Scheller-Wolf

We study an extension of the Erlang A model, which represents a system with customer abandonment under congestion-based control schemes. Our model may have either reneging or state-dependent balking, and can cope with possible adjustments to the arrival/service rates when there is a queue. We derive non-asymptotic and asymptotic Normal representations of performance indicators and discuss the congestion properties of the extended Erlang A model from non-asymptotic and asymptotic perspectives.

4 - Optimal Staffing for Sales Transaction Support Centers
Aliza Heching, IBM TJ Watson Research Center, Mathematical Sciences, Yorktown Heights, NY, 10598, United States of America, ahechi@us.ibm.com, Emre Barut

Sales transaction support centers reduce the amount of transaction work performed by sellers allowing them to spend more time with customers and increase revenue generation. Adequate staffing ensures that staff with appropriate skills is available to support incoming service requests. We describe a suite of analytical tools including hierarchical forecasting and request assignment to determine staffing requirements. These tools were deployed across multiple geographies and lines of business.

■ MC32

Hilton- Union Sq 12

Service Science Best Paper Award

Sponsor: Service Science

Sponsored Session

Chair: P K Kannan, University of Maryland, Smith School of Business, College Park, MD, United States of America, PKannan@rhsmith.umd.edu

1 - Adaptive Mobile News Personalization using Social Networks
Roland Rust, U. of Maryland, R.H. Smith School of Bus., College Park, MD, 20742, United States of America, rrust@rhsmith.umd.edu, Michel Wedel, Tuck Siong Chung

We present an adaptive personalization system for personalizing news feeds on mobile devices. It learns from an individual's reading history, automatically discovers new material as a result of shared interests in the user's social network and adapts the news feeds shown to the user. We show that using article choices from an individual's social network improves the quality of personalization, leading to more readership of the news articles provided.

2 - Managing Customer Arrivals in Service Systems with Multiple Servers
Christos Zacharias, New York University, Stern School of Business, New York, NY, 10012, United States of America, czachari@stern.nyu.edu

We analyze a discrete multi-server queueing model for scheduling customer arrivals in service systems with parallel servers. Theoretical and heuristic guidelines are provided for the effective practice of appointment overbooking to offset no-shows. The benefits of resource-pooling are demonstrated in decreasing operational costs and increasing customer throughput.

3 - Impact of Economic Uncertainty on Product Line Design and Capacity Management
Muge Yayla-Kullu, RPI Lally School of Management, 110 8th Street, Troy, NY, 12180, United States of America, YAYLAH@rpi.edu, Jennifer K. Ryan, Jayashankar Swaminathan

We study the effects of uncertainty in consumer spending due to economic volatility on the product line decisions of a firm with limited resources. We consider a firm that offers services with differing qualities, unit costs, and resource consumption rates. Consumers are heterogeneous in their purchasing behavior and the parameters of this behavior is only resolved after capacity investments are made.

■ MC33

Hilton- Union Sq 13

Managing Uncertainty in Innovation

Cluster: New Product Development

Invited Session

Chair: Pascale Crama, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, Singapore, pcrama@smu.edu.sg

Co-Chair: Fabian Sting, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, fsting@rsm.nl

1 - University Research Funding: The Benefits of Local Knowledge
Pascale Crama, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, Singapore, pcrama@smu.edu.sg, Anand Nandkumar, Reddi Kotha

University research is financed through university and federal funds. The federal grant application process has been shown to be biased towards older PIs and less innovative projects. We study how university funding can address this issue by using a different selection process. This is particularly valuable for young researchers and innovative projects, which fare badly in the project selection process used by federal agencies. We test our predictions with data from a Midwestern university.

2 - Identifying Overestimated Ideas in Organizations: The Case of Process Innovations
Christoph Fuchs, Rotterdam School of Management, Erasmus University, cfuchs@rsm.nl, Maik Schlickel, Fabian Sting

Drawing on a process innovation database, we find that process innovation ideas are more likely to be overestimated by their creators. The degree of overestimation is stronger for ideas (1) that were created by higher- versus lower-ranked individuals, (2) that were generated collectively versus individually, and (3) that were generated by individuals with previously lower idea implementation success. These findings help companies to reduce uncertainty in the management of innovations.

3 - The Role of Decision Rights in Collaborative Development Initiatives
Nektarios Oraiopoulos, University of Cambridge, Judge Business School, Trumpington Street, Cambridge, CB2 1AG, United Kingdom, n.oraiopoulos@jbs.cam.ac.uk, Vishal Agrawal

In this paper, we study initiatives for co-development of new products and technologies. In such settings, it may be difficult a priori to specify contracts contingent on the outcome. Therefore, we investigate the efficacy of different contractual structures, which instead specify the decision-making process.

4 - Competitive Intelligence and Market Research in R&D Markets
Yi Xu, University of Maryland, yxu@rhsmith.umd.edu, He Chen, Manu Goyal

We develop a dynamic model where two risk-neutral firms compete to develop a new product whose market value is uncertain and the firms can actively manage their information - acquiring information through market research or acquiring information on competitor's decisions through competitive intelligence. We show that competitive intelligence emerges endogenously as an optimal information acquisition strategy even though market research is costless and can perfectly resolve market uncertainty.

■ MC34

Hilton- Union Sq 14

Humanitarian Logistics

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Bahar Yetis Kara, Associate Professor, Bilkent University, Bilkent, Ankara, Turkey, bkara@bilkent.edu.tr

1 - Compromising System and User Interests in Shelter Location and Evacuation Planning
Vedat Bayram, Bilkent University, Endustri Muhendisligi Bolumu, Ankara, 06800, Turkey, bayram@bilkent.edu.tr, Barbaros Tansel, Hande Yaman Paternotte

Traffic management and the decision of where to locate the shelters are critical for an evacuation plan. We develop a nonlinear MIP model that optimally locates shelters and assigns evacuees to the nearest shelter sites using shortest paths, within a given degree of tolerance, so that the total evacuation time is minimized. We develop a solution method that can handle practical size problems using second order cone programming techniques. This research is supported by TUBITAK grant no. 213M434.

2 - A Decision Support Tool for Post-Disaster Debris Operations
Alvaro Lorca, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, alvarolorca@gatech.edu, Pinar Keskinocak, Melih Celik, Ozlem Ergun

Effective management of post-disaster debris removal is crucial due to the size, cost, and complicated nature of the problem. In this talk, we present a decision support tool that makes use of a mixed integer programming model and addresses pre- and post-disaster debris removal decisions regarding processing facility location, process selection and debris flow. The impact of the tool is illustrated on a disaster dataset based on Hurricane Andrew.

3 - Evacuation Management under Hazardous Convective Weather Events
Hasan Manzour, University of Oklahoma, School of Industrial and Systems Eng, Norman, United States of America, smh.manzour@ou.edu, Suleyman Karabuk

Hazardous convective weather events (e.g., tornadoes) cause hundreds of fatalities and thousands of injuries in the US every year. We propose evacuation as a response policy; identify the challenges involved; discuss and assess the potential benefits and costs. We uncover important characteristics of optimal evacuation plans, which can affect practical implementations. In addition, we quantify the benefits of forecast lead time, contributing to the discussions in weather forecast research area.

4 - Locating Temporary Shelter Areas after an Earthquake: A Case for Turkey

Bahar Yetis Kara, Associate Professor, Bilkent University, Bilkent, Ankara, Turkey, bkara@bilkent.edu.tr, Firat Kilci, Burcin Bozkaya

In this study, we address the problem of locating temporary shelter areas after a disaster. We have developed a shelter location-allocation optimization model and a GIS-based decision support system for TRC. In this talk, we first propose a mixed integer linear programming based methodology for selecting the location of temporary shelter sites. We validate the mathematical model by generating a base case scenario using real data on Kartal, Istanbul, Turkey.

■ MC35

Hilton- Union Sq 15

Socially Responsible Operations

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Betzabe Rodriguez Alamo, University of Puerto Rico - Mayaguez, Call Box 9000, Mayaguez, PR, 00682, United States of America, betzabe.rodriguez@upr.edu

1 - Finding Solutions to Cattle-Farmers Financial Crisis: Blasting the Payment System

Dhania Silva, University of Puerto Rico, Mayagüez, Mayagüez, PR, United States of America, Dhania.silva@upr.edu, Betzabe Rodriguez Alamo

The milk industry in Puerto Rico is the most important activity for the agricultural sector; hence, is heavily regulated. In the intent to ensure farmers' fair remuneration, some government policies have been prejudicial; resulting in a decrease of 1.6 percent on the number of farmers per year. We propose a mathematical model of the cattle farmer payment system that will consider social paradigms on equity and fairness, and focuses on influencing operational decisions towards societal needs.

2 - An Agent-based Model to Analyze the Emerging Advanced Biofuel Supply Chain

Leilei Zhang, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, leileizh@iastate.edu, Guiping Hu

We develop an agent-based model to investigate the interactions of different stakeholders along the biofuel supply chain. Decisions are analyzed on famers' land allocation, biofuel production, biofuel blending, and biofuel market prices. The agent-based model is built upon decision making process faced by each entity along the advanced biofuel supply chain. The results from the agent-based model are evaluated and compared with a bottom-up equilibrium model.

3 - A Stochastic CVaR Approach to Disaster Relief with Social Costs

Amy Givler, Graduate Research Assistant, Rensselaer Polytechnic Institute, 2215 5th Ave, Troy, NY, 12180, United States of America, givlea@rpi.edu, John Mitchell

In many disaster relief problem formulations, social costs, or costs incurred by the population suffering from the disaster, are neglected. This stochastic scenario-based formulation focuses on pre-positioning of points of distribution (PODs) while incorporating social costs in the form of walking costs. Additionally, the risk measure used for these social costs is conditional value at risk (CVaR), a convex monotonic risk measure that focuses on the expectation in the worst scenarios.

4 - Vulnerability to Natural Disasters: A Decision Theory Approach

Saylisse Davila, saylisse.davila@upr.edu, Roy Ruiz, Fernando Salazar, Juan Ayala

This work presents an innovative application of decision theory as the conceptual model for tsunami vulnerability assessments. The model fuses expert knowledge in the form of qualitative data with high-dimensional quantitative data and addresses the gaps in the literature where models disregard the hierarchical nature of the data and the relationships among variables. Preliminary work on the vulnerability to tsunamis of Puerto Rican coastal communities will be shown.

5 - Design Factors for Medical Device Functionality in Developing Countries

Lourdes Medina, Assistant Professor, UPRM, Call Box 9000, Mayaguez, PR, 00680, United States of America, lourdes.medina@upr.edu, Ana Gauthier, Ilka Rodriguez, Giovanni Cruz

This study focuses on determining which design factors of medical devices are most important when designing for developing countries. The determination of the importance of a design factor is based on a literature review, a statistical analysis of current products designed for these countries and a survey developed to be sent to individuals who have had heavy involvement with medicine in the developing world.

■ MC36

Hilton- Union Sq 16

Network Traffic Modeling

Sponsor: Telecommunications

Sponsored Session

Chair: Soumyo Moitra, Senior Member of Technical Staff, SEI/Carnegie mellon, 4500 Fifth Avenue, Pittsburgh, PA, 15213, United States of America, smoitra@sei.cmu.edu

1 - Entity-Centric Network Modeling

Markus De Shon, Founder and Principal Threat Scientist, E8 Security, 720 University Ave, Suite 200, Palo Alto, CA, 94301, United States of America, mdeshon@gmail.com

Raw network and log data is often only weakly identified with the real entities active on the network: users and hosts. We present a comprehensively entity-centric modeling approach that identifies hosts and users on the network, models those entities, associates ephemeral and permanent identifiers with those entities, and tracks them over time.

2 - Modeling and Visualizing Behavioral Anomalies for Network Security

Bryan Olsen, Cyber Security Engineer, Pacific Northwest National Laboratory, PO Box 999, Richland, WA, 99352, United States of America, bryan.olsen@pnnl.gov, Daniel Best, Ryan Hafen, William Pike

Identifying useful anomalies in high-volume computer network traffic (such as emerging threats or network configuration changes) is difficult due to evolving adversary tactics and the large number of network actors. We present CLIQUE, a modeling and visualization system that supports behavior-based situational awareness and investigation. CLIQUE detects and displays emerging anomalies in live network traffic, and supports drill down into details on the individual behaviors underlying them.

3 - Inferring Patterns in Network Traffic: Time Scales and Variation

Soumyo Moitra, Senior Member of Technical Staff, SEI/Carnegie mellon, 4500 Fifth Avenue, Pittsburgh, PA, 15213, United States of America, smoitra@sei.cmu.edu

In this paper we analyze time series from network traffic and develop some metrics related to variation in traffic patterns. These metrics depend on the time scale used in their estimation and therefore we explore the effect of varying time scales. The metrics are illustrated with public data and the implications of the results are discussed.

■ MC37

Hilton- Union Sq 17

DM2: Data Mining in Decision Making with Theory & Applications

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Dr. Asil Oztekin, Assistant Professor, University of Massachusetts Lowell, One University Ave., Southwick 201D, Lowell, MA, 01854, United States of America, Asil_Oztekin@uml.edu

1 - A Data Analytic Approach to Predict the Success of Heart Transplants

Dr. Asil Oztekin, Assistant Professor, University of Massachusetts Lowell, One University Ave., Southwick 201D, Lowell, MA, 01854, United States of America, Asil_Oztekin@uml.edu, Ali Dag, Dr. Fadel Megahed, Ahmet Yucel

Predicting the survival of heart transplant patients is an important yet challenging problem for researchers. Without re-balancing the training set, data mining classification algorithms can generate deceptively high accuracy rates overall but still perform poorly on detecting the minority class. The objective of our study is to improve the prediction of 1-, 5- and 9-year survival outcomes following a heart transplant surgery by examining a large, nation-wide dataset.

2 - Automatic Recognition of Adverse Events in News: A Data Mining Approach

Weiguo Fan, Professor of Accounting & Information Systems, Virginia Tech, 3007 Pamplin Hall, Blacksburg, VA, 24061, United States of America, wfan@vt.edu, Alan G. Wang, Xuan Zhang, Mi (Jamie) Zhou

Corporate adverse events are important resources for investors. However, adverse events are often scattered across different news media and difficult to recognize. By using three years of news data collected for S&P 500 companies, we identify relevant adverse events, extract event features, train and optimize a classification model. This classification model can then be used to automatically recognize adverse events from multiple news channels.

3 - EMS Dispatch Priorities: Comparing Logistic Regression Model Performance with Established Protocol

Michael Dohan, Lecturer (Information Systems), Lakehead University, 955 Oliver Road, Thunder Bay, ON, P7B 5E1, Canada, msdohan@lakeheadu.ca, Joseph Tan, Tim Hardie, Norm Gale, Dave Johnson

Assessing ambulance call priority accurately is crucial to emergency medical service (EMS) performance. Calls dispatched at a priority higher than necessary amount to an inefficient use of EMS resources. This article shows that an established EMS prioritization protocol is outperformed by a proposed logistic regression model, created with a historical dataset of EMS calls. This research identifies factors associated with increased accuracy, providing direction for improving dispatch practice.

4 - Business Analytics for Undergrads

David Olson, Professor, University of Nebraska Lincoln, CBA 209, Lincoln, NE, 68588-0491, United States of America, david.olson@unl.edu, Demet Batur

We view business analytics as an evolution in emphasis to expose students to database concepts (extended to big data), knowledge management (from information systems), quantitative modeling (to include visualization as well as analytic/simulation modeling), and data mining (tools useful for making decisions in typical business data mining applications). This presentation describes what we found others doing, and presents our design of a business undergraduate core course in business analytics.

■ MC38

Hilton- Union Sq 18

Scheduling Staff and Space in Healthcare

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, amycohn@med.umich.edu

1 - Block Scheduling for a Pediatric Residency Program

Peter Mayoros, University of Michigan, Ann Arbor, MI, United States of America, pmayoros@umich.edu, Amy Cohn

In a residency program, the block schedule determines what service (e.g. inpatient, ICU, NICU, emergency department, etc.) each resident works on during each month across a full year. The schedule must meet both the patient care needs of the health system and also the educational and personal needs of the resident. We present an integer programming-based approach used to create the block schedule for incoming interns at the University of Michigan Mott Children's Hospital.

2 - Block Scheduling for a Surgical Residency Program

William Pozehl, University of Michigan, Ann Arbor, MI, United States of America, pozewil@umich.edu, Amy Cohn

Residents in a surgical residency program must complete many different rotations to complete their educational requirements. Meanwhile, program directors must schedule residents from multiple different programs and even different institutions to also ensure adequate coverage for patient care. We present models for and analysis of this complex, multi-criteria combinatorial optimization problem.

3 - Shift Scheduling in Pediatric Emergency Medicine

Young-Chae Hong, University of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, hongyc@umich.edu, Amy Cohn

When scheduling residents to staff a pediatric emergency department, many complex constraints must be satisfied to ensure a feasible solution. In addition, there are several different criteria (based on patient coverage, resident educational training, and resident personal preferences) upon which the quality of a schedule is judged. We present models and algorithms for addressing the multi-criteria nature of this problem, with real-world results from Mott Children's Hospital.

4 - Coordination of Surgical Blocks and Ambulatory Clinics at a Large Teaching Hospital

Brian Lemay, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, blemay@umich.edu, Amy Cohn

We consider the challenge of coordinating surgical block time and ambulatory clinic time across an array of heterogeneous surgeons at a major teaching hospital. Models, algorithms, and analysis are presented to address this multi-criteria combinatorial optimization problem.

■ MC39

Hilton- Union Sq 19

Innovations in Healthcare Delivery Systems

Sponsor: Health Applications

Sponsored Session

Chair: Mili Mehrotra, University of Minnesota, 321 19th Ave South, Minneapolis, United States of America, milim@umn.edu

1 - Managing Office Revisit Intervals and Patient Panel Sizes in Primary Care

Hessam Bavafa, Assissant Professor, Wisconsin School of Business, 975 University Ave, Madison, WI, 53706, United States of America, bavafa@wharton.upenn.edu, Christian Terwiesch, Sergei Savin

In recent years, the drive to contain health care costs in the US has increased scrutiny of the traditional mode of delivering primary care where a patient is treated by his primary care physician during a face-to-face visit. In particular, two approaches, the use of "e-visits" and greater reliance on non-physician providers, have been suggested as lower-cost alternatives to the traditional set-up. We quantify the overall impact of using these two approaches on patients and physicians.

2 - Bundled Payments for Healthcare Services

Diwakar Gupta, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, guptad@me.umn.edu, Mili Mehrotra

We model the proposer-selection and information-sharing problems that arise when implementing CMS' bundled payment for care improvement initiative. Possessing private information, proposers compete for beneficiaries but not for selection. We show that an optimal strategy for CMS, under its current approach, may be to either announce a fixed threshold or keep the selection process uncertain, depending on market characteristics. We also characterize parameters of an optimal menu of contracts.

3 - Stochastic Optimization for Multi-unit nurse Planning under Patient Volume Uncertainty

Kibaek Kim, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL, 60439, United States of America, kibaekkim@mcs.anl.gov

We study the problem of nurse planning for multiple care units in the presence of patient volume uncertainty. The problem is formulated as a two-stage stochastic integer program with mixed-integer recourse. We present a novel decomposition method, which allows us to solve real-world problems. Using patient census data from Northwestern Memorial Hospital, we analyze the value of the stochastic planning solutions and the cost implications of using cross-trained nurses.

4 - Towards Cost-effective Multiple Disease Screening

Mohsen Bayati, Stanford Graduate School of Business, Stanford, CA, 94305, United States of America, bayati@gsb.stanford.edu, Sonia Bhaskar, Andrea Montanari

Recently, in response to the rising costs of healthcare, companies have been investing in programs to improve the health of their workforce. These programs aim to reduce the incidence of chronic illnesses which impact future costs and require a low-cost annual screening to detect individuals with a high risk of developing chronic disease. We offer a multiple disease screening procedure that highly maximizes the predictive ability based on multi-task learning from machine learning.

■ MC40

Hilton- Union Sq 20

Methodologies for Health Policy Making

Sponsor: Health Applications

Sponsored Session

Chair: Monica Gentili, Visiting Assistant Professor, Institute for People and Technology, Georgia Institute of Technology, Atlanta, Georgia, mgentili3@mail.gatech.edu

1 - Primary Care Network Development: The Regulator's Perspective

Vedat Verter, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, vedat.verter@mcgill.ca, Anna Graber, Michael Carter

A mixture of fee-for-service, capitation and salary remuneration schemes is often used for funding primary care. These payment mechanisms often vary with the type of facility in the primary care network. We propose a formulation that allows the regulator to identify the most appropriate primary care network configuration. The proposed framework focuses on cost, accessibility and appropriateness of provided care. We illustrate the model use on the geographical area of Kingston, Ontario, Canada.

2 - Modeling the Spread of HIV and HCV among Injection Drug Users: A Network-based Model
Rui Fu, Stanford University, 74 Barnes CT, Stanford, CA, 94305, United States of America, ruif@stanford.edu, Margaret Brandeau

To capture the biological and behavioral variability among IDUs, we construct a network-based model that simulate the transmission of HIV and HCV. We include two types of relationships (edges): sexual partner and needle sharing buddy. Empirical degree distribution derived from survey data informs the initialization and evolution of simulated network. Efficacy of several intervention programs that target the IDU population are evaluated using this model.

3 - What are the Areas in Need for Improving Spatial Access to Pediatric Primary Care?
Monica Gentili, Visiting Assistant Professor, Institute for People and Technology, Georgia Institute of Technology, Atlanta, Georgia, mgentili3@mail.gatech.edu, Nicoleta Serban, Julie Swann

We make inferences on the geographic access to pediatric primary care across 14 states in the U.S. Our measurement models for geographic access are based on optimization models that match patients with providers considering a series of user and provider system constraints. We will compare the derived measures for two population groups, children insured by Medicaid and/or CHIP and other children on private insurance or health insurance exchange.

■ MC42

Hilton- Union Sq 22

Healthcare Operations and Scheduling

Sponsor: Health Applications

Sponsored Session

Chair: Greg Zaric, Ivey Business School, 1255 Western Road, London, ON, N6G 0N1, Canada, gzaric@ivey.uwo.ca

1 - Forecasting Patient Arrivals and Census in an Emergency Department
Azaz Sharif, PhD Candidate, Western University, 1151 Richmond Street, London, ON, N6A 3K7, Canada, asharif9@uwo.ca, David Stanford, Greg Zaric

Emergency Department (ED) physician pay in Ontario is determined in part on pay-for-performance contracts based on operational benchmarks. To assist in planning and meeting these benchmarks we built a forecasting model to produce short-term forecasts of arrivals and ED census. We used regression and time series techniques to model arrivals in each of the 5 'Canadian Triage and Acuity Scale' categories. This analysis provides ED managers with valuable insight to efficiently allocate ED resources.

2 - Distributed Surgical Case Scheduling via Logic-based Benders Decomposition
Vahid Roshanaei, PhD Student, University of Toronto, 5 King's college road, Toronto, Canada, vroshana@mie.utoronto.ca, Dionne Aleman, Curtiss Luong, David Urbach

We study the problem of surgical case scheduling where patients are collaboratively planned amongst a coalition of multiple hospitals in a strategic network. A novel general integer programming model along with a logic-based Benders decomposition approach are developed. Computational experiments demonstrate that our LBBD approach is able to find optimal solutions 98.7% faster than the integer model solved via Gurobi optimizer on small-to-medium test cases, and 75.3% faster on large test cases.

3 - Addressing Overcrowding in an Outpatient Clinic through New Room Allocation Policies
Jacqueline Griffin, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA, 02115, United States of America, ja.griffin@neu.edu, Vahab Vahdatzad, James Stahl

In order to examine overcrowding in a cardiovascular outpatient clinic, we construct a discrete-event simulation model focusing on patient flow, appointment room availability, and staffing. A simulation-optimization approach is used to define new policies for the reallocation of a fixed number of beds among different physicians within the clinic. Specifically, the impact of a hybrid allocation policy, using a balance of both pooled and designated room allocation is examined.

4 - Design and Scheduling of Home Health Care Services
Onur Ozturk, PhD, Ivey Business School, Western University 1255 Western Road, London, ON, N6G0N1, Canada, oozturk@uwo.ca, Mehmet Begen, Greg Zaric

Home health care (HHC) has become a growing service sector in most countries due to aging population, increasing costs and limited resources. In HHC, healthcare providers design and deliver medical care to patients with home visits. We investigate an efficient and robust design of HHC services to provide home visit schedules subject to limited resources and regulatory restrictions. Besides planning HHC visits, we also quantify trade-offs between HHC investment and desired service levels.

■ MC43

Hilton- Union Sq 23

Decision Diagrams in Optimization I

Sponsor: Computing Society

Sponsored Session

Chair: John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, United States of America, jh38@andrew.cmu.edu

1 - MDD-Based Lagrangian Relaxation
Andre Augusto Cire, University of Toronto Scarborough, 1265 Military Trail, Toronto, ON, M1C 1A4, Canada, andre.cire@gmail.com, Willem-Jan van Hoeve, David Bergman

Decision diagrams have been used to obtain tight relaxations for a number of practical applications, including single-vehicle routing problems and employee rostering. We demonstrate that such relaxations can be greatly enhanced by incorporating dual information in the form of Lagrangian multipliers. Computational experiments on scheduling problems indicate that this technique can improve solving times substantially in a branch-and-bound framework.

2 - Zero-Suppressed Binary Decision Diagrams
David Morrison, University of Illinois, Urbana-Champaign, 1624 T St Apt 4, Sacramento, CA, 95811, United States of America, drmorr0@gmail.com, Edward Sewell, Sheldon Jacobson

Zero-suppressed binary decision diagrams (ZDDs) are a modification of standard binary decision diagrams (BDDs) that exhibit better compression for many combinatorial optimization problems. In this talk we discuss the advantages of ZDDs over BDDs, and present a characterization of ZDDs for the maximal independent set problem.

3 - Dualization using Decision Diagrams and Its Application for Itemset Mining
Takahisa Toda, Graduate School of Information Systems, the University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, To, 1828585, Japan, toda.takahisa@gmail.com

Dualization of Boolean functions is one of the most fundamental problems on Boolean functions. Many problems in data mining, logic, artificial intelligence etc are known to be equivalent to dualization. We present a dualization algorithm using decision diagrams over modern SAT solver, and propose its application for itemset mining.

4 - Compact Representations of All Members of an Independence System
Utz-Uwe Haus, IFOR, D-MATH, ETH Zurich, Raemistr 101, Zurich, Switzerland, uhaus@ethz.ch, Carla Michini

We show that for every independence system there exists a top-down construction rule for a binary decision diagram (BDD) representing all independent sets.For packing and covering problems with logarithmically bounded bandwidth the width of the BDD is bounded by the number of variables.Besides enumerating or counting all solutions and optimizing a class of nonlinear objective functions that includes separable functions,the results can be applied for effective evaluation of generating functions.

■ MC44

Hilton- Union Sq 24

Multi-Channel Advertising

Sponsor: Information Systems

Sponsored Session

Chair: Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu

1 - Beyond the Last-Touch: Attribution in Online Advertising
Ron Berman, United States of America, ronber@wharton.upenn.edu

Advertisers that utilize multiple publishers typically compensate them based on effort (CPM) or performance (CPA) and Last-Touch attribution. Our analytical model shows that CPA causes moral-hazard while existence of a baseline conversion rate by consumers causes adverse selection. We resolve these issues using the Shapley value and requiring that publishers run an experiment as proof of effectiveness. We then proceed to demonstrate the advantages of this method on several live campaigns.

2 - Media Exposure through the Funnel: A Model of Multi-Stage Attribution

Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu

Consumers are exposed to ads across a number of channels, which can jointly affect the conversion behavior. In this paper, we propose a HMM of an individual consumer's behavior based on the conversion funnel to measure the effect of every ad and assign due credit. The model is estimated on a large online auto campaign. We observe that different ad formats affect consumers differently based on their underlying states. Finally, only a fraction of online conversions are driven by online ads.

■ MC45

Hilton- Union Sq 25

Field Experiments

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu

Chair: Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu

1 - The Impact of Fit Information in Online Retail

Antonio Moreno-Garcia, Kellogg School of Management, 2001 Sheridan Rd, MEDS Department, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu, Santiago Gallino

We describe a field experiment studying the impact of offering better product fit information to customers in online retail.

2 - Dynamic Pricing in Online Retailing: Evidence from Field Experiments

Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu, Santiago Gallino, Marshall Fisher

Competition among online retailers is intense. Prices and availability have been made transparent to customers as well as to competing retailers. We designed a series of field experiments to measure price elasticity accounting for demand substitution among similar products and competing retailers, and to test a best response pricing algorithm in real business environment.

3 - Creating Reciprocal Value through Operational Transparency

Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu, Tami Kim, Chia-Jung Tsay

We investigate whether organizations can create value by introducing operational transparency between consumers and producers. Although existing theory posits that increased contact between the two parties can diminish performance, we conducted two field and two laboratory experiments in food service contexts that suggest that the introduction of transparency improves service quality and efficiency.

4 - Sharing Delay Information in Services: A Field Study

Qiuping Yu, Assistant Professor, Kelley School of Business, Indiana University, 1275 E 10th St, Bloomington, IN, 47405, United States of America, yqp2009@gmail.com, Gad Allon, Achal Bassamboo

We explore the impact of delay announcements by conducting a field experiment at a medium sized call center. The call center provides announcements to customers on certain days of the week, while provides no announcements to customers of the same type on other days of the week. With such experimental design, we investigate the problem of whether and how customers use the announcements as points of reference when they make abandonment decisions.

■ MC46

Hilton- Lombard

Advances in MIP Modeling Systems

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Miles Lubin, MIT Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, mlubin@mit.edu

1 - Modeling with Meaning: Metaconstraints and Semantic Typing

Tallys Yunes, University of Miami, School of Business Administration, Coral Gables, FL, 33146, United States of America, tallys@miami.edu, John Hooker, Andre Cire

Metaconstraints are constraints possessing behavioral parameters for relaxation, branching, and inference. Relaxations of metaconstraints create auxiliary variables related to other variables in the model. Semantic typing facilitates the detection and enforcement of such relations by giving specific meaning to variables, yielding stronger models. It also provides other modeling benefits, such as consistency checking and error detection. We motivate and illustrate these concepts through examples.

2 - Solver-independent MILP Callbacks in JuMP with Applications to Robust Integer Optimization

Iain Dunning, MIT Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, idunning@mit.edu, Dimitris Bertsimas, Miles Lubin, Joseph Huchette

We present the unique solver-independent callback functionality of JuMP, a modeling language embedded in the Julia language. Users can write efficient code for lazy constraints, user cuts, and heuristics, which we demonstrate for classic problems like the travelling salesman problem. We then demonstrate a JuMP extension, JuMPeR, for robust optimization. We can solve robust MILPs with either reformulations or cutting planes while not concerning the user with details of the underlying solver.

3 - Leveraging Model Transformations in Algebraic Modeling Systems

John Siirola, Analytics, Sandia National Laboratories, P.O. Box 5800, MS 1326, Albuquerque, NM, 87185, United States of America, jdsiiro@sandia.gov, William Hart, Jean-Paul Watson

"Flat" algebraic representations force modelers to explicitly convert or relax high-level constructs, which can obscure much of the structure in the model. We will show how high-level non-algebraic modeling constructs in Coopr can be coupled with automated model transformations to improve model clarity and abstraction. This allows modelers to explicitly apply transformations that link the structured model to a solver, thereby separating the core model from subsequent reformulation decisions.

4 - Conveying Logical Conditions to MIP Solvers through an Algebraic Modeling Language

Robert Fourer, President, AMPL Optimization Inc, 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com, David M. Gay, Victor Zverovich

Although algebraic modeling languages get their name from traditional numerical algebra, they are readily extended to "logical" constraints that appear naturally in applications. Logic extensions have indeed been available in modeling languages for some time. We describe our experiences incorporating logic into the AMPL language; the challenges have proved to be not so much in generalizing language forms and processing, as in communicating the resulting optimization problems to popular solvers.

■ MC47

Hilton- Mason A

Stochastic Optimization for Natural Resources

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Miguel Lejeune, Associate Professor, George Washington University, 2201 G Street, NW, Washington, DC, 20052, United States of America, mlejeune@gwu.edu

1 - Building a Stochastic Problem from its Roots: A Forestry Management Example

Ignacio Rios, Universidad de Chile, Jose Miguel Carrera 439 D215, Santiago, RM, Chile, irios@ing.uchile.cl, Roger Wets, Ignacio Rios, Andres Weintraub

We analyze how to deal with the uncertainty before solving a stochastic optimization problem and we apply it to a forestry management problem. In particular, we start from historical data to build a stochastic process for wood prices and for bounds on its demand. Then, we generate scenario trees considering different number of scenarios and different scenario generation methods. Finally, we describe a procedure to compare the solutions obtained with each approach and we apply it to our problem.

2 - Stochastic Programming with Reliability Requirements for Tactical Level Forest Harvesting

Janne Kettunen, Assistant Professor, The George Washington University School of Business, 2201 G Street, NW, Funger Hall 415, Washington, DC, 20052, United States of America, jkettune@gwu.edu, Miguel Lejeune

Major goals of private nonindustrial forest owners in harvesting include achieving a steady flow of revenues whilst reaching an overall satisficing revenue level. Accounting for these, we develop a stochastic programming framework. We use a Boolean reformulation method to linearize the proposed integer chance-constrained models and develop a computationally tractable approach. We demonstrate the model with real data and derive insights about optimal harvesting strategies.

3 - A Risk-averse Multistage Stochastic Programming Model in Forestry

Bernardo Pagnoncelli, Assistant Professor, Universidad Adolfo Ib·Òez, Diagonal las Torres 2640, Oficina 533-C, Santiago, RM, 7910000, Chile, bernardo.pagnoncelli@uai.cl, Adriana Piazza

An important source of uncertainty in forestry problems is timber price. I will present a one species model in which prices follow a geometric Brownian motion or an Ornstein-‹hlenbeck processes. Using stochastic dynamic programming techniques I will characterize the optimal policy for the first case and provide sufficient conditions for optimality in the second case. Risk aversion is represented by the Conditional Value-at-Risk and comparisons with the risk neutral case are provided.

4 - Stochastic Programming Models for Salmon Farming

Asgeir Tomasgard, NTNU- Trondheim, Norwegian University, Norway, asgeir.tomasgard@iot.ntnu.no

We present two models for the salmon farming value chain. The first model considers the fresh water stadium where the salmon is kept in tanks until it is ready for sea water (the smolt stadium) and minimizes the total expected costs related to smolt production. The next model considers making optimal smolt orders, deployment plans and finally harvesting in the seawater facilities. The most important sources of uncertainty are growth, temperature, price and mortality.

■ MC48

Hilton- Mason B

Network and Graphs 1

Contributed Session

Chair: Jordi Pereira, Universidad Catolica del Norte, Avda. Angamos 0610, Antofagasta, Chile, jorgepereira@ucn.cl

1 - Discovering and Exploring Overlapping Community Structures in Large Networks

Junming Yin, University of Arizona, McClelland Hall, Tucson, AZ, 85721, United States of America, junmingy@email.arizona.edu, Eric Xing, Qirong Ho

We present a novel scalable approach to detecting overlapping community structures in a large-scale network. Our approach builds on a new triangular characterization of networks and a fast stochastic variational inference (SVI) algorithm. Empirical results show that our triangular model SVI procedure is not only faster but also more accurate. We also demonstrate that our method is able to discover interesting communities on a massive IMDB co-actor network with 896K actors.

2 - Hybrid Statistical Data Mining Framework for Multi-Commodity Fixed Charge Network Flow Problems

Anurag Ladage, Graduate Student, Rochester Institute of Technology, 6000 Reynolds Drive, Rochester, NY, 14623, United States of America, aal1284@rit.edu, Scott Grasman, Ernest Fokoue

This paper presents a new approach to analyze the network structure in multi-commodity fixed charge network flow problems (MCFCNF). This methodology uses the historical data produced from traditional MCFCNF model as input for the machine-learning model. Further, we reshape the problem as a binary classification problem and employ machine-learning algorithms to predict the network structure. The quality of the solutions generated will be measured on basis of its feasibility and optimality gap.

3 - Whom Should we Tenure? Network Analysis for Predicting Research Impact

Shachar Reichman, Massachusetts Insitute of Technology, Sloan School of Management, 77 Massachusetts Ave, Cambridge, MA, 02459, United States of America, shachar@mit.edu, John Silberholz, Dimitris Bertsimas, Erik Brynjolfsson

We propose an analytics approach to support the tenure decision-making process at academic institutions. Using a large-scale bibliometric database of OR papers, we predict scholars' long-term performance using publication data from the first five years of their careers. These models select candidates with significantly better future citation counts and h-indexes than those selected by tenure committees, with similar performance on research awards, teaching awards, and journal editorships.

4 - A Numerical Method for Modelling Wavefront Propagation and Reflection from Rigid Boundary

Daisy Dahiya, Research Scholar, IIT Bombay, Department of Mathematics, Powai, Mumbai, 400076, India, daisydahiya@gmail.com

We present a numerical method based on the shortest path algorithm on graphs to model the propagation and reflection of a wavefront in an inhomogeneous moving medium with rigid boundary. The governing equation is the generalized eikonal equation. The solution of this equation may cease to be smooth and numerical methods are used to obtain the weak solution. Also if the medium of propagation has rigid boundaries then the wavefront may reflect after hitting the rigid boundary.

5 - Network Construction Problems with Maximum Lateness Minimization Objective

Jordi Pereira, Universidad Catolica del Norte, Avda. Angamos 0610, Antofagasta, Chile, jorgepereira@ucn.cl, Igor Averbakh

A network needs to be constructed by a single construction crew. A vertex is recovered when it becomes connected to the depot by an already constructed path. Each vertex of the network has a due date for its recovery time. The problem is to obtain a construction schedule that minimizes the maximum lateness of the vertices. We put forward the problem, discuss its computational complexity, and several solution methods. These methods are then compared on random and real life instances.

■ MC49

Hilton- Powell A

Networks Robustness and Vulnerability Analysis

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Foad Mahdavi Pajouh, University of Florida, 350 N Poquito Rd, Shalimar, Fl, 32579, United States of America, mahdavi@ufl.edu

1 - An Integer Programming Framework for Critical Elements Detection in Graphs

Alexander Veremyev, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States of America, averemyev@ufl.edu, Eduardo Pasiliao, Oleg Prokopyev

We study the problem of minimizing connectivity and cohesiveness of a graph by removing vertices and edges. We develop an integer programming approach under an assumption that the connectivity and cohesiveness metrics are general (possibly, nonlinear) functions of sizes of the remaining connected components and vertex degrees. Encouraging computational experiments are reported to illustrate the performance of the developed framework.

2 - The Minimum Edge Blocker Dominating Set Problem
Jose Walteros, University of Florida, Gainesville, FL, United States of America, jwalteros@ufl.edu, Foad Mahdavi Pajouh, Eduardo Pasiliao, Vladimir Boginski

The minimum edge blocker dominating set problem (EBDP) is to remove a subset of edges of minimum cardinality in a weighted undirected graph, such that the minimum weight of a dominating set in the remaining graph is bounded below by a given threshold. We develop an exact algorithm for solving the EBDP, which solves the proposed formulation via branch and cut where nontrivial constraints are added in a lazy fashion. We provide some computational results obtained by the proposed approach.

3 - An Integer Programming Approach for Fault-tolerant Connected Dominating Sets
Austin Buchanan, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, buchanan@tamu.edu, Je Sang Sung, Sergiy Butenko, Eduardo Pasiliao

This paper considers the minimum k-connected d-dominating set problem, which is a fault-tolerant generalization of the minimum connected dominating set (MCDS) problem. Three IP formulations are proposed and their integer hulls are studied. Despite having exponentially many constraints, the three LP relaxations can be solved in polytime. A lazy-constraint approach is proposed to solve the problem. For the MCDS problem (where k=d=1) the times are fastest in literature.

4 - New Analytical Lower Bounds for the Maximum Clique Number of a Graph
Vladimir Stozhkov, University of Florida, 2930 SW 23rd Ter, Apt 203, Gainesville, FL, 32608, United States of America, vstozhkov@ufl.edu, Eduardo Pasiliao, Grigory Pastukhov, Vladimir Boginski

We propose three new lower bounds for the maximum clique number of a graph. The first two are degree-adjacency-based and triangle-based, respectively. They both are derived from the Motzkin-Straus formulation. The third one is degree-based and derived from famous graph inequalities. We prove a variety of theoretical results for our new bounds. Finally, we conduct computational experiments to compare our three new bounds with well-known lower bounds by accuracy and complexity.

■ MC50

Hilton- Powell B

Service Parts Networks and Inventory Optimization

Cluster: Network Design

Invited Session

Chair: Stefan Minner, Technische Universität München, Arcisstr. 21, Munich, 80333, Germany, stefan.minner@tum.de

1 - Sustainable Multi-echelon Inventory Control with Shipment Consolidation and Non-linear Freight Costs
Johan Marklund, Professor, Lund University, Box 118, Lund, 22100, Sweden, Johan.Marklund@iml.lth.se, Olof Stenius, Sven Axsäter

We consider a 1-warehouse-N-retailer inventory system. Inventories are reviewed continuously while shipments from the warehouse are consolidated for groups of retailers and shipped periodically. We derive the probability distributions for the amount of goods on each shipment, enabling non-linear freight cost structures to be included in the model. The analysis is exact, encompassing joint optimization of multi-modal transportation and inventory decisions, with respect to costs and CO2 emissions.

2 - Determining Optimal Parameters of Expediting Level Policies
Ulrich Thonemann, University of Cologne, Albertus-Magnus-Platz, Koeln, 50923, Germany, ulrich.thonemann@uni-koeln.de, Raik Oezsen

We consider a situation where inventory managers have the option to expedite open orders. We incorporate an expediting level policy in a periodic-review base-stock inventory model and solve the model optimally. We numerically analyze the sensitivity of the inventory system with respect to the key parameters and quantify the benefit of order expediting using data from the service division of a global equipment manufacturer.

3 - Optimal and Heuristic Repairable Stocking and Expediting in a Fluctuating Demand Environment
Rob Basten, University of Twente, Postbus 217, Enschede, 7500AE, Netherlands, r.basten@utwente.nl, Joachim Arts, Geert-Jan Van Houtum

We consider a single stock point. Spare items are purchased at time zero and their demand follows a Markov modulated Poisson process. Defective items are sent to a repair shop that offers the option to expedite repairs. We formulate the decision to use this option as a Markov decision process, characterize the optimal policy, and propose a heuristic policy. We show how to compute optimal initial stocking levels in combination with those policies. A numerical study gives managerial insights.

■ MC51

Hilton- Sutter A

Recent Advances in First Order Methods

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

1 - Stochastic Subgradient Mirror-Descent Algorithm with Weighted Averaging
Angelia Nedich, UIUC, 1308 West Main Street, Urbana, Il, 61801, United States of America, angelia@illinois.edu

The talk is on a stochastic subgradient mirror-descent method for solving convex minimization problems. A method with weighted iterate-averaging and its per-iterate convergence rate are presented. The novel part of the approach is the choice of weights that are used to construct the averages, which allow us to recover the known optimal rates with simpler algorithms than those currently existing in the literature. Some new convergence results can also be obtained.

2 - Mirror Prox Algorithm for Multi-Term Composite Minimization and Semi-Separable Problems
Niao He, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, United States of America, nhe6@isye.gatech.edu, Anatoli Juditsky, Arkadi Nemirovski

We present a composite version of Mirror Prox algorithm for solving monotone variational inequalities of special structure, which inherits the favourable efficiency estimate of its prototype. We demonstrate that the proposed approach can be successfully applied to Lasso-type problems with several penalizing terms and to problems of semi-separable structures considered in the alternating directions methods, implying in both cases methods with the O(1/t) complexity bounds.

3 - Algorithms and Theory for Nonconvex Quadratic Optimization: Phase Retrieval and Beyond
Mahdi Soltanolkotabi, UC Berkeley, 736 Escondido Road, Aprt. 341, Stanford, CA 94305, United States of America, mahdisol@stanford.edu, Emmanuel Candes

We consider recovery of the seemingly hidden phase of an object from intensity-only measurements. We show that a nonconvex formulation of the problem recovers the phase information exactly from a minimal number of magnitude-only measurements. To solve this nonconvex problem, we develop an iterative algorithm that escapes all local minima and provably converges to the global optimum with a geometric rate. Our proposed scheme is near optimal in terms of usage of computational and data resources.

4 - Block Successive Upper Bound Minimization Method of Multipliers for Linearly Constrained Convex OPT
Mingyi Hong, Research Assistant Professor, University of Minnesota, 3626 E 44th Street, Apt 309, Minneapolis, United States of America, mhong@umn.edu

Consider the problem of minimizing the sum of a smooth convex function and a separable nonsmooth convex function subject to linear coupling constraints. Problems of this form arise in many contemporary applications. Motivated by the huge size of these applications, we study a new class of first order primal-dual algorithms called the block successive upper-bound minimization method of multipliers to solve this family of problems.

■ MC52

Hilton- Sutter B

Recent Advances in Linear Programming and Complementarity Problems

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Hande Benson, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, hvb22@drexel.edu

1 - Constraint Optimal Selection Techniques (COSTs) for Nonnegative Linear Programming Problems

Alireza Noroziroshan, PhD Student, University of Texas at Arlington, 600 Grand Ave, Apt#103, Arlington, TX, 76010, United States of America, alireza.noroziroshan@mavs.uta.edu, Bill Corley, Jay Rosenberger

We describe an active-set, cutting-plane approach called Constraint Optimal Selection Techniques(COSTs)and present an efficient new COST for solving nonnegative linear programming problems. We give a geometric interpretation of the new selection rule and provide computational comparisons of the new COST with existing linear programming algorithms for some large-scale sample problems.

2 - Preconditioners for Linear Programming

Javier Pena, Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, jfp@andrew.cmu.edu, Vera Roshchina, Negar Soheili

It is known that the behavior of algorithms for linear programming is determined by how "well conditioned" the problem instance is. We show that a combination of two preprocessing steps typically improves the conditioning of a problem. Our approach is based on a comparison among three different but related notions of conditioning for linear programming.

3 - Central Path Curvature for LP

Yuriy Zinchenko, University of Calgary, 2500 University Dr NW, MS524, Calgary, AB, T2N1N4, Canada, yzinchen@ucalgary.ca

Similarly to the diameter of a polytope, one may define its curvature based on the worst-case central path associated with solving an LP posed over the polytope. A continuous analogue of the Hirsch conjecture and a discrete analogue of the "average curvature" result of Dedieu, Malajovich and Shub may be introduced. A continuous analogue of a diameter d-step equivalence result may also be proved. We demonstrate how to construct a family of polytopes attaining the largest conjectured curvature.

4 - Fast Algorithms for Online Stochastic Convex Programming

Shipra Agrawal, Researcher, Microsoft Research, C702 Mantri Sarovar, Bangalore, India, shipra@microsoft.com, Nikhil Devanur

We introduce the online stochastic Convex Programming (CP) problem, a very general version of stochastic online problems, which allows arbitrary concave objectives and convex feasibility constraints. We present fast algorithms for these problems, which achieve near-optimal regret guarantees for both the i.i.d. and the random permutation models of stochastic inputs. Applications include many dynamic resource allocation and revenue management problems.

■ MC53

Hilton- Taylor A

Optimization and Financial Engineering

Cluster: Optimization in Finance

Invited Session

Chair: Martin Haugh, Columbia University, 500 West 120th Street, Room 332, New York, NY, 10027, United States of America, mh2078@columbia.edu

1 - A Drift Switching Jump-Diffusion Model for Reserve Management

Ning Cai, Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, ningcai@ust.hk

We propose a drift switching reflected jump-diffusion model for international reserve management to capture both the jump behavior in reserve dynamics and the leptokurtic feature of the reserve increment distribution. The model is simple and produces a closed-form expression for the total expected discounted cost of managing reserves.

2 - Multiperiod Portfolio Optimization with Many Risky Assets and General Transaction Costs

Victor DeMiguel, avmiguel@london.edu

We analyze the optimal portfolio policy for a multiperiod mean-variance investor facing many risky assets and general transaction cost. For proportional transaction costs, we give a closed-form expression for a no-trade region. For market impact costs, we show that at each period it is optimal to trade to the boundary of a state-dependent rebalancing region. Finally, we show empirically that the losses associated with ignoring transaction costs may be large.

3 - Dynamic Portfolio Optimization with Transaction Costs

John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

Dynamic portfolio optimization presents multiple challenges, such as parameter estimation and incorporation of transaction costs. This talk will discuss results comparing comparing various approaches to this issue.

4 - Tax-Aware Dynamic Asset Allocation

Chun Wang, Columbia University, 323 S. W. Mudd Building, 500 W. 120th Street, New York, NY, 10027, United States of America, cw2519@columbia.edu, Martin Haugh, Garud Iyengar

The asset allocation problem with taxes has several variations depending on: (i) whether we use the exact or average tax-basis and (ii) whether we allow the full use of losses or the limited use of losses. It is a challenging problem due to high-dimension and path-dependence. We consider all of these variations, develop several sub-optimal trading policies and use duality techniques based on information relaxations to assess their performances. We show that much larger problems can be tackled.

■ MC54

Hilton- Taylor B

Default and Systemic Risk

Sponsor: Financial Services Section

Sponsored Session

Chair: Agostino Capponi, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, 21218, United States of America, acappon1@jhu.edu

1 - Repo Chains

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris 418, New York, NY, 10027, United States of America, alirezat@columbia.edu, Marco Di Maggio

We study the financial institutions' role as intermediaries between cash lenders (e.g. money market funds) and borrowers (e.g. hedge funds), and study how a chain of repurchase agreements can function as a mechanism for propagation and amplification of risk.

2 - Funding without Tears: A Unified Approach to XVA

Stephan Sturm, Assistant Professor, WPI, 100 Institute Road, Worcester, MA, 01609, United States of America, ssturm@wpi.edu, Agostino Capponi, Maxim Bichuch

The financial crisis lead to an opening of the LIBOR-OIS spread. Default risk has become a real possibility and banks can no longer borrow and lend at the same rate. Also traders face different rates when financing their hedging positions. Many large banks have created unified XVA desk that takes care of the total value adjustment. We propose a unified methodology for the calculation of the XVA and provide a detailed study of hedging a stock option with defaultable corporate bonds.

3 - Likelihood Estimation for Large Financial Systems

Justin Sirignano, Stanford University, 3 Gibbs Court, Irvine, CA, 92617, United States of America, jasirign@stanford.edu, Gustavo Schwenkler, Kay Giesecke

We consider the problem of parameter estimation for large interacting stochastic systems. Maximum likelihood estimation is computationally intractable due to the scale and complexity of such systems. Weak convergence results are exploited to develop approximate maximum likelihood estimators for such systems. An important application is systemic risk in banking systems and other large financial systems.

4 - Systemic Risk and Network Topology

Peng-Chu Chen, PhD Student, Purdue University, 315 N. Grant Street, West Lafayette, 47906, United States of America, chen621@purdue.edu, Agostino Capponi

We provide an analytical framework to rank financial networks based on level of systemic risk. We introduce the concept of majorization to quantify the degree of network homogeneity and compare the losses generated after interbank clearing occurs. We analyze balancing and unbalancing networks. Given two balancing networks, if one majorizes the other, it generates smaller losses. Oppositely, given two unbalancing networks, one generates smaller losses than the other only if it is majorized by it.

■ MC55

Hilton- Van Ness

MINLP Methodology and Applications

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Merve Bodur, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu

1 - Global Optimization of Mixed-integer Nonlinear Optimization Problems in BARON

Mustafa Kilinc, Carnegie Mellon University, Department of Chemical Engineering, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, mkilinc@andrew.cmu.edu, Nick Sahinidis

We report recent developments in BARON. New features include integrality-based techniques, such as preprocessing, probing, constraint management, branching and node selection rules. Specific cutting plane generation now produces knapsack cuts, GUB cuts, clique cuts, implication cuts and flow cuts. Mixed-integer linear programming relaxations are solved to construct new feasible solutions and improve relaxations at nodes of the search tree. Extensive computational results will be presented.

2 - A Risk-averse Two-stage Stochastic Programming for Retrofitting Transportation Networks

Jie Lu, Clemson University, 102 Calhoun St., Apt. 130, Clemson, SC, 29631, United States of America, jlu3@clemson.edu, Yongxi Huang, Akshay Gupte

We develop a risk-averse two-stage stochastic programming model with the conditional-value-at-risk (CVaR) as the risk measure. This approach considers a variety of random outcomes to provide more robust solutions and generalizes prior modeling efforts. A mixed integer nonlinear programming problem is formulated with integer variables appearing in the second stage. We develop a decomposition algorithm based on generalized Benders decomposition method and present numerical implementations.

3 - On Convex Relaxations of Network Interdiction Problems

Danial Davarnia, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, d.davarnia@ufl.edu, Jean-Philippe P Richard, Mohit Tawarmalani

Network interdiction problems are often reformulated as bilinear mixed integer programs through dualization of the inner problem. We develop convex relaxations for these models. In particular, we give a procedure to derive the convex envelope of a single bilinear term over a relaxation of the model. We also describe the corresponding triangulation. We conclude by comparing these results to those obtained through KKT reformulations of interdiction problems.

■ MC56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Maximal Software, Inc. - Server-Based Version of the MPL OptiMax Component Library

Bjarni Kristjansson, President, Maximal Software Inc., 2111 Wilson Boulevard, Suite 700, Arlington, VA, 22201, United States of America, bjarni@maximalsoftware.com

We will be demonstrating the server-based version of the MPL OptiMax Component Library, which makes implementing and deploying real-world optimization applications for servers, clouds, and mobile platforms a relatively quick and easy process, using standard programming languages, such as CSharp, Visual Basic, C/C++ or Python.

2 - See the New KNITRO SQP Algorithm in Action

Richard Waltz, President, Ziena Optimization LLC, waltz@ziena.com

KNITRO is the premier solver for nonlinear optimization problems. This software demonstration will highlight the new KNITRO SQP algorithm. The KNITRO SQP algorithm offers improved performance on select models, as well as warm-start and re-optimization capabilities. We will provide comparisons with the existing active-set and interior-point methods in KNITRO, and examples highlighting the advantage of the SQP approach.

■ MC64

Parc- Cyril Magnin I

POMDPs and Applications

Sponsor: Applied Probability Society

Sponsored Session

Chair: David Brown, Duke University, 100 Fuqua Drive, Durham, United States of America, dbbrown@duke.edu

1 - Bayesian Inventory Management with Change-Points in Demand

Adam Mersereau, Associate Professor, UNC Chapel Hill, CB 3490, Chapel Hill, NC, 27599-3490, United States of America, ajm@unc.edu, Zhe Wang

We consider an adaptive inventory control problem in which at some known points in time, the demand process may change abruptly with some probability. The underlying demand process is never revealed to the decision maker. Using a Bayesian framework, we analyze the optimal policy as demands are observed. We prove structural properties and we construct two novel lower bounds. From our bounds we develop two heuristic policies that exhibit small optimality gaps in numerical testing.

2 - Improving Intelligence Collection through Social Networks

Nedialko Dimitrov, Naval Postgraduate School, Monterey, Monterey, United States of America, ned@nps.edu, Moshe Kress

Intelligence analysts face a glut of information. To produce a complete analysis quickly, an analyst has to identify relevant information within that glut. In this talk, we discuss novel methods of assisting this intelligence collection task by exploiting social network structure.

3 - Near-optimal Regret Bounds for Reinforcement Learning in Factored MDPs

Ian Osband, Stanford University, MS&E Dept, Stanford, Ca, 94305, United States of America, iosband@stanford.edu, Benjamin Van Roy

Any learning algorithm over MDPs will have worst-case regret which grows with the square root of the number of state-action pairs. In many cases of interest the state and action spaces are so huge that it is impossible to guarantee good performance on any reasonable time frame. We show that, if the system can be represented as a factored MDP, we can obtain regret bounds polynomial in the number of parameters of the MDP, which may be exponentially smaller than the number of states or actions.

4 - Duality and Observability in Partially Observable Markov Decision Processes

Stefan Rampertshammer, Duke University, 100 Fuqua Dr, Durham, United States of America, stefan.rampertshammer@duke.edu, David Brown

We examine a continuation-value iteration technique for studying POMDPs which operates without reference to beliefs. We propose a relaxation of the observation structure which leverages the geometry of continuation-value iteration to greatly improve tractability.

■ MC65

Parc- Cyril Magnin II

Stochastic Systems

Sponsor: Applied Probability Society

Sponsored Session

Chair: Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, mss@us.ibm.com

1 - A Service System with On-demand Agent Invitations

Alexander Stolyar, Bell Labs, Alcatel-Lucent, 600 Mountain Ave., 2C-322, Murray Hill, NJ, 07974, United States of America, Sasha.Stolyar@alcatel-lucent.com, Guodong Pang

We consider a system where service agents are invited on-demand, and respond (accept or decline) after a random delay. Arriving customers and accepting agents are matched in the order of their arrival/acceptance. We study asymptotic behavior of a queue-based feedback agent invitation scheme, as the system scale becomes large.

2 - An Infinite-dimensional Skorokhod Map, with Applications to Fluid Limits

Kavita Ramanan, Professor, Brown University, 182 George St, Providence, RI, 02912, United States of America, kavita_ramanan@brown.edu

Scheduling policies such as Earliest-Deadline-First and Shortest-Remaining-Processing-Time serve jobs according to a continuous parameter priority. For both policies, we obtain new formulations of fluid equations and establish convergence to these equations. Our main tool is the introduction of an infinite-dimensional Skorokhod map on the space of measure-valued processes, which may be of independent interest. This is joint work with Rami Atar, Anup Biswas and Haya Kaspi.

3 - Insensitivity of Proportional Fairness in Heavy Traffic

Bert Zwart, CWI, Science Park 123, Amsterdam, Netherlands, Bert.Zwart@cwi.nl, Maria Vlasiou, Jiheng Zhang

A Bandwidth Sharing Network is a mathematical abstraction of a communication network like the Internet. For a network with proportial fairness and a dense class of service requirement distributions, we establish a diffusion limit through a state space collapse result. The invariant distribution is determined by first moments only, confirming a conjecture of Kelly et al.

4 - Improving the Scalability of Search in Networks Through Multiple Random Walks

Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, mss@us.ibm.com, Don Towsley, Sean Barker

Efficient search is of fundamental importance in communications/social networks. Assuming an underlying n-node network topology of expander graphs with bounded degree, we derive hitting time results for multiple random walks (RWs) and establish that multiple RWs scale very well: O(log n) search latency, asymptotically zero search failure probability, and O(1) overhead per query. However, to achieve these properties, it is important to tailor the number of RWs to the popularity of the content.

■ MC66

Parc- Cyril Magnin III

Joint Session QSR/DM: Panel Discussion: Funding Opportunities

Sponsor: Quality, Statistics and Reliability & Data Mining

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Panel Discussion: Funding and R&D Opportunities

Moderator: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu, Panelists: Ashit Talukder, Romeijn Edwin, Alexandra Medina-Borja

In this panel, program officers and division chief from NSF and NIST will talk about funding opportunities. The panelists are: Dr. Edwin Romeijn and Dr. Alexandra Medina-Borja from National Science Foundation; Dr. Ashit Talukder from NIST.

■ MC67

Parc- Balboa

IIE Transactions Session

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jianjun Shi, Professor, Georgia Institute of Technology, 765 Ferst Dr NW, Atlanta, United States of America, jianjun.shi@isye.gatech.edu

1 - Ensemble Modeling for Data Fusion in Manufacturing Process Scale-up

Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall,, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Xinwei Deng

In manufacturing scale-up, design of experiments is widely used to identify optimal process settings, followed by production runs to validate the settings. Both experimental and observational data are collected. However, a single type of data set is often used to model the process. We propose an ensemble modeling strategy to integrate the two types by constrained likelihood approach. Simulations and a case study of wafer manufacturing are provided to illustrate the merits of the proposed method.

2 - High-dimensional Process Monitoring using Embedding Distribution in Reproducing Kernel Hilbert Space

Shuai Huang, Assistant Professor, University of Washington, Industrial and Systems Engineering, United States of America, shuaihuang@usf.edu

We propose a novel RKHS-based control chart and a change point detection method that can be applied to high-dimensional processes with sophisticated process distributions, to detect a wide range of process changes beyond the ones that are detected by traditional SPC methods. Extensive experiments on both simulated and real-world processes demonstrated that the proposed methods lead to improved statistical stability, fault detection power, and robustness.

3 - Optimal Offline Compensation of Shape Shrinkage for 3D Printing Processes

Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Avenue, Los Angeles, CA, 90089, United States of America, qiang.huang@usc.edu, Jizhe Zhang, Arman Sabbaghi, Tirthankar Dasgupta

Dimensional accuracy is a key control issue in direct 3D printing. We develop a new approach to (1) model and predict part shrinkage, and (2) derive an optimal shrinkage compensation plan to achieve dimensional accuracy. Experimental results demonstrate the ability of the proposed compensation approach to achieve an improvement of one order of magnitude in reduction of geometric errors for cylindrical products.

■ MC68

Parc- Davidson

Recent Trends in Composing Heterogeneous Simulation Models

Sponsor: Simulation

Sponsored Session

Chair: Peter Haas, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, phaas@us.ibm.com

1 - Complex Events Modeling, Simulation, and Analysis (CEMSA)

Nabil Adam, Distinguished Professor and Assoc Provost for Research, Rutgers University, 1 Washington Park, Newark, NJ, 07102, United States of America, adam@adam.rutgers.edu

CEMSA enables analysts quickly integrate data, simulation models, and expertise to arrive at credible consequence analysis of complex events (e.g., a coordinated cyber/physical attack that disables transportation and causes the release of a toxic chemical plume). CEMSA aims to reduce turnaround time and costs, provide enhance interoperability within and across organizations. We present technical detail of some CEMSA components and discuss an example of its possible use.

2 - A Reflective Middleware Framework for Next Generation Multisimulations

Sharad Mehrotra, Professor, University of California, Irvine, 2084 Donald Bren Hall, Irvine, CA, 92617, United States of America, uci.sharadmehrotra@gmail.com, Nalini Venkatasubramanian

We present a reflective middleware framework, RAISE, to integrate multiple autonomous simulators to model complex scenarios. RAISE extracts metamodels from simulators, observes their execution, facilitates information exchange, and reflects the modified features in the integrated simulation. Using a case study from emergency response, we discuss several challenges in enabling accurate multisimulations.

3 - Accelerating the Execution of Stochastic Composite Simulation Models

Peter Haas, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, phaas@us.ibm.com

Stochastic composite simulation models can be used to study complex stochastic "systems of systems". For a composite model made up of loosely coupled component models, we provide a method for speeding up composite-model simulations. To run n Monte Carlo replications of the composite model, we execute certain component models fewer than n times, re-using results as needed. The number of component-model replications is chosen to maximize an efficiency measure as in Glynn and Whitt (1992).

4 - AROMA: A Spatial Agent-Based Software Platform for Integrated Modeling of Natural Resources

Saeed Ghafghazi, PostDoctoral Fellow, Institute for Energy and Environmental Policy, Queen's University, #2312-2424 Main Mall, Vancouver, BC, V6T1Z4, Canada, saeed.ghaf@queensu.ca

This paper presents the development and use of AROMA (Agent-based Resource Optimization Modeling Arena). AROMA is a GIS- and agent- based software platform that allows integrated modeling of natural resources related systems. A case study investigating the impact of supplier-buyer and lumber market dynamics on wood fiber supply chain in Northeastern Ontario is presented and implications for economic and environmental sustainability of the emerging biorefineries in the region are discussed.

■ MC69

Parc- Fillmore

Carbon Footprint and the Management of Supply Chains

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, College of Business Administration, Department of Management, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

1 - Cap and Trade Emissions Trading: An Economic Analysis

Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, College of Business Administration, Department of Management, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

Carbon emissions trading emerges as an effective market-based mechanism to curb the carbon emissions. Using a utility-based model, this paper studies the optimal policy of production and carbon trading decisions of a firm operating in a segmented customer market, and examines the impacts of carbon trade, carbon price and carbon cap on these decisions.

2 - Optimal Carbon Capture and Storage Contracts using Historical CO2 Emissions Levels

Wenbo (Selina) Cai, Assistant Professor, New Jersey Institute of Technology, MEC 308, University Heights, Newark, NJ, 07102, United States of America, cai@njit.edu, Dashi Singham

In an effort to reduce carbon emissions to the atmosphere, carbon capture and storage technology is developed to collect carbon from emissions generators and store it underground. We develop optimization models to facilitate a storage operator's decisions on the price and volume of service contracts to maximize his expected profit subject to the limited capacity at the storage site while encouraging the participation of the emissions sources.

3 - Modeling Carbon Control Policies: Tax versus Cap-and-Trade

Arvind Sainathan, Nanyang Business School, NTU, S3-B2A-03 50 Nanyang Avenue, Singapore, Singapore, asainathan@ntu.edu.sg, S. Viswanathan

We consider and compare the performance of two key carbon control policies: tax and cap-and-trade. We characterize the Stackelberg equilibrium under the tax policy, and the unique trading equilibrium in the cap-and-trade policy. We also consider other well-known mechanisms for carbon control, and compare them with these two policies. Finally, we propose two new schemes and derive key insights based on our analysis.

4 - Adjusting Closed Loop Transportation Capacities to Uncertain Carbon Tax with Stochastic Demands

Seyyed Ali Haddad Sisakht, Iowa State University, 3004 Black Engineering Bldg., Ames, United States of America, alihadad@iastate.edu, Sarah M. Ryan

We formulate a closed-loop supply chain network design problem under carbon tax uncertainty and stochastic demands. We propose a solution approach with adjustable robust optimization where mode transportation capacities and product flows can adapt to changing tax rates and product flows also vary by scenario. Solving the mixed-binary stochastic semidefinite program indicates that increasing carbon tax uncertainty in the initial periods expands the benefit of adjustability.

■ MC70

Parc- Hearst

Incorporating Ecological Concerns into Harvest Scheduling

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Erin Belval, Colorado State University, Campus Delivery 1472, Fort Collins, CO, United States of America, mccowene@gmail.com

1 - Incorporating Edge Effects Into Harvest Scheduling

Kai Ross, PhD. Student, University of Washington, Loew Hall 304, Seattle, WA, 98195, United States of America, mailkaiross@gmail.com, Sandor Toth

When a forest is cut, new edges are formed altering many ecological factors such as sun exposure and risk to wind throw. We introduce a new harvest scheduling model that incorporates the edge effects of these factors on yield. The mechanics of the model will be illustrated with a case study where the potential loss of yield to wind throw is commercially significant.

2 - Can Sustainable Forest Management Help Mitigate Climate Change?

Marc-André Carle, Assistant Professor, Université Laval, 1065, Avenue de la Médecine, Québec, QC, Canada, Marc-Andre.Carle@osd.ulaval.ca, Mathieu Bouchard, Steve Vallerand, Sophie D'Amours, Martin Simard

In the past decade, carbon concentration in the atmosphere has increased significantly. The potential of forests to help mitigating climate change has been widely acknowledged. This talk presents several modeling strategies for incorporating carbon accounting and sequestration into strategic forest management models. Three case studies from the Province of Quebec will be presented and discussed.

■ MC71

Parc - Lombard

Analysis of Matching Markets

Cluster: Auctions

Invited Session

Chair: Thayer Morrill, NC State University, NC, United States of America, thayer_morrill@ncsu.edu

1 - New Algorithms for Fairness and Efficiency in Course Allocation

Hoda Atef Yekta, PhD Candidate, University of Connecticut, School of Business, 2100 Hillside Road Unit 1041, Storrs, CT, 06269, United States of America, Hoda.AtefYekta@business.uconn.edu, Robert Day

This research formulates the course allocation problem as a multi objective mathematical model considering both efficiency and measures of fairness. Results of four proposed heuristic algorithms are compared with existing mechanisms and we show that our new algorithms can improve both efficiency and fairness of the results.

2 - Internally Stable Matchings and Exchanges

Yicheng Liu, liuyicheng1991@hotmail.com, Pingzhong Tang

We propose an alternative notion of stability for matchings and exchanges, coined internal stability, which only requires stability among matched agents. For internal stability, we analyze the social welfare bounds and computational complexity. Our results indicate that internal stability addresses both the social welfare and computational difficulties associated with traditional stability.

3 - The Secure Boston Mechanism

Thayer Morrill, NC State University, NC, thayer_morrill@ncsu.edu, Umut Dur, Robert Hammond

We introduce a new algorithm that is a hybrid between the Boston and Deferred Acceptance algorithm. While not strategy-proof, this ``secure" Boston algorithm significantly reduces the incentive for students to strategically manipulate their reported preferences while maintaining the desirable feature of the Boston mechanism of assigning as many students as feasible to their favorite school. We run an experiment in order to test the performance of our new assignment procedure.

4 - Two-sided Matching with Incomplete Information

Sushil Bikhchandani, UCLA Anderson School of Management, University of California, Los Angeles, CA, United States of America sushil.bikhchandani@anderson.ucla.edu

Stability in a two-sided matching model with non-transferrable utility (NTU), interdependent preferences, and one-sided incomplete information is investigated. The notion of incomplete-information stability used here is similar to that of Liu et al. (2014). With anonymous preferences, all strictly individually-rational matchings are incomplete-information stable. An ex post incentive-compatible mechanism exists for this model. Extensions to two-sided incomplete information are investigated.

■ MC72

Parc- Stockton

Optimization and Analysis of Smart Grids with Renewable Energy and Storage

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Masood Jabarnejad, PhD Student, Auburn University, 333 East Magnolia Ave. APT 44, Auburn, AL, 36830, United States of America, masood@auburn.edu

1 - Electricity Markets and Operations with Multi-stage Optimization
Alberto J. Lamadrid, Assistant Professor, Lehigh University, 621 Taylor Street, r451, Bethlehem, PA, 18015, United States of America, ajlamadrid@Lehigh.EDU

We present a two stage program for operations and market clearing of the electricity system with high penetrations of renewable energy sources. The formulation is a stochastic program with robust operational reserves for the system operator. The first stage is a multi-period, security constrained Optimal Power Flow (SC-OPF), with Markovian transitions over time, forecasting a fixed time horizon. The second stage is a single period SC-OPF, incorporating the realizations of stochastic variables.

2 - Financial Rights for Energy Storage
Josh Taylor, Asst. Professor, U. Toronto, 10 King's College Rd., Toronto, Canada, josh.taylor@utoronto.ca

The strong analogy between energy storage and transmission motivates us to ask: should storage buy and sell power at wholesale market prices, or should its physical and financial operations be decoupled? The latter case is non-traditional and is the subject of this talk. We define financial storage rights, which enable passive storage to recover costs, redistribute the system operator's budget surpluses, and enable market participants to hedge against nodal price volatility.

3 - Optimization Models and Algorithm for Layouts of Ocean Wave Energy Farms
M. Mohsen Moarefdoost, Lehigh University, 200 W Packer Ave, Bethlehem, PA, United States of America, mom211@lehigh.edu, Lawrence V. Snyder

We present models and algorithms for choosing optimal locations of wave energy conversion (WEC) devices within an array, or wave farm. The location problem can have a significant impact on the total power of the farm due to the complicated hydrodynamic interactions among the devices and ocean waves. The wave energy converter location problem (WECLP) is non-linear and non-convex, so we propose an iterative heuristic for the general problem as well as the model's analytical properties.

4 - Techno-Economic Optimization of a High-Flux Solar Thermal Receiver using Surrogate Models
Michael Wagner, Mechanical Engineer, National Renewable Energy Laboratory, 15013 Denver West Parkway, Golden, CO, 80401, United States of America, Michael.Wagner@nrel.gov, Alexandra M. Newman, Rob Braun

We optimize a novel concentrating solar power tower receiver technology by choosing geometry and optical design. We use computationally expensive engineering models to generate surrogates that represent the objective function, which accounts for revenue as a function both of the design of the system and of the annual plant electricity production. Solar flux and material temperature constraints are highly nonlinear, making it difficult to determine a feasible solution; we present results.

■ MC73

Parc- Mission I

Investment in Electricity Markets

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Golbon Zakeri, Dr., University of Auckland, #70 ymonds street, Auckland, New Zealand, g.zakeri@auckland.ac.nz

1 - A Column Generation Approach for Generation Expansion Planning with High Renewable Penetration
Angela Flores, Research Assistant, Energy Center, University of Chile, Av. Tupper 2007, Santiago, Chile, angelafq@gmail.com, Rodrigo Moreno, Rodrigo Palma, Golbon Zakeri

The high penetration of renewables that is envisaged in future power systems will significantly increase the need for flexible operational measures and generation technologies. These sources of flexibility will need to be properly considered in system expansion models. In this framework, we propose a column generation approach that permits the consideration of Unit Commitment constraints in long-term system planning problems in an efficient fashion.

2 - Investment in Electricity Markets with Risk Averse Agents
Golbon Zakeri, Dr., University of Auckland, #70 ymonds street, Auckland, New Zealand, g.zakeri@auckland.ac.nz, Corey Kok, Andy Philpott

We will present investment results from competitive equilibrium models over electricity markets with risk averse generators and retailers. We will compare investment levels under different risk mitigating structures such as vertical integration with when risk trade through instruments such as contract for differences are implemented.

3 - The Value of Electricity Storage for Intermittent Renewable Integration: A Hybrid Modeling Approach
Claudia Octaviano, Research Associate, MIT, 77 Massachusetts Ave, E19-411, Cambridge, MA, 02139-4307, United States of America, claus@mit.edu

Renewable electricity faces several integration challenges due to its intermittency. While critical to decarbonize the power sector, renewables require storage devices and demand response to reach large-scale deployment. To assess the value of storage, a capacity expansion model with renewable resources at the hourly time-scale is coupled to the MIT EPPA model, a global general equilibrium model. We discuss economy-wide implications of the availability of storage for long-term climate policy.

4 - Including Short-Term Operation Details in Strategic Generation Expansion Models
Adelaida Nogales, Research Assistant, Institute for Research in Technology, Alberto Aguilera, 23, Madrid, Ma, 28015, Spain, adelaida.nogales@iit.upcomillas.es, Efraim Centeno, Sonja Wogrin

Renewable technologies are expected to reach large penetration levels in electric power systems. These technologies are changing the unit commitment of the rest of the generation facilities and therefore, operation-related issues become more relevant for an adequate analysis of generation expansion problems. We propose a generation expansion equilibrium model including an oligopolistic market representation and with key operation-related details. An efficient resolution methodology is proposed.

■ MC74

Parc- Mission II

Stochastic and Robust Optimization in Electric Power Systems Operations and Planning

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

1 - Strategic Offering for a Wind Power Producer: A Stochastic MPEC Approach
Luis Baringo, Postdoctoral researcher, ETH Zurich, EEH - Power Systems Laboratory, Physikstrasse 3 - ETL G 23, Zurich, 8092, Switzerland, luis.baringo@eeh.ee.ethz.ch, Antonio J. Conejo

A stochastic mathematical program wind equilibrium constraints (MPEC) is proposed to derive the optimal offering strategy of a wind power producer participating in the day-ahead and balancing markets. This producer owns a large enough wind power capacity and is able to behave strategically in order to alter market prices according to its own interest. Uncertainties concerning wind power productions, market prices, and rivals' offering decisions are efficiently modeled using a set of scenarios.

2 - Distributionally Robust Congestion Management with Dynamic Line Ratings
Jianhui Wang, Decision and Information Sciences Division/Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221, Argoone, IL, 60439, United States of America, jianhui.wang@anl.gov, Feng Qiu

Dynamic Line Rating or DLR, which monitors the ambient environment to estimate the thermal rating of a transmission line, has been shown to be very effective in utilizing the capacity of transmission lines. In this work, we propose a new distributionally robust optimization based congestion management model that selectively uses DLR to alleviate system congestion while keeping the overloading risk at the system level within a safe range.

3 - Multistage Stochastic Power Generation Expansion Planning
Jikai Zou, Graduate Research Assistant, Georgia Institute of Technology, 765 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, jikai.zou@gatech.edu, Shabbir Ahmed, Andy Sun

We consider a power generation expansion problem with uncertainty in demand and fuel price. In particular, we develop a multistage stochastic mixed integer programming approach to determine the numbers of power plants to be built during the planning horizon. The differences among two-stage, multistage and a "hybrid" models are addressed. We propose an efficient approximation scheme by exploiting a special substructure, and give an analytical bound on the optimality gap of the algorithm.

4 - Do-Not-Exceed Limits for Renewable Resources with Robust Corrective Topology Control
Kory Hedman, Assistant Professor, Arizona State University, PO Box 875706, GWC 206 School of ECEE, Tempe, AZ, 85287-5706, United States of America, Kory.Hedman@asu.edu, Akshay Korad

Do-not-exceed (DNE) limits specify a desired dispatch range that a renewable power producer must stay within in order to maintain reliability. These DNE limits can be determined with robust optimization. Corrective transmission topology control can be used to manage congestion and renewable uncertainty in the smart grid. This talk will present how corrective topology control can be used to improve do-not-exceed limits for renewable resources.

■ MC75

Parc- Mission III

Operations Research to Inform Health Policies

Sponsor: Minority Issues Forum

Sponsored Session

Chair: Maria Mayorga, Associate Professor, North Carolina State University, 111 Lampe Dr., Raleigh, NC, 27695, United States of America, memayorg@ncsu.edu

1 - A Dynamic Programming Model to Assess when it is Optimal to Stop a Trial of Labor
Karen Hicklin, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, kthickli@ncsu.edu, Vidyadhar Kulkarni, Meera Viswanathan, Evan Myers, Julie Ivy

The cesarean section rate in the U.S. was reported to be 32.8% in 2011, rising from 4.5% in 1970. Due to the increased risk of short-term complications associated with cesarean sections, among other things, there is general consensus that current rates are too high. A dynamic programming decision model was created to provide time-based thresholds conditional on dilation for when to stop a trial of labor in order to maximize the expected utility of healthy outcomes for the mother and child.

2 - Modeling Smoking Cessation Aid Choices and Outcomes
Rachel Townsley, North Carolina State University, 400 Daniels Hall, College of Engineering, NCSU, Raleigh, NC, 27695, United States of America, rmtownsl@ncsu.edu, Maria Mayorga

Despite declining prevalence, cigarette smoking remains the leading cause of preventable death in the developed world. We use discrete event simulations informed by statistical choice models to model behavior and disease progression and evaluate policy strategies to improve cessation rates in a heterogeneous US population. We focus on quantifying the impact of incentivizing the use of cessation aids to alter smoker choice in a quit attempt, evaluating policies by QALYs gained and societal cost.

3 - The Effect of Mindfulness Meditation on Decreasing the Stroke Incidence in the US
Raj Ambavane, Clemson University, 220 Elm St #321, University Place, Clemson, SC, 29631, United States of America, rambava@g.clemson.edu, Amin Khademi, Lu Shi

Mindfulness meditation has shown promise in clinical trials in reducing systolic blood pressure, one of the main causes of stroke. We develop an agent-based simulation model simulating the stroke trend in the US to estimate the effect of mindfulness meditation on the incidence of strokes. Our results show that mindfulness meditation, if properly utilized along with the regular antihypertensive medication, could be effective in ultimately reducing the incidence of strokes.

4 - A Microsimulation Population Model to Evaluate Sodium Reduction Initiatives in Los Angeles County
Irene Vidyanti, Los Angeles Department of Public Health, 3530 Wilshire Boulevard, Los Angeles, CA, 90010, United States of America, irenevidyanti@gmail.com, Ricardo Basurto-Davila

The Future Elderly Model (FEM) is a microsimulation model originally developed to examine health and health care costs among the elderly national Medicare population. FEM is adapted for use in Los Angeles (LA) County by re-weighting and calibrating to various data sources to form FEM-LA. FEM-LA is then used to evaluate long term health impact of Los Angeles County Department of Public Health's sodium reduction initiatives in population 51 years old and older.

■ MC76

Parc- Embarcadero

The Data Lifecycle - Selected Case Studies

Sponsor: The Practice Track

Sponsored Session

Chair: Rainer Dronzek, Director-Operations Research, McDonald's, 1253 N Schmidt Road, Romeoville, IL, 60446, United States of America, rainer.dronzek@us.mcd.com

1 - The Data Lifecycle: A QSR Case Study
Rainer Dronzek, Director-Operations Research, McDonald's, 1253 N Schmidt Road, Romeoville, IL, 60446, United States of America, rainer.dronzek@us.mcd.com

The lifecycle of data begins with collection and progresses through preparation, analysis, presentation, activation, storage, reuse and destruction. Several specific data sets in the Quick Service Restaurant industry will be presented and the lessons learned, successes and opportunities for each step of the data lifecycle will be discussed. The session will also highlight the realities of dealing with real world data.

2 - So Much Data, So Little Time - A Customer Analytics Perspective
Ben Fuqua, Vice President, Elicit, 525 Third Street North, Suite 509, Minneapolis, MN, 55401, United States of America, ben.fuqua@elicitinsights.com, Jim Sawyer

Analytics professionals can encounter real world problems and wrestle with Big Data with a pragmatic perspective. Understanding what data is important, such as deciding how to gauge Customer's response a retailer's value proposition affords us the opportunity to consider novel solution possibilities and data combinations. The data lifecycle and quality are always restrictions. But navigating those restrictions and leading Senior Executives to data driven decisions requires additional skills.

3 - Sentiment Analytics with Automatic Facial Expression Recognition Software
Marian Bartlett, Co-Founder & Lead Scientist, Emotient, 4435 Eastgate Mall, Suite 320, San Diego, CA, 92121, United States of America, marni@emotient.com, Ed Colby

Dr. Bartlett will explain a state-of-the-art approach applying machine learning, computer vision and cognitive science to facial expression recognition. She will demonstrate the data lifecycle from collection via a standard camera; frame-by-frame processing (detecting emotions, overall sentiment and gender demographics); and show the aggregate, anonymous data visualized as emotion-based heat maps. She will conclude by discussing how this data can be interpreted to derive key business insights.

4 - Too Much Data - When to Focus on What
Oliver Bandte, Customer Analytics Team Manager, The Boston Consulting Group, 35 State St, Boston, MA, United States of America, oliver.bandte@bcg.com

As traditional data scientists have always longed for higher quantities of data to feed the prevalent statistical techniques, we may have come in many organizations to a point where data integrity has to be called into question due to the variety of its sources. Dr. Bandte will demonstrate a few real life examples where "more data" did not always mean "more insght"as data integrety, analytical rigor, and insight actionability started to suffer from data abundance.

■ MC77

Parc- Market Street

Joint Session Analytics/HAS: Predictive and Prescriptive Analytics for Reducing Health Risks

Sponsor: Analytics & Healthcare

Sponsored Session

Chair: Doug Popken, Chief Data Scientist, Next Health Technologies, 5347 S Valentia Way, Englewood, CO, 80111, United States of America, doug.popken@nexthealthtechnologies.com

1 - An Adaptive Risk Grouper for Predicting Health Plan Member Health, Cost, and Attrition Risks

Tony Cox, Chief Sciences Officer, Next Health Technologies, 5347 S Valentia Way, Englewood, CO, 80111, United States of America, tony.cox@nexthealthtechnologies.com

We consider how to optimize the performance of multi-criteria risk "groupers" that predict individual member risks (health, cost, and attrition risks) by adaptively clustering members based on high-information combinations of predictor values. Performance is improved by re-training as new data arrive and using an ensemble of the resulting models to make final predictions. Cross-validation shows the lift from adaptively optimized grouping compared to traditional non-adaptive risk groupers.

2 - E-Cigarettes: Promise, Peril, and Probabilistic Population Prediction

Bill Poland, VP & Lead Scientist, Pharsight, A Certara Company, 100 Mathilda Place Suite 160, Sunnyvale, Ca, 94086, United States of America, bill.poland@certara.com

E-cigarettes, which deliver nicotine without carcinogenic tar, hold the promise to save the lives of many smokers who switch to them, but risks include failure to quit cigarettes (dual use), increased initiation to nicotine products among youth, relapse of former smokers to e-cigarettes, and e-cigarettes becoming a "gateway to smoking." To capture these uncertainties and weigh benefits vs. risks, prediction of e-cigarette health impacts must use a broad range of probability-weighted scenarios.

3 - Big Data Assembly for Optimizing Health Care Metrics

Doug Popken, Chief Data Scientist, Next Health Technologies, 5347 S Valentia Way, Englewood, CO, 80111, United States of America, doug.popken@nexthealthtechnologies.com

Health care insurers want to manage their members in order to maximize retention, minimize costs, and maximize health. Prescriptive approaches being developed by NextHealth Technologies include "nudging" member behavior via targeted messaging. Implementation requires assembling a wide array of historical data at the member level to feed into the models. This talk discusses the content and structure of data required to enable our prescriptive modeling framework.

■ MC78

Parc- Mason

Dynamic Decision Making

Sponsor: Decision Analysis

Sponsored Session

Chair: Robert Winkler, Duke University, Fuqua School of Business, Box 90120, Durham, NC, 27708-0120, United States of America, rwinkler@duke.edu

1 - Idea Generation and Idea Execution

Kevin McCardle, Professor, UCLA Anderson School of Management, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, kevin.mccardle@anderson.ucla.edu, Ilia Tsetlin, Robert Winkler

We develop a stochastic dp to determine whether to start and when to stop investing effort on a research project. A project is characterized by: probability it can be successfully completed, arrival rate of that conditional success, payoff if successful, fixed start-up costs, and opportunity cost. The idea is to make opportunity cost endogenous, in the sense that if the current project is abandoned, the only option is to search for similar projects. Analytic and numeric results are presented.

2 - Risk Aversion, Information Acquisition and Technology Adoption

Canan Ulu, Georgetown University, McDonough School of Business, Georgetown University, Washington, DC, 20057, United States of America, cu50@georgetown.edu, James E. Smith

We study the impacts of risk aversion and uncertainty on technology adoption decisions, using a dynamic programming model. The effects of risk aversion on optimal policies can be complex and subtle.

3 - Empirical Stopping Rules

John Mamer, Professor, UCLA Anderson School of Management, Suite D518, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, john.mamer@anderson.ucla.edu, Manel Baucells

The classical solution to the optimal stopping problem depends heavily on the decision maker's knowledge of the offer distribution. We explore a general approach to the optimal stopping problem when the offer distribution is not known. Our approach replaces knowledge of the offer distribution with the empirical distribution function, and offers simple decision rules. We explore the performance of these rules both analytically and with Monte Carlo simulation.

4 - Dismissing Decision Tasks: The Optimality of the M–Shaped Structure

Saed Alizamir, Yale University, New Haven, CT, United States of America, saed.alizamir@yale.edu, Francis de Vericourt, Peng Sun

We consider a sequential hypothesis-testing problem where the Decision Maker faces a random stream of decision tasks that accumulate over time, creating congestion. The agent needs to dynamically choose when to terminate the information collection process and make a final decision. The DM can also dismiss tasks from the queue, in the sense that she makes her decision a priori without running any test. We model the problem as a MDP and our analysis reveals the optimality of an M-shaped structure.

■ MC79

Parc- Powell I

50th Anniversary Update from Some Ramsey Award Winners

Sponsor: Decision Analysis

Sponsored Session

Chair: Sam Bodily, John Tyler Professor, Darden School, UVA, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, BodilyS@Darden.virginia.edu

1 - Description of Session by Session Chair

Sam Bodily, John Tyler Professor, Darden School, UVA, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, BodilyS@Darden.virginia.edu

The 3 speakers will each present 20 minutes of new expository material about what is important to the DA community today. This may include their work on some aspect of DA that has been advanced since they received their award. They have been asked to leave the audience with some provocative questions regarding work in our field. After they speak, I will moderate about 30 minutes of interactive discussion involving the speakers and the audience on their questions and the future of DA.

2 - MultiAttribute Utility: The Next 40 Years

David Bell, Harvard Business School, Boston, MA, United States of America, dbell@hbs.edu

In the early 1970's Keeney and Raiffa started this branch of Decision Analysis. A lot has been accomplished. Is it now a mature field? Or has this been just the beginning?

3 - DA Challenges and Opportunities: An Idiosyncratic View of Decision Analysis

Bob Clemen, Professor Emeritus, Duke University, 100 Fuqua Dr, Box 90120, Durham, NC, 27707, United States of America, robert.clemen@duke.edu

I will present my own view of challenges that decision analysis faces now and in the foreseeable future. Those challenges provide many opportunities, but there are substantial barriers. The future of DA, in my opinion, is not for the weak of heart.

4 - The Past Suggests the Future

James Dyer, The University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, United States of America, j.dyer@mccombs.utexas.edu

Experiences from the past still suggest research on unsolved problems, such as conditional probabilities in decision trees and descriptive utility models.

■ MC80

Parc- Powell II

Price, Ambiguity and Value of Information

Sponsor: Decision Analysis

Sponsored Session

Chair: Emanuele Borgonovo, Full Professor, Bocconi University, Via Roentgen 1, Milan, Italy, emanuele.borgonovo@unibocconi.it

1 - Prescriptive Modeling of Ambiguity Aversion: Is it Necessary?
Gordon Hazen, Full Professor, Northwester University, United States of America, gbh305@northwestern.edu

After Ellsberg, we know that individuals tend to be ambiguity (uncertainty) averse for probabilities, a behavior inconsistent with expected utility theory (EU). Here we remind listeners that many decision models have plausible reformulations in which ambiguity aversion can still occur but as a consequence of EU risk aversion. We present examples involving plant licensing, accident analysis, and medicine. We thereby question the need for prescriptive modeling of ambiguity averse preferences.

2 - A Model of Mental Accounting and Reference Price Adaptation
Woonam Hwang, PhD Candidate, London Business School, Regent's park, London, NW14SA, United Kingdom, whwang@london.edu, Manel Baucells

We propose a model of mental accounting for consumption and payment decisions. Consumers hold reference prices in mind, which they use to compare with the benefit of consumption and with the price paid for an item. Reference prices are determined by a memory-based psychological process of adaptation to "price reminders". The model explains a wide array of observed anomalies such as sunk-cost effects, payment depreciation, reluctance to trading, preference for pre-payment, and the flat-rate bias.

3 - Ambiguity-Risk Model and Ambiguity Measure: Separating Ambiguity from Risk in Preference Model
Ying He, Assistant Professor, University of Southern Denmark, Campusvej 55 DK-5230 Odense M, Odense, Denmark, ying.he08irom@utexas.edu, James Dyer, John Butler, Jianmin Jia

We propose a preference condition to separate ambiguity from risk in utility model where ambiguity is modeled by second order lottery. Such a separation model provides an ambiguity measure based on preference. Applying Taylor expansion to this measure, we show that this ambiguity measure is reduced to the variance of the second order lottery. Finally, by assuming further preference conditions, we obtain an additive utility model over three components, namely, value, risk, and ambiguity.

4 - Decisions and Reliability
Alessandra Cillo, Bocconi University, Italy, alessandra.cillo@unibocconi.it, Emanuele Borgonovo

It is critical to understand the relative importance of systems in a decision-making process. Importance measures serve for this purpose. However, the value-sensitivity measures might not be fully informative when the selection among competing alternatives is of concern. While value of information has been invoked as an appropriate sensitivity measure, its link to traditional importance measures has not been discussed yet. This work provides such link.

5 - Probabilistic Sensitivity Analysis: Foundations and Estimation
Emanuele Borgonovo, Full Professor, Bocconi University, Via Roentgen 1, Milan, Italy, emanuele.borgonovo@unibocconi.it, Elmar Plischke, Gordon Hazen

Value of information, density-based, variance-based sensitivity measures can all be obtained from a common rationale. We prove a convergence result for all these techniques that shows that they can be estimated from the same Monte Carlo sample.

■ MC81

Parc- Divisadero

Joint Session Data/AI/HAS: Big Data Analytics and Smart Health II

Sponsor: Data Mining, Artificial Intelligence, & Healthcare

Sponsored Session

Chair: Sung Won Han, New York University, 650 First Avenue, New York, United States of America, sungwonhan2@gmail.com

1 - A Stochastic Appointment Scheduling System for an Outpatient Physical Therapy Service
Peifang Tsai, Assistant Professor, National Taipei Univ of Technology, 1, Sec. 3, Zhongxiao E. Rd., Taipei, 10608, Taiwan - ROC, p.jennifer.tsai@gmail.com

Motivated by an outpatient physical therapy service, the aim of this research is to develop a stochastic overbooking model to enhance the service quality and to increase the utilization of multiple resources. When patients call, they are assigned to appointment blocks. A patient might require more than one resource and a probability of no-show. Two estimation methods were proposed and a numerical example was used to compare this stochastic model with traditional appointment systems.

2 - Recent Development in Methodology for Gene Network Problems and Inferences
Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com, Judy Hua Zhong

This presentation discusses the recent development of methodologies for estimating cancer gene networks, which has been a very important problem in genomic projects for decades. To estimate the network, a directed acyclic graph in terms of probabilistic graphical modeling has been used. However, with those ultra-high dimensional data, the estimation of the gene networks is a very challenging problem. We discuss the recent development based on the score-and-search approach.

3 - Predicting Outcomes of Chemotherapy for Non-Small-Cell Lung Cancer (NSCLC) By Aggregate Level Data
Frank Puk, PhD Student, University of Texas at Arlington, pukkinming@gmail.com, Haomiao Jin, Shinyi Wu

This study aims to develop prediction models that forecast outcomes of chemotherapy for NSCLC using aggregate level data collected from a systematic review. Two methods were explored: 1) a multivariate meta-regression model was developed to predict outcomes of new clinical trials; and 2) a patient-level prediction model was developed using individual data simulated from aggregate level characteristics. The derived models can assist both new clinical trial design and customized chemotherapy.

■ MC82

Parc- Haight

Exact Methods for Multi-Objective Combinatorial Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Pekka Korhonen, Professor, Aalto University, School of Business, Aalto, FI, 11000, Finland, Pekka.Korhonen@Aalto.fi

1 - Exact Methods for Multi-Objective Combinatorial Optimization
Matthias Ehrgott, Professor, Lancaster University, Bailrigg, Lancaster, United Kingdom, m.ehrgott@lancaster.ac.uk

In this tutorial I will summarise exact approaches to the solution of multi-objective combinatorial optimisation (MOCO) problems. These include generalisations of algorithms for single objective ombinatorial optimisation problems, the two-phase method as a specific approach to solving MOCO problems whose single objective versions are "easy" in a certain sense, general scalarisation techniques and adaptations of branch and bound to deal with multiple objectives.

■ MC83

Parc- Sutro

Big Data Analytics for Various Applications

Sponsor: Data Mining

Sponsored Session

Chair: Seoung Bum Kim, Associate Professor, Korea University, Anam-Dong, Seongbuk-Gu, Seoul 136-713, Seoul, Korea, Republic of, sbkim1@korea.ac.kr

1 - Adaptive Clustering-based Control Chart for Time-varying and Multimode Process Control

Jihoon Kang, PhD Candidate, Korea University, Anam-dong, Seongbuk-gu, Chang-ee guan 816, Seoul, Korea, Republic of, jihoon.kang82@gmail.com, Seoung Bum Kim

Traditional control charts have become restricted in that many manufacturing processes now have unprecedented characteristics. A clustering-based mahalanobis (CBM) control chart integrating a control chart with a clustering algorithm has recently been introduced, and it effectively handles the limitations caused by the distributions containing multimode in-control observations. In the present study, we enhance CBM chart for adaptive monitoring of multimode process under time-varying situation.

2 - Exploring the Relation of Twitter Activity with the Movements in Turkish Stock Market

Mustafa Gökce Baydogan, Assistant Professor, Department of Industrial Engineering, Bogaziçi University, Bebek, Istanbul, 34342, Turkey, mustafa.baydogan@boun.edu.tr, Özgür Güney, Hazan Deniz Marti, Hande Acet

This study explores if social media (especially Twitter) can provide information about the future movements in Turkish Stock Market. Specifically, various features are extracted from tweets for each day to predict the next day activity (i.e. trading volume, percent change in the index). We also explore the use of these features at different granularities (i.e. hourly) to see whether Twitter activity within the day or between the days has better predictive power.

3 - A New Spatial Anomaly Detection Algorithm with Multiple Spatial Maps in Multistage Manufacturing System

Byunghoon Kim, PhD Student, Rutgers University, United States of America, byungkim@scarletmail.rutgers.edu, Young-Seon Jeong, Seung Hoon Tong, In-Kap Chang, Myong-Kee Jeong

The prompt detection of abnormal dynamic random access memory (DRAM) wafers based on multiple spatial maps is one of the primary issues that challenge the process to increase yield rates and product qualities. In this talk, we present a new spatial anomaly detection algorithm for detecting abnormality of a DRAM wafer with multiple spatial maps. The proposed procedure is validated using real-life DRAM wafers for practical viability.

Monday, 4:30pm - 6:00pm

■ MD01

Hilton- Golden Gate 6

Analytics for Surviving Austerity: Doing More with Less

Sponsor: Military Applications Society

Sponsored Session

Chair: Aaron Burciaga, Senior Manager, Operations Analytics, Accenture, Arlington, VA, United States of America

1 - Optimizing Marine Security Guard Assignments

Maro Enoka, Senior Operations Research Analyst, United States Marine Corps, 14014 Trawler Drive, Woodbridge, VA, 22193, United States of America, maro.enoka@gmail.com

The USMC manually assigns 1,500 Marines to 149 embassies annually while attempting to satisfy many assignment requirements. Historically, this has been a laborious process requiring over 6,000 hours per year. This paper introduces an assignment tool that uses a multi-commodity network flow formulation to optimally assign Marines to embassies. The tool dramatically reduces labor hours and creates assignments that are superior to manual assignments with regard to several measures of effectiveness.

2 - Manpower Reductions: Leveraging Existing Tools to Solve Problems beyond Their Design

Randal Allen, Lone Star, 4555 Excel Parkway, Suite 500, Addison, TX, 75001, United States of America, rallen@lone-star.com, Don Hanks

Decision support tools, created to solve specific problems associated with predictive analytics, can be leveraged to answer questions beyond the designer's original intent. Understanding how to map new problems into existing architectures and translate data into tool inputs, is the key to success in extending the utility of existing tools. A powerful example is the use of a decision support tool to measure the impacts of manpower reductions in air traffic control resources.

3 - Delivering High Performance Analytics to USA DoD/GSA Supply Chain Clients

Will Donovan, Accenture, Sowwah Square, 9th Floor, Abu Dhabi, United Arab Emirates, william.c.donovan@accenture.com

The USA General Services Administration was seeking a supply chain solution for war fighter and contractor clients in Afghanistan via supply sourses in Central Asia, and required a complex algorithm to understand actual cost avoidances by consolidating freight in Almaty, Kazakhstan. By combining data from ERP, Transport, Cataloging and a Cloud Based Meta Data Repository into a powerful data application (based in Qlikview), the client received contract mission impact assurance in real-time.

■ MD02

Hilton- Golden Gate 7

TIMES Distinguished Speaker - Haim Mendelson

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Cheryl Druehl, George Mason University, 4400 University Drive, Fairfax, United States of America, cdruehl@gmu.edu

1 - Online Business Models

Haim Mendelson, Stanford Graduate School of Business, 655 Knight Way, Stanford, US, 94305-7298, United States of America, haim@stanford.edu

There's a lot of talk about business models these days, especially in innovation and entrepreneurship circles. I'll start by suggesting a simple way to think about business models, and we'll apply it to a number of online and offline scenarios. We'll then consider the business models of Facebook applications and discuss quantitative metrics that characterize them, based on joint research with Ken Moon.

■ MD03

Hilton- Golden Gate 7

Experimental Economics in E-Commerce

Sponsor: eBusiness

Sponsored Session

Chair: Rajiv Mukherjee, Assistant Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, rmukherjee@mail.smu.edu

1 - Evolution of Trust under Information Sharing, Advice and Delegation

Yu Wang, Assistant Professor, The University of Texas at Dallas, 800 W Campbell Rd, United States of America, yuwang@utdallas.edu, Özalp Özer, Upender Subramanian

Trust has been identified as a crucial success factor for channel cooperation. For example, despite the potential for opportunistic behavior, some retailers rely upon manufacturers who have more information about their product to assist them in store-level decisions. Using laboratory experiments, we study (i) to what extent trust develops or deteriorates over time and (ii) how different forms of assistance affect the evolution of trust and cooperation.

2 - Flexibility and Consumption: An Experimental Investigation

Sreekumar Bhaskaran, Associate Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, sbhaskar@mail.cox.smu.edu, Sanjiv Erat, Rajiv Mukherjee

In this paper, we investigate how the flexibility to defer or advance consumption affects a consumer's decision about to when to actually consume a product or service. The effect of this flexibility on capacity choice is also considered.

3 - Learning under Uncertainty with Multiple Priors - An Experiment
Yaroslav Rosokha, Assistant Professor, Purdue University, yrosokha@purdue.edu

We investigate the learning process under uncertainty using the multiple priors model of Epstein and Schneider (2007). We gather data for subjects making a sequence of decisions that are concurrent with arrival of new information (signals). We estimate the set of priors, the worst- and the best- case scenarios considered by subjects at different moments in time.

4 - Prediction Markets and Biases
Karthik Kannan, Purdue University, 403 W State Street, West Lafayette, IN, United States of America, kkarthik@purdue.edu

We analyze how biases such as homophily and social influence affect the efficacy of prediction markets. Using an analytical model as well as an experimental setup, we confirm the negative impact of such biases on information aggregation and suggest insights into mitigating the negative effects. Thus, we evaluate the role of network structure on the efficacy of the wisdom of crowd activities.

■ MD04

Hilton- Continental 1

Social Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St George Street, Toronto, ON, Canada, Ming.Hu@rotman.utoronto.ca

1 - Dynamic Pricing in the Presence of Social Learning and Strategic Consumers
Yiangos Papanastasiou, London Business School, Regent's park, London, United Kingdom, yiangosp@london.edu, Nicos Savva

When a product of uncertain quality is first introduced to market, consumers may be enticed to strategically delay their purchasing decisions in anticipation of the product reviews of their peers. This paper investigates how the presence of social learning affects the strategic interaction between a dynamic-pricing monopolist and a forward-looking consumer population.

2 - Dynamic Pricing of Experience Goods: The Impact of Consumer Reviews
Man Yu, HKUST Business School, Clear Water Bay, Hong Kong, Hong Kong - PRC, manyu@ust.hk, Laurens Debo, Roman Kapuscinski

In this talk, we focus on dynamic pricing of experience goods whose quality is initially unknown both to consumers and to the firm, but the early buyers can communicate their experiences after consumption via e.g. word-of-mouth, websites, smartphones applications or other media.

3 - Peer Effect of iPhone Adoption in Mobile Communication Networks
Tony Ke, UC Berkeley, IEOR, Etcheverry Hall, Berkeley, CA, 94720, United States of America, kete@berkeley.edu, Zhuqing Yang

We construct a social network using one year's mobile calls between all subscribers in a big city in China. The strength of social ties is measured by call duration. Based on the network, we identify the peer effect of iPhone adoptions, by using subscribers' birthdays as an instrument variable. Implications on how network ties and network structures modulate the peer influence will be covered.

■ MD05

Hilton- Continental 2

MSOM Student Paper Competition Finalists

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Guillaume Roels, UCLA, 110 Westwood Plaza, B511, Los Angeles, CA, 90066, United States of America, guillaume.roels@anderson.ucla.edu

Co-Chair: Goker Aydin, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

Co-Chair: Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

1 - 2014 MSOM Student Paper Competition Finalists
Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

The MSOM Student Paper Competition is awarded annually by the Manufacturing & Service Operations Management Society at the INFORMS Annual Meeting for papers judged to be the best in the field of operations management.

■ MD06

Hilton- Continental 3

Nonprofit Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Sripad Devalkar, Indian School of Business, ISB Campus Gachibowli, Hyderabad, India, sripad_devalkar@isb.edu

1 - Nonprofit Logic Models as Production Process Maps
Natalie Privett, Assistant Professor of Management and Policy, Robert F. Wagner Graduate School of Public Service, 295 Lafayette St, 2nd Floor, New York University, New York, NY, 10012, United States of America, natalie.privett@nyu.edu

Nonprofit organizations ultimately strive to produce social change by means of delivering specific goods and services. In the nonprofit sector, the logic model is a popular strategic management tool that visually links an organization's resources, activities, outputs, and outcomes. From an operations perspective, logic models have the potential to be leveraged as production process maps to increase operational efficiency, bridge nonprofit and operations theory and ultimately achieve outcomes.

2 - Signaling Operational Efficiency through Intermediate Results in Non-profit Markets
Milind Sohoni, Associate Professor, Indian School of Business, milind_sohoni@isb.edu, Sripad Devalkar

A common concern with non-profit markets is the lack of credible information about a NPO's operational efficiency. We study a model that allows a NPO to monitor, and release information about, intermediate benefits delivered to signal efficiency to donors. The trade-off, in such situations, is between the additional overhead and the increased probability of raising donations. We analyze when such a model could result in higher sustainability of a development project.

■ MD07

Hilton- Continental 4

Simulation Based Education in Supply Chain and Project Management

Cluster: Tutorials

Invited Session

Chair: Yale T. Herer, Technion - Israel Institute of Technology, Faculty of Industrial Engineering, Haifa, 32000, Israel, yale@technion.ac.il

1 - Simulation Based Education in Supply Chain and Project Management
Avinoam Tzimerman, Technion - Israel Institute of Technology, Faculty of Industrial Eng. and Manage., Haif, 32000, Israel, AvinoamT@Technion.ac.il, Avraham Shtub, Yale T. Herer

We present two state-of-the-art simulators for simulation based training (SBT) in Operations Management education. Both simulators are built on the concepts of ease of use, scenario based training, flexibility, and supportive data. We present an overview of SBT and demonstrate the two simulators by presenting exercises that highlight the benefits of using educational simulators along with classroom instruction. Attendees will gain an appreciation of how these simulators can help them in the classroom.

■ MD08

Hilton- Continental 5

Nicholson Student Paper Prize

Cluster: Nicholson Student Paper Prize

Invited Session

Chair: Kavita Ramanan, Professor, Brown University, 182 George st, Providence, RI, 02912, United States of America, kavita_ramanan@brown.edu

1 - Nicholson Student Paper Prize
Kavita Ramanan, Professor, Brown University, 182 George st, Providence RI 02912, United States of America, kavita_ramanan@brown.edu

The George Nicholson Student Paper Competition is held each year to identify and honor outstanding papers written by a student in any area represented by INFORMS. The top participants in this competition are selected as finalists by the prize committee and invited to present their work in these sessions.

■ MD09

Hilton- Continental 6

Big Data Optimization for Data Mining and Statistical Analysis

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Joshua Griffin, SAS Institute Inc., 100 SAS Campus Drive, Cary, United States of America, joshua.griffin@sas.com

1 - High Performance Second-Order Procedures for Dense SVM and Quantile Regression
Yan Xu, Senior Manager, SAS Insitute Inc., 100 SAS Campus Dr., Cary, NC, 27519, United States of America, yan.xu@sas.com, Joshua Griffin

Quantile Regression and SVM classifiers require solutions to large-scale linear and quadratic optimization problems respectively. In special cases, a low-rank factorization of the reduced primal-dual Augmented system is available. This factorization can be exploited in a parallel computing environment, permitting dense problems with billions of observations to be efficiently solved.

2 - Quasi-Newton Extensions of an Active-set Approach for Mixed Linear Models
Wenwen Zhou, SAS Institute Inc., Cary, United States of America, Wenwen.Zhou@sas.com

A primal-dual regularized augmented Lagrangian active-set approach is modified to accept inexact second-order Quasi-Newton approximation. This is crucial for many optimization problems arising in statistics and data mining where the true Hessian is expensive and or unavailable

3 - Distributed Hessian-Free Optimization for Data Mining Applications
Joshua Griffin, SAS Institute Inc., 100 SAS Campus Drive, Cary, United States of America, joshua.griffin@sas.com, Ben-Hao Wang

This talk focuses on several Hessian-free approaches in a distributed environment for bound constrained optimization with expensive function evaluations, where Hessian matrices, as well as Hessian-vector products, are either prohibitive computationally or unavailable.

■ MD10

Hilton- Continental 7

Disruptive Technologies and Business Models

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu

1 - Agent Behavior in the Sharing Economy: Evidence from AirBnB
Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu, Dennis Zhang, Antonio Moreno-Garcia

Using availability and pricing data from a rising peer-to-peer online hospitality service platform — AirBnB, we study agent behavior in the sharing economy.

2 - Agent Behavior in the Sharing Economy: Evidence from AirBnB
Dennis Zhang, Kellogg School of Management, Evanston, IL, 60208, United States of America, zjj1990228@gmail.com, Antonio Moreno-Garcia, Jun Li

Using availability and pricing data from a rising peer-to-peer online hospitality service platform — AirBnB, we study agent behavior in the sharing economy.

3 - Sharing Economy - A Model of Shared Resource Utilization
Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu, Jose Guajardo

The emergence of shared resource utilization as a consumer trend in many markets is imposing new challenges for incumbent firms in certain markets. These enjoyed economies of scale and hence created high entry barriers for new entrants to compete profitable. However, the use of spare capacity to provide services has started to present a credible threat to incumbent firms in these markets. In this paper, we formulate a model that characterizes the supply side when faced with a sharing economy.

4 - Channel Integration & Sales Concentration: Empirical Evidence
Ioannis Stamatopoulos, PhD Student, Northwestern University, 1400 Chicago, Evanston, IL, 60201, United States of America, aikalaaa@gmail.com, Antonio Moreno-Garcia, Santiago Gallino

Competing for an increasingly demanding customer pool, retailers progressively integrate their B&M and Online channels. In this paper, using a proprietary dataset coming from the implementation of a Ship to Store (StS) capability of a large US housewares retailer, we find that StS causes a statistically and economically significant drop in sales concentration.

■ MD11

Hilton- Continental 8

Managing Relationships in Supply Chains

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Sammi Yu Tang, Assistant Professor, University of Miami, 5250 University Drive, Coral Gables, FL, 33146, United States of America, ytang@miami.edu

1 - Inspection and Cooperation in Supply Quality Management
Cuihong Li, University of Connecticut, 2100 Hillside Road, Storrs, CT, United States of America, Cuihong.Li@business.uconn.edu

We study a buyer purchasing from a supplier with the concern of quality. The buyer can inspect the incoming units to penalize the supplier for defects, or cooperate with the supplier to improve the quality. We consider both complementary and substitutable relationships between the buyer's and supplier's quality improvement efforts.

2 - Resource Allocation in Humanitarian Setting: Inventory and Disease Progression
Jayashankar Swaminathan, Professor, UNC-CH, McColl Bldg., Chapel Hill, NC, United States of America, msj@unc.edu, Karthik Natarajan

In this paper we study inventory management in the context of supplementary food and disease progression in a finite time horizon. In addition to presenting structural properties, we will explore the efficacy of pragmatic heuristics in this context.

3 - Supplier Diversification under Random Yield and Price Dependent Demand
Nan Yang, Assistant Professor, Olin Business School, Washington University in St. Louis, Campus Box 1156, 1 Brookings Drive, St. Louis, MO, 63130, United States of America, yangn@wustl.edu, Lingxiu Dong, Guang Xiao

We consider a firm's supply diversification problem when it faces supply random yield and price sensitive demand. We study two pricing schemes: responsive pricing and ex ante pricing. We characterize the sourcing decisions under each pricing scheme and compare them to study the strategic relation between diversification and pricing in hedging against supply uncertainty.

4 - Managing Competition and Cooperation in Supply Chains
Shuya Yin, University of California, Irvine, Merage School of Business, Irvine, CA, 92697, United States of America, shuya.yin@uci.edu, Saibal Ray, Yuhong He

Upstream suppliers often need to decide whether or not to reply on dominant retailers in the market place when they sell through the downstream partners. On one hand, powerful retailers would help the upstream suppliers gain strong market shares. But on the other hand, these retailers may use their market dominance to negotiate better contract terms with their suppliers. We propose an economic model to gain some understanding of the basic trade-offs involved in such decision making processes.

5 - Procurement Contracting under Product Recall Risk
Gang Wang, University of North Carolina at Chapel Hill, Kenan-Flagler Busienss School, Chapel Hill, NC, 27599, United States of America, Gang_Wang@kenan-flagler.unc.edu, Lauren Lu, Jayashankar Swaminathan

Managing product quality and mitigating the financial impact of product recalls pose great challenges to manufacturers due to demand uncertainty and non-contractibility of suppliers' quality effort. To understand the interdependence of supply chain quantity and quality decisions, we develop a procurement contractual framework under both demand and recall risks.

■ MD12

Hilton- Continental 9

Empirical Operations Management and Sustainability

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Ruben Lobel, University of Pennsylvania, 3730 Walnut St, JMHH - suite 500, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu

1 - Drivers of Product Expiration in Retail Supply Chains
Arzum Akkas, MIT, 77 mass ave, cambridge, ma, 02142, United States of America, aakkas@mit.edu, David Simchi-Levi, Vishal Gaur

Using a zero inflated negative binomial model applied to propriety archival data, we examine the degree to which product expiration of consumer packaged goods at retail stores is related to store operations, supply chain practices, and product configuration decisions. Our work identifies how much manufactures versus retailers contribute to the drivers of expiration. This will help alleviate the incentive issues related to reimbursement schemes for the cost of expired products.

2 - Understanding Customers Retrials in Call Centers: An Empirical Study
Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Achal Bassamboo, Kejia Hu

We study the impact of waiting times and service quality on the retrial behavior of customers in a call center.

3 - An Empirical Investigation of the Productivity Paradox
Kamalini Ramdas, London Business School, Regent's Park, London, United Kingdom, kramdas@london.edu, Jonathan Williams

Research in economics and operations management has identified huge variation in productivity within the same geographic regions, industries, and even firms. Using data from the US automotive industry, we examine key drivers of variation in productivity in automotive assembly plants. We develop insights for managers and highlight avenues for future research.

4 - Operations Management in Sustainable Production Systems
Farnaz Ghazi Nezami, Assistant professor, Kettering University, Industrial and Manufacturing Engineering Department, 1700 University Ave., Flint, MI, United States of America, fghazinezami@kettering.edu

In this study, a mathematical model is presented to investigate the integrated maintenance-production planning problem. The objective is to minimize the total cost of production, maintenance and energy with respect to demand, reliability and energy consumption profile of the machine in a multi-period, multi-product environment.

■ MD14

Imperial B

External Letters of Recommendation for Tenure: Hear from those Who Write and Read Them

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Hakan Yildiz, Assistant Professor, Michiagn State University, 632 Bouge Street, East Lansing, Mi, 48824, United States of America, yildiz@bus.msu.edu

1 - External Letters of Recommendation for Tenure: Hear from those who Write and Read Them
Hakan Yildiz, Assistant Professor, Michiagn State University, 632 Bouge Street, East Lansing, Mi, 48824, United States of America, yildiz@bus.msu.edu, Alice E. Smith, Manus Rungtusanatham, Ravi Anupindi, James Bookbinder, Raghu Raghavan

External letters of recommendation are required as part of the tenure process. These letters are solicited from leading scholars in the relevant discipline at peer institutions. In this panel, we will hear from a diverse set of leading scholars who have been involved in several tenure evaluations, both in the form of acting as an external reviewer and internal decision maker. If you have any questions/topics that you want the panel to address, please send an e-mail to yildiz@msu.edu

■ MD15

Hilton- Exec. Boardroom

Applications of DEA

Cluster: Data Envelopment Analysis

Invited Session

Chair: John Ruggiero, University of Dayton, Dayton, OH, United States of America, jruggiero1@udayton.edu

1 - Evaluating MMA Judging Nonparametrically
John Ruggiero, University of Dayton, Dayton, OH, United States of America, jruggiero1@udayton.edu

In this paper, we analyze decision making of mixed martial arts judges. We extend the nonparametric DEA model to estimate indifference curves. The approach allows us to derive a measure of consistency of a given judges performance. Our application focuses on controversial fights in the UFC.

2 - Likelihood Ranking of Decision Making Units
Markku Kallio, Professor, Aalto University, Runeberginkatu 22-24, Helsinki, Finland, markku.kallio@aalto.fi

For decision making units (DMUs), we assume that the input-output vectors represent a random sample of some probability distribution, for example, a multi-variate log-normal distribution. For efficiency analysis of the DMUs we employ common prices for all DMUs and choose such prices based on maximum likelihood estimates. We define the profit based ranking criterion for each DMU by the likelihood that the random profit is at most the profit of that DMU. Return based ranking is defined similarly.

3 - Malmquist and Hicks-Moorsteen Productivity Indexes for Cluster Analysis
Diogo Filipe Cunha Ferreira, Dr, Instituto Superior Tècnico (IST), University of Lisbon, Av. Rovisco Pais, Lisbon, 1049-001, Portugal, diogo.cunha.ferreira@tecnico.ulisboa.pt, Rui Cunha Marques

This work discusses the usefulness of Malmquist and Hicks-Moorsteen indexes for cluster efficiency spread and productivity gaps analysis. It is proposed working out with geometric distance functions and super-efficient slack-based directional distance functions that may account for subjective criteria. Finally, a robust three-step bootstrap-based algorithm is presented, which overcomes a lot of non-parametric methods shortcomings and incorporates environmental information when it is required.

4 - Input Substitutability in English Higher Education
Jill Johnes, Senior Lecturer Economics, Lancaster University, LUMS, Lancaster, LA14YX, United Kingdom, j.johnes@lancaster.ac.uk

This paper investigates input substitutability in English higher education and compares merging and non-merging institutions. A stochastic frontier translog output distance function is estimated using a thirteen-year panel of data for all institutions in England. Some differences between merging and non-merging institutions in labour and capital substitutability are revealed, and administrative input becomes an abundant resource for merged institutions. Policy implications are discussed.

5 - Performance Benchmarking of School Districts in New York State
Thomas Sexton, Stony Brook University, 317 Harriman Hall, Stony Brook University, Stony Brook, NY, 11790-3775, United States of America, Thomas.Sexton@StonyBrook.edu, Kelly Stickle, Shane Higuera, Christie Comunale

We apply DEA as a benchmarking methodology to measure the performance of New York State school districts and provide detailed alternative improvement programs for each district. In the 2011-12 academic year, New York State's 695 school districts spent $53.7 billion to educate almost 2.7 million elementary and secondary pupils, at a cost of over $19,000 per pupil. Elementary and secondary education accounts for nearly one-quarter of all state and local expenditures in New York State.

■ MD16

Hilton- Franciscan A

New Models in Revenue Management and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Sami Najafi-Asadolahi, Assistant Professor, Santa Clara University, Leavey School of Business, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, snajafi@scu.edu

1 - Impact of Sourcing on Retailers' Optimal Store-Brand Quality and Pricing Decisions
Candi Yano, Professor, IEOR Dept. and Haas Sch. of Bus., UC Berkeley, Berkeley, CA, 94720, United States of America, yano@ieor.berkeley.edu, Bo Liao

Store brand products may be produced in-house, by a third-party supplier, or by a national-brand manufacturer of competing products. We derive equilibrium results to show how the combination of sourcing and pricing power affects the retailer's optimal store-brand quality and prices for both the store- and national-brand products. Among other things, we find that the retailer may use the lever of store-brand quality in unintuitive ways to improve his profitability in this competitive setting.

2 - Price Incentives for Online Retailers using Social Network Information
Ludovica Rizzo, MIT, lrizzo@mit.edu, Xubo Sun, Georgia Perakis, Maxime Cohen, Marjan Baghaie

We consider an online retailer with social network information about its customers (friends, referrals, etc.). Since its customers are heterogeneous, we propose and analyze a clustering model according to social network information to estimate the buying probability of customers and subsequently a model for providing targeted discounts to "influencers". This gives rise to a bilevel optimization problem. We test our approach with real data. This work is in collaboration with an online retailer.

3 - A La Carte or Buffet: Pricing for Grocery Delivery
Elena Belavina, Assistant Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, United States of America, belavina@uchicago.edu, Karan Girotra

Grocery delivery is a market that many try to conquer. Appropriate pricing is key for success. There is little consensus among different players (at times even within one firm operating in different locations) on what is the best pricing scheme. For example, Amazon Fresh in Seattle is using per order pricing while in San Francisco - subscription fee. We provide recommendation for the preferred pricing scheme based on various characteristics (delivery logistics, demand variability etc.).

4 - Is Over-Promising of Product Features Desirable When Consumers are Loss-Averse?
Sami Najafi-Asadolahi, Assistant Professor, Santa Clara University, Leavey School of Business, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, snajafi@scu.edu, Nishant Mishra, Andy Tsay

We consider a firm selling two versions of a single product at different times to consumers who are loss-averse. In the first period, each consumer decides whether to buy a single unit of the first version, and if he does, whether to continue buying a single unit of the second version when it is released. We find that over-promising the features in the first version may benefit the firm's profitability by increasing consumers' willingness to buy the second version.

■ MD17

Hilton- Franciscan B

Innovation in Services and Retail

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Antonio Moreno-Garcia, Kellogg School of Management, 2001 Sheridan Rd, MEDS Department, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu

1 - Inventory Showrooms in Online Retail
Antonio Moreno-Garcia, Kellogg School of Management, 2001 Sheridan Rd, MEDS Department, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu, David Bell, Santiago Gallino

Using data from a leading online retailer of eyewear, we study the effect of opening brick and mortar showrooms to display inventory that can be ordered online.

2 - User-Path Approach and Efficient Implementation in Online Content Recommendation Services
Yonatan Gur, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, United States of America, ygur@stanford.edu, Omar Besbes, Assaf Zeevi

A new class of online services allows media sites to direct readers from articles they currently read to other suggested web-based content. Based on a rich database we propose a class of user-path focused heuristics for creating recommendations. We validate and measure the value captured by suggested policies compared to current practice through a controlled experiment. Our work is based on collaboration with a leading provider of online content recommendations.

3 - Learning Local Relationships in Networks with Observational or Experimental Data
Spyros Zoumpoulis, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, szoumpou@mit.edu

We infer local relationships between networked entities based on data, focusing on quantifying the rate of learning. Our theoretical results are guarantees on the rate of learning expressed in terms of the number of needed samples/experiments. We show applications in (i) making marketing decisions; (ii) inferring how consumers influence one another in the context of mobile app installations; (iii) inferring causal relations between brain regions during epileptic seizure events.

4 - Inventory Management for Luxury Goods
Ruslan Momot, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Ruslan.Momot@insead.edu, Elena Belavina, Karan Girotra

Firms selling conspicuous goods face a trade-off: producing more allows for extracting more revenues but compromises the product's reputation for exclusivity. We capture this trade-off in a dynamic model of strategic customer and firm behaviour that includes limited memory. Firms should follow stationary cyclic strategies alternating scarcity and overproduction. The former builds a reputation whereas the latter exploits it. The longer the customer memory, shorter is the overproduction phase.

■ MD18

Hilton- Franciscan C

Practice-driven Revenue Management II

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: So Yeon Chun, Assistant Professor, McDonough School of Business, Georgetown University, 3700 O St NW, Washington, United States of America, sc1286@georgetown.edu

1 - Dynamic Pricing and Inventory Control for Nonperishable Products with Demand Learning
Boxiao Chen, University of Michigan, 1919 McIntyre Drive, Ann Arbor, MI, 48105, United States of America, boxchen@umich.edu, Xiuli Chao, Hyun-Soo Ahn

We consider a finite horizon problem of dynamic pricing and inventory control for a nonperishable product. We develop an data-driven policy that does not require explicit information about random demand and show that it is asymptotically optimal with a provable bound.

2 - Dynamic Pricing and Loyalty-reward Program
Hakjin Chung, University of Michigan, Tappan St 701, R4431, Ann Arbor, MI, 48109, United States of America, hakjin@umich.edu, So Yeon Chun, Hyun-Soo Ahn

We study the impact of loyalty program on the seller's pricing strategy and revenue. In particular, we examine how the option to pay with reward points influence a consumer's choice on how she/he buys. We then incorporate the consumer's behavior into a dynamic pricing problem and study how the terms of reimbursement (i.e., the revenue that the seller receives from reward sales) affect the seller's pricing strategy.

3 - Optimal Pricing of Reservations and Advance Selling in Queues
Jaelynn Oh, Assistant Professor, University of Utah, jaelynn.oh@business.utah.edu, Xuanming Su

Customers who make reservations in advance do not have to wait in line when they arrive for service. We study whether and how firms should charge for reservations and relate our results to advance selling strategies.

4 - Pricing Sponsored Content in Wireless Networks with Multiple Content Providers
Martin I Reiman, DMTS, Alcatel-Lucent Bell Labs, 600 Mountain Ave., Murray Hill, NJ, 07974, United States of America, martyreiman@gmail.com, Matthew Andrews, Yue Jin

We consider a wireless service provider (SP) that offers a 'sponsored content' service to multiple content providers (CPs), modeling it as a sequential game. The SP moves first, setting prices for sponsoring. Then the CPs react by deciding how much content to sponsor. Finally the end users react by accessing content depending on what has been sponsored. We solve this problem under a variety of assumptions related to the SP's knowledge of parameters and ability to price discriminate.

■ MD19

Hilton- Franciscan D

Product Quality, Information, Social Learning, and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Xuying Zhao, University of Notre Dame, 361 Mendoza College of Business, Notre Dame, IN, 46545, United States of America, Xuying.Zhao.29@nd.edu

1 - The Impact of Online Consumer Review Valence on a Firm's Pricing
Xuying Zhao, University of Notre Dame, 361 Mendoza College of Business, Notre Dame, IN, 46545, United States of America, Xuying.Zhao.29@nd.edu, Zhan Pang

For experience products or services, prior users' experiences and review ratings will impact the remaining potential consumers' willingness to pay (or valuation). We study the the impact of online consumer review valence on a firm's pricing and profit.

2 - Quality Provision with Heterogeneous Consumer Reservation Utilities
Rachel Chen, University of California at Davis, 3208 Gallagher Hall, Davis, CA, 95691, United States of America, rachen@ucdavis.edu, Lian Qi, Leon Zhu

We study how a monopolist selects its optimal quality level and price when consumers differ in their willingness-to-pay (WTP) for quality and reservation utility for the basic product. We find that firms might want to offer higher quality products during an economic recession. For the optimal product line, we show that due to the heterogeneity in consumer reservation utilities the concern for cannibalization may distort the product quality upwards.

3 - Optimal Procurement Design in the Presence of Asymmetric Yield and Cost Information
Xiang Fang, University of Wisconsin-Milwaukee, 3202 N Maryland Avenue, Milwaukee, WI, 53211, United States of America, fangx@uwm.edu, Yuanjie He

We study a two-tier decentralized supply chain with a supplier and a retailer. The supplier's production process is subject to a random yield. The retailer faces uncertain demand. The supplier may hold private information regarding its random yield distribution and/or production costs. We derive the optimal menu of contracts for the retailer and then we analyze the value of information to the supplier, the retailer and the entire supply chain.

4 - Overbooking and Cancellation under Dynamic and Static Policies
Wei Wang, Scientist, PROS Inc, 3100 Main St, #900, Houston, TX, 77002, United States of America, weiwang@pros.com, Darius Walczak

Overbooking and cancellation are important topics for revenue management and pricing, and much research including a dynamic programming based solution have been done on these topics. However in practice airlines today are still applying static approaches. We present a comparison on modelling overbooking and cancellation using both dynamic and static policies.

■ MD20

Hilton- Yosemite A

Transportation Analytics

Sponsor: Analytics

Sponsored Session

Chair: Sudip Bhattacharjee, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, CT, United States of America, sbhattacharjee@business.uconn.edu

1 - Stack Train Aerodynamic Optimization
Steven Tyber, General Electric, 1 Research Circle, K1-4A66, Niskayuna, NY, 12309, United States of America, tyber@ge.com, Bex Thomas, Amal Desilva

Over the past 20 years, the growth of intermodal (IM) freight has exceeded that of every other commodity group transported via rail. Revenues generated by IM freight are currently on pace to supplant coal as the largest single source of revenue for railroads. Despite its widespread use, IM trains are generally less fuel efficient than other rolling stock owing to greater aerodynamic drag. We explore the role of loading on drag and develop a MIP approach to produce aerodynamic load assignments.

2 - Rail Fleet Optimization
Amal Desilva, General Electric, 3475 Piedmont Road, NE, Suite 250, Atlanta, GA, United States of America, amal.desilva@ge.com

Many companies use Railroads to ship products and commodities using various types of railcars. An optimization model that optimizes the use of railcars is presented. Shippers can own or lease their own private railcars or they can use railcars owned by railroads. The output from the model is an optimal shipping plan for the planning period using either shipper's cars or railroad cars. A Mixed Integer Linear Programming solver is used to solve the optimization model.

3 - Mitigating Passenger Impacts under Airline Disruptions
Jon Petersen, Operations Research Scientist, Taleris, petersej@taleris.com

Airlines continually face irregularities which preclude their original schedules from being operated. Recovering from disruptions are of central importance but extraordinarily complex, so airlines typically decompose the problem into separable components at the cost of solution quality. We show how passenger delays and misconnections are improved upon by concurrently optimizing schedule and passenger resources through the use of mixed integer programming over a superimposed time-space network.

4 - Big Data Analytics to Improve Operational Decision Making in Rail Networks
Sudip Bhattacharjee, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, United States of America, sbhattacharjee@business.uconn.edu, Erdem Telatar, Onur Dulgeroglu, Kimberly Mallory

Rail schedules are complex operations, where multiple categories of trains share the same network and infrastructure. To ensure that the different categories of trains run efficiently, scheduling and planning take center stage. We present a data analytics framework on a large data set to measure key performance indicators (KPI), and identify root causes of delays, to help scheduling and planning operations. We also discuss big data challenges and data quality issues of field data.

■ MD21

Hilton- Union Sq 1

Electrical Vehicles Routing

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Mahyar Nejad, Wayne State University, United States of America, mahuar@wayne.edu

1 - Electric Vehicle Routing and Recharging with Uncertain Charging Station Availability

Irina Dolinskaya, Assistant Professor, Northwestern University, Evanston, IL, 60208, United States of America, dolira@northwestern.edu, Diego Klabjan, Timothy Sweda

Planning long-distance trips with an electric vehicle depends on both the locations and availabilities of charging stations. We consider an adaptive routing problem in which an electric vehicle driver chooses his or her path and recharging stops based on the availability of nearby charging stations. We present a dynamic programming algorithm for finding an optimal routing and recharging policy and derive properties of optimal policies.

2 - Route Choice Decisions of Electric Vehicle Drivers under Different Traffic Conditions

Shubham Agrawal, United States of America, shubham@purdue.edu, Srinivas Peeta

The limited range of electric vehicles makes drivers more sensitive to trip energy consumption than conventional vehicles for route choice decisions. This study analyzes the impact of traffic condition on electric vehicle routing decisions by computing generalized user travel costs that factor battery discharge patterns. Computational results are illustrated using a simulation framework.

3 - Evaluation of Market Penetration Rate of Electric Vehicles on Network Performance

Amit Kumar, Purdue University, West Lafayette, IN, United States of America, kumar44@purdue.edu, Shubham Agrawal, Hong Zheng, Srinivas Peeta

This study seeks to establish the linkage between market penetration rates of electric vehicles and network performance that can be leveraged by the policy makers to improve system performance. We analyze the route choice behavior of electric vehicle drivers by factoring battery recuperation profiles in a dynamic user equilibrium setting. Numerical results are illustrated.

4 - Optimal Routing for Plug-in Hybrid Electric Vehicles

Mahyar Nejad, Wayne State University, United States of America, mahuar@wayne.edu, Ratna Babu Chinnam

We introduce the Energy-Efficient Routing problem (EERP) for Plug-in Hybrid Electric Vehicles (PHEVs). The objective of the EERP is to not only find a path to any given destination, but also to identify the predominant operating mode for each segment of the path in order to minimize the fuel consumption. We propose two exact algorithms, and a Fully Polynomial Time Approximation Scheme to solve the EERP. The results show that incorporating our proposed algorithms during route planning leads to significant energy savings for PHEVs.

■ MD22

Hilton- Union Sq 2

Energy Logistics and Supply Chains

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Yao Zhao, Associate Professor, Rutgers University, 1 Washington street, Newark, NJ, 07102, United States of America, yaozhao@andromeda.rutgers.edu

1 - Energy Supply Chain: Future Energy Security of Pakistan

Raza Rafique, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, razaalirafique@gmail.com, KwonGi Mun, Yao Zhao

Pakistan is experiencing 25-40% shortfall of electricity supply nation-wide which hampers economic growth, and give rise to political turmoil and social instability. We formulated a dynamic model to gradually build up end-to-end energy supply chain with limited budget. Results obtained demonstrated great potential and can provide guideline to ensure future energy security of Pakistan.

2 - A Design of Energy Supply Network: Insights, Security, and Sustainability

KwonGi Mun, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, kwongmun@pegasus.rutgers.edu, Yao Zhao, Endre Boros, Rafique Raza

By testing an optimal energy supply network in Pakistan, we found that a design of energy supply network may cause an inefficient supply of electricity unless it is optimized with an integrated network. We test and design heuristics and an optimal decision model for introducing new strategies to design energy supply network. A main contribution is that well-formulated energy supply network can explain how to ensure energy supply and energy security.

3 - Fast Algorithms for Two-stage Robust Security Constrained Unit Commitment Problem

Wei Yuan, PhD candidate, IMSE,USF, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, weiyuan@mail.usf.edu, Tongxin Zhen, Eugene Litvinov, Bo Zeng

Unit Commitment (UC) is the cornerstone in energy industry. Two-stage Robust UC has been developed to deal with the uncertainties in power systems: renewable energy, demand uncertainty, etc. However, this tri-level optimization model is difficult to solve considering large-scale power systems. In this research, we investigate the strong formulations for basic UC model, derive new valid inequalities considering network constraints and implement a novel cutting plane generation procedure.

■ MD23

Hilton- Union Sq 3

Same-Day Delivery and Routing

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Alejandro Toriello, Assistant Professor, Georgia Tech ISyE, 765 Ferst Dr NW, Atlanta, GA, 30332, United States of America, atoriello3@isye.gatech.edu

1 - Same Day Delivery for Online Purchases

Stacy Voccia, PhD Candidate, University of Iowa, 108 John Pappajohn Business Building, Room S210, Iowa City, IA, 52242, United States of America, stacy-voccia@uiowa.edu

Same day delivery for online purchases is a recent trend in online retail. Same day delivery, however, is a logistically complicated and expensive service to operate. We introduce a dynamic pick-up and delivery problem with deadlines that incorporates key features associated with same day delivery logistics. In order to make better-informed decisions, our solution approach incorporates information about future orders into routing decisions.

2 - Strategies for Handling Temporal Uncertainty in Pick-up and Delivery Problems with Time Windows

Niels Agatz, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3000DR, Netherlands, nagatz@rsm.nl, Jordan Srour

We develop and compare different routing strategies for a pickup and delivery problem with inaccurate advance time window information. In this problem, the pickup locations are known in advance but the time window information is inaccurate until shortly before the desired service.

3 - The One-dimensional Dynamic Dispatch Waves Problem

Mathias Klapp, Ph.D. Student, Georgia Tech ISyE, 765 Ferst Dr NW, Atlanta, GA, 30332, United States of America, maklapp@gatech.edu, Alan Erera, Alejandro Toriello

We study same-day delivery (SDD) distribution systems by formulating the dynamic dispatch wave problem (DDWP) that models a warehouse where orders arrive randomly throughout the day. The decision maker dispatches a vehicle to serve a subset of open orders at each action period (wave), to minimize operational costs and charges for unserved requests. We study the DDWP with requests over a line; we efficiently solve the deterministic case and give heuristics and dual bounds for the stochastic case.

■ MD24

Hilton- Union Sq 4

Parking and Network Modeling Innovations

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Yingyan Lou, Assistant Professor, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, yingyan.lou@asu.edu

1 - Parking Search Equilibrium on a Network

Shoupeng Tang, Stephen Boyles

All the vehicles need to park at some location on a network, but before arriving at the location, a vehicle does not know if there are available parking spaces. However, the probability of existing a specific number of available parking spaces can be calculated based on the flow arriving rate and the leaving rate of that location. While the leaving rate is known, the arriving rate should be calculated through the equilibrium process. A solution algorithm is developed with the help of a transformed network to get to stochastic traffic equilibrium with parking search uncertainties.

2 - A Dynamic User Equilibrium Formulation with Dynamic Parking Pricing

Rui Ma, University of California, Davis, CA, United States of America, drma@ucdavis.edu, H. Michael Zhang

We extend the differential complementarity system based dynamic user equilibrium formulation with the impacts of dynamic parking pricing for urban networks. We show that this formulation can simultaneously capture departure-time, route, mode and parking choices. We also show how the proposed framework can be used to determine the optimal dynamic parking pricing schemes to maximize the social welfare.

3 - Impacts of Traveler Information Provision Strategies on Parking Searching Problem

Peiheng Li, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, peihengl@asu.edu, Xuesong Zhou, Yingyan Lou

We analyze the parking search problem using a simple network, with explicit considerations of spatial capacities of parking lots and travelers' searching processes between and within each parking lot. The impacts of information provision on route choices of travelers and on network performance are further evaluated under three different information provision strategies.

4 - The Optimal Control of Day-to-day Traffic Dynamics under Hysteresis

Feng Xiao, Southwest Jiaotong University, Chengdu, China, xiaofeng@swjtu.edu.cn, Hai Yang, Hongbo Ye

Understanding the mechanism of network flows' evolution can help design more efficient demand-control schemes.Inspired by previous studies, the optimal control of the new system developed in this study is realized by utilizing the link-based dynamic congestion pricing. The Pontryagin's maximum principal is used in our paper to find the optimal toll scheme with various targets, such as the minimum total convergence time, minimum toll revenue or minimum system cost towards system optimum and combined objectives. Necessary conditions for optimal congestion prices are analyzed to uncover bang-bang charging strategy. Numerical examples will be provided to illustrate the resulting trajectory of the flow evolution under the optimal control schemes.

■ MD25

Hilton- Union Sq 5

Transportation Network Design and Pricing

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Lu Tong, Beijing Jiaotong University, School of Traffic and Transportation, Beijing Jiaotong University, Beijing, 100044, China, tonglu57@gmail.com

1 - A Network Equilibrium Model to Evaluate Distance-based Fare Pricing Policies in Toronto

Anchor Chin, Ryerson University, 350 Victoria Street, Toronto, ON, Canada, anchor.chin@ryerson.ca, Joseph Y.J. Chow

We propose a systematic way to analysis the adoption of distance- or path-based fare system for a public transit network. A stochastic user equilibrium model was developed to evaluate distance-based fare pricing policies by modifying Lam et al's (1999) model to include paths that belong in two OD sets (station-to-station, zone-to-zone). The model is applied to an original network constructed from the Toronto Transportation Commission subway system to derive insights for adoption of smart card fare system.

2 - Parking Management to Improve Urban Efficiency: A Dynamic Performance-based Pricing Game

Daniel Mackowski, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, mackows2@illinois.edu, Yanfeng Ouyang, Yun Bai

In this paper we develop a dynamic pricing model for parking spaces in urban areas that is implementable with current technologies. Given real-time demand information, the bi-level model adjusts prices regularly with the objective of eliminating unnecessary vehicle circling (while looking for parking). An illustration shows the benefits of frequent, informed pricing updates as provided by this model compared to current "smart parking" systems.

3 - Transportation Network Design Model for Maximizing Activity-Travel Accessibility

Lu Tong, Beijing Jiaotong University, School of Traffic and Transportation, Beijing Jiaotong University, Beijing, 100044, China, tonglu57@gmail.com, Xuesong Zhou, Harvey Miller

Accessibility is an important performance measure which is often neglected in transportation network design models. This talk presents a linear integer programming model to maximize end-to-end accessibility within space-time constraints. A time-dependent network representation and a Lagrangean relaxation based solution method are then developed to solve this problem in real-world applications.

■ MD26

Hilton- Union Sq 6

Reliable Facility Location Models

Sponsor: Location Analysis

Sponsored Session

Chair: Kayse Maass, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, leekayse@umich.edu

1 - Decomposition of Facility Disruption Correlations via Augmentation of Virtual Supporting Stations

Siyang Xie, University of Illinois at Urbana-Champaign, 3150 Newmark Civil Engineering Lab, 205 N. Mathews Ave, Urbana, IL, 61801, United States of America, sxie13@illinois.edu, Xiaopeng Li, Yanfeng Ouyang

This paper proposes a new framework for analyzing service facility disruptions under general spatial correlation. We show equivalence among multiple types of correlation representations, and develop transformation and decomposition methods that can transform any correlated disruption pattern into one (by adding auxiliary supporting stations) with independent disruptions only. Numerical studies are conducted for insights.

2 - Reliable Facility Location under Uncertain Correlated Disruptions

Mengshi Lu, University of California, Berkeley, 4141 Etcheverry Hall, University of California, Berkeley, CA, 94720-1777, United States of America, mengshi@berkeley.edu, Zuo-Jun Max Shen

We present a reliable facility location model that allows disruptions to be correlated with an uncertain joint distribution, and minimizes the expected cost under the worst-case distribution. We believe this robust optimization model could serve as an alternative approach for solving reliable facility location problems. Compared to the traditional approach, it better captures disruption propagation effect, requires much less computational effort, and delivers more favorable designs.

3 - Service Reliability, Availability and Survivability Models on Vulnerable Stochastic Networks

Jose Santivanez, Associate Porfessor, Universidad del Turabo, PO Box 3030, Gurabo, PR, 00778, Puerto Rico, santivanezj@suagm.edu, Emanuel Melachrinoudis

Networks providing some critical service in the form of flow are vulnerable to intentional or unplanned disruptions. This paper focuses on the comparison of different network topologies using survivability-based metrics and on the location of facilities on existing networks so that service availability/survivability is maximized when demands for service and disruptions occur.

4 - Location Problem for Interdependent Critical Infrastructure Networks under Disruption Risks

Xiaopeng Li, Assistant Professor, Mississippi State University, PO Box 9546, 235L Walker Hall, 501 Hardy Road, Starkville, MS, 39762, United States of America, xli@cee.msstate.edu, Fang Zhou, Jiaqi Ma

This paper studied a location design problem that determines optimal facility location of multiple types of facilities where each facility is subject to a capacity loss risk. The system interdependence is specified as that the productivity of a facility of a type may be dependent of resource inputs from facilities of other types or transshipment from facilities of the same type. We construct a mathematical model with a customized solution approach to describe and solve this problem.

■ MD27

Hilton- Union Sq 7

Railway Operations Modeling and Analysis

Sponsor: Railway Applications

Sponsored Session

Chair: Matthew Petering, Associate Professor, University of Wisconsin-Milwaukee, P.O. Box 784, Milwaukee, WI, 53201, United States of America, mattpete@uwm.edu

1 - Cyclic Timetabling and Platforming of Heterogeneous Traffic on a Unidirectional Railway Line

Matthew Petering, Associate Professor, University of Wisconsin-Milwaukee, P.O. Box 784, Milwaukee, WI, 53201, United States of America, mattpete@uwm.edu

We present the literature's first two MILP models of a cyclic, combined train timetabling and platforming problem. The objectives of these models are to minimize (1) the timetable period and/or (2) the total journey time of all train types. The first model falls outside the framework of the well-known periodic event scheduling problem (PESP) and considers objectives 1 and 2. The second model nearly falls within the PESP framework and focuses on objective 2. Experimental results are discussed.

2 - Cyclic Timetabling and Platforming of Mixed Train Types on a Bidirectional Railway Line

Mojtaba Heydar, mheydar@uwm.edu, Matthew Petering

We consider cyclic timetabling and platforming of heterogeneous traffic on a single-track, bidirectional railway line. Two objectivesóminimizing timetable cycle length and the total journey time of all train types dispatched during one cycleóare considered. Constrains include headways on the main line and on the sidings in each station. Heuristic and exact methods are combined with a math model to solve large, real-world problem instances. The impact of various factors on capacity is discussed.

3 - Freight Rail On-time Performance in Scandinavia

Hans Boysen, Lic.Eng., Royal Institute of Technology (KTH), Department of Transport Science, Stockholm, SE-10044, Sweden, heboysen@kth.se

Shipper and consignee supply chain reliability, operator asset utilization and network capacity all depend on on-time operation and arrival of freight trains. The experience of on-time performance of freight rail operations in Scandinavia is reviewed, including definitions, performance targets and levels achieved.

4 - Delivering Actionable Intelligence to Point of Performance

Kandukuri Raju, Consultant, Tata Consultancy Services, Kensington B, Powai, Hiranandani, Mumbai, 400072, India, kandukuri.raju@tcs.com, Kshitij Goel

Paper describes structured process to arrive at appropriate performance metrics to monitor and organize them in a meaningful dashboard view to convey actionable intelligence to the decision maker at point of performance on real time and it brings out an approach to utilize historic data from different sources. Customer order prioritization to improve customer retention will be presented as an example.

■ MD28

Hilton- Union Sq 8

Aviation Applications Section: Keynote Presentation

Sponsor: Aviation Applications

Sponsored Session

Chair: Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

1 - The Case for Autonomy in Airspace Operations

Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

Parimal Kopardekar, Principal Investigator for NASA's NextGen Airspace projects will present a keynote address entitled "The Case for Autonomy in Airspace Operations".

■ MD29

Hilton- Union Sq 9

The George B. Dantzig Disseration Award

Cluster: George B. Dantzig Dissertation Award

Invited Session

Chair: Sudhendu Rai, Xerox, Webster, NY, United States of AmericaSudhendu.Rai@xerox.com

1 - The George B. Dantzig Disseration Award

Sudhendu Rai, Xerox, Webster, NY, United States of America Sudhendu.Rai@xerox.com

The George B. Dantzig Disseration Award recognizes dissertations that are innovative and relevant to the practice of operations research and the management sciences. The award has been established to encourage academic research that combines theory and practice and stimulates greater interaction between doctoral students, their advisors and the world of practice. Problem scope and potential magnitude of impact of research are considered. In this session, the award finalists will present their research.

■ MD30

Hilton- Union Sq 10

Contemporary Scheduling

Cluster: Scheduling and Project Management

Invited Session

Chair: Joseph Leung, Distinguished Professor, New Jersey Institute of Technology, University Height, Newark, NJ, 07102, United States of America, joseph.y.leung@njit.edu

1 - Fast Approximation Algorithms for Bi-criteria Scheduling with Machine Assignment Costs

Kangbok Lee, Assistant Professor, York College, CUNY, 94-20 Guy Brewer Bldv., Jamaica, NY, 11451, United States of America, klee5@york.cuny.edu, Joseph Leung, Bertrand Lin, Zhao-hong Jia, Wenhua Li, Michael Pinedo

Parallel machine scheduling problems are considered where the processing of the jobs on the machines involves two types of objectives. The first type is one of two classical scheduling objectives (total completion time or the makespan) while the second type involves an actual cost associated with the processing of a specific job on a given machine. Fast heuristics are proposed and their worst-case analysis is presented.

2 - Scheduling Jobs with Release Dates, Equal Processing Times, and Inclusive Processing Set Restriction

Chung-Lun Li, Chair Professor of Logistics Management, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong - PRC, chung-lun.li@polyu.edu.hk, Qingying Li

We consider the problem of scheduling a given set of n jobs with equal processing times on m parallel machines to minimize the makespan. Each job has a given release date and is compatible to only a subset of the machines. The machines are ordered and indexed in such a way that a higher-indexed machine can process all the jobs that a lower-indexed machine can process. We present a solution procedure to solve this problem in O(n^2 + mn log n) time. Some extensions of our results are discussed.

3 - Scheduling Jobs on Parallel Batch Machines with Non-identical Capacities to Minimize Makespan

Jun Qiang Wang, Professor, Northwestern Polytechnical University, POX 504, NPU, Xi'an, Xi'an, China, wangjq@nwpu.edu.cn, Joseph Leung

We schedule a set of equal-processing-time jobs with arbitrary job sizes on a set of batch machines with different capacities to minimize makespan. We show that there is no polynomial algorithm with an absolute worst-case ratio less than 2, unless P = NP. We then give a polynomial algorithm with an absolute worst-case ratio exactly 2. Moreover, we give a polynomial algorithm with asymptotic worst-case ratio of 3/2. Computational experiments show that our algorithm performs very well in practice.

4 - Production and Logistics Scheduling with Batching in Steel Industry

Lixin Tang, Chair Professor, Northeastern University, 3-11 Wenhua Road, Heping District, Shenyang, 110004, China, lixintang@mail.neu.edu.cn

The optimization of production and logistics scheduling problems is a kind of key issues in steel industry. Since these problems are mainly characterized by huge equipment and high operating cost, they are organized in batches in order to reduce the total setup and operating cost. In this talk we will discuss three important problems in operation management in the steel industry: the batching decision problem, production scheduling with batching, and logistics scheduling

with batching.

5 - Level Workforce Planning for Multistage Transfer Lines
George Vairaktarakis, Professor, Case Western Reserve University, 10900 Euclid Ave, 323 PBL, Cleveland, OH, 44106, United States of America, gxv5@po.cwru.edu, Joseph Szmerekovsky, Jiayan Xu

We study the maximin workforce size and the min workforce range leveling objectives for serial paced transfer lines. The number of workers needed to complete each operation of a job in precisely c periods is given. For two stations we develop fast algorithms even though the range problem is NP-complete. For 2-stations, we show that level workforce schedules perform well even when evaluated on other metrics. Our algorithms are shown to perform less well for m-stations.

■ MD31

Hilton- Union Sq 11

Digital Services in the Sharing Economy

Sponsor: Service Science

Sponsored Session

Chair: Siva Viswanathan, Associate Professor, University of Maryland College Park, 4313 Van Munching Hall, R.H. Smith School of Business, UMD, College Park, MD, 20742, United States of America, sviswana@rhsmith.umd.edu

1 - Finishing School for Entrepreneurs? Invisible Work and Innovation in the Sharing Economy
Arun Sundararajan, Professor of Information, Operations and Management Sciences, Leonard N. Stern School of Business, NYU, 44 West 4th Street, New York, United States of America, asundara@stern.nyu.edu, Vivian Li

We model the supply-side mechanisms by which peer-to-peer platforms like Airbnb, eBay, Etsy, Lyft, and Kickstarter are gateways for innovation, catalyze entrepreneurship and induce economic growth, testing our theories using transactional data from two large peer-to-peer marketplaces, and supplemented by data from a nationwide survey. (This research is supported by grants from the Ewing Marion Kauffman Foundation and Google Inc.)

2 - Understanding Effects of Message Design on Platform-mediated Information Sharing: A Field Experiment
Tianshu Sun, PhD Candidate, Smith School of Business, University of Maryland, 3330 Van Munching Hall, PhD Student Office, College Park, MD, 20742, United States of America, tianshusun@rhsmith.umd.edu, Siva Viswanathan, Elena Zheleva

Information Sharing is central in sharing economy. Despite digital platforms increasing ability to mediate information sharing, few studies have examined their optimal design choices. We examine whether and how a platform can enhance effectiveness of information sharing, by varying message shared between customers. Through a randomized field experiment on a digital deal platform, we test effectiveness of two pieces of information in message: sender's purchase and existence of referral rewards

3 - Design of Effective Reward Scheme on Crowdfunding Platform
Yong Tan, Professor, University of Washington, Michael G. Foster School of Business, Seattle, WA, 98195-3226, United States of America, ytan@u.washington.edu, Shengsheng Xiao, Jane Xue Tan

Designing effective reward schemes on online crowdfunding platform is a problem faced by project creators. In this paper, we investigate the effect of reward scheme on project success. Specifically, we examine the factors such as the number of reward tiers, price of each tire, and two popular strategies (i.e. "above all" and "backer limitation").

■ MD32

Hilton- Union Sq 12

Workforce Planning I

Cluster: Workforce Management and Engineering

Invited Session

Chair: Yun Fong Lim, Associate Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, yflim@smu.edu.sg

1 - Makespan Minization with Individual Learning
Huan Jin, University of Iowa, huan-jin@uiowa.edu, Michael Hewitt, Barrett Thomas

We consider the problem of minimizing the makespan of a set of tasks while accounting for the impact of learning. The challenge is that learning models are nonlinear, limiting exact methods. We use a recent linear reformulation technique to overcome the nonlinearity. The resulting linearity at the cost of increased problem size. To overcome the problem size, we introduce a computationally efficient method of finding an initial solution and introduce bounds for some of the problem variables.

2 - Effects of Work Structure on Worker Allocation Models with Learning and Forgetting
Austin Chacosky, Rochester Institute of Technology, atc7417@mail.rit.edu, Scott E. Grasman

This talk presents the expansion of worker allocation models with human learning and forgetting to include work structures. Utilizing a reformulation technique to counteract the increased solve times of learning curve incorporation, realistically-sized production systems are modeled. Results advise production managers on assignment and cross-training levels, as well as how their production structure may impact those responses.

3 - Workforce Agility and Workforce Flexibility: What are the Differences?
Ruwen Qin, Missouri University of Science and Technology, United States of America, qinr@mst.edu

Workforce agility, the strategic management of organizational labor capability in dynamic business environments, is a key facet of an organization's overall agility. However, the literature dealing specifically with workforce agility is limited. In this paper we review the research literature on workforce agility to define and clarify distinctions between workforce agility and workforce flexibility. We further identify key gaps in the literature to promote the development of this area.

4 - Cellular Bucket Brigades with Hand-Off Times
Yun Fong Lim, Associate Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, yflim@smu.edu.sg

We introduce a new design of bucket brigades to boost their productivity. We assume hand-off times are significant and propose simple rules for workers to share work. We identify a sufficient condition for the system to self-balance. Our results suggest that the new design could be substantially more productive than traditional bucket brigades.

■ MD33

Hilton- Union Sq 13

Organizing for Successful Product Development

Cluster: New Product Development

Invited Session

Chair: Svenja Sommer, HEC Paris, 1 Rue de la Libération, Jouy en Josas, France, sommers@hec.fr

1 - The Role of Customer Interaction on Product Innovation Success
Philipp Cornelius, UCL, Management Science and Innovation, London, United Kingdom, philipp.cornelius.12@ucl.ac.uk, Bilal Gokpinar

Using a large-scale dataset of new product development projects from a crowdfunding platform, this paper first provides strong causal evidence on the beneficial economic effect of customer interaction on product development success. We then address two important questions regarding customer interaction. First, do organisations actually incorporate and benefit from ideas generated as a result of customer interaction? Second, what kind of customers should organisations listen to for NPD success?

2 - Incentivizing Collaboration in Global Product Development Teams
Sara Rezaee Vessal, HEC Paris, 1 Rue de la Liberation, Jouy en Josas, FR, 78350, France, sara.rezaee-vessal@hec.edu, Svenja Sommer

To successfully compete on an international scale, multinationals increasingly turn towards globally dispersed product development teams, both to draw on a diverse set of expertise and to access more accurate local market knowledge. However, dispersion also creates additional challenges for collaboration, which can have negative effects on project performance. In this study, we compare dispersed and co-located teams and address the question how to incentivise them.

3 - Modular Product Development for Risky Programs: Co-development versus Collaboration
Suri Gurumurthi, University of North Carolina, 1210 Environ Way, Chapel Hill, NC, 27517, United States of America, Suri_Gurumurthi@kenan-flagler.unc.edu

Using simple optimization models, we compare the benefits of just having a modular design of the product, to those resulting from a modular approach to pairing key resource groups and tasks in the development process. The benefits to time-to-market and development cost are compared. Further, we show that deploying self-contained and modular co-development teams (as opposed to independent collaborating teams) can yield greater dividends in the presence of risk and uncertainty.

■ MD34

Hilton- Union Sq 14

Community-Based Operations Research

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Michael Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu

1 - Optimal Physician Traveling Assignment for Improving Care Access in an Outpatient Care Network

Yan Li, Purdue University, West Lafayette, IN, 47907, United States of America, li528@purdue.edu, Nan Kong, Qipeng Zheng

We develop a mixed integer programming model to assign physicians for outpatient care networks to improve patient access to care. We term our model the multi-commodity capacitated traveling facility location problem. We use mental health in the veterans integrated service networks as a case study. Our numerical studies demonstrate conditions under which the idea of scheduling sessions at satellite clinics is appealing and show the efficiency of our column generation-based primal heuristics.

2 - Food Retailers and Obesity in US Adults

Paul Griffin, Penn State, University Park, State College, United States of America, pmg14@engr.psu.edu, Renfei Yan

Food environment has been shown to be associated with obesity rate. We estimate the marginal effect on obesity rate in U.S. adults based on the addition of a new food retailer type in a community. We consider loan and grant subsidies to strategically design a food store establishment plan.

3 - Evaluating the Effectiveness of Tutoring and Mentoring Programs at Homewood Children's Village

Ran Bi, Graduate Student, University of Pittsburgh, 2700 O'Hara St., Pittsburgh, United States of America, rab172@pitt.edu, Xin Jin, Louis Luangkesorn

Many community organizations seek to improve their communities through providing children and teenagers with tutoring and mentoring. However, there is little understanding on the effect of these interventions on academic and behavioral outcomes. We analyze interventions and academic data for students with a goal of identifying interventions that have the most effect on academic outcomes at a community based program working with Pittsburgh Public Schools.

4 - Community-engaged Decision Modeling for Local Economic Development

Michael Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu, Sandeep Jani, Leibiana Feliz

Main Street organizations develop local development initiatives that support economic and social goals. This requires appropriate data and capacity to apply analytic methods. We discuss a pilot study for Boston Main Streets that links values, data, communication, analysis and action. Results demonstrate the benefits of qualitative and quantitative methods to enable practitioners to make best use of primary and secondary data for decision-making and information systems design.

5 - Pro Bono O.R.: an Operational Research Society initiative

Graham Rand, g.rand@lancaster.ac.uk

The Operational Research Society recently appointed a O.R. Pro Bono Manager, to oversee a scheme that provides free O.R. support by O.R. professionals to Third Sector organisations (mainly charities). How projects and volunteers are found and matched will be described. The advantages for the organisations, for the ORS and for the volunteers will be explained, as well as some of the difficulties faced. Examples will be given of completed projects.

■ MD35

Hilton- Union Sq 15

Operations Research in Public Policy Analysis

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Ronald McGarvey, Assistant Professor, University of Missouri, E3437 Lafferre Hall, Columbia, MO, 65211, United States of America, mcgarveyr@missouri.edu

1 - Structuring a Waste Collection Contract using Robust Optimization

Maryam Nikouei Mehr, University of Missouri, Columbia, OH, 65211, mcgarveyr@misssouri.edu, Ronald McGarvey

The University of Missouri has a contract with the City of Columbia to provide waste collection services on campus. An interesting aspect of this contract is that the University is charged according to a fee structure that is different for different types of receptacles. Our research aims to analyze the location and utilization of receptacles across the campus in order to identify a strategy that minimizes the contract expenses to accommodate the University's demand for waste services.

2 - Technical Barriers to, and Policy Options for, Large-Scale Solar Electricity Deployment in India

Aimee Curtright, Physical Scientist, RAND Corporation, 4570 Fifth Avenue, Pittsburgh, PA, 15213, United States of America, acurtrig@rand.org, N.C. Thirumalai, Zhimin Mao, Oluwatobi Oluwatola

RAND and CSTEP are studying the technical barriers and policy options for meeting India's aggressive solar goal of 22 GW by 2022. CSTEP's techno-economic models explore the economic viability of solar, specifically in the Indian context (e.g., locational-specific solar resource data). This presentation examines the sensitivity of costs to different financial mechanisms, technology improvements, and solar resource assumptions, and the policy implications of tradeoffs between them.

3 - Integrating the Location and Inventory Decisions of a Supply Chain

Fang Fang, Ph. D. Student, School of Business Administration, University of Miami, University of Miami, Coral Gables, FL, 33146, f.fang@umiami.edu, Harihara Natarajan

Jointly determining location and inventory decisions in a supply chain is important to ensure low costs. To integrate these decisions, we develop a model that employs a novel approach, incorporating both cycle and safety inventories without introducing nonlinearities. Preliminary computational results suggest that our model and method can be effective.

4 - Optimal Design of Personalized HPV Vaccination Program

Shengfan Zhang, Assistant professor, University of Arkansas, United States of America, shengfan@uark.edu, Fan Wang

The human papillomavirus (HPV) is the most common sexually transmitted virus in the U.S. To prevent multiple cancers attributable to the HPV, HPV vaccine is recommended for preteens and teens who have not been exposed to HPV. We develop a simulation model for the optimal design of personalized HPV vaccination program, which incorporates multiple social-behavioral and demographic risk factors. The efficacy of the HPV vaccination program is evaluated in terms of the HPV-related health outcomes.

■ MD36

Hilton- Union Sq 16

Topics In Telecommunications

Sponsor: Telecommunications

Sponsored Session

Chair: Stanko Dimitrov, University of Waterloo, 200 University Avenue West, Waterloo, Canada, sdimitro@uwaterloo.ca

1 - A Defragmentation Problem of Wavelength Assignment for the Next Generation ROADM Networks

Youngho Lee, Korea University, Sung Buk Ku, Seoul, Korea, Republic of, yhlee@korea.ac.kr, Gilhyun Do, IkKyun Jeong, Jeongyi Moon, Junsang Yuh, Binnam Kim

This talk presents a defragmentation problem of channel assignment in deploying the next generation network of reconfigurable optical add drop multiplexers (ROADM). We develop mixed integer programming models for the problem and propose a novel branch and cut procedure for solving large-scale problems. Promising computational results are presented.

2 - On the Geographic Expansion and Integration Strategies of Telecommunications Service Providers
Steven Powell, Professor Emeritus, CIS Department, California State Polytechnic University, Pomona, 3801 W. Temple Avenue, Pomona, CA, 85248, United States of America, srpowell@csupomona.edu

In order to achieve higher growth and economies of scale telecommunications service providers (TSPs) have expanded their wireless and wireline services geographically and integrated their service offerings. Using a decision model based on the performance and risk characteristics of a TSP's business portfolio, this paper analyzes the geographic expansion and service integration strategies of a cross-section of major TSPs from 2000 to 2012.

3 - A Game-theoretic Model of Network Throughput and Reliability: Survey & Prospects
Yupo Chan, University of Arkansas at Little Rock, 2801 South University Ave, Little Rock, United States of America, yxchan@ualr.edu

A network is only useful if it is reliable, secure, and functioning properly. It has to be devoid of unexpected failures due to natural/technological disasters and outside attacks. A stochastic network, characterized by arcs (links) and nodes that can fail unexpectedly, is proposed to mimic such unpredicted interruptions. Through such a stochastic-network model, we identify game-theoretic strategies and tactics to prevent disruptions caused by natural/technological hazards and hostile tampering.

■ MD37

Hilton- Union Sq 17

Supply Chain Optimization and Analytics

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Dahai Xing, Data Scientist, Walmart Labs, 2000 Sierra Point Parkway, Brisbane, CA, 94005, United States of America, DXing@walmartlabs.com

1 - Multivariate Time Series Forecasting using Matrix Completion Algorithms
Ashin Mukherjee, Staff Data Scientist, WalmartLabs, 850 Cherry Avenue, San Bruno, CA, 94066, United States of America, AMukherjee1@walmartlabs.com

Forecasting multivariate time series data is a common problem in business and industrial statistics. In this work we propose a novel matrix completion based algorithm when the underlying data shows strong correlations across time series. The proposed method is completely non-parametric and does not require extraneous estimation of seasonality or trend. The effectiveness of the proposed methodology is demonstrated through a multivariate demand forecasting problem in an e-commerce setting.

2 - Supply Chain Analytics: Simple vs. Complex
Homarjun Agrahari, Director, Supply Chain Analytics, FleetPride, Inc., 600 E. Las Colinas Boulevard, Irving, TX, 75039, United States of America, homarjun.agrahari@fleetpride.com

Most Supply Chain Analytics projects deal with complex solutions for complex problems. However, there is beauty (and lots of money) in simple solutions. I will talk about how simple Analytics has helped FleetPride supply chain. I will also discuss skills every student must have if she/he plans to build a career in industry.

3 - Transportation Challenges in the Multi-channel Retail World
Dahai Xing, Devadas Pattathil

The speakers will introduce the challenges and solutions in the multi-channel retail world. A multi-channel retailer not only has to transport inbound goods from offshore and domestic vendor, but it also has to handle outbound small package delivery. The operational challenges and complexity multiplies when the retailer also handles returns process; and provides warehouse-to-warehouse transfers, inter-store transfers, etc.

4 - Optimal Lead Time and Stocking Levels under Dynamically Evolving Demand in Multi-Channel Retailing
Nevin Mutlu, PhD Candidate, Virginia Tech, 607 Clay St. Apt 10., Blacksburg, VA, 24060, United States of America, nmutlu@vt.edu, Ebru Bish, Erick Wikum

As traditional brick-and-mortar retailers expand their sales channels to online and mobile orders, the consumer adoption rates of these emerging channels is increasing over time. We develop a novel, dynamic demand model to realistically represent the demand across channels in our multi-period optimization model. We perform numerical studies to show that the retailers' optimal decisions in this dynamic environment differ significantly from those under the presence of static demand.

5 - Use of Optimization in Store Selection for Online Order Fulfillment
Guru Pundoor, Scientist, Supply Chain Optimization, Walmart eCommerce, 850 Cherry Avenue, San Bruno, CA, 94066, United States of America, GPundoor@walmart.com

A primary consideration in eCommerce is customer order fulfillment. Different companies employ different strategies with the conflicting objectives of improving service level while controlling costs. In this talk, we will focus on how a multi-channel retailer can use optimization technology to make strategic sourcing decisions by using the brick and mortar network for fulfilling online orders.

■ MD38

Hilton- Union Sq 18

OR Techniques to Improve Patient Scheduling

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, amycohn@med.umich.edu

1 - Reducing Patient Delays in Outpatient Infusion Centers
Sarah Bach, University of Michigan, Ann Arbor, MI, United States of America, sbach@umich.edu, Amy Cohn

Patients receiving chemotherapy in outpatient infusion centers often must get blood work done in the lab, visit their physician in the clinic, and have the pharmacy prepare their drugs before receiving the infusion. We use collaboration with nurses and physicians in the clinical environment, data collection and analysis, simulation, and optimization techniques to develop ways to improve the patient experience and reduce delays in this complex series of activities.

2 - Improving Patient Access for an Outpatient Endocrinology Clinic
Joanna Fleming, University of Michigan, Ann Arbor, MI, United States of America, flemjo@umich.edu, Amy Cohn

A new weight loss and management program for high-risk patients has is under investigation, but requires a frequent and carefully-structured series of visits to the endocrinology clinic. Limits in clinic capacity are hampering the ability of the program to be implemented and effectively evaluated. We use observation, data analysis, simulation, and optimization to assess potential for improving access to timely appointments.

3 - Causal Analysis of Emergency Department Delays
Shervin AhmadBeygi, Director of Systems Redesign, Deparment of Veterans Affairs - Washington DC Medical Center, 50 Irving Street N.W., Washington DC, DC, 20422, United States of America, shervin@umich.edu

Emergency Department (ED) delay is a widespread problem that negatively affects patient safety, quality of care, and patient and provider satisfaction. We employ novel data analytics approaches such as causal networks and competing risk analysis and use historical data to study the causes of ED delays. The results of this analysis provide recommendations on how to alleviate the problem of excess ED delays.

■ MD39

Hilton- Union Sq 19

Operations Analysis for Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, dai@jhu.edu

1 - Optimal Mix of Elective Surgical Procedures under Stochastic Patient Length of Stay
Hessam Bavafa, Assissant Professor, Wisconsin School of Business, 975 University Ave, Madison, WI, 53706, United States of America, bavafa@wharton.upenn.edu, Sergei Savin, Lerzan Ormeci

We consider the problem of allocating daily hospital service capacity among several types of elective surgical procedures. Our focus is on the interaction between two major constraining hospital resources: operating room and bed capacity. In our model, each type of surgical procedure has an associated revenue, deterministic procedure duration and stochastic hospital length of stay.

2 - Pricing and Operational Performance in Outpatient Services of China's Public Hospitals
Xiaofang Wang, Associate Professor, Renmin University of China, School of Business, 59 Zhongguancun St, Haidian, Beijing, China, wangxiaofang@rbs.org.cn

Inefficient and unnecessary care has contributed the growing cost and increased congestion at government-run public hospitals in China. Among other healthcare reform policies, adjusting fees for outpatient services plays an important role in eliminating Yi Yao Yang Yi to make health care more accessible and affordable. We develop a model to jointly determine the optimal pricing and the optimal service policy to maximize the benefits collected by the hospital and provide policy insights.

3 - Resource Allocation Considering Quality of Care in Hospice Operations
Leela Nageswaran, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, lnageswa@andrew.cmu.edu, Alan Scheller-Wolf, Aliza Heching

We study the problem of allocating nurses in hospices, factoring in the interplay between staffing choices and realized quality of care. The hospice has a choice of overworking their full-time nurses or hiring per diem nurses. The resulting quality of care impacts the rates at which new patients enroll with, and existing patients leave, the provider. We model the problem as a discrete time Markov chain and obtain characteristics of the optimal resource allocation policy.

4 - If You'd Give, You'll Get: Analysis and Remedies of Donor Priority Rule
Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, dai@jhu.edu

It has been proposed that registered organ donors should be given a higher priority over non-donors when they need organ transplants in the future. We use a queueing and game theoretic model to predict the equilibrium under this policy. Our analysis provides insights into potential policy-induced welfare distortions. As a result, the overall social welfare can be lower due to the policy. We provide simple and effective remedies to correct these distortions.

■ MD40

Hilton- Union Sq 20

Bundled Payments and Payment Systems

Sponsor: Health Applications

Sponsored Session

Chair: Margret Bjarnadöttir, Assistant Professor of Management Science and Statistics, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America

1 - Opportunities for OR/MS in Healthcare Payment Reform
Renata Konrad, Worcester Polytechnic Institute, 100 Institute Rd, Worcester, United States of America, rkonrad@wpi.edu, Margret Bjarnadöttir, Ruben Proano, David Anderson

Healthcare reimbursement is at the forefront of healthcare reform debates in the US. Bundled payment systems have been proposed as a practical and promising reimbursement alternative to induce incentives that lower healthcare expenditures. Significant evidence suggests that such systems achieve improved quality outcomes, and better coordinated care at a lower cost. This talk provides an overview of bundled payments and discusses directions for operations research and management science.

2 - Bundled Payments: A Post-Acute Care Provider Prospective
Brenda Courtad, University of Cincinnati, 2925 Campus Green Dr, Cincinnati, OH, 45221, United States of America, courtabl@mail.uc.edu, Michael Magazine

Taking part in the Bundled Payment for Care Improvement Demonstration with Medicare requires many decisions to be made. We will present and discuss some of these decisions from a post-acute care provider prospective.

3 - Optimal Facility In-network Selection for Healthcare Payers under Reference Pricing
Aurelie Thiele, Visiting Associate Professor, MIT, 77 Mass Ave, Rm E40-121, Cambridge, MA 02139, United States of America, aut204@lehigh.edu, Victoire Denoyel, Laurent Alfandari

In reference pricing (RP), a payer determines a maximum amount for a procedure; patients who select a provider charging more pay the difference. This has strong potential in cost reduction for payers, quality increase for patients & visibility for high-value providers. Inspired by a CalPERS program, we use robust optimization to set a reference price and providers subject to it. We present & analyze a MIP to fill the gap of quantitative insights on RP w.r.t price, quality & geographic coverage.

4 - Automatic Detection of Episodes of Care in an Insurance Claims Repository
Ruben Proano, Assistant Professor, Rochester Institute of Technology, Rochester, NY, United States of America, rpmeie@rit.edu, Margrét BjarnadÛttir, Renata Konrad, David Anderson

This talk presents the ongoing efforts to automatically determine what medical services should be bundled as an episode of care. The ability to determine these bundles is key for an eventual adoption of bundled payments as a healthcare cost reimbursement strategy, instead of the commonly used fee-for-service. This talk focuses on the efforts to mine a large aggregated insurance claims repository with six years of data for Upstate New York.

■ MD41

Hilton- Union Sq 21

Stochastic Models in Healthcare Delivery

Sponsor: Health Applications

Sponsored Session

Chair: Mucahit Cevik, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu

1 - Hypertension Management under Noise-Free Paradigm: Insights to the Optimal Medication Prescriptions
Abdolmanaf Zargoush, PhD Candidate, McGill University, 1001 Sherbrooke, Montreal, QC, H3A1G5, Canada, abdolmanaf.zargoush@mcgill.ca, Stella Daskalopoulou, Vedat Verter, Mehmet Gumus

We formulate the "antihypertensive prescription problem" as a finite-horizon Markov Decision Process (MDP). The optimal policies, which are of threshold nature, provide valuable insights on the key question in hypertension management: "which medication" and "when" should be prescribed given the patient's blood pressure level and age?

2 - A MDP Model for Breast and Ovarian Cancer Intervention Strategies for BRCA1/2 Mutation Carriers
Mehrnaz Abdollahian, PhD. Student, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, mehrnaz@mail.usf.edu, Tapas Das

Women with BRCA1/2 mutations have higher risk for breast and ovarian cancers. Available interventions vary significantly in cost, cancer prevention, and in resulting death from other causes. We developed a Markov decision process model to obtain optimal intervention strategies using both cost and quality-adjusted life years as rewards.

3 - Multi-dose Vial Administration with Non-Stationary Demand and Delayed Service
Maryam Hasanzadeh Mofrad, PhD. Student, University of Pittsburgh, Pittsburgh, PA, 15261, United States of America, hasanzadeh.mofrad@gmail.com, Jayant Rajgopal, Lisa M. Maillart, Bryan A. Norman

Previous work on determining dynamic vaccine administration policies to minimize open vial waste assumes that unvaccinated customers are lost and that the arrival rate is stationary both throughout the replenishment cycle as well as within each session. We reformulate the Markov decision process model to account for these factors and present the results of extensive numerical study for both clinic-level and country-level performance.

4 - Effects of Budgetary Restrictions on Mammography Screening Policies
Mucahit Cevik, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu, Turgay Ayer, Oguzhan Alagoz

The consideration of a budget constraint on the total available resources for mammography screening becomes a necessity especially for resource-limited countries. We formulate an MDP model to assess changes on mammography screening decisions and risk of getting cancer, when only a limited budget per woman is available.

■ MD42

Hilton- Union Sq 22

Health Care Supply Chain, Competition, and Risks Management

Sponsor: Health Applications

Sponsored Session

Chair: Wen-Ya Wang, San Jose State University, One Washington Square, San Jose, CA, United States of America, wenya.wang@sjsu.edu

1 - Integrated Pharmaceutical Supply Chains: Dynamic and Oligopolistic Competition Perspectives

Sung Chung, New Mexico Institute of Mining and Technology, 801 Leroy Place, Socorro, United States of America, schung@nmt.edu, Changhyun Kwon

We propose an integrated pharmaceutical supply chain management framework that allows us to explicitly consider the dynamic control of medication inventories at distribution centers and demand markets. We address the issues pertaining to pharmaceutical supply chains such as price fluctuations as a result of competition across firms, and changes in pharmaceutical supply flows over time. We also provide a case study in which managerial insights are derived.

2 - No Silver Bullet: Identifying Security Vulnerabilities Of Hospital Databases

Liam O'Neill, Associate Professor, University of North Texas - Health Science Center, 3500 Camp Bowie Blvd, Fort Worth, TX, 76107, Liam.ONeill@unthsc.edu, Guatam Das, Nan Zhang, Heng Huang

Analytical processing was used to identify security vulnerabilities in public hospital databases. Using medical domain knowledge, we recovered the real age of 64 patients, the gender of 796 patients, and the zip codes of 1,219 patients. We demonstrate that standard methods to mask personal health information can be reversed, thereby increasing the risk of re-identification of individual patients.

3 - Inventory Management of Reusable Surgical Instruments

Adam Diamant, Adam.Diamant09@Rotman.Utoronto.Ca, Joseph Milner, Fayez Quereshy

We study inventory policies for surgical instruments that must be sterilized between uses. We model the process as a discrete-time Markov chain, obtaining the steady-state probabilities for the amount of usable inventory on-hand at the beginning of each day. By showing several structural properties, we derive an expression for the optimal number of instrument sets to carry. We apply our theoretical results to a dataset collected from a surgical unit at a large hospital in Toronto.

4 - Price Competition under Subsidization: Application to Medicare Reform

Lijian Lu, PhD, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, llu16@gsb.columbia.edu, Awi Federgruen

We consider price competition models, in which a significant part of the price is subsidized by a third party. We characterize the equilibrium behavior and derive comparison results for the price equilibria under alternative subsidy schemes. Applying our results to the Medicare insurance market, we estimate the impacts of various proposals, in particular the Wyden-Ryan plan, on government cost, insurer, and beneficiary's welfare.

■ MD43

Hilton- Union Sq 23

Decision Diagrams in Optimization II

Sponsor: Computing Society

Sponsored Session

Chair: John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, United States of America, jh38@andrew.cmu.edu

1 - Solving Binary Quadratic Programming Problems with Binary Decision Diagrams

David Bergman, School of Business, University of Connecticut, One University Place, Stamford, United States of America, david.bergman@business.uconn.edu, Andre Augusto Cire

Binary decision diagrams (BDDs) have recently been proposed as a mechanism for solving discrete optimization problems. This talk discusses an extension of this work to the binary quadratic programming problem. A set of instances is described for which the BDD technique outperforms existing state-of-the-art technique.

2 - Parallel Combinatorial Optimization with Decision Diagrams

Willem-Jan van Hoeve, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, vanhoeve@andrew.cmu.edu, David Bergman, Andre Cire, Vijay Saraswat, Horst Samulowitz, Ashish Sabharwal

We propose a new approach for parallelizing search for combinatorial optimization that is based on a recursive application of approximate decision diagrams. This generic scheme can, in principle, be applied to parallelize MIP, SAT, or CP search, provided that a decision diagram representation for the problem is available. We demonstrate our method on the maximum independent set problem, and show that our parallel search scales effectively up to 256 workers.

3 - Weighted —AND/OR Multivalued Decision Diagrams (AOMDD) for Sum and Max Queries

Rina Dechter, Professor, UCI, Irvine, CA 92697-3425, Irvine, United States of America, dechter@ics.uci.edu, William Lam

I will present Weighted AOMDDs which capture problem decomposition, multi-valued variables, and can express real-valued functions. I will show that the AOMDD size exponential in the problem's semantic-width, a new, and more informative parameter (though hard to compute). Specific demonstration as well as empirical evaluation will be given.

4 - Optimization with Zero-suppressed BDDs: Case Study Research in Power Distribution Networks

Takeru Inoue, NTT Network Innovation Labs., Hikarinooka 1-1, Yokosuka, Ka, 2390847, Japan, inoue.takeru@lab.ntt.co.jp, Ryo Yoshinaka, Keiji Takano, Takayuki Watanabe, Jun Kawahara, Akihiro Kishimoto, Koji Tsuda, Shin-ichi Minato, Yasuhiro Hayashi

Determining loss minimum configuration in a power distribution network is a hard discrete optimization problem involving many variables. Since existing methods employ local updates, they eventually get stuck at local minima. We present an optimization method providing global optimal solution utilizing a compressed search space represented by zero-suppressed BDDs. Our method is also remarkably efficient; optimization of a large-scale network with 468 switches was solved just in a minute.

■ MD44

Hilton- Union Sq 24

Information, Information Accuracy and Information Policy in E-commerce Applications

Sponsor: Information Systems

Sponsored Session

Chair: Juan Feng, Associate Professor, City University of Hong Kong, Kowloon Tung, Hong Kong, Hong Kong - PRC, juafeng@gapps.cityu.edu.hk

1 - Does Screening Mechanism Hurt or Help Crowdsourcing Contests?

Jiahui Mo, Assistant Professor, Nanyang Technological University, jiahui.mo@utdallas.edu

In crowdsourcing contests platforms, seekers are allowed to adopt screening mechanism within a contest. Some seekers use two stage contests, with the first stage as the screening stage to select candidates and the second stage as the winner selection stage. Some other seekers do not have screening stage but select winners directly. This research explores how screening mechanism in crowdsourcing contests influences solvers, seekers and platforms.

2 - IT Investment under Competition: The Role of Value Uncertainty

Mingdi Xin, Assistant Professor, University of California at Irvine, United States of America, mingdi.xin@uci.edu, Vidyanand Choudhary

How does competition impact firms' incentive to invest in information technology (IT)? On one hand, firms in highly competitive industries may be more motivated to invest in IT to improve performance and competitive position. On the other hand, firms' investment incentive depends on their ability to appropriate the return, and the value of IT investment is more likely to be competed away in competitive industries. This paper examines firms' IT investment decisions in a game theoretic model.

3 - The Effect of Consumer Rating Behavior in an App Market

Lin Hao, Assistant Professor, Mendoza College of Business, University of Notre Dame, lhao@nd.edu, Xiaofei Li, Jiuping Xu, Yong Tan

This paper investigates the influence of consumer rating behavior on three players in an app market, the app developer, app consumers, and the platform owner. Specifically we studies under the uncertainty about the horizontal characteristics of an app, how consumers' different rating behaviors could affect their app purchase decisions, the developer's quality and price decision, and the platform owner's decision on the sharing percentage in the app revenue sharing contract.

4 - When Online Reviews Meets Sales Volume Signal: Does More Information Leads To A Happy Ending?
Juan Feng, Associate Professor, City University of Hong Kong, Hong Kong, Hong Kong - PRC, juafeng@cityu.edu.hk, Yang Liu, Xiuwu Liao

We study the impact of two types of information, that is, sales volume signal and online review, on consumers' purchase decision and on firms' optimal pricing strategies over time. We find that more information, or more accurate information, does not always lead to a welfare increase to firms or consumers.

■ MD45

Hilton- Union Sq 25

Opportunities in Behavioral Operations: Different Perspectives

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Andrew Davis, Assistant Professor, Cornell University, 401J Sage Hall, Ithaca, NY, 14853, United States of America, adavis@cornell.edu

1 - Laboratory Experiments on the Operations-Finance Interface
Vishal Gaur, Cornell University, Johnson School, Ithaca, NY, United States of America, vg77@cornell.edu

I shall identify some opportunities for testing theoretical models on the interface of operations management and finance through controlled experiments in the lab or the field.

2 - Human Behavior in Production and Supply Chain Systems
Wallace Hopp, University of Michigan, Ross School of Business, Ann Arbor, MI, 48109, United States of America, whopp@umich.edu

Considering human behavior can alter the structure of operations management problems in some classical settings, and can present entirely new problems in other settings. In this talk, we will explore the impact of behavioral issues, such as motivation, trust and fairness in production and supply chain settings. The focus will be to identify common threads apparent from results so far, and to highlight areas of potential future research interest.

3 - Behavioral Opportunities in Revenue Management and Pricing
Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, serguei.netessine@insead.edu, Jun Li

Behavioral work in operations management has paid relatively little attention to the issues if revenue management and pricing. In this talk we will discuss empirical evidence suggesting that there are ample opportunities for behavioral researchers.

■ MD46

Hilton- Lombard

Cutting Plane and Formulation Techniques for Mixed Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Sina Modaresi, Graduate Research Assistant, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, sim23@pitt.edu

1 - Valid Inequalities for the Pooling Problem
James Luedtke, Associate Professor, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, jrluedt1@wisc.edu, Jeff Linderoth, Claudia D'Ambrosio

We investigate relaxations for the non-convex pooling problem, which arises in production planning problems in which products with are mixed in intermediate pools in order to meet quality targets at their destinations. We derive valid nonlinear convex inequalities, which we conjecture define the convex hull of this non-convex set for some special cases. Numerical illustrations will be presented.

2 - Obtaining Deeper Intersection Points for Generalized Intersection Cuts
Aleksandr Kazachkov, Ph.D. Student, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, akazachk@cmu.edu, Egon Balas, Francois Margot, Selvaprabu Nadarajah

Generalized intersection cuts offer a non-iterative method to generate cuts for mixed-integer linear programs, by finding a collection of intersection points that can be used to generate cuts through a linear program. We demonstrate theoretical properties of proper collections of intersection points and empirically evaluate several procedures for generating points. The goal is to obtain deeper intersection points, so that the corresponding cut-generating program yields better cuts.

3 - Lifted Mixing Inequalities for a Generalized Mixing Set
Ayse Arslan, University of Florida, 3700 Windmeadows Blv., P180, Gaineville, FL, 32608, United States of America, nur.arslan@ufl.edu, Jean-Philippe P Richard, Yongpei Guan

In this paper, we study a generalization of the mixing set introduced by Pochet and Gunluk, 2001. We show that the traditional mixing inequalities can be used to obtain facet-defining inequalities for the set in consideration through lifting. We further prove that the associated lifting function is subadditive. We therefore use an efficient lifting procedure to obtain a family of facet-defining inequalities for the set in consideration.

4 - On Some Generalizations of Split Cuts
Diego Moran, Dr., United States of America, dmoran@gatech.edu, Sanjeeb Dash, Oktay Gunluk

Split cuts form a well-known class of valid inequalities for mixed-integer programming problems (MIP). Cook et al. (1990) showed that the split closure of a rational polyhedron P is again a polyhedron. In this paper, we extend this result from a single rational polyhedron to the union of a finite number of rational polyhedra. We also show how this result can be used to prove that some generalizations of split cuts, namely cross cuts, also yield closures that are rational polyhedra.

■ MD47

Hilton- Mason A

Joint Session Optim/ MIF: Developments in Stochastic Integer Programming Methods

Sponsor: Optimization/Optimization Under Uncertainty & Minority Issues Forum

Sponsored Session

Chair: Lewis Ntaimo, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ntaimo@tamu.edu

Co-Chair: Saravanan Venkatachalam, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX 77843, United States of America, saravanan@entc.tamu.edu

1 - A Branch-and-Bound Method for Stochastic Integer Bilinearly-Constrained Programs
Christopher Hagmann, Purdue University, 480 Stadium Mall Dr., West Lafayette, United States of America, chagmann@purdue.edu, Nan Kong, Pratik Parikh

The warehouse-inventory-transportation problem was developed to integrate warehousing decisions in developing distribution plans in supply chain practice. The resultant problem is a two-stage stochastic integer bilinearly-constrained program. We propose an algorithm that decomposes the problem by branching on variables responsible for the bilinearity. The resulting tree of SIPs is searched and fathomed using scenario decomposition. Various strategies are compared for the test instances.

2 - Fenchel Decomposition for SIP with Second-Stage Integer Variables
Saravanan Venkatachalam, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX 77843, United States of America, saravanan@entc.tamu.edu, Lewis Ntaimo

This talk presents a computational study of a Fenchel decomposition algorithm for two stage stochastic integer programs having integer variables in second stage with special structure. A Benders' decomposition framework is used and a new heuristics is devised to aid in generating Fenchel cuts in a stage-wise decomposition setting.

3 - Exploiting Submodularity in Integer Programming under Uncertainty
Shabbir Ahmed, Professor, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, sahmed@isye.gatech.edu

Various classes of integer programming models under uncertainty can be reformulated into deterministic mixed integer nonlinear programming (MINLP) formulations involving nonlinear functions of binary variables that exhibit a diminishing marginals property known as submodularity. This talk will discuss various approaches to exploit this submodularity to develop effective mixed integer linear programming (MILP) based methods for such MINLP problems.

4 - Fenchel Disjunctive Decomposition for Mean-Risk Stochastic Integer Programs

Lewis Ntaimo, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ntaimo@tamu.edu, Michelle Alvarado, Guglielmo Lulli

Mean-risk stochastic integer programs (SIPs) include both expectation and a dispersion statistic in the objective function and are difficult to solve. We derive an integrated Fenchel and disjunctive decomposition method for mean-risk SIPs with fixed recourse for the absolute semideviation mean-risk measure. Fenchel decomposition cuts are generated based on a subset of scenarios and are lifted and translated using disjunctive programming so that they are valid for the rest of the scenarios.

■ MD48

Hilton- Mason B

Network and Graphs 2

Contributed Session

Chair: Yongwhan Lim, PhD, MIT, 70 Pacific Street, Cambridge, MA, 02139, United States of America, yongwhan@mit.edu

1 - Multi-factor Stock Analysis using Graph Theory

Deepika Pardasani, Columbia University, 116th St and Broadway, New York, NY, 10027, United States of America, dp2673@columbia.edu, Yared Nigussie, Bo Zhang

We use graph theory to understand structural properties of stock markets. We consider different market graphs: one based on stock returns, others with vertices weighted by factors like liquidity measure, Dividend Yield, and Price-to-Earnings Ratio. We investigate portfolios at various time horizons to derive meaningful economic information by examining clustering coefficients, correlation distributions and changing temporal properties of market graphs.

2 - Dynamical Network Structures in Multi-Layered Networks

Rene Janssen, Netherlands Defence Academy, Faculty of Military Sciences, Enys House, Het Nieuwe Diep 8, Den Helder, 1781 AC, Netherlands, rhp.janssen@nlda.nl, Herman Monsuur, AriÎn van der Wal

In modeling (inter)actions and cooperation as networks, actors may be represented as nodes that simultaneously belong to multiple interdependent networks. We present a method that is used to implement, analyze and evaluate basic principles that may be used by the actors in an organization to drive the process of constant change. We demonstrate our approach to networks in which two basic principles are operational: reciprocity and covering.

3 - Stochastic Linear Threshold Model of Diffusion in Networks

Yongwhan Lim, PhD, MIT, 70 Pacific Street, Cambridge, MA, 02139, United States of America, yongwhan@mit.edu, Alex Teytelboym, Asuman Ozdaglar

We provide an analytical expression for the expected number of adopters in any network with any seed in terms of a new centrality measure. We describe network topologies that maximize and minimize diffusion when the seed is random. We also pin down the topology that maximizes overall diffusion when the seed can be targeted. For certain topologies, we derive the exact number of adopters, as the network grows large. We discuss how the structure of the network affects early history of diffusion.

4 - Efficient Parallel Algorithms for Network Interdiction Problems

Dia St. John, University of Arkansas, Bell Engineering Center, Fayetteville, AR, 72701, United States of America, destjohn@uark.edu, J. Cole Smith, Chase Rainwater

Network interdiction is a well-known problem class with many important applications, including disruptions in supply chain infrastructures and communication networks. This work focuses on decreasing the computational run time required to solve large-scale network interdiction models to optimality through the use of new parallel computing methodologies.

■ MD49

Hilton- Powell A

Supply Chain Network Competition: Advances in Models, Methods, and Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Anna Nagurney, John F. Smith Memorial Professor, Isenberg School of Management, University of Massachusetts Amherst, Amherst, MA, United States of America, nagurney@isenberg.umass.edu

1 - Supply Chain Network Competition with Information Asymmetry in Quality and Minimum Quality Standards

Dong Li, Doctoral Student, Isenberg School of Management, University of Massachusetts, 121 Presidents Drive, Amherst, MA, 01003, United States of America, dongl@som.umass.edu, Anna Nagurney

We construct a supply chain network model with information asymmetry in product quality. The competing firms with, possibly, multiple manufacturing plants, which may be located on-shore or off-shore, are aware of the quality of the product that they produce but consumers only know the average quality. We propose the models and demonstrate how minimum quality standards can be incorporated. The numerical examples, accompanied by sensitivity analysis, reveal interesting results and insights.

2 - The Closed-loop Supply Chain Network with Competition and Design for Remanufactureability

Qiang Qiang, Penn State Univ., 30 E. Swedesford Rd., Malvern, PA, 19355, United States of America, qzq10@psu.edu

A two-period closed-loop supply chain network is investigated. In the first period, each manufacturer decides on the production quantity and level of remanufactureability, which has impact on the cost of both new and remanufactured products. In period two, manufacturers can manufacture and/or remanufacture products, taking into account that consumers have different valuations of new and remanufactured products. Through a series of case studies, we answer several important research questions.

3 - Supply Chain Network Sustainability under Competition and Frequencies of Economic Activities

Min Yu, Assistant Professor, Pamplin School of Business, University of Portland, Portland, OR, United States of America, yu@up.edu, Jonas Floden, Anna Nagurney

We develop a competitive supply chain network model with multiple firms, each of which produces a differentiated product by brand and weights its generated emissions in an individual way. The supply chain network economic activities have associated with them distinct capacities and the firms seek to determine their optimal product flows and frequencies of operation so that their utilities are maximized where the utilities consist of profits and weighted emissions.

4 - Supply Chain Supernetwork Model with Suppliers Risk Diversification

June Dong, Professor, School of Business, SUNY, Oswego, NY, United States of America, june.dong@oswego.edu, Jun Ma

Recently, supply chain risks are getting higher and higher. Firms are now seeking ways to diversify their suppliers. We consider multiple competitive supply chains that serve multiple demand markets. Each player seeks to maximize its profit, while each manufacturer also manages to diversify its suppliers. We develop a supernetwork model to capture the nature of the problem. Risk parameters are introduced. Variational Inequality formulations are derived and numerical examples are provided.

■ MD50

Hilton- Powell B

Optimization, Network 1

Contributed Session

Chair: Cenk Caliskan, Associate Professor, Department of Finance and Economics, Woodbury School of Business, Utah Valley University, Orem, UT, 84058, United States of America, cenk.caliskan@uvu.edu

1 - The Least Cost Influence Problem (LCIP) in Dynamic Social Networks

Dilek Gunnec, Assistant Professor, Ozyegin University, Cekmekoy, Istanbul, Turkey, dilek.gunnec@ozyegin.edu.tr, Raghu Raghavan

Identifying critical nodes on a social network is an important problem in both marketing and epidemiological settings. The LCIP is an NP-Hard problem that is polynomially solvable on tree networks under the assumption that all neighbors of a node exert equal influence. We explore the extensions of the LCIP to a dynamic social network setting. The two important aspects of the problem include modeling of dynamic social networks and the integration of these dynamic effects to spreading behavior.

2 - Optimizing Social Media Message Dissemination Problem for Emergency Communication

Xin Ma, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, xma@tamu.edu, Justin Yates

We introduce a formal model for the Social Media Message Dissemination (SMMD) problem, which includes emphasis on single and multiple message scenarios and examines key communication characteristics in the development of more targeted messaging strategies in extreme events. We present a detailed experimental design on random networks and real Twitter sub-networks and discuss our findings. We also include analysis of heuristics for SMMD and discuss the potential use in real-world applications.

3 - Transmission Expansion Planning Considering Energy Storage Systems

Cameron MacRae, Phd candidate, School of Mathematical and Geospatial Sciences, RMIT University, GPO Box 2476, Melbourne, 3001, Australia, cameron.macrae@rmit.edu.au, Andreas Ernst, Melih Ozlen

In the electricity grid, energy storage systems (ESS) provide a way of both smoothing supply and matching demand. We develop an extension to the transmission network expansion planning (TEP) problem that considers the installation of both ESS and additional circuits. The model is tested on the well known Garver 6-bus and IEEE 25-bus test circuits and some preliminary results are discussed.

4 - Optimizing Information Flow In an Adaptive Network

Mohsen Dadashi, University of Arkansas, Department of Industrial Engineering, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, mdadashi@uark.edu, Chase Rainwater, Edward Pohl

In this talk, information flow in an organization is modeled as a social network. Actors are classified into different levels. Actors have multiple states which represent their willingness to reveal their known information. The model analyzes the information received by a specific targeted actor. First, a sensitivity analysis is done to identify the influence of current network parameters on the result. Second, network modifications are examined in order to optimally create new connections.

■ MD51

Hilton- Sutter A

First-order Methods for Large-scale Convex Optimization

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Necdet Serhat Aybat, Assistant Professor, Penn State University, Dept. of Industrial Engineering, University Park, PA, 16802, United States of America, nsa10@psu.edu

1 - Practical Inexact Proximal Quasi-Newton Method with Global Complexity Analysis

Xiaocheng Tang, Lehigh University, Industrial and Systems Engineering Dept., United States of America, xiaocheng.t@gmail.com, Katya Scheinberg

Recently several methods were proposed for sparse optimization which make careful use of second-order information to improve local convergence rates. Here we propose a general framework, and also a new algorithm, which uses limited memory BFGS Hessian approximations, and provide a global convergence rate analysis in the spirit of proximal gradient methods, which includes analysis of method based on coordinate descent.

2 - Low-rank Matrix and Tensor Recovery: Theory and Algorithms

Donald Goldfarb, Professor, Dept. of Industrial Engineering and Operations Research, Columbia University, New York, NY, 10027, United States of America, goldfarb@columbia.edu, Cun Mu

To exploit structured data, convex low-rank completion and robust PCA models for matrices have been extended to tensors. We establish recovery guarantees for these models and introduce a new convex relaxation for the tensor Tucker rank, which is theoretically and empirically much better than the one most commonly used. We propose first-order algorithms to solve both models, and empirically investigate their recoverability properties, and the computational performance of our algorithms.

3 - A Parallel Method for Large Scale Convex Regression Problems

Zi Wang, PhD Candidate, Penn State University, Dept. of Industrial Engineering, University Park, PA, 16802, United States of America, zxw121@psu.edu, Necdet Serhat Aybat

Convex regression (CR) problem deals with fitting a convex function to a finite number of observations. Computing the least squares (LS) estimator via solving a quadratic program (QP) is the most common technique. However, computing the LS estimator is not practical using interior point methods when the number of observations is very large. The first-order method proposed in this paper efficiently solves large-scale instances of CR problem with limited memory through parallelization.

4 - An Evolving Gradient Resampling Method for Machine Learning

Stefan Solntsev, Northwestern University, stefans@u.northwestern.edu, Jorge Nocedal

We propose an optimization method for machine learning that is neither purely batch nor purely stochastic method. It belongs to the class of semi-stochastic methods that have recently received much attention, and that include the Stochastic Average Gradient and Stochastic Variance Reduced Gradient methods. The novel feature of our algorithm is that, unlike the two methods just mentioned, it is appropriate even in the case of an infinite training set.

■ MD52

Hilton- Sutter B

Algorithms for Optimization and Learning

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Angelia Nedich, UIUC, 1308 West Main Street, Urbana, Il, 61801, United States of America, angelia@illinois.edu

Co-Chair: John Mitchell, Professor, Rensselaer Polytechnic Institute, 325 Amos Eaton, Math Sciences, 110 Eighth St, Troy, NY, 12180, United States of America, mitchj@rpi.edu

1 - Distributed Optimization over Directed Graphs

Alexander Olshevsky, University of Illinois, 1308 West Main Street, Urbana, IL, 61801, United States of America, olshevsky.alex@gmail.com, Angelia Nedich

The widespread availability of copious amounts of data has created a pressing need to develop optimization algorithms which can work in parallel when input data is unavailable at a single place but rather spread throughout multiple locations. We consider the problem of optimizing a sum of convex functions in a network where each node knows only one of the functions and develop a stochastic gradient method which is fully decentralized and robust to unpredictable node and link failures.

2 - A New Exact Algorithm for the Bilevel Linear Programming Problem

Lizhi Wang, Associate Professor, Iowa State University, Iowa State University, Ames, IA, 50011, United States of America, lzwang@iastate.edu, Pan Xu, Mohammad Rahdar, Bokan Chen

We present a new exact algorithm for the bilevel linear programming problem. This algorithm adopts a branch-and-bound framework but uses a new approach to the separation problem to eliminate bilevel infeasible solutions from the linear programming relaxation. We will report preliminary numerical results.

3 - Complementarity Formulation for l0 Norm Minimization Problems

Xin Shen, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, United States of America, shenx5@rpi.edu, Mingbin Feng, John Mitchell, Jong-Shi Pang, Andreas Waechter

Recently l0 norm minimization has become a remarkably active area of research in optimization. The problem is NP-hard and replacing it by the l1 norm is a common way to get an approximate solution. We consider an alternative way of formulating the problem as a mathematical program with complementary constraints. We further discuss the completely positive relaxation and compare the properties of various formulations, including stationary conditions, local and global optimality.

■ MD53

Hilton- Taylor A

Portfolio Optimization and Solution Methods

Cluster: Optimization in Finance

Invited Session

Chair: David Brown, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, dbbrown@duke.edu

1 - Dynamic Portfolio Choice and Learning for a Regime Switching Model

Andrew Lim, Professor, National University of Singapore, 15 Kent Ridge Drive, Singapore, 119245, Singapore, andrewlim@nus.edu.sg, Poomyos Wimonkittiwat

We discuss approximate methods for solving dynamic portfolio choice problems with learning when the underlying market is driven by a hidden markov model with unknown parameters and unobserved regime. These methods illustrate how sampling methods from Bayesian statistics can be used to approximately solve dynamic portfolio choice problems.

2 - A Fast Regression Approach to Solving the Dual Problems of Dynamic Programs

Helin Zhu, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, 30332, United States of America, hzhu67@gatech.edu, Enlu Zhou, Fan Ye

In recent years, the primal-dual approach has become a powerful procedure in solving (reward maximization) dynamic programs by providing lower-upper bound pairs of the value functions. In practice, obtaining tight upper bounds on the value function requires good approximations of the optimal penalty function, which might be a time-consuming process. In this talk, we present an efficient least-squares regression approach to generate good approximations of the optimal penalty function.

3 - Accounting for Risk Measure Ambiguity when Optimizing Financial Positions

Jonathan Li, Assistant Professor, Telfer School of Management, 55 Laurier Avenue East Ottawa, Ottawa, Canada, jonathan.li@telfer.uottawa.ca, Erick Delage

While many risk measures have been proposed in the past, it is still a great challenge today to select a risk measure that faithfully represents a decision maker's true risk attitude. In this work, we present new robust forms of measures that account precisely for the risk preference of a decision maker when comparing and optimizing financial positions. Such measures can be evaluated and optimized through solving linear programs. Examples of portfolio optimization are provided.

■ MD54

Hilton- Taylor B

Joint Session FSS/OPT: Optimal Portfolio Management and Execution

Sponsor: Financial Services Section & Optimization

Sponsored Session

Chair: Liming Feng, Associate Professor, University of Illinois at Urbana-Champaign, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, fenglm@illinois.edu

Co-Chair: Jingnan Chen, Assistant Professor, Singapore University of Technology and Design, Singapore, amy11011@gmail.com

1 - Optimal Dynamic Portfolio Liquidation Strategies

Somayeh Moazeni, Princeton University, Princeton, NJ, United States of America, somayeh@Princeton.edu

In the execution cost problem, an investor wants to minimize the total expected cost and risk in the execution of a portfolio of risky assets in order to achieve desired positions. In this talk, we discuss optimal stochastic dynamic programming strategies with linear temporary and permanent price impact models and the importance of market condition on the computed strategy.

2 - Asset Allocation under Generalized Hyperbolic Distribution: Optimal Portfolios and Performance

Luis Chavez-Bedoya, Research Professor, Esan Graduate School of Business, Alonso de Molina 1652, Surco, Lima, Peru, l.chavezbedoya@gmail.com, John Birge

We analyze the asset allocation problem under generalized hyperbolic (GH) distribution of returns. We provide expressions to compute the optimal portfolio weights. Also, the optimal mean-variance (MV) portfolio is studied and new conditions under which the MV framework is consistent with expected utility maximization are derived. Finally, we define general measures of performance to assess the effectiveness of a set of common portfolio rules.

3 - Optimal Portfolio Liquidation with a Markov Chain Approximation Approach

Jingnan Chen, Assistant Professor, Singapore University of Technology and Design, Singapore, amy11011@gmail.com

We consider the optimal portfolio liquidation problem where the objective is to minimize trading cost and risk when financial portfolios are liquidated over a short period of time. We propose Markov chain approximation approaches for computing the optimal trading strategies numerically and for studying analytical properties of such strategies.

■ MD55

Hilton- Van Ness

Optimization Modeling and Methodologies in Big Data

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Jiming Peng, University of Houston, Houston, United States of America, jopeng@uh.edu

1 - Optimization via Clustering in Machine Learning

Young Woong Park, Northwestern University, 2145 Sheridan rd, Evanston, IL, 60208, United States of America, ywpark@u.northwestern.edu, Diego Klabjan

We propose a clustering-based iterative algorithm for optimization problems, where we start by aggregating the original data and then in subsequent steps iteratively disaggregate. We apply the algorithm to common machine learning problems such as the least absolute deviation regression and support vector machine. We derive problem-specific data aggregation/disaggregation procedures. We also show optimality, convergence, and optimality gap in each iteration. A computational study is provided.

2 - Alternating Direction Methods for Penalized Classification

Brendan Ames, Assistant Professor, University of Alabama, Department of Mathematics, Tuscaloosa, AL, 35487, United States of America, bpames@ua.edu

Linear Discriminant Analysis is a classical technique for dimension reduction in supervised classification. However, this technique relies on the fact that the data being processed contains fewer features than observations, which typically fails to hold in a high-dimensional setting. In this talk, we present a modification, based on l1-regularization and the alternating direction method of multipliers, for performing LDA in the high-dimensional setting.

3 - The Bundle Recommendation Problem

Tao Zhu, Data Scientist, WalmartLabs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, tzhu@walmartlabs.com

Recent research on recommender systems has been mainly concentrating on improving the relevance or profitability of individual recommended items. But in reality, users are usually exposed to a set of items and they may buy multiple items in a single order. Thus, the relevance or profitability of one item may actually depend on the other items in the set. In this paper, we introduce a novel problem called the Bundle Recommendation Problem (BRP) and discuss how to solve it in practice."

■ MD56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Statistics.com - XLMiner V2015: Text Mining, Ensemble Methods, Feature Selection and More

Peter Bruce, President, Statistics.com, 612 N Jackson Street, Arlington, VA, 22201, United States of America, peterbruce@statistics.com, Daniel H. Fylstra

XLMiner software, used for years in MBA education, is now an industrial-strength data mining tool, enabling you to easily create forecasting, classification, prediction and affinity analysis models, using datasets far exceeding traditional Excel worksheets. Attend this session for a preview of XLMiner V2015 and learn how you can apply powerful text mining methods, ensemble methods, and feature selection methods for better-than-ever results – rivalling the best enterprise data mining software with far less cost and risk.

2 - ARTELYS Corp. - Artelys Crystal Super Grid, a Power Systems Modeling Software for Cost-Benefit Analysis of Energy Projects
Guillaume Tarel, Vice President, Artelys Corp., Montreal, QC, H3H2P5, Canada, guillaume.tarel@artelys.com

This presentation focuses on the use of Artelys Crystal Super Grid, a power systems modeling software developed by Artelys. Our users are investors, regulation authorities and independent system operators (ISO), ministries, consultants or transmission system operators (TSO/RTO). Their objective is to evaluate in detail the interest of specific projects (generation/transmission/storage) in terms of revenue, social welfare, pollutant emissions and security of supply in a region. To this purpose, Artelys Crystal Super Grid uses built-in libraries of power assets and indicators, along with a powerful optimization engine, to simulate systems with tens of interconnected regions on an hourly basis. Its intuitive interface allows for efficient analysis, comparison and evaluation of large number of scenarios.

■ MD64

Parc- Cyril Magnin I

Markov Lecture

Sponsor: Applied Probability Society
Sponsored Session

Chair: Peter Glynn, Stanford University, Huang Engineering Center 357, Stanford CA 94305, United States of America, glynn@stanford.edu

1 - Perspectives on Traffic Modeling
Peter Glynn, Stanford University, Huang Engineering Center 357, Stanford CA 94305, United States of America, glynn@stanford.edu

A fundamental "model input" to most stochastic models used in operations settings is the "traffic model" describing the exogenous flow of work into the system. Many of the major research contributions in our field relate to limit theorems and approximations developed for such systems. Such limit theorems are usually used as a tool for predicting key performance measures associated with model outputs. But such theory also can be interpreted as providing insights into the main features of the model input that determine performance. In this talk, we will propose some general principles for traffic modeling, and discuss the role that limit theorems play in offering insight into the key features that must be captured in order to obtain model predictions of reasonable quality. This work is joint with Harsha Honnappa, Jeff Hong, and Xiaowei Zhang.

Discussant
Presenting Author: Assaf Zeevi,Columbia University, United States of America, assaf@gsb.columbia.edu

Discussant
Presenting Author: Pierre L'Ecuyer,University of Montreal, Montreal, Canada, lecuyer@iro.umontreal.ca

■ MD65

Parc- Cyril Magnin II

Modeling & Simulation in Healthcare Service Delivery

Sponsor: Simulation
Sponsored Session

Chair: Taesik Lee, Associate Professor, KAIST, 291 Daehak-ro, Yuseong-gu, E2-2102, Daejeon, Korea, Republic of, taesik.lee@kaist.edu

1 - Primary Care Design: Appointment Template and Staffing Model
Jingshan Li, Associate Professor, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, jingshan@engr.wisc.edu, Tingmao Wang, Molly Williams, Jeffrey Sleeth, Sally Kraft, Xiang Zhong

This work is dedicated to investigating the optimized appointment template and staffing model in primary care clinics under different clinic settings. A discrete event simulation model is developed to analyze the patient flow in the primary care processes with complex interactions among patients, care providers, and resources. Using the simulation model, different appointment templates and team structures are investigated.

2 - Selecting Hierarchical Facility Locations for Healthcare Planning
Taesik Lee, Associate Professor, KAIST, 291 Daehak-ro, Yuseong-gu, E2-2102, Daejeon, Korea, Republic of, taesik.lee@kaist.edu, Hoon Jang

We develop a location model to analyze locations of EDs in three-level EMS system in Korea. This problem is a multi-flow, nested, and non-coherent hierarchical facility location problem. While most hierarchical location models use median, covering, and fixed charge objectives, we use a cooperative covering objective. The cooperative covering objective is a more appropriate choice for assessing the accessibility to EMS, which provides more useful information to decision makers in public health.

3 - A Simulation Study of a Hospital Emergency Department in Hong Kong
Yong-Hong Kuo, Research Assistant Professor, The Chinese University of Hong Kong, Big Data Decision Analytics Res. Centre, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong - PRC, yhkuo@cuhk.edu.hk, Janny Leung, Colin Graham, Omar Rado, Benedetta Lupia

This paper presents a case study which uses simulation to analyze patient flows in a hospital emergency department in Hong Kong. We will talk about the challenges that we faced when developing our simulation model and present our findings by using the model.

4 - Optimization and Simulation Analyses for Optimal Liver Allocation Boundaries
Chun-Hung Chen, Professor, George Mason University, 4400 Univ Dr, Fairfax, VA, 22030, United States of America, cchen9@gmu.edu, Rajesh Ganesan, Naoru Koizumi, Monica Gentili

The U.S. organ transplant system has geographic disparities in access to and outcomes of transplantation. Researchers still report that a number of key elements that determine equity in transplantation vary significantly depending on the location of a patient. This study used a mathematical programming model to explore: (i) optimal locations of liver transplant centers; and (ii) optimal lowest boundaries as an alternative to the existing OPO boundaries across the contiguous United States.

5 - Real-time ECG Monitoring for the Early Diagnosis of Myocardial Infarction
Heeyoung Kim, Assistant Professor, KAIST, 291 Daehak-ro, Yuseong-gu,, Daejeon, Korea, Republic of, heeyoungkim@kaist.ac.kr

The electrocardiogram (ECG) is the most important source for the early diagnosis of myocardial infarction. We propose a new wavelet-based method to extract ECG features that discriminate the normal and abnormal subjects, and to monitor the extracted features for a real-time fault detection. The proposed method is shown to be computationally efficient and effective in monitoring the health condition via numerical experiments.

■ MD66

Parc- Cyril Magnin III

Applied Probability and Bayesian Models for Industrial Statistics

Sponsor: Quality, Statistics and Reliability
Sponsored Session

Chair: Refik Soyer, George Washington University, Washington, DC, United States of America, soyer@gwu.edu

1 - Utility-based Inventory Management
Suleyman Ozekici, Professor, Koc University, Department of Industrial Engineering, Istanbul, Turkey, sozekici@ku.edu.tr, Filiz Sayin, Fikri Karaesmen

We take a utility-based approach to the newsvendor model where we suppose that there is random demand and supply which may be correlated with the financial markets. The newsvendor exploits this correlation and manages his risks by investing in a portfolio of financial instruments. The decision problem therefore includes not only the determination of the optimal ordering policy, but the selection of the optimal portfolio that reduces inventory risks.

2 - New Maximum Entropy Methods for Modeling Lifetime Distribution
Ehsan Soofi, Distinguished Professor, University of Wisconsin-Milwaukee, Lubar School of Business, P.O. Box 742, Milwaukee, WI, 53201, United States of America, esoofi@uwm.edu

We introduce two new maximum entropy methods for modeling the distribution of time to an event. One method is within the classical maximum entropy framework and provides characterizations of change point models such as the piecewise exponential distribution. The second method uses the entropy of the equilibrium distribution for the objective function and provides new characterizations of the exponential, Weibull, Pareto, and uniform distributions. With the same moment constraints, the two methods provide different models for the inter-arrival time are different.

3 - Bayesian Perspectives in Reliability Growth Testing
Refik Soyer, George Washington University, Washington, DC, United States of America, soyer@gwu.edu, Thomas Mazzuchi

In this talk we consider inference and decision problems that arise in reliability growth tests. In doing so, we present a general Bayesian framework that enables us update our inferences as well as our decisions in a dynamic manner. We illustrate the implementation of our methods using actual data and discuss computational issues.

4 - Monitoring Remaining Project Completion Uncertainty, a Bayes Network Approach

Johan Rene van Dorp, Professor, George Washington University, 1776 G Street, NW, Suite 101, Washington, DC, 20052, United States of America, dorpjr@gwu.edu, Ifechukwu Nduka

A Bayesian Network approach is presented modeling statistical dependence amongst activity duration uncertainties in a project network using AGENA RISK. Traditional approaches, such as PERT, ignored statistical dependence or, when taking it into account, did not allow for monitoring of remaining project completion uncertainty given partial project completion in a coherent manner. Early results show a strong Bayes learning effect of in a small project example under a mild degree of dependence.

■ MD67

Parc- Balboa

Statistical Approaches to Personalized Healthcare I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abe Zeid, Northeastern University, 360 Huntington Ave, Boston, United States of America, zeid@coe.neu.edu

1 - Hospital 30-Day Non-index Readmission and Care Transitions

Wei Liu, Ph.D. Student, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47906, United States of America, liu317@purdue.edu, Ping H. Huang, Steven M. Witz

We explored three types of care transition as measured by 30-day hospital readmissions. Descriptive statistic analyses were conducted to investigate the variations among these care transitions. In addition, hospital utilizations were compared among patient groups classified by the type of care transitions that they experienced. We also identified patient risk factors to assist decision support of care coordination among providers.

2 - Operating Room (OR) Scheduling under Uncertainty

Yazhuo Liu, University of South Florida, 4202 E. Fowler Ave., ENB 118, Tampa, FL, 33613, United States of America, yazhuoliu@mail.usf.edu, Peter Fabri, Jose Zayas-Castro

In this presentation, we propose an operating room (OR) scheduling model which considers doctors' preferred blocks, uncertain surgery durations, emergency levels of surgeries, and etc. We apply a stochastic programming approach to minimize operation cost while ensuring the quality of care for patients. Computational results based on the data from a local surgery center (SC) will be reported.

3 - Benefits of Distribution Flexibility using Newsvendor Model for Health-care Services

Yolanda Obaze, PhD Student, University of North Texas, 1155 Union Circle, Denton, TX, 76203, United States of America, yolanda.obaze@unt.edu, Victor Prybutok, Shailesh Kulkarni

This research examines a multi-process, multi-distribution newsvendor healthcare model. The contribution of the work includes examining the transportation, inventory and storage costs associated with meeting demand. The parameters for the constraints are the result of qualitative research conducted with Community Based Organizations that provide healthcare services.

4 - The Impact of Insurance Coverage and Unobservable Health Status on Readmission Rates

Sezgin Ayabakan, UT Dallas, 800 W Campbell Rd, UTD Naveen Jindal School of Management, Richardson, TX, 75080, United States of America, ayabakan@utdallas.edu, Zhiqiang (Eric) Zheng, Indranil Bardhan

Hospital readmission rate is adopted as a hospital quality metric. However, non-clinical factors such as patients' insurance coverage and unobservable health status can also impact readmissions. We develop a Hidden Markov Model to investigate their impact on readmissions. We utilize a comprehensive panel dataset of inpatient visits in North Texas. Our analyses reveals that focusing solely on readmission rates can be misleading, without regard to patients' health status and insurance coverage.

■ MD67

Parc- Balboa

Statistical Approaches to Personalized Healthcare I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abe Zeid, Northeastern University, 360 Huntington Ave, Boston, United States of America, zeid@coe.neu.edu

1 - Hospital 30-Day Non-index Readmission and Care Transitions

Wei Liu, Ph.D. Student, Purdue University, 315 N. Grant Street, west lafayette, IN, 47906, United States of America, liu317@purdue.edu, Ping H. Huang, Steven M. Witz

We explored three types of care transition as measured by 30-day hospital readmissions. Descriptive statistic analyses were conducted to investigate the variations among these care transitions. In addition, hospital utilizations were compared among patient groups classified by the type of care transitions that they experienced. We also identified patient risk factors to assist decision support of care coordination among providers.

2- Operating Room (OR) Scheduling under Uncertainty

Yazhuo Liu, University of South Florida, 4202 E. Fowler Ave., ENB 118, Tampa, FL, 33613, United States of America, yazhuoliu@mail.usf.edu, Peter Fabri, Jose Zayas-Castro

In this presentation, we propose an operating room (OR) scheduling model which considers doctors' preferred blocks, uncertain surgery durations, emergency levels of surgeries, and etc. We apply a stochastic programming approach to minimize operation cost while ensuring the quality of care for patients. Computational results based on the data from a local surgery center (SC) will be reported.

3- Benefits of Distribution Flexibility using Newsvendor Model for Health-care Services

Yolanda Obaze, PhD Student, University of North Texas, 1155 Union Circle, Denton, TX, 76203, United States of America, yolanda.obaze@unt.edu, Victor Prybutok, Shailesh Kulkarni

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■ MD68

Parc- Davidson

Recent Advances in Simulation Metamodeling Techniques

Sponsor: Simulation

Sponsored Session

Chair: Xi Chen, Assistant Professor, Virginia Polytechnic Institute and State University, Industrial and Systems Engineering, 1145 Perry St., Blacksburg, VA, 24060, United States of America, xchen.ise@vt.edu

1 - A Bayesian Framework for Quantifying Uncertainty in Stochastic Simulation

Wei Xie, Rensselaer Polytechnic Institute, 110 8th Street, Center for Industrial Innovation 5207, Troy, NY, 12180-3590, United States of America, xiew3@rpi.edu, Russell Barton, Barry Nelson

When we use simulation to estimate the performance of a stochastic system, the simulation often contains input models that were estimated from real-world data; therefore, there is both simulation and input uncertainty in the performance estimates. We propose a Bayesian framework to measure the overall uncertainty while simultaneously reducing the influence of simulation estimation error due to output variability. Our approach is supported with both theoretical analysis and an empirical study.

2 - Regularized Radial Basis Function Models for Stochastic Simulation

Yibo Ji, National University of Singapore, 1 Engineering Drive 2, #06-25, Singapore, 117576, Singapore, jiyibo@nus.edu.sg, Yibo Ji

In this paper, we study radial basis function models for stochastic simulation. We construct a RBF model by minimizing the regularized loss over a reproducing kernel Hilbert space (RKHS). We then show how the regularized RBF (R-RBF) model can be efficiently improved by a rank-one update, and derive the closed form of the leave-one-out cross-validation error for RBF models. We discuss connections between stochastic kriging and R-RBF based on RKHS duality theory and present numerical results.

3 - Large Scale Simulation Optimization with Additive Gaussian Process Models

Szu Hui Ng, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, isensh@nus.edu.sg

Metamodels are commonly used as fast surrogates for the objective function to facilitate the optimization of simulation models. The Gaussian process model is a popular metamodeling tool due to its flexibility in global fitting. However, for large data sets, computational complexity hinders its application. In this research, we propose an additive Gaussian process model that eases the computational burden and incorporated in a sequential search algorithm for simulation optimization.

4 - Sequential Experimental Designs for Stochastic Kriging

Xi Chen, Assistant Professor, Virginia Polytechnic Institute and State University, Industrial and Systems Engineering, 1145 Perry St., Blacksburg, VA, 24060, United States of America, xchen.ise@vt.edu, Qiang Zhou

We establish a sequential experimental design framework for applying stochastic kriging to predicting performance measures of complex stochastic systems. The proposed framework enjoys the flexibility to adapt to a variety of design criteria and the ability to correctly account for sampling uncertainty inherent in a stochastic simulation. We propose several novel design criteria under the proposed framework, and compare their performances through illustrative examples.

■ MD69

Parc- Fillmore

Joint Session ENRE/DAS: Expert Judgment and Learning Curves in Energy & Environment & Decision Analysis

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Max Henrion, CEO, Lumina Decision Systems, 26010 Highland Way, Los Gatos, Ca, 95033, United States of America, henrion@lumina.com

1 - Decision Frameworks for Energy Technology R&D Portfolio Analysis

Erin Baker, University of Massachussetts, Amherst, MA. edbaker@ecs.umass.edu

In this paper we apply two decision frameworks to a decision on public energy technology R&D portfolio selection in the face of climate change. We compare the results of the two frameworks across three expert elicitation studies (used to estimate probability distributions over technological outcomes) and three Integrated Assessment Models (used to estimate how the outcomes of technological change impact the economy and the cost of abatement), to look for robust policy insights.

2 - Optimal Energy R&D Investment Allocation under Uncertainty for a Low-carbon Future

Valentina Bosetti, Fondazione Eni Enrico Mattei (FEEM), corso Magenta 63, Milan, Lo, 20123, Italy, valentina.bosetti@feem.it, Giacomo Marangoni, Gauthier De Maere, massimo Tavoni

This paper provides insights on the optimal portfolio of EU RD&D energy investments, given the intrinsic and endogenous uncertainty of learning. The goal is to find optimal first stage R&D investments that maximize total welfare, where the second stage depends on the cumulated first stage R&D investments and the conditional realization of learning parameters which reflect expert elicitation data. We solve the problem using approximate dynamic programming.

3 - Keep it Simple to Keep it Cool: Understanding the Performance of Energy and Climate Forecasts

Ines Azevedo, Associate Professor, Carnegie Mellon University, Baker Hall 129, 5000 Forbes Avenue, Pittsburgh, 15213, United States of America, iazevedo@cmu.edu

Energy and climate modelers have often been using sophisticated and complex model to forecast energy and climate related quantities. In this work, I focus on forecasts of energy quantities, and assess in which cases simpler models could have performed better, and draw key conclusions for clime and energy policy.

4 - How to Recalibrate and Combine Overconfident Experts

Max Henrion, CEO, Lumina Decision Systems, 26010 Highland Way, Los Gatos, Ca, 95033, United States of America, henrion@lumina.com

Overconfidence in expert elicitations may be evident from low overlap between probability distributions from different experts. We use this evidence to estimate the degree of overconfidence by expert, and recalibrate them to obtain better calibrated aggregate distributions. We demonstrate the practical value of the method on expert elicitations of the future cost and performance of low-carbon energy technologies.

5 - using Expert Judgment, Modeling and Optimization to Inform Energy R&D Decisions

Gabriel Chan, Harvard Kennedy School of Government, Cambridge, MA, 02138, United States of America, gabe_chan@hksphd.harvard.edu, Laura Diaz Anadon

We propose design principles and a method to support public R&D decision-making. Our method utilizes inputs from an expert elicitation exercise that collected inputs from 100 experts. The elicitations parameterize an energy system model, which we use in a sampling and optimization framework to support public energy R&D allocation decisions.

■ MD70

Parc- Hearst

Supply Chain Management in the Forest Sector

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Marc-André Carle, Assistant Professor, Université Laval, 1065, Avenue de la Médecine, Quebec, QC, Canada, Marc-Andre.Carle@osd.ulaval.ca

1 - Supply Chain Design under Uncertainty for Advanced Biofuel Production Based on Bio-oil Gasification

Qi Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50010, United States of America, qili@iastate.edu, Guiping Hu

A two-stage stochastic programming is formulated to maximize biofuel producers' annual profit considering uncertainties in supply chain. A case study based on Iowa illustrates that it is economically feasible to meet the desired demand using corn stover as the biomass feedstock. Also, farmers' participation can have a significant impact on the profitability and robustness of this supply chain.

2 - Industrial Routing Problem

Mikael Rönnqvist, Professor, Université Laval, Département de Génie Mécanique Pavillon, 1065, Avenue de la Médecine, Quebec, QU, G1V 0A6, Canada, mikael.ronnqvist@gmc.ulaval.ca, Patrik Flisberg, Marc-André Carle, Vincent Monbourquette, Philippe Marier

Routing problems in industrial setting can be very challenging with all extra real world constraints imposed. We propose an efficient solution method which accounts for many products, multiple periods with strict inventory considerations, several goals, special loading patterns, backhaul rules and many desirable characteristics for queuing issues. We report on its use at a large forest company and analyse its performance compared to manual planning.

3 - Stochastic Approaches to Sawmill Operations Planning Problem in a Rolling Horizon

Jorge Vera, Professor, Pontificia Universidad Catolica de Chile, Dept. Industrial and System Engineering, Vicuna Mackenna 4860, Santiago, 7820436, Chile, jvera@ing.puc.cl, Alfonso Lobos

Operations planning in sawmills is an example of decision making in different time horizons, where tactical decisions might not be optimal for short term operations, due to various sources of uncertainty. We address this problem using various stochastic and robust optimization models and we show how these could be solved in such a way to increase the probability that tactical decisions will be compatible with operational decisions. We simulate various cases in a rolling horizon decision process.

4 - Strategic Planning of Forest Residues Supply Chains with Environmental Considerations

Claudia Cambero, PhD Candidate, University of British Columbia, 2943-2424 Main Mall, Vancouver, BC, V6T1Z4, Canada, cambero.claudia@gmail.com, Taraneh Sowlati

We present an optimization model to design regional forest residues supply chains for the production of bioenergy and biofuels. The objective is to maximize the NPV of the entire supply network. The model considers expected changes in biomass supply and cost as well as in products' demand and price when deciding on the facilities' installation period. A case study is presented where we compare the environmental impact of the optimal solution against the current situation in the region.

■ MD71

Parc - Lombard

Dynamic Matching Markets

Cluster: Auctions

Invited Session

Chair: John Dickerson, CMU, 9219 Gates-Hillman Center, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu

1 - Dynamic Matching using Approximate Dynamic Programming
Nikhil Bhat, Columbia University, nbhat15@gsb.columbia.edu, Ciamac Moallemi

We provide tractable algorithms for a large number of challenging dynamic decision making problems such as 1) Allocation of cadaveric kidneys to patients, 2) Matching ads with impressions, 3) Cyclic paired transfer of kidneys, by analyzing them using a general model. Our policies are easy to compute and interpret, and further come with approximation guarantees. With simulation experiments on kidney allocation, we show that we obtain gain over existing algorithms in literature.

2 - Dynamic Matching Market Design
Mohammad Akbarpour, Stanford University, 579 Serra Mall, 265F, Stanford, CA, 94305, mohamwad@stanford.edu, Shayan Oveis Gharan, Shengwu Li

We show that, in dynamic matching markets, waiting to thicken the market can be substantially more important than increasing the speed of transactions. In particular, simple local algorithms that wait to thicken the market can perform very close to optimal algorithms. We prove our claims by analyzing a simple but illuminating model of dynamic matching in networked markets where agents arrive and depart stochastically.

3 - The Roles of Common and Private Information in Two-Sided Matching with Interviews
Sanmay Das, Associate Professor, Washington University in St. Louis, sanmay@seas.wustl.edu, Zhuoshu Li

We consider two sided matching markets where employers have a fixed budget for the number of applicants they may interview. Employers receive noisy signals of how good each applicant is, and these signals include common and private components. We analyze how the strengths of these two components affect matching outcomes (both differentially across different quality candidates, and in the aggregate number of matches) when decisions about whom to interview are strategic.

4 - FutureMatch: Learning to Match in Dynamic Environments
John Dickerson, CMU, 9219 Gates-Hillman Center, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu, Tuomas Sandholm

Kidney exchange, an innovation where willing but incompatible donor-patient pairs can exchange organs, is inherently dynamic. We present FutureMatch, an empirical framework for learning to match in a general dynamic model. We validate it on real data. Not only does dynamic matching result in more expected transplants than myopic, but even dynamic matching under economically inefficient (equitable) objectives can result in significant increases in social welfare over efficient myopic matching.

■ MD72

Parc- Stockton

Energy I

Contributed Session

Chair: Harikrishnan Sreekumaran, Doctoral Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, harikrishnan@purdue.edu

1 - Investigation of Bidder Asymmetry in Japanese Electric Power Procurement Auction
Shigeharu Okajima, Waseda University, 1-6-1 nishi waseda Shinjyuku ku, Tokyo, Japan, shigeharu.okajima@gmail.com, Hiroko Okajima

This paper investigates the differences in the bidding patterns between incumbents and entrants in Japanese electric power procurement auctions. we analyze Japanese electric power auction data to examine bidder asymmetry, which potentially reduces competition as shown in auction theory. We find that strong bidders change depending on types of auctions.

2 - Equilibrium Wind Hedge Contract Structures through Nash Bargaining
Harikrishnan Sreekumaran, Doctoral Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, harikrishnan@purdue.edu, Andrew Liu

Wind hedge contracts are to help wind project developers secure financing and manage risk. In such a contract, a strike price of electricity and a quantity are to be specified. We use Nash bargaining to study the equilibrium contract structures as a result of bargaining between the two parties involved. The resulting model is a bilinear, stochastic program, which is solved by the sample average approximation approach. Numerical results as well as comparative statics are provided.

3 - Security of Gas Supply in Europe: A Model-based Analysis
Tobias Baltensperger, ETH Zurich, ETL K22, Physikstrasse 3, Zurich, ZH, 8092, Switzerland, t.baltensperger@control.ee.ethz.ch

The security of gas supply is an intensely discussed issue in Europe since the continent relies heavily on external suppliers for its needs. In this talk, we try to provide insight into the mechanics of today's gas markets. To this end, we propose an equilibrium model of the global natural gas market and we show the consequences of potential supply disruptions on European consumers. Furthermore, we discuss cost-efficient ways of increasing security of supply for European countries.

4 - An Integrated Framework to Study Electricity and Reserve Markets with Storage Systems
Yang Chen, Mississippi State University, PO Box 9542, Mississippi State, MS, 39762, United States of America, yc352@msstate.edu, Mengqi Hu, Zhi Zhou

In this research, a general modeling framework for an electricity market with thermal units, renewable energy, storage devices and demand response is proposed, where energy and reserve services are jointly dispatched. A MIQP model is implemented based on the modified IEEE 118-bus data, and several metrics (e.g., system cost, electricity/reserve price) are used to analyze the impacts of different components (e.g., renewable energy, storage) to electricity and ancillary service markets.

5 - Delta-hedging of a Hydro Power Plant with Focus on Revenue from Ancillary Services using Stochastic
Hubert Abgottspon, ETH Zurich, Physikstrasse 3, Zürich, 8092, Switzerland, abgottspon@eeh.ee.ethz.ch

Provision of ancillary services offers revenue opportunities for hydro power producers. Such products influence the production schedule of the power plant considerably. It is however difficult to predict if ancillary services will be provided in future time stages, thus resulting to production risk. A stochastic program is proposed, which estimates the sensitivity of the production schedule for varying remuneration of ancillary services, which could then be used to lower the risk exposure.

■ MD73

Parc- Mission I

Energy/Climate Modeling, Policy and Decision Making

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Olaitan Olaleye, PhD Candidate, University of Massachusetts, 120A Marston Hall, University of Massachusetts, Amherst, Amherst, MA, 01003, United States of America, oolaleye@umass.edu

Co-Chair: Erin Baker, University of Massachussetts, Amherst, edbaker@ecs.umass.edu

1 - The Use of Rate-Based Constraints to Control CO2 Emissions
David Young, Senior Technical Leader, Electric Power Research Institute, 3420 Hillview Ave, c/o EPRI, Palo Alto, CA, 94304, United States of America, dyoung@epri.com

The EPA recently proposed regulations under the Clean Air Act 111(d) to limit carbon dioxide emissions from existing generation units. The proposed restrictions take the form of a constraint on the average emissions rate by state, rather than by the more familiar cap on total emissions. This work considers the challenges in modeling rate-based constraints, and compares compliance outcomes at the national level against equivalent caps using the US-REGEN model.

2 - Complementarity Modeling of Overlapping Biofuel Policies: Cost Containment Strategies in the LCFS

Adam Christensen, NSF SEES Fellow and Postdoctoral Researcher, Johns Hopkins University, 3400 N Charles ST, Ames Hall 313, Baltimore, MD, 21218, United States of America, adam.christensen@jhu.edu, Ben Hobbs, Sauleh Siddiqui, Chris Malins

The two most influential biofuel policies in the US are the federal Renewable Fuel Standard (RFS) and California based Low Carbon Fuel Standard (LCFS). In many cases a single gallon of biofuel can qualify for compliance under both programs. However, in the event of a lack of supply of low carbon fuels, it is possible that the LCFS compliance cost could grow to unreasonable levels. A detailed market model of both the RFS and LCFS is developed and cost containment strategies are presented.

3 - R&D Portfolio Allocation in Response to Climate Change

Olaitan Olaleye, PhD Candidate, University of Massachusetts, 120A Marston Hall, University of Massachusetts, Amherst, Amherst, MA, 01003, United States of America, oolaleye@umass.edu

We examine the role of technical advancement in a portfolio of Solar, Nuclear, CCS, Bio-Fuels, Bio-Electricity and Electric Transportation. We show that Bio-Electricity complements CCS, while most technology pairs are substitutes. We find that scenarios without CCS have significant cost drawback reaching full abatement. Portfolios with CCS stochastically dominate those without; and renewables-only portfolios are dominated. We also show how the optimal portfolio varies with risk.

4 - How to Choose an Appropriate Mathematical Model for Energy/climate Policy Analysis?

James Merrick, Stanford University, Huang Engineering Center, Stanford, CA, 94305, United States of America, jmerrick@stanford.edu

For certain classes of problems, the suitability of model structure cannot be tested via predictive power. So, how to choose an appropriate model? A framework is proposed to provide a logical basis for thinking about this issue. Conditions are stated where a given structure can be logically `more appropriate' than an alternate. The corollary follows that in other cases, appropriateness comes down to subjective judgement. For illustration, the framework is applied to energy-economic modelling.

■ MD74

Parc- Mission II

Stochastic Control and Optimization of Power Systems with Renewables

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Harsha Gangammanavar, Visiting Assistant Professor, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, 90089, United States of America, gangamma@usc.edu

1 - Real-time Pricing in Smart Grid: An ADP Approach

Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, United States of America, andrewliu@purdue.edu, Jingjie Xiao

We propose an approximate dynamic programming (ADP)-based modeling and algorithm framework to integrate wholesale markets' dispatch operation with demand response under electricity real-time pricing (RTP). With controllable charging/discharging of plug-in electric vehicles, our numerical results show that RTP can lower the expected values of wholesale electricity prices, increase capacity factors of renewable resources, and reduce system-wide CO_2 emissions.

2 - On the Identification of Generator Bid Stack from Public Market Data

Boris Defourny, Assistant professor, Industrial system engineering department at lehigh university, H.S. Mohler Laboratory, 200 West Packer, Bethlehem, Pa, 18015, United States of America, defourny@lehigh.edu

We study the problem of identifying aggregated bids from power generators, using high-frequency price data and load data publicly posted by independent system operators. We consider gas price data to identify bids sensitive to gas prices. We discuss results obtained with an inverse optimization approach based on the spot price formation mechanism.

3 - 99 Percent from Renewables? A Fresh Look at the Question of Maximum Penetration

Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu, Javad Khazaei, Luke Cheng

We re-examine recent claims that we can provide 99 percent of our electricity using renewables and storage. We also use a streamlined, aggregate model which ignores grid capacity, but we introduce the important dimension that energy from fossil fuels can be purchased from the current generator stack, or at a very high price. We show that properly modeling the marginal cost of energy resources limits the maximum an economic portfolio would produce from renewables.

4 - Simulation and Optimization of Wind Energy for Modeling Sub-hourly Economic Dispatch

Harsha Gangammanavar, Visiting Assistant Professor, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, 90089, United States of America, gangamma@usc.edu, Suvrajeet Sen, Victor Zavala

We present a two-stage stochastic optimization method to address the operating paradigm change from hourly to sub-hourly dispatch in the presence of intermittent generation. The method is based on stochastic decomposition which can accommodate scenarios from external simulators. The scalability and performance of this method is demonstrated on a real scale power system for the state of Illinois.

■ MD75

Parc- Mission III

Joint Session MIF/HAS: Healthcare Analytics

Sponsor: Minority Issues Forum & Healthcare

Sponsored Session

Chair: Shannon LaToya Harris, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu

Co-Chair: Jerome Niyirora, Assistant Professor, SUNYIT, 100 Seymour Rd, Utica, NY, 13502, United States of America, jerome.niyirora@sunyit.edu

1 - The Analytics of a Service Network in Emergency Department

Jerome Niyirora, Assistant Professor, SUNYIT, 100 Seymour Rd, Utica, NY, 13502, United States of America, jerome.niyirora@sunyit.edu

Many factors that cause ED overcrowding are outside of the control of ED managers, except bottlenecks in the clinical processes. We propose using service-based networks in ED to streamline patient care. We construct a service network using CPT codes and then use centrality measures to identify services that are more influential and are more likely to help improve throughput, if administered at the point of care or resources are allocated to them appropriately.

2 - A Predictive Model for Advance Appointment Cancellations

Shannon LaToya Harris, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu, Jerrold May

Outpatient scheduling is complicated by advanced cancellations and patient no-shows. We built a model to predict advance cancellations, and how far in advance of the appointment such cancellations occur. The model is validated using data from VA Healthcare System outpatient clinics.

3 - Admission Control in a Two Class Loss System with Periodically Varying Parameters and Abandonments

Gabriel Zayas-Caban, Cornell University, 1731 Broadview Lane, Ann Arbor, MI, 48105, United States of America, gz63@cornell.edu

Customer demand and service processes for many service systems are time dependent, and customers in such systems may renege prior to or during service. Motivated by these considerations, we consider the control of admissions for a two class loss system with periodically varying parameters and where customers may abandon before completing service. We use a Markov decision process formulation and sample path arguments to determine properties of the optimal dynamic policy.

4 - The Erlang – A Model for Healthcare Applications

William Massey, Professor, Princeton University, Princeton University, Princeton, NJ, 08544, United States of America, wmassey@princeton.edu

The Erlang-A has many healthcare applications. As a Markov process, we can assume non-homogeneous Poisson arrivals for a multi-server queue with exponentially distributed service and abandonment times. Using fluid limits, we can use the resulting dynamical system to approximate controls for the transient, time-dependent behavior. We demonstrate how these techniques are relevant to the management of emergency rooms, hospital bed cleaning services, and nursing homes.

■ MD76

Parc- Embarcadero

O.R. Approaches to Plan and Build Data Networks

Sponsor: The Practice Track

Sponsored Session

Chair: Brian Eck, Quantitative Analyst, Google, Inc., 1300 Crittenden, Building CL3, Office 2S5, Mountain View, CA, 94043, brianeck@google.com

1 - How Data Network Traffic Measurement Effects Pricing, Behavior and Strategy

Muntazir Mehdi, Capacity Planner, Microsoft Corporation, 15803 Bear Creek Pkwy, E232, Redmond, 98052, United States of America, mumehdi@microsoft.com, Elena Helmer, Ivan Philips, Denver Maddux

Data traffic is monitored every second. The data has to be aggregated and mined for insights. Four aggregation schemes are used: Max,95P,Sum and Avg. These agg schemes have unique relevance in the data network context. By changing the order of operations; we can predict the peering/exchange contracts that best suit the bidirectional demand profiles. We demonstrate that such analysis can be leveraged to the entire span of data network strategy:capacity, peering contracts, interconnect/edge strategy.

2 - Optimization Techniques used in Fibre Optic Network Design

Chris Forbes, Optimisation Consultant, Biarri, 9 Vendale Ave, Brisbane, 4105, Australia, chris.forbes@biarri.com

With the increased popularity of fiber to the home networks across the world a commercial need arose to produce minimum cost designs. Construction costs often reach into the billions so even small percentage savings can have a significant impact for businesses. We will explore optimization techniques used in commercial fibre optic network design today; including a staged MIP approach as well as some more recent heuristic approaches based on the Capacitated Minimum Spanning Tree problem.

3 - Intra-Datacenter Network Capacity Planning at Google

Behdad Masih, Qauntitative Analyst, Google Inc., 1600 Amphitheatre Parkway, Mountain View, CA, 94043, United States of America, behdadm@google.com

In this talk, we will review how statistical techniques are used to provision networking resources at Google's infrastructure. By merging and aggregating the performance metrics of thousand of servers across Google's fleet, we forecast the required networking capacities at different layers of the network as a function of other hardware resources such as cpu and disk.

■ MD77

Parc- Market Street

Joint Session Analytics/CPMS: 2014 Innovative Applications in Analytics

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Pooja Dewan, General Director Decision Support, BNSF Railway, 2400 Western Center Blvd, Fort Worth, tx, 76131, United States of America, Pooja.Dewan@bnsf.com

1 - An SMS Text Classification System for UNICEF Uganda

Rick Lawrence, Manager, Machine Learning, IBM Research, Cognitive Computing Research, Yorktown Heights, NY, 10598, United States of America, ricklawr@us.ibm.com

U-report is an open-source SMS platform operated by UNICEF Uganda, designed to give Ugandan youth a voice on issues that impact them. Data received by the system are either SMS responses to polls conducted by UNICEF or unsolicited reports of problems occurring anywhere within Uganda. This talk describes an automated message- routing system deployed by IBM Research at UNICEF. We discuss a dual-supervision learning technique to leverage human-generated labels on both features and text examples.

■ MD78

Parc- Mason

Decision Analysis 1

Contributed Session

Chair: Purushothaman Ethiraj, Analytics Manager, Hewlett Packard, CV Raman Nagar, Bangalore, India, purushothaman.ethiraj@hp.com

1 - An Approximate Dynamic Programming Approach to Stochastic Resource Planning

Stan Solomon, Doctoral Candidate, University of Missouri-St. Louis, 1 University Blvd., 236 Express Scripts Hall, St. Louis, MO, 63121, United States of America, ssbcd@umsl.edu, Cipriano Santos, Haitao Li, Keith Womer

This research addresses the problem of assigning resources to tasks in a stochastic environment. Classic dynamic programming methods using Bellman's optimality equation suffer from the well-known curses-of-dimensionality and cannot be applied to large scale applications. To resolve the curse-of-dimensionality found in large applications, this research focuses on developing an Approximate Dynamic Programming algorithm. Hewlett-Packard's resource planning problem will be studied as an application.

2 - Resource Reallocation and Target Setting Based on Efficiency and Fairness

Wonghong Li, University of Science and Technology of China, Jinzhai Road 96, Hefei, 230026, China, liwh@mail.ustc.edu.cn

We develop a novel method for a resource reallocation problem that typically appears in organizations such as governmental agencies, universities, business firms and army units. The decision maker is interested in maximizing the efficiency and fairness simultaneously when reallocating available resources to decision-making units. We develop an approach based on data envelopment analysis to obtain a most preferred allocation plan. Numerical examples are used to illustrate the approach.

3 - A Decision Model for Supplier Selection

Baichun Feng, Webster University, 545 Garden Ave, St. Louis, MO, 63119, United States of America, baichunfeng18@webster.edu, Hong Ren

This paper proposes an new approach based on artificial intelligence to solve the supplier selection problem. This approach will learn the decision makers' preference from the historical data and solve the supplier selection problem subsequently. A numerical example is used to demonstrate the usefulness of this approach. Contribution to research in strategic supplier selection and suggestions for future research are discussed.

4 - Big Data, Databases and Decision Systems Interactions

Orhan Güvenen, Professor, Bilkent University, Bilkent University IISBF Z-03, Bilkent / «ankaya, Ankara, 06800, Turkey, gorhan@bilkent.edu.tr

Big data plays important role in every part of research, analysis and decision making. Effective, optimal and ethical decision making requires technologically advanced big data analysis techniques, databases in their analytic use, endogenizing security, minimum error margins and information distortion. Those requirements are necessary conditions in every strata for predictive, scientific, operational decision making and scientific management.

5 - Predicting Winning Probability of Open Deals of Sales Pipeline using Logistic Regression

Purushothaman Ethiraj, Analytics Manager, Hewlett Packard, CV Raman Nagar, Bangalore, India, purushothaman.ethiraj@hp.com, Atul Yadav

Effective sales pipeline management is one of critical part of sales management and forms an important lever in managing sales performance of an Organization. The present research will focus on identifying key variables that influence the deal conversions and predict the winning probability of all open deals in pipeline. Using binary logistic regression we have been able to predict the deal status correctly in 73.8% of total deals leading to accurate forecast and better business planning.

■ MD79

Parc- Powell I

Decision Analysis Society Awards

Sponsor: Decision Analysis

Sponsored Session

Chair: Jeffrey Keisler, Professor, Univ. of Massachusetts, Boston, 100 Morrissey Blvd, Boston, MA, 02125, United States of America, jeff.keisler@umb.edu

1 - 2014 Decision Analysis Student Paper Award

Seth Guikema, Assistant Professor, Johns Hopkins University, 313 Ames Hall, Department of Geog & Env. Engineering, Baltimore, MD, 21218, United States of America, sguikema@jhu.edu

The Student Paper Award is given annually to the best decision analysis paper by a student author, as judged by a panel of the Decision Analysis Society of INFORMS. Students who did not complete their Ph.D. prior to May 1, 2013 are eligible for this year's competition.

2 - 2014 Ramsey Medal Award

Jim Matheson, Chairman, SmartOrg, Inc., 855 Oak Grove Ave, Ste 202, Menlo Park, CA, 94025, United States of America, jmatheson@smartorg.com

The Ramsey Medal of the Decision Analysis Society is awarded for distinguished contributions in decision analysis. Distinguished contributions can be internal, such as theoretical and procedural advances in decision analysis, or external, such as developing or spreading decision analysis in new fields. We will introduce the 2014 Ramsey Medal winner, followed by a presentation by the winner.

3 - 2014 Decision Analysis Publication Award

Ali Abbas, Professor, University of Southern California, Industrial and Systems Engineering, Price School of Public Policy, Los Angeles, CA, United States of America, aliabbas@illinois.edu

This award is given annually to the best decision analysis article or book published in the second preceding calendar year (i.e. calendar year 2012 for consideration in 2014). The intent of the award is to recognize the best publication in "decision analysis, broadly defined." This includes, but is not limited to, theoretical work on decision analysis methodology (including behavioral decision making and non-expected utility theory), descriptions of applications, and experimental studies.

■ MD80

Parc- Powell II

Panel Discussion: Meet the Editors – Service Science Track

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, Professor, National Taiwan University, 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw

1 - Panel Discussion: Meet the Editors – Service Science Track

Moderator: P K Kannan, University of Maryland, Smith School of Business, College Park, MD, United States of America, PKannan@rhsmith.umd.edu

Panel discussion will include editors from Journal of Service Research, Service Science and Services Industries Journal.

■ MD81

Parc- Divisadero

Joint Session Data/Computing: Statistical Learning in Stochastic Optimization

Sponsor: Data Mining & Computing

Sponsored Session

Chair: Victoria Chen, Professor, The University of Texas at Arlington, Dept. Industrial & Manuf. Sys. Engr., P.O. Box 19017, Arlington, TX, 76019, United States of America, vchen@uta.edu

1 - Two-stage Stochastic Programming for Adaptive Interdisciplinary Pain Management

Na Wang, Ph.D student, The University of Texas at Arlington, 500 West First Street, Arlington, TX, 76019, United States of America, na.wang@mavs.uta.edu, Jay Rosenberger

This research proposes two-stage stochastic programing (2SP) to optimize personal treatment strategies for adaptive pain management. Previous research has predicted pain outcomes using non-convex quadratic statistical models. Based upon these nonconvex quadratic models, this research refits piecewise linear prediction models that have almost no loss of fidelity. With the piecewise linear models, 2SP can be modeled as a mixed integer linear program to optimize treatment.

2 - A Generalized MILP and DACE based Approximate Dynamic Programming and its Application

Zirun Zhang, Ph.D. student, The University of Texas at Arlington, 500 West First Street, P.O. Box 19017, Arlington, TX, 76019, United States of America, zirun.zhang@mavs.uta.edu, Victoria Chen, Jay Rosenberger

We develop a generalized Approximate Dynamic Programming method for finite horizon and non-stationary process by Mixed Integer Linear Programming, and Design and Analysis of Computer Experiment. Tree based supervised learning methods are employed to approximate value functions. A real world large scale stochastic multistage decision problem is formulated and solved by the method. The solution quality is compared by various methods and we conclude MILP and DACE based ADP is the best approach.

3 - A Design and Analysis of Computer Experiments-based Approach to Approximate Dynamic Programming

Asama Kulvanitchaiyanunt, asama.kulvanitchaiyanunt@mavs.uta.edu, 500 West First Street, Woolf Hall Room 420, Arlington, TX, 76019, United States of America, asama.kulvanitchaiyanunt@mavs.uta.edu, Victoria Chen, Jay Rosenberger

This research seeks to develop a solution method called Design and Analysis of Computer Experiment (DACE)-based approach to solve an infinite horizon dynamic programming. Multivariate Adaptive Regression Splines (MARS) is used to approximate future value functions in stochastic dynamic programming (SDP) problems with continuous state variables. The training data set is updated sequentially based on the conditions. Three different algorithms presented based on the conditions of sampling process.

4 - Local Linear Regression and Low-Discrepancy Sampling for Approximate Dynamic Programming

Danilo Maccio, National Research Council, Via De Marini 6, Genoa, Italy, danilo.maccio@cnr.it, Victoria Chen, Cristiano Cervellera

Approximate Dynamic Programming is the standard method for the numerical solution of the well-known Bellman's equations. With such technique, two main issues arise: (i) the choice of a class of models to approximate the value functions; (ii) the definition of an efficient sampling of the domain where estimates of the value functions are computed. In this work the use of local linear regression based models is investigated when low-discrepancy sampling methods are used to sample the state space.

■ MD82

Parc- Haight

Preferences and Multiple Objectives

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Gülser Köksal, Middle East Technical University, IE Dept., METU, Ankara, Turkey, koksal@metu.edu.tr

1 - An Interactive Approach to Two-Response Design Optimization Problem

Melis Ozates, Research Assistant, Middle East Technical University, METU, Industrial Engineering Department, Ankara, 06800, Turkey, mozates@metu.edu.tr, Murat Köksalan, Gülser Köksal

We develop an interactive approach to aid in determining the design parameter values for the case of two responses. The approach incorporates decision maker preferences interactively using an achievement scalarizing function. We capture the random nature of the responses statistically and guide the decision maker towards preferred solutions.

2 - Representing Preferences by Choquet Integral: Guideline to Specify Capacity Type and a Modification

Leman Esra Dolgun, Anadolu University, Endustri Muhendisligi Bolumu, Eskisehir, Turkey, ledolgun@anadolu.edu.tr, Nimetullah Burnak, Gülser Küksal

This study considers representing decision maker preferences by Choquet integral in existence of interactions among criteria. Structures of interactions that can be handled by different capacity types are studied and represented via interaction plots with the purpose of providing a guideline for specifying the capacity type in practical applications. A dummy region solution is proposed to relax some of these conditions and thus improve the ability of Choquet integral in handling interactions.

3 - A Chinese Postman Problem with Multi Objectives

Ezgi Eroglu, Graduate Student, Middle East Technical University, METU Universiteler Mah. Dumlupinar Blv., No:1 «ankaya, Ankara, 06800, Turkey, eroglu.ezgi.90@gmail.com, Meral Azizoglu

Our study considers a Chinese postman problem having multiple weights for each edge. Our aim is to minimize the total weight of the first weights while keeping the sum of the second weights below a threshold value. We investigate the properties of the optimal solution and the optimal solutions of the continuous relaxation. We develop an optimization algorithm and report its favorable results.

■ MD83

Parc- Sutro

Machine Learning, Data Mining, and Statistics II

Sponsor: Data Mining

Sponsored Session

Chair: Cynthia Rudin, MIT Sloan School of Management, 100 Main Street, Cambridge, MA, 02139, United States of America, rudin@mit.edu

1 - MIP Models and Methods for Interpretable Linear Classification

Berk Ustun, PhD Candidate, Massachusetts Institute of Technology, 5 Cambridge Center, 7-790, Cambridge, MA, 02139, United States of America, ustunb@mit.edu, Cynthia Rudin

We present a comprehensive approach to create accurate and interpretable linear classification models using mixed-integer programming. Our approach can build models that incorporate many interpretability-related qualities, and that strike a user-defined balance between accuracy and interpretability. We use our approach to create scoring systems and M-of-N rule tables for applications in medicine, marketing and crime. In addition, we propose methods to train models on large-scale datasets.

2 - Dynamic Ensemble-based Prediction of Equity Price Direction

Nick Street, Professor and Departmental Executive Officer, The University of Iowa, S210 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, nick-street@uiowa.edu, Mike Rechenthin

We propose a dynamic ensemble classification technique designed specifically to predict short-term (around one minute) directional price movements in stocks. The model automatically adjusts for concept drift and transfers knowledge obtained from other stocks to improve its predictions. We demonstrate the effectiveness of this model and discuss some surprising insights regarding the effectiveness of different predictors.

3 - Interpretation Clustering of RNA Expression Data using Quadratic Programming

Kristin Bennett, Professor, Rensselaer Polytechnic Inst., Math Sciences, Dept AE327, 110 8th Street, Troy, NY, 12180, United States of America, bennek@rpi.edu, Chris Fasano, Elisabeth Brown, Chris Gatti

Typically one clusters data and then interprets the clusters. We take interpretations and then find clusters that fit the interpretations. We use quadratic programs to find all data fitting the profiles within experimental error. The resulting composite interpretations applied to RNA-Seq time series data from an embryonic stem cell model are used to help understand human cerebral cortex formation.

Tuesday, 8:00am - 9:30am

■ TA01

Hilton- Golden Gate 6

Mission Planning I

Sponsor: Military Applications Society

Sponsored Session

Chair: Chase Murray, Auburn University, 3301 Shelby Center, Auburn, AL, United States of America, CCM0022@auburn.edu

1 - Multi-depot Vessel Routing in a Direction Dependent Wavefield

Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com, Daniel Schroeder, Alvaro Maggiar, Irina Dolinskaya

Considerable research has been done on the vehicle routing problem and its variants; however only limited work deals with possible environmental conditions and their effects on the vehicle routes. This research presents the multiple-depot vehicle routing problem for surface vessels; the vehicles must traverse a time-invariant direction-dependent medium. Our model captures environmental effects and vessel dynamics on the considered paths. Multiple heuristics are developed and tested.

2 - A New Approach to Planning Cooperative Missions

Paul Scerri, Carnegie Mellon University, Robotics Institute, 5000 Forbes Avenue, Pittsburgh, PA 15213, United States of America pscerri@cs.cmu.edu, Bob Jacobs

This talk describes initial work using an iterative planning algorithm called DIMS to plan cooperative manned and unmanned vehicle missions against an adversary. The algorithm iterates between planning, simulating and model shaping to quickly find interesting cooperative plans in a very large solution space. With the addition of techniques from game theory, specifically fictitious play, the convergence of the algorithm is further improved.

3 - Dynamic Programming for Task Assignment in Multi-Human Multi-Robot Interaction Systems

Monali Malvankar, University of Western Ontario, Schulich School of Medicine & Dentistry, London, ON, Canada, mmalvan@uwo.ca, Siddhartha Mehta, Eduardo Pasiliao

Multi-human multi-robot interaction is a complex system in which robots, e.g., Unmanned Aerial Vehicles (UAVs), may share information with a group of human operators to perform geographically-dispersed priority-based tasks within a specified time. A dynamic programming model is developed to optimally allocate tasks to teams of human operators with the objective to maximize the overall system performance while considering human factors.

4 - An Adaptive UAV Routing Model with Uncertainty on Intelligence Values

Mike Moskal, University at Buffalo, 342 Bell Hall, Department of Industrial and Systems Eng, Buffalo, NY, 142620, United States of America, mmoskal@buffalo.edu, Rajan Batta

We consider a UAV routing problem to maximize information fulfillment across an entire mission. An area of operation is discretized into a series of grids, each assigned a value representing the importance of surveying that area at that point in time. These values fluctuate as intelligence needs change, introducing an element of uncertainty. The presented model is capable of maximizing information fulfillments, reducing the impact of uncertainty, and delivering a real-time UAV route.

■ TA02

Hilton- Golden Gate 7

Outsourcing, Offshoring, and the Changing Nature of Organizational Boundaries and Architectures

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Saikat Chaudhuri, The Wharton School, University of Pennsylvania, 2000 Steinberg Hall-Dietrich Hall, 3620 Locust Walk, Philadelphia, PA, 19104, United States of America, saikatc@wharton.upenn.edu

1 - Risk Sharing Partnerships In Outsourced Offshore Knowledge Process Networks

Ravi Aron, Associate Professor, Johns Hopkins University, 100 International Drive, Room 1331, Baltimore, MD, 21202, United States of America, raviaron@jhu.edu, Praveen Pathak

We look at a panel data of 22 pairs of knowledge intensive processes that have been outsourced to offshored providers. Each pair consists of very similar processes wherein one contract has a risk-sharing clause and the other does not, while other features remain the same. We find that over a period of time risk sharing leads to less physical monitoring, higher customer satisfaction and output quality. Our findings have implications for firms sourcing specific capabilities from specialists.

2 - The Human Cost of Complexity: Linking Product Architecture and Employee Turnover

Alan MacCormack, Harvard University, Soldiers Field, Boston, MA, 02163, United States of America, amaccormack@hbs.edu, Dan Sturtevant

Recent studies of software suggest modular systems are cheaper to maintain (in terms of defects) and easier to adapt (in terms of productivity). But few studies explore the human costs that such systems generate for those working within them. In this study, we explore the impact of complexity on employee turnover. We find developers working on the most complex parts of a system are more likely to leave. Our results further highlight the critical links between technical and social systems.

3 - The Determinants and Evolution of Major Inter firm Transactions in the US Apparel Sector

Xiao Zhao, University of Ottawa, 21 Cotswold Crescent, Toronto, ON, M2P1N1, Canada, mimosazhao@gmail.com, Margaret Dalziel

We investigate the determinants of major inter firm transactions, relying on a longitudinal dataset of over 2,000 of the largest transactional relations between publicly traded firms in the U.S. apparel sector. The results indicate the importance of inter firm complementarity, rather than inter firm similarity, in explaining the sector architecture.

4 - The Impact of Offshore Outsourcing Scale, Scope & Vendor Relationships on Firm Market Value Creation

Saikat Chaudhuri, The Wharton School, University of Pennsylvania, 2000 Steinberg Hall-Dietrich Hall, 3620 Locust Walk, Philadelphia, PA, 19104, United States of America, saikatc@wharton.upenn.edu

As outsourcing expands to higher-end tasks, the outcomes and implications remain unclear. Extant literature poses contradictory predictions on the extent a firm should outsource and engage with vendors. We examine a sample of publicly announced IT/ITES outsourcing deals from 2000-2009, and find that greater sophistication of outsourced tasks lowers market value creation for the client, while increased scale has a positive effect. These effects are amplified by longer client-vendor relationships.

■ TA03

Hilton- Golden Gate 7

Social Media and Business Marketing

Sponsor: eBusiness

Sponsored Session

Chair: Bin Zhang, University of Arizona, McClelland Hall, Room 430, P.O. Box 210108, Tucson, AZ, 85721, United States of America, binzhang@arizona.edu

1 - Generative Diffusion of Innovations and Knowledge Networks in Open Source Projects

Zhewei Zhang, Temple University, Philadelphia, PA, 19122, United States of America, zhang@temple.edu, Sunil Wattal, Bin Zhang, Youngjin Yoo

We conceptualize an open source community as a constellation of dynamic, multiple and heterogeneous informal knowledge networks. OSS development is therefore affected by these networks. We identify two knowledge networks, a more professional, developer-project network and a more social, developer-developer network, which a developer can simultaneously belongs to. We argue that the two networks emphasized on different types of knowledge transfer, and have different effects on project development.

2 - Potential of Social Media for Disaster Management

Lucy Yan, Indiana University, Kelley School of Business, Business 570C, Bloomington, IN, 47401, United States of America, yanlucy@indiana.edu, Alfonso Pedraza-Martinez

Social media has been widely used in disseminating information and important messages. It may increase the amount of data available to humanitarian workers in the aftermath of disasters and may also inform the general public. However, little attention has been paid to explore the role of social media on disaster management. We propose a framework to integrate social media in disaster management for real time decision making.

3 - Are Searches on Weekends More Influential on Stock Price?
Qiang Ye, Harbin Institute of Technology, 92 Xidazhi Street, School of Management,, Harbin, 150001, China, yeqiang@hit.edu.cn, Xianwei Liu

This study proposes a new measure using the proportion of the searches done on weekdays in a week. Based on daily search volume data from search engines, we try to explore the search weekend effects and its impact on stock price. We find that searches done on weekends are more influential on future stock price than searches done on weekdays. To validate the empirical findings, we define a week in different orders and got consistent results.

■ TA04

Hilton- Continental 1

Operations Management and Marketing

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Xuanming Su, University of Pennsylvania, The Wharton School, Philadelphia, PA, 19104, United States of America, xuanming@wharton.upenn.edu

1 - Dynamic Matching in a Sharing Economy
Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St George Street, Toronto, ON, Canada, Ming.Hu@rotman.utoronto.ca, Yun Zhou

Sharing economy has significantly changed many marketplaces in recent years. Examples include the ridesharing services such as Uber. These examples share a common structure of a two-sided market that engages three parties: the supply side, the demand side, and an intermediate firm. In this research, we propose a general framework of dynamically matching supply with demand by the intermediary firm and explore the optimal and heuristic matching policies.

2 - Customer Referral Incentives and Social Media
Evan Sadler, NYU, 44 W 4th St, New York, NY, United States of America, esadler@stern.nyu.edu, Ilan Lobel, Lav Varshney

We study the optimal structure of referral incentive programs that are used to attract customers to businesses. We show that the shift from person-to-person referrals to social media referrals leads to nonlinear payment polices being optimal, but that capped linear policies are a good approximation.

3 - On the Optimality of Synchronizing Pricing and Replenishment with Strategic Customers
Leon Zhu, Associate Professor, University of Southern California, Bridge Hall 401, University Park Campus, Los Angeles, CA, 90089, United States of America, leonyzhu@usc.edu, Ying-Ju Chen

We investigate the joint inventory and revenue management problem with strategic customers for the classical economic order quantity setting. We establish the optimality of the cyclic intertemporal price discrimination even for the homogeneous customer setting. The optimal replenishments and price promotions are synchronized and no capacity rationing is needed. For the heterogeneous customer setting, we find that high frequent intertemporal price discounts can arise as a predominant feature.

4 - Holiday Retailing with Gift Cards
Alice Lu, University of Pennsylvania, Philadelphia, PA, United States of AmericaUniversity of Pennsylvania, xingwei@wharton.upenn.edu, Xuanming Su

Gift cards are popular among retailers and consumers during holidays. Most states require retailers to transfer a portion of unredeemed value on gift cards to the state government. This paper studies the profitability of gift cards and the influence of different state laws on retailer strategies and consumer behavior.

■ TA05

Hilton- Continental 2

Bayesian Estimation and Optimization

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Tong Wang, National University of Singapore, 15 Kent Ridge Drive, Singapore, 119245, Singapore, tong.wang@nus.edu.sg

1 - New Approximations for Bayesian Bandit Problems
Michael Kim, Assistant Professor, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, kimmi@mie.utoronto.ca, Andrew Lim

In his seminal work, Gittins showed that the optimal policy of a multi-armed bandit problem is of index-type. Computing Gittins indices however, are not always easy. For example, Bayesian bandits have infinite dimensional state spaces, and consequently computing the Gittins index is an intractable problem. In this work, we propose new approximation techniques for the DP equations of Bayesian bandits, and show how they lead to explicit solutions that do not require backwards recursion.

2 - A Parsimonious Non-parametric Method for Recommendations
Jeremy Chen, Department of Decision Sciences, National University of Singapore Business School, 15 Kent Ridge Drive, Singapore, 119245, Singapore, jeremy.chen@nus.edu.sg, Weijia Gu, Michael Kim, Sheryl Kimes, Andrew Lim

Recommender systems feature in the business models of many large internet companies. Most recommender systems are based on parametric models of the characteristics of alternative choices and the preferences of users. However, in most settings, usage data is readily available, while data on users and the characteristics of alternatives are not. We present non-parametric methods making recommendations leveraging only usage data. We believe this work is of strong practical significance.

3 - Data-driven Inventory Management with Demand Substitution in Retailing
Anna-Lena Sachs, University of Cologne, Albertus-Magnus-Platz, Cologne, Germany, anna-lena.sachs@uni-koeln.de, Stefan Minner

We formulate a data-driven model that integrates forecasting and inventory optimization by considering the effects of external factors on demand, unobservable lost sales and substitution behavior. Using data from a large European retail, we investigate the trade-off between learning about substitution behavior from highly censored data versus learning about demand from little censored data. We find that more learning about substitution yields slightly better results in terms of profits.

4 - Estimation and Optimization of Logit Demand Model with Covariates, Missing Data, and Auxiliary Info
Tong Wang, National University of Singapore, 15 Kent Ridge Drive, Singapore, SG, 119245, Singapore, tong.wang@nus.edu.sg, Baiyu Li, Andrew Lim

We consider parameter estimation, parameter uncertainty characterization, and decision optimization for an inventory control problem with a demand model that includes customer choice with stochastically changing covariates, missing observations and auxiliary information. Customer arrivals follow a Poisson process, and the choices follow a Logit model. We estimate the parameters using MCMC algorithm in a Bayesian setting, which provides us with a framework to account for parameter uncertainty.

■ TA06

Hilton- Continental 3

Operational Issues in Trade-in Programs

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

1 - Optimal Dynamic Pricing for Trade-in Programs
Mohammad Ghuloum, PhD Student, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, mghuloum@indiana.edu, Goker Aydin, Gil Souza

Trade-in managers (e.g., college booksellers) start the selling season with zero inventory and have to simultaneously acquire and sell used products. Unlike conventional dynamic pricing models, the inventory is not readily available at the beginning of the horizon. This paper studies the optimal acquisition and selling prices for such firms.

2 - Trade-in Rebates for Price Discrimination and Product Recovery
Mark Ferguson, Professor, University of South Carolina, Columbia, SC, United States of America, mark.ferguson@moore.sc.edu, Gil Souza, Vishal Agrawal

Many OEMs offer trade-in rebates to their existing customers when they purchase newer versions of a product. In business-to-business settings, the amounts of the rebates are often opaque to the firm's other customers, resulting in customized rebate amounts. We investigate how this practice affects the firm's decisions regarding secondary markets and offering remanufactured products.

3 - Consumer Trade-in Program Design and the Quality of Returns
Fei Qin, Postdoctoral Fellow, McGill University, Desautels Faculty of Management, Montreal, QC, H3A1G5, Canada, qinfei99@gmail.com, Michael Fry, Uday Rao

We study the structure of the supply chain facilitating used-product return from, and resale to, end consumers. By modeling a variety of trade-in supply chain structures in practice, we show their impact on the performance of the trade-in firm, the retailer, and the channel.

4 - Lemons, Trade-ins, and Remanufacturing
Ximin (Natalie) Huang, PhD Student, Georgia Institute of Technology, Atlanta, GA, United States of America, ximin.huang@scheller.gatech.edu, Atalay Atasu, Beril Toktay

Trade-in programs have been shown to partially mitigate the lemons problem in secondary markets. In this paper, we show when and how remanufacturing traded-in products can further improve the efficiency in secondary markets.

■ TA07

Hilton- Continental 4

Service Science: Toward Systematic Service System Innovation

Cluster: Tutorials

Invited Session

Chair: Paul Maglio, University of California, Merced, Merced, CA, United States of America, pmaglio@ucmerced.edu

1 - Service Science: Toward Systematic Service System Innovation
Paul Maglio, University of California, Merced, Merced, CA, United States of America, pmaglio@ucmerced.edu

Service science is the study of complex service systems. It may involve methods and theories from operations, industrial engineering, marketing, computer science, psychology, information systems, design, and more. In fact, understanding innovation in service systems often requires combining multiple methods because of the complex ways in which interactions among people, technology, organizations, and information create value in different contexts and under different conditions. Service Science the journal documents empirical, modeling, and conceptual studies of complex service systems, and is the archival record of service science the field. The journal is also helping to shape the field. This tutorial will review the emergence of service science the field by analyzing papers published in Service Science the journal, and discuss the new field's foundations, prospects, and opportunities.

■ TA08

Hilton- Continental 5

Optimization and Modeling for Individual Decision-Making

Cluster: Social Media Analytics

Invited Session

Chair: Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43210, United States of America, allen.515@osu.edu

1 - SMERT Modeling of #BringBackOurGirls Tweets
Anthony Afful-Dadzie, Lecturer, University of Ghana Business School, P. O. Box LG 78, Legon, Ac, Ghana, afful-dadzie@ug.edu.gh, Theodore Allen

The twitter campaign has brought global attention to the important cause of abducted girls in Nigeria. Subject Matter Expert Refined Topic (SMERT) models permit the exploration of freestyle text in a way that permits intuitive editing of the topic definitions. The results show the range and level of constructive discourse.

2 - DDAER Policy Optimization for Improved Facebook Experiences
Chen Xie, Consultant, Flexis North America Inc. Corporate Operations Department, 110 Polaris Parkway Suite 305, Westerville, OH, 43082, United States of America, chen.xie@flexis.com

Facebook users have many choices to make about how active to be, what types of posts as well as security settings. There are also many ways to measure their success including the numbers of positive events (contacts from friends) and negative events (unwanted contacts). We gather personal experience data and apply dynamic decision approximate empirical reward processes which are a generalization of Markov decision processes. We show how a personal policy can be formed to improve user experience.

3 - SMERT Modeling of Stephen Colbert Tweets
Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43210, United States of America, allen.515@osu.edu

Stephen Colbert has generated over 3,000 tweets from @StephenAtHome with over 6 million followers. Using our own Subject Matter Expert Refined Topic (SMERT) model, we identify a list of intuitive topics. Then, we chart the evolution over time of issues addressed to try to understand the Colbert mind. Results include the topics of relative fixation and omission.

4 - Experimentation and Modeling of Facebook Privacy Settings
Shih-Hsien Tseng, Assistant Professor, School of Commerce at Kainan University, 33857 No. 1 Kainan Road, Luzhu Shiang, Ta, Taiwan - ROC, tsengsh@mail.knu.edu.tw, Theodore Allen, Chen Xie, Zhenhuan Sui

Hundreds of millions of people use Facebook for pleasure or work. We use planned experiments to explore the impact of privacy settings and activity level on outcomes including the numbers of spam messages, positive contacts, likes, and undesirable contacts. The methods could be applied by others and possibly inform future software development.

■ TA09

Hilton- Continental 6

Novel Techniques in Integer Programming

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Imre Polik, SAS Institute, Cary, NC, 27513, United States of America, imre.polik@gmail.com

1 - Valid Inequalities for Mixed Integer Second Order Cone Optimization (MISOCO)
Aykut Bulut, Lehigh University, 200 W Packer Avenue, Bethlehem, PA, 18015, United States of America, aykut@lehigh.edu, Ted Ralphs

We investigate the computational performance of the valid inequalities for MISOCO problem from literature. These valid inequalities include conic MIR cuts introduced by Atamturk and Narayanan, conic Gomory cuts introduced by Cezik and Iyengar, and disjunctive conic cuts introduced by Belotti et al. We solve the MISOCO problem using a branch and bound scheme and measure the reduction in the size of the search tree due to valid inequalities used.

2 - Using and Reusing Dual Information in Branch and Bound
Menal Güzelsoy, SAS, 100 SAS Campus Drive, Cary, NC 27513, United States of America, menal.guzelsoy@sas.com

In this talk we present several techniques to reuse dual information (such as dual feasible solution and dual rays) later in branch and bound. Bound tightening and branching decisions will both benefit for his extra information. The effectiveness of the ideas will be demonstrated with the SAS/OR mixed-integer linear solver.

■ TA10

Hilton- Continental 7

Dynamic Optimization with Uncertain Demand

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Omar Besbes, Associate Professor, Columbia University, 3022 Broadway, New York, NY, 10027, United States of America, ob2105@columbia.edu

Co-Chair: Ciamac Moallemi, Barbara and Meyer Feldberg Associate Professor of Business, Columbia Business School, 3022 Broadway, Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

1 - Capacity Constraints across Nests in Assortment Optimization under the Nested Logit Model
Jacob Feldman, Cornell University, Ithaca, NY, 14850, United States of America, jbf232@cornell.edu, Huseyin Topaloglu

We consider assortment optimization problems when customers choose according to the nested logit model and there is a capacity constraint limiting the total capacity consumption of all products offered in all nests. For the cardinality constrained case, we develop an effcient algorithm to compute the optimal assortment. When the capacity consumption of each product is arbitrary, we give an algorithm to obtain a 4-approximate solution.

2 - Dynamic Inventory Management with Limited Observations
Juan Chaneton, PhD Student, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, jchaneton15@gsb.columbia.edu, Omar Besbes, Ciamac Moallemi

We consider a dynamic inventory management problem in which the retailer has only partial access to the stochastic process that drives inventory evolution. In such settings, the retailer's decision should account not only for the current inventory state, but also for the way decisions (current and past) affect information acquisition. We assess the impact of this information limitation in a common retailing optimization problem.

3 - Connections between Least Squares Monte Carlo and Math Programming Based ADP
Selvaprabu Nadarajah, Assistant Professor, University of Illinois at Chicago, Liautaud Graduate School of Business, Chicago, IL, United States of America, selvan@uic.edu, Francois Margot, Nicola Secomandi

Least squares Monte Carlo (LSM) and math programming ADP methods are widespread in financial engineering and operations research. We connect recent LSM and math programming ADP methods using an approximate linear programming (ALP) relaxation approach based on restricting the ALP dual. This work provides a new perspective on LSM and additional insights into existing ALP relaxations. We also present methodological extensions motivated by this analysis.

4 - Centralized and Decentralized Dynamic Price and Lead Time Quotation
Baykal Hafizoglu, ASU, Tempe, AZ, United States of America Arizona State University, baykal@asu.edu, Pinar Keskinocak, Esma Gel

We discuss the dynamic price and lead time quotation problem in a make-to-order system under two decision making settings: (1) centralized setting considers a central agent determining price and lead times, and (2) decentralized setting assumes that price and lead time decisions are taken respectively by marketing and manufacturing departments. We explore the optimal policy structure under both settings and discuss the inefficiencies of decentralized decision making.

■ TA11

Hilton- Continental 8

Topics in Supply Chain Management

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Houyuan Jiang, University of Cambridge, Judge Business School, Trumpington Street, Cambridge, United Kingdom, h.jiang@jbs.cam.ac.uk

1 - Optimal Sourcing Decision and Information Sharing Under Multi-tier Disruption Risk in a Supply Chain
Jiho Yoon, Doctoral Candidate, Michigan State University, N468 North Business Complex, Michigan State University, East Lansing, MI, 48824-1121, United States of America, yoon@bus.msu.edu, Claudia Rosales, Srinivas Talluri

We consider a three-tier supply chain consisting of a manufacturer and two suppliers. Both suppliers may experience disruptions; the effect of disruption risk on manufacturer's sourcing decisions is analyzed. We study the effect of information sharing in the supply chain and identify conditions under which the first-tier supplier is willing to share second-tier supplier information.

2 - New Risk Concepts for Supply Chain Design Models
Stefan Nickel, KIT, Kaiserstrasse 12, Karlsruhe, Ba, 76131, Germany, stefan.nickel@kit.edu, Francisco Saldanha da Gama, Iris Heckmann

Risk concepts have been applied in a broad variety of research fields and methodologies. Most of these approaches, however, consider risk as a static concept and do not address the dynamic nature and potential aggravation of risk. We introduce new risk concepts that consider risk as a dynamic concept, whose impact may aggravate over time and propagate through the network. We present mathematical programming models of these risk concepts for different supply chain design models.

3 - To Supply or Not to Supply to a Competing Buyer
Zhibin (Ben) Yang, Assistant Professor, University of Oregon, Eugene, OR, 97403, United States of America, zyang@uoregon.edu, Haresh Gurnani, Xinxin Hu

We study the supplier's allocation of limited production capacity to a buyer that sells to the same market, using a three-stage model. We characterize the buyer and the supplier's market competition equilibrium in which the buyer may strategically withhold excessive supply, and analyze the supplier's capacity allocation and pricing decisions.

4 - Supply Chain Contracting with Limited Demand Information
Houyuan Jiang, Dr, University of Cambridge, Judge Business School, Trumpington Street, Cambridge, United Kingdom, h.jiang@jbs.cam.ac.uk, Serguei Netessine

The well-known wholesale price and buy-back contracts in supply chains are investigated when only limited demand information is available to the retailer and the supplier. We show that these contracts, in particular the buy-back contract, cannot coordinate the supply chain in general. We study supply chain coordination conditions. We characterize efficiency of these contracts.

■ TA12

Hilton- Continental 9

Doctoral Work in Sustainable Operations Management

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: David Drake, Assistant Professor, Harvard Business School, Boston, MA. United States of America, ddrake@hbs.edu

1 - Service-level Elasticity of Demand for Mobile Money Cash Transactions
Karthik Balasubramanian, Doctoral Student, Harvard Business School, Boston, MA, United States of America kbalasubramanian@hbs.edu, David Drake

"Mobile money" can transform the lives of 2 billion people that live on less than $2 a day. However, the mobile money agents (who exchange cash for electronic value and vice versa) that are crucial to the development of mobile money ecosystems face severe inventory problems. We study the service-level elasticity of demand for cash transactions: how does service level affect demand for an agent's services?

2 - Extended Producer Responsibility (EPR), Secondary Markets & Export Restrictions
Isil Alev, Doctoral Student, Georgia Tech School of Industrial and Systems Engineering, Atlanta, GA, United States of America isilalev@gatech.edu, Vishal Agrawal, Atalay Atasu

EPR-based take-back legislation is the prevalent policy for several durable products such as electronics; however, existing analysis ignores the durable nature of the products and presence of secondary markets. In our work, we analyze the effectiveness of EPR in the presence of secondary markets and show that it may result in unintended adverse environmental outcomes. We then extend our work by analyzing the effect of export bans in practice and show that they exacerbate these adverse outcomes.

3 - The State of Scope 3 Carbon Emissions Reporting in Supply Chains
Christian Blanco, PhD Student, UCLA Anderson School of Management, Los Angeles, CA, United States of America christian.blanco.2016@anderson.ucla.edu, Felipe Caro, Charles Corbett

Protocol organizations previously focused on carbon reporting for emissions emitted from company owned equipment (scope 1) and energy purchases (scope 2), but are increasingly including indirect emissions from upstream suppliers (scope 3). We compare scope 3 emissions disclosed to CDP to a benchmark by Huang et al. (2009). We find firms are beginning to account for an increasing portion of their supply chain's carbon emissions, but opportunities still remain for expanding scope 3.

4 - The Impact of Ecolabeling on the Optimal 'Green' Product Line
Karthik Murali, University of Illinois, Urbana, IL, United States of America, kmurali4@illinois.edu, Michael Lim, Nicholas C. Petruzzi

We study the optimal product line problem through a model of vertical differentiation in the context of 'green' attributes which are characterized by unobservability to consumers and consumer confusion in evaluating the utility derived from these attributes. Ecolabels provided by trusted certifying agencies or firms themselves are used to exhibit 'green' attributes. We characterize ensuing implications of ecolabeling for the environment and derive policy implications for government intervention.

■ TA14

Imperial B

Panel Discussion: Journal Publication Tips

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Shengfan Zhang, Assistant professor, University of Arkansas, United States of America, shengfan@uark.edu

1 - Panel Discussion: Successful Journal Publication Tips
Moderator: Shengfan Zhang, Assistant professor, University of Arkansas, United States of America, shengfan@uark.edu, Panelists: Dan Adelman, Stephen Graves, Jason Merrick, David Woodruff, Michael Gorman

Panel discussion will include editors from Decision Analysis, MSOM, MS, and OR.

■ TA15

Hilton- Exec. Boardroom

DEA Methodology

Cluster: Data Envelopment Analysis

Invited Session

Chair: Ole Bent Olesen, Professor, University of Southern Denmark, Campusvej 55, 5230 Odense, Denmark, ole@sam.sdu.dk

1 - Cone Ratio and Assurance Regions in Slack Based DEA Models – A Challenge

Ole Bent Olesen, Professor, University of Southern Denmark, Campusvej 55, 5230 Odense, Denmarkole@sam.sdu.dk, Niels Christian Petersen

There exists a close link between input or output oriented radial cone ratio DEA and the corresponding DEA model with assurance regions. This link is less straight forward for the case of non-radial slack based measures. In this paper we analyze the relationship between assurance regions and cone ratio formulations of such additive models. Certain problems are identified and their relations to multi-objective programming are discussed.

2 - Pitfalls of the Multi-stage DEA Model with Additive Efficiency Decomposition

Chien-Ming Chen, Nanyang Business School, Nanyang Technological University, 50 Nanyang Ave., Singapore, 639798, Singapore, cmchen@ntu.edu.sg, Sheng Ang

This paper highlights several problems of the multi-stage DEA model with additive efficiency decomposition. We show that the decomposition weights are non-increasing in the sequence of stages and illustrate the problems with a case study.

3 - The Orientation of DEA Models with Dual-role Factors

Wen-Chih Chen, National Chiao Tung University, 1001 Ta Hsueh Rd., Hsinchu, Taiwan - ROC, wenchih@faculty.nctu.edu.tw

In contrast to conventional input/output factors, dual-role factors are those can be both inputs and outputs simultaneously. This study investigates issues on the orientation of DEA models with dual-role factors. We also propose efficiency measures for the cases with dual-role factors.

4 - Stochastic Programming Approach to DEA for Evaluation of Future Efficiency

Yuma Konishi, Osaka University, 2-1 Yamadaoka, Suita, Osaka, Japan, yuma.konishi@ist.osaka-u.ac.jp, Hiroshi Morita

DEA is developed without uncertainty. But there is so much uncertainty that cannot be ignored for future efficiency prediction. Stochastic programming framework of DEA enables us to determine how to take actions before getting observation results, in contrast to after getting one by the deterministic DEA. We show SPDEA approach for evaluating future efficiency to cope with the risk attitudes, and illustrate the difference of evaluation of future efficiency among some risk attitudes.

■ TA16

Hilton- Franciscan A

Dynamic Mechanism Design in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Santiago Balseiro, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27705, United States of America, srb43@duke.edu

1 - Dynamic Allocation and Learning with Strategic Arrivals

Philipp Strack, Microsoft Research New England, One Memorial Drive, Cambridge, MA, 02142, United States of America, philipp.strack@gmail.com, Benny Moldovanu, Alex Gershkov

A designer allocates several indivisible object to a stream of randomly arriving agents. The long-lived agents are privately informed about their value for an object, and about their arrival time to the market. The designer learns about future arrivals from past arrivals, while agents strategically choose when to make themselves available for trade. We inquire whether the complete information, efficient policy is implementable and characterize revenue maximizing mechanisms.

2 - Dynamic Mechanism Design with Budget Constrained Buyers

Santiago Balseiro, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27705, United States of America, srb43@duke.edu, Gabriel Weintraub, Omar Besbes

In online advertising, ad slots are typically allocated using a second-price auction or some variation of it. We explore, using a dynamic mechanism design approach, whether other auction formats could improve the auctioneer's profit in the presence of budgets constraints.

3 - On the Durable Good Monopoly Problem

Gerardo Berbeglia, Assistant Professor, Melbourne Business School, 200 Leicester Street, Melbourne, 3053, Australia, g.berbeglia@mbs.edu, Peter Sloan, Adrian Vetta

A duropolist is a monopolist in the market of a durable good. We study the equilibria of the associated bargaining game with atomic consumers and finite horizon that satisfy the standard skimming property. We prove that duropoly profits are always at least as large as static monopoly profits, but never exceed double the static monopoly profits. Lastly, we show that the bounds are tight. The bounds hold regardless of the number of periods, number of consumers, and their specific values.

4 - Bandit Networks: Learning Without Experimentation

Ankur Mani, Massachusetts Institute of Tech, 20 Ames Street #385, Cambridge, MA, 02139, United States of America, amani@MIT.EDU, Ilan Lobel, Josh Reed

We consider a firm consisting of a network of retail stores. None of the retail store managers have an incentive to experiment individually to find the value of alternative policies. We show that under certain conditions, learning occurs in this network of stores regardless of the lack of experimentation.

■ TA17

Hilton- Franciscan B

Behavioral Perspectives

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Mirko Kremer, Professor, Penn State University, 460 Business Building, University Park, PA, United States of America, muk22@smeal.psu.edu

1 - Capacity Decisions under Information Asymmetry – Experimental Evidence

William Schmidt, Assistant Professor, Johnson Graduate School of Management, 314 Sage Hall, Ithaca, NY, 14853-6201, United States of America, wschmidt@cornell.edu, Ryan Buell

We examine capacity choices under information asymmetry and find that decision makers more often make choices consistent with Pareto optimization logic. This has material implications for both research and practice as it yields dramatically divergent predictions compared to more commonly modeled alternatives.

2 - Working Smarter Not Harder: Queue Discretion, Batching, and Performance in Outsourced Teleradiology

Maria Ibanez, Doctoral Student, Harvard Business School, Morgan Hall 428, Soldiers Field Road, Boston, MA, 02163, United States of America, mibanez@hbs.edu, Jonathan Clark, Robert Huckman, Bradley Staats

We examine how knowledge workers exert discretion on the order in which to execute tasks and the subsequent performance implications of those choices. Using two and a half years of data on more than 2.7 million cases read by outsourced radiologists working at one of the largest teleradiology firms in the US, we explore potential heuristics in ordering decisions, and how this endogenous ordering affects performance.

3 - Impact of Queueing System Design on Human Servers' Behavior

Masha Shunko, Purdue University, 403 W. State Street, West Lafayette, IN, 47906, United States of America, mshunko@purdue.edu, Julie Niederhoff, Yaroslav Rosokha

In queueing systems with human servers, service rate may depend on many factors. Based on series of lab and field experiments, we analyze the impact of queueing system layout and visibility of the queue length on service speed. We show that layout with parallel queues and good visibility of the queue length are important determinants of workers' speed.

4 - The Impact of Congestion on Diagnostic Accuracy

Mirko Kremer, Professor, Penn State University, 460 Business Building, University Park, PA, United States of America, muk22@smeal.psu.edu, Francis de Vericourt

We investigate decision-making and judgment in the context of diagnostic services systems that pose difficult trade-offs for the (human) server. For instance, in triage systems additional testing improves diagnostic accuracy for one patient, but increases congestion in the system (thus delaying service provision to other patients).

■ TA18

Hilton- Franciscan C

Revenue Management in Retail and Service I

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Andrew Vakhutinsky, Principal Scientist, Revionics, 52 Cannon Ball Rd., Sharon, MA, 02067, United States of America, Andrew.Vakhutinsky@revionics.com

Co-Chair: Natalia Viktorovna, Sr. Operations Research Specialist, SAS Institute, 100 SAS Campus Drive, Cary, NC, United States of America, Natalia.Viktorovna@sas.com

1 - A Simulation Study of BAR by Day Heuristics

Jason Chen, SAS Institute, SAS Campus Drive, Cary, NC, 27513, United States of America, Jason.Chen@sas.com

A BAR (Best Available Rates) by Day policy sets a rate for each occupancy day. The rate of a multi-day stay is equal to the sum of each occupancy day's rate. Its simple form makes this type of policy attractive to many hotels. However, the interaction of multi-day stays that share the same occupancy days makes the difficult network problem even harder to solve. We present the simulation study of several BAR by Day heuristics using real hotel data.

2 - The Re-layout Problem in Grocery Stores

Ilknur Uludag, Industrial and Systems Engineering, 3301 Shelby Center Auburn University, Auburn, AL, 36849-5346, United States of America, izt0002@auburn.edu, Alice E. Smith

In this study,the facility re-layout problem in grocery stores is studied. Although the process of the re-layout in a store is time consuming and costly, the re-layout problem has not been investigated in detail in the retail industry. A mathematical model for the solution of the problem is developed and tested using real world data and randomly generated scenarios. The best solutions by the mathematical model are presented. A greedy heuristic for the problem is proposed for large size problems.

3 - Demand Models for Substitutable Grocery Products

Setareh Borjian, MIT Operations Research Center, Cambridge, MA, United States of America, sborjian@mit.edu, Andrew Vakhutinsky

We describe the demand for a product assortment in a grocery retail category using choice modelling approach. We estimate the parameters of models based on the transactions history from a large national grocery chain, and compare the models using different sales periods. We show that among other factors, promotion has significant effect in demand variation and should therefore be considered as an input to the models to get a more accurate estimation of demand.

4 - An Attribute-based Retail Assortment Model

Jeff Moore, Revionics, 2998 Douglas Blvd, Suite 350, Roseville, CA, 95661, United States of America, jmoore@revionics.com, Bryan Ball, Andrew Vakhutinsky

We will present an analysis of several methods of "sight unseen" demand forecasting for retail goods using attribute-based models. We will describe the product attributes used, the method of holdout testing used to gauge prediction accuracy and to compare models, and the various modeling approaches employed (regression models, decision trees, and random-forests). We will describe how these methods performed across a set of test cases using retail demand history.

■ TA19

Hilton- Franciscan D

Dynamic Learning and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Stefanus Jasin, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI United States of America, sjasin@umich.edu

1 - Model Selection in Pricing and Revenue Management

Arnoud V. den Boer, University of Twente, Drienerlolaan 5, Enschede, 7522 NB, Netherlands, a.v.denboer@utwente.nl

In optimization problems, simple mathematical models that discard important factors may sometimes be preferred over more realistic models. This can happen if the parameters of the simpler models are easier to estimate than the parameters of the complex model; there thus is a trade-off between modeling error and statistical error. We propose a data-driven method to decide when misspecified models give better results, and apply it to pricing and revenue management problems.

2 - Dynamic Pricing and Demand Learning with Limited Price Experimentation

He Wang, MIT, 77 Mass Ave, E40-130, Cambridge, MA, 02139, United States of America, wanghe@mit.edu, David Simchi-Levi, Alexander Weinstein

In a dynamic pricing problem where the demand function is unknown a priori, price experimentation can be used for demand learning, but in practice sellers are faced with business constraints that prevent them from conducting extensive experimentation. We consider a dynamic pricing model where the seller can only change price for a limited number of times during the sales window, and show that simple policies can achieve asymptotically optimal regret bounds.

3 - Application of Self-Adjusting Controls for Dynamic Pricing with Unknown Demand

George Chen, Stephen M. Ross School of Business, University of Michigan, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, georgeqc@umich.edu, Stefanus Jasin, Izak Duenyas

We study the network-RM pricing problem with unknown demand functions in both parametric and nonparametric cases. Using the self-adjusting heuristic, we get the best attainable revenue loss rate in the parametric setting. Moreover, a much sharper performance can be achieved if parametric demand function family is well-separated. We also show that self-adjusting heuristic almost attains the best achievable revenue loss rate for the nonparametric setting if demand is sufficiently smooth.

4 - Near-optimal Bisection Search for Nonparametric Dynamic Pricing with Inventory Constraints and Unknown

Murray (Yanzhe) Lei, PhD, University of Michigan, 701 Tappan Street, R3410, Ann Arbor, MI, 48109, United States of America, leiyz@umich.edu, Stefanus Jasin, Amitabh Sinha

We consider a general class of revenue management problems with inventory constraints, where the price-dependent demand function is unknown. We develop nonparametric dynamic pricing algorithms and provide upper bounds on the revenue losses comparing to a clairvoyant in asymptotic regime: for single-product problems, our algorithm matches the theoretic lower bound; for multiple-product problems, our algorithm outperform existing literature, especially when there are a lot of different products.

■ TA20

Hilton- Yosemite A

Facility Logistics I

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: Sadan Kulturel-Konak, Pennsylvania State University-Berks, Tulpehocken Rd. PO Box 7009, Reading, PA, United States of America, sadan@psu.edu

1 - Role of Product Exposure in Retail Design

Corinne Mowrey, PhD Candidate, Wright State University, 207 Russ Center, 3640 Col Glenn Hwy, Dayton, OH, 45435, United States of America, mowrey.4@wright.edu, Pratik Parikh

A key aspect of retail facility design, often alluded to but rarely analyzed, is product exposure to the shopper along their travel path. From a shopper's perspective, a greater amount of product exposure means less time spent searching for items of interest. From a manager's perspective, converting a shopper's time from searching to purchasing would likely result in increased sales. We discuss an approach to quantify product exposure for various retail layouts and share preliminary insights.

2 - Flow Balancing with Uncertain Demand for Automated Package Sorting Centers

Luis Novoa, PhD Candidate, George Washington University, Department of Decision Sciences, School of Business, Washington, DC, 20052, United States of America, ljnovoa@gwmail.gwu.edu, David Morton, Ahmad Jarrah

At package carriers' hubs, primary sorters direct incoming packages to secondary sorters for further segregation to the outbound destinations level. We study the problem of assigning package destinations to secondary sorters to balance the hub's workload while considering the uncertainty in package volumes and adhering to loading capacities. Hybrid stochastic/robust formulations, solution algorithms and computational performance are discussed. Benefits from proposed models are quantified.

3 - Dynamic Facility Layout Problem using a Hybrid Approach

Sadan Kulturel-Konak, Pennsylvania State University-Berks, Tulpehocken Rd. PO Box 7009, Reading, PA, United States of America, sadan@psu.edu

This study presents a hybrid approach to solve the Dynamic Facility Layout Problem (DFLP) on the continuous plane with unequal area departments. In our hybrid approach, once the Genetic Algorithms (GA) sets up relative department positions, actual department locations and shapes are determined by solving a Linear Programming (LP) problem. Results for the problems studied in the literature earlier and for newly defined problems will be presented.

4 - SINGA Port – The Next Generation Container Port Concept
Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, Singapore, iseleelh@nus.edu.sg, Dah-Chuan Gong, Brett Peters, Matthew Petering, Ek Peng Chew

We will discuss a project to design a "Sustainable Integrated Next Generation Advanced Port," which can handle 20 million TEUs per annum. A novel container terminal is proposed with features of a double-story structure, indented storage yard, overhead bridge crane, and automated lifting vehicle. We will argue how we overcome the challenges that we have faced. We will also illustrate what analyses have been done to make the final design and explore the research issues behind the project.

■ TA21

Hilton- Union Sq 1

Innovative Solutions for Congestion Mitigation I

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Siriphong (Toi) Lawphongpanich, University of Florida, Industrial and Systems Engineering, Gainesville, FL, 32611, United States of America, Lawphong@ise.ufl.edu

Co-Chair: Yafeng Yin, University of Florida, Gainesville, FL, United States of America, yafeng@ce.ufl.edu

1 - Congestion Pricing for Improving Network Service: A Simulation-Based Optimization Approach
Lei Zhang, Associate Professor, University of Maryland, 1173 Glenn Martin Hall, College Park, MD, 20742, United States of America, lei@umd.edu, Xiqun (Michael) Chen

An innovative surrogate optimization is proposed for congestion pricing with computationally expensive objective functions assessed by simulation-based dynamic traffic assignment. Response surfaces are exploited by DIRECT a modification to Lipschitzian optimization. The framework is applied to optimize mileage based tolls of a freeway sub-network. We investigate invariant macroscopic fundamental diagrams validated by fixed and probe traffic flow data. Various optimal toll scenarios are compared.

2 - Profit Maximization of a Private Toll Road with Cars and Trucks
Xiaolei Guo, Assistant Professor, University of Windsor, 401 Sunset Ave., Odette School of Business, Windsor, ON, N9B 3P4, Canada, guoxl@uwindsor.ca

Profit maximization of a private toll road is not only important to the road operator itself, but also important to the government, because understanding the profit-oriented behaviors is the first step to setting proper regulations. This paper looks into the profit maximization problem of a private toll road competing against a free alternative in presence of cars and trucks, where trucks differ from cars in value of time, congestion externality, and pavement damage.

3 - On the Design of Multi-Period Tradable Credit Schemes for Travel Mobility
Mohammad Miralinaghi, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47906, United States of America, smiralin@purdue.edu, Srinivas Peeta

Credit-based congestion pricing is a strategy to mitigate congestion by creating artificial markets for mobility credits. This study develops a multi-period equilibrium modeling framework to capture the evolution of credit price when credit demand and supply vary with time. To enable the central authority to manage the credit supply, transfer fee and reservation credit price are applied to stored credits for consumption in future periods.

4 - Dual-Toll Pricing Problem for Regulating Hazmat Transportation under Nonlinear Delay
Changhyun Kwon, University at Buffalo (SUNY), 318 Bell Hall, Buffalo, NY, 14221, United States of America, chkwon@buffalo.edu, Tolou Esfandeh, Rajan Batta

We investigate a dual-toll setting policy to mitigate the risk of hazmat shipment in transportation networks. We formulate the problem as a bi-level program wherein the first level aims at minimizing the risk via dual toll, and the second level explores the user equilibrium flow pattern of the regular vehicles and hazmat carries. We suggest an inverse optimization procedure and approximate methods based on piecewise linearization.

■ TA22

Hilton- Union Sq 2

Selective and Time Dependent Routing Problems

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Mehmet Basdere, Northwestern University, The Technological Institute, 2145 Sheridan Road Room C210, Evanston, IL, 60208, United States of America, mehmetbasdere2016@u.northwestern.edu

1 - The Traveling Salesman Problem with Time-dependent Service Times
Duygu Tas, Postdoctoral Fellow, CIRRELT and Canada Research Chair in Distribution Management, HEC Montreal, Bureau 3520, Pavillon Andre-Aisenstadt, Campus de l'Université de Montreal, Montreal, QC, H3C 3J7, Canada, duygu.tas@cirrelt.ca, Gilbert Laporte, Ola Jabali, Michel Gendreau

The Traveling Salesman Problem (TSP) with time-dependent service times is a generalization of the classical TSP where the duration required to serve any customer is defined as a function of the moment to begin service at that location. This talk will describe the analytical insights derived from the properties of service time and fundamental routing assumptions (e.g., first-in-first-out), and present experimental results obtained by using different service time functions.

2 - Race Course Configuration Problem
Mehmet Basdere, Northwestern University, The Technological Institute, 2145 Sheridan Road Room C210, Evanston, IL, 60208, United States of America, mehmetbasdere2016@u.northwestern.edu, Karen Smilowitz, Sanjay Mehrotra

In this talk, we present a new type of tour finding problem in the marathon course design setting. The aim is to find a valid marathon course that minimizes the average distance to the medical facilities within the region of interest without preventing the public access to those facilities while visiting a predetermined subset of landmark streets. The underlying problem becomes a variant of selective travelling salesman problem.

3 - Solution Methods for the Rural Postman Problem with Time Windows
Ingrid Marcela Monroy Licht, PhD Student, École Polytechnique de Montréal, 2500, Chemin de Polytechnique, Montreal, Canada, ingrid-marcela.monroy-licht@polymtl.ca, Ciro Alberto Amaya, André Langevin

The rural postman problem consists in finding an optimal tour visiting a subset of required arcs. We present a MIP formulation for the case with time windows and we solve the problem using a cutting plane algorithm. A competitive Adaptive Large Neighborhood Search metaheuristic is proposed for solving larger instances. Computational experiments are done on a large set of instances with up to 104 required edges.

■ TA23

Hilton- Union Sq 3

Network Design and Repositioning for Bike-sharing Systems

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Sin C. Ho, Aarhus University, 8210 Aarhus, Denmark, sinch@asb.dk

Co-Chair: W. Y. Szeto, The University of Hong Kong, Shatin, N.T., Hong Kong- PRC, ceszeto@hku.hk

1 - Bicycle Network Design with Genetic Algorithm
C. S. Shui, The University of Hong Kong, Hong Kong, China, samshui@hku.hk, W. Y. Szeto

This study introduces a bicycle network design problem that maximizes coverage and demand satisfaction simultaneously within a limited budget. Genetic Algorithm is adopted with two repairing operators introduced to improve the solution search. A case study in Tuen Mun, Hong Kong shows that the GA can solve single and bi-objective design scenarios with various budget levels. The tradeoff between two objectives is also investigated through varying the weighting factor.

2 - An Artificial Bee Colony Algorithm for the Public Bike Repositioning Problem

W. Y. Szeto, Shatin, N.T., Hong Kong- PRC
The University of Hong Kong, ceszeto@hku.hk, C. S. Shui

This paper introduces an artificial bee colony algorithm to solve the shared bikes repositioning problem. A modified version is proposed to improve the solution quality of the original version. Two objectives, minimizing total duration and minimizing maximum duration, are examined to show their relationships with the number of operating vehicles.. The trade-off between the service duration and the tolerance of demand dissatisfaction is also illustrated.

3 - Iterated Tabu Search for the Bike Repositioning Problem

Sin C. Ho, Aarhus University, 8210 Aarhus, Denmark, sinch@asb.dk, W. Y. Szeto

We study the static bike repositioning problem where the problem consists of selecting a subset of stations to visit, sequencing them, and determining their pick-up/drop-off quantities under various operational constraints. The objective is to minimize the total penalties incurred at all the stations. We present an iterated tabu search heuristic to solve the described problem. Experimental results show that this heuristic can generate high quality solutions using small computing times.

■ TA24

Hilton- Union Sq 4

Emerging Vehicle and Sensor Technologies

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Stephen Boyles, Assistant Professor, University of Texas at Austin, 301 E Dean Keeton St Stop C1761, Austin, TX, 78712, United States of America, sboyles@mail.utexas.edu

1 - Autonomous Vehicle Intersection Modeling in Dynamic Traffic Assignment

Michael Levin, The University of Texas at Austin, ECJ 6.2, Austin, TX, 78712, United States of America, michaellevin@utexas.edu, Stephen Boyles

Autonomous vehicle intersection policies offer opportunities for capacity increase, which to date have been studied in custom micro-simulations. We propose an algorithm for modeling such policies in dynamic traffic assignment that simplifies tile-based reservation models to ensuring separation at a reduced number of conflict points. The model is compared with published micro-simulation results and used to analyze intersection-auction congestion-pricing under user equilibrium behavior.

2 - Network Contraction Methods for Dynamic Pricing at Charging Stations

Ehsan Jafari, PhD Candidate, The University of Texas at Austin, Austin, TX, United States of America, ejafari@utexas.edu, Stephen Boyles

Dynamic pricing strategies can potentially mitigate load issues on the power grid due to electric vehicle charging. This talk presents network contraction-based methodologies for rapid assessment of pricing strategies.

3 - A Game-theoretical Framework for Traffic Signal Control Systems with Connected Vehicles

Lin Xiao, University of Minnesota, Minneapolis, MN, United States of America, lxiao@umn.edu, Henry X. Liu

In this paper, a game-theoretical framework for traffic signal control with connected vehicles is proposed. The game is designed in the way that connected vehicles and signal controller will determine the signal timing plan via negotiating. This framework utilizes the connected vehicles' two-way communication capability, which didn't attract much attention in previous studies. Numerical study shows that the proposed framework outperforms traditional traffic signal control method with connected vehicles.

4 - Online Auction Designs for Traffic Intersection Operations

R. Jayakrishnan, University of California, Irvine, CA, United States of America, rjayakri@uci.edu, Roger Lloret-Batlle

The purpose of this paper is to analyze the general case of online auctions in the traffic intersection problem. Insights are developed based on a general framework and mechanisms for efficiently utilizing available time budgets, with signal formulations that are not necessarily constrained to traditional cycle designs.

■ TA25

Hilton- Union Sq 5

Public Transportation

Contributed Session

Chair: Ramesh Bollapragada, Professor, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA, 94132, United States of America, rameshb@sfsu.edu

1 - Identifying Communication Needs for Disabled and Elderly during Transportation

Lavanya Marella, Graduate Research Student, University of Tennessee, 511 John D. Tickle Building, 851 Neyland Drive, Knoxville, TN, 37996, United States of America, lmarella@vols.utk.edu, Yuting Li, Eric Arendt, Rapinder Sawhney, Dhanush Agara Mallesh

One of the top barriers preventing the disabled from using public transportation was their ability to ask bus drivers basic questions concerning destination, safety and general comments. The research objective of identifying these communication needs is executed by partnering with three major transit agencies covering five counties in Tennessee and surveying the participants (passengers and drivers). Survey results are data-mined to identify future technological solutions.

2 - Reducing Traffic Congestion on all San Francisco Bay Area Highways

Ramesh Bollapragada, Professor, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA, 94132, United States of America, rameshb@sfsu.edu, Uyen Tran

In this paper, we study the traffic trends of Interstate 80 and US 101 across the nine counties of the San Francisco Bay Area over the time period between 1992 and 2013, discovering the bottlenecks, and presenting several managerial insights, through sensitivity analysis, on how to allocate limited resources that provide the infrastructure to support the locations with the highest potential for traffic growth and, therefore, relieve congestion and reduce traffic time on the studied locations.

3 - Critical Systems Management Issues of Implementing the Positive Train Control Technology in a Region

Yalda Khashe, PhD Candidate, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, 90089, United States of America, khashe@usc.edu

Positive Train Control (PTC) is a generic term referring to a range of fully integrated technologies that overlay existing safety systems to prevent train-to-train collision and improve worker safety. One of the challenges that railroad industry is facing for implementing PTC is the complications of introducing this new technology to an already existing system and its effect on the Technological, organizational and human subsystems and their interactions.

■ TA26

Hilton- Union Sq 6

Facility Location

Contributed Session

Chair: Victor Blanco, Universidad de Granada, Fac. Ciencias Economicas y Empresariales, Granada, Spain, vblanco@ugr.es

1 - On the Continuous Fermat-Weber Problem for a Convex Polygon Using Euclidean Distance

Thomas Zhang, Wayzata High School, 4955 Peony Lane, Plymouth, MN, 55446, United States of America, thomaszh3@gmail.com, John Carlsson

We consider the continuous Fermat-Weber problem, where the customers are continuously distributed on a convex polygon. We derive a closed-form expression for finding the average distance from a given point to continuously distributed customers along the boundary, minimize the expression using a Weiszfeld-type procedure, and derive a closed-form formula to find the average distance for a given point to the entire convex polygon, assuming uniform distribution.

2 - A SOCP Formulation for Continuous Location Problems under Refraction

Victor Blanco, Universidad de Granada, Fac. Ciencias Economicas y Empresariales, Granada, Spain, vblanco@ugr.es, Diego Ponce, Justo Puerto

Refraction phenomenon describes the process that occurs when the light changes of medium and the phase velocity is changed but its frequency remains constant. This phenomenon is applicable to model different region-dependent transport systems where each region is allowed to be traversed with a given speed. We extend the Snell's law to any dimension and any lp norms and address the problem of locating a new facility under this effect. Computational experiments run in Gurobi are reported.

3 - Robust Facility Location Optimization with Location-dependent Demands
Juan Carlos Espinoza Garcia, ESSEC Business School, Avenue Bernard Hirsch, CS 50105, Cergy, 95021, France, juancarlos.espinoza@essec.edu, Laurent Alfandari

We present a robust optimization approach to location problems where the allocation of demand is dependent on the final choice of locations. We consider allocation rules from a global perspective (Master planning) and from a demand/supply dependent point of view. We develop the model in the context of differentiated goods, utilizing a hedonic price model for the estimation of demand allocation. Finally, we present an application to New Housing Developments planning.

4 - Integrating Uncertain Data in Disaster Relief Facility Location
Bin Li, University of Arkansas, Bell Engineering Building 4110, Fayetteville, AR, 72703, United States of America, binli@email.uark.edu, Ashlea Milburn

A multi-objective formulation of the minimax regret for the facility location problem that allows decision makers to open an efficient number of facilities when there is demand uncertainty. The problem is motivated by the recent need of integrating social data from multiple sources in order to make optimal decisions. CPLEX is used for solving three different optimization problems based on three different facility location strategies.

■ TA27

Hilton- Union Sq 7

Demand-Responsive Rail Service Design

Sponsor: Railway Applications

Sponsored Session

Chair: Kuilin Zhang, Assistant Professor, Michigan Technological University, 1400 Townsend Drive, 870 Dow Environmental Sciences, Houghton, MI, 49931, United States of America, klzhang@mtu.edu

Co-Chair: Dengfeng Yang, Sr. R&D Engineer, Infor US Inc., 8777 N. Stemmons Freeway, Dallas, TX, United States of America, dengfeng.yang@infor.com

1 - Demand-oriented Trains Timetables for a Single Railway Line
Eva Barrena, HEC and Interuniversity Research Center, CIRRELT, 3000 Chemin de la Côte-Sainte-Catherine, Montréal, Canada, eva.barrena@cirrelt.ca, Leandro C. Coelho, Gilbert Laporte, David Canca

We study the design and optimization of train timetables for a rail rapid transit line adapted to a dynamic demand environment. The objective is to minimize the average passenger waiting time at the stations. We first propose two mathematical programming formulations. We then analyze the properties of the problem before introducing a metaheuristic in order to solve large instances of the problem within short computation times.

2 - Comprehensive Operational Dynamic Real-time Train Re-routing for a Freight Train Network
Alborz Parcham-Kashani, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, akashani@gatech.edu, Alan Erera

We present a comprehensive model for the operational problem of dynamically re-routing freight trains in real-time in the event of a network disruption. The model considers the direct and indirect impact of re-routing decisions on the arrival time of rail cars at their final destinations. Compared to past solutions implemented by our sponsor, our model takes into account the potential benefit of avoiding re-routing options that create unnecessary congestion at terminals.

3 - Capacity Evaluation along Baltimore-DC Based on Directional vs. Bidirectional Scenarios of Operation
Hamed Pouryousef, Michigan Tech. University, 824 Dow, CEE Dept. Michigan Tech. Uni, 1400 Townsend Dr, Houghton, MI, 49931, United States of America, hpouryou@mtu.edu, Pasi Lautala

This research takes advantage of the strengths of multiple simulation packages developed in the U.S. and Europe, namely Rail Traffic Controller (RTC), OpenTrack and RailSys, on Baltimore-DC corridor. The main objective was to use their features and capabilities to compare a directional operation approach with current bidirectional approach and estimate the potential speed improvements and eventually better capacity utilization obtained along the segment with directional approach.

4 - Quadratic Programming Model for Optimizing Demand-responsive Transit Timetables
Huimin Niu, Professor and Dean, School of Traffic and Transportation,, Lanzhou Jiaotong University, Lanzhou, China, hmniu@mail.lzjtu.cn, Xuesong Zhou

This talk focuses on optimizing real-time passenger train timetables under time-dependent, geographically distributed demand matrices. A quadratic programming model with linear constraints is developed to dynamically adjust train departure and dwell times at each station to accommodate existing and predicted passenger demands in the near future. We present a few numerical examples to demonstrate the effectiveness of the proposed model.

■ TA28

Hilton- Union Sq 8

Air Transport Data Analysis for Safe and Efficient Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Eric Feron, Georgia Institute of Technology, 270 Ferst Drive, School of Aerospace, Atlanta, GA, 30332-0150, United States of America, feron@gatech.edu

1 - A Decision Theoretic Approach to Aircraft Collision Avoidance
Mykel Kochenderfer, Assistant Professor, Stanford University, 496 Lomita Mall, Durand Building, Room 250, Stanford, CA, 94305, United States of America, mykel@stanford.edu

The Traffic Alert and Collision Avoidance System (TCAS) is currently mandated worldwide on all large transport aircraft to reduce the risk of collision. TCAS uses deterministic models and heuristic rules, which limit the robustness of the system. This talk presents a decision theoretic approach for designing collision avoidance systems. This approach has been used to produce an optimized system that is poised to become the next international standard for collision avoidance.

2 - Using Analytics to Predict and Reduce Delays in Airport Terminals
John-Paul Clarke, Associate Professor, Georgia Institute of Technology, 270 Ferst Drive, Atlanta, GA, 30332, United States of America, johnpaul@gatech.edu, Harold Nikoue

In this talk, we present a decision support tool that predicts excessive passenger wait times inside the airport based on flight information, smart-phone-derived passenger movement data, and planned staffing levels. As part of this work, we developed a stochastic simulation to model the demand at the airport, and determine how changes in staffing levels can mitigate congestion.

3 - Data-Driven Methods for Detection of Anomalous Trajectories
Nikunj Oza, NASA, nikunj.c.oza@nasa.gov

Currently, problems in the National Airspace are found using exceedances, which are pre-defined, known anomalies. They cannot identify unknown anomalies. Data-driven methods for anomaly detection and identify data points that do not fit statistically with most of the data. These methods have been used to identify previously unknown but safety-relevant anomalies. This talk will describe our recent work on data-driven anomaly detection on radar track data over LAX, DEN, and the New York metroplex.

4 - A Comprehensive Flight Risk Model
Suresh Rangan, Technical Fellow, FedEx, 3131 Democrat Rd, Memphis, TN, 38118, United States of America, Suresh.Rangan@fedex.com, Mingzhou Jin, Ying Zhang

Various risks are involved in flight operations, including crew proficiency, equipment, environment, performance, and external pressures. Based on investigation on the practice and interactions with pilots, a comprehensive risk model is proposed to incorporate the logic relationship between dozens of factors and overall risk. Factor weights are verified with historical data. The model is used to minimize the overall risk and enhance flight safety in the most effective way through optimization.

■ TA29

Hilton- Union Sq 9

Project Management 1

Contributed Session

Chair: Laleh Ghalami, Wayne State University, 4500 Cass Ave., #427, Detroit, MI, 48201, United States of America, laleh.ghalami@wayne.edu

1 - Project and Portfolio Management: Combination of Data Envelopment Analysis and Structural Equation

Roseane Silveira, UFRN, Av Salgado Filho, 3000, Campus Universiterio, Lagoa Nova, Natal, 59072970, Brazil, roseane_rodrigues1@hotmail.com, Mariana Almeida, Jesus Aramayo

In this study, we present a model of combined use of data envelopment analysis and structural equations to construct an evaluation model of project management and portfolio selection applicable to brazilian petroleum industry. This model is possible to evaluate the influences from: project teams; quality and scope, and planning and control for successful management and establish benchmarks in project portfolio. The results can help to make decision for future improvement.

2 - Influence of Contractual Incentive and Trust on Contractor's Cooperative Behavior

Yongcheng Fu, Tianjin University, 92 Weijin Road, Nankai District, Tianjin, 300072, China, fuyongcheng@tju.edu.cn, Lihan Zhang, Yongqiang Chen

This paper distinguished two kinds of contractor's cooperative behavior, task-based behavior and relationship-based behavior, and studied the following research questions: 1) how the combination of contractual incentive and trust influence contractor's cooperative behavior; 2) how to determine the optimal incentive coefficient; 3) what are the boundary conditions for the complementation of contractual incentive and trust.

3 - Knowledge Sharing in the Inter-organizational Teams: The Influence Mechanisms of Relationships and Task Conflicts

Zhi Chen, University of Science and Technology of China, School of Management, Hefei, 230026, China, zhichen@mail.ustc.edu.cn

Knowledge sharing within inter-organizational teams is critical to team creativity. We proposed a model relating team conflict to knowledge sharing, and knowledge sharing to team creativity. The moderating effect of shared leadership on the relationship between team conflict and knowledge sharing were examined.

4 - Constrained Project Allocation Problem

Abdulaziz Alkabaa, PhD Student, University of Tennessee, 851 Neyland Drive, Knoxville, TN, 37996, United States of America, aalkabaa@utk.edu, Alberto Garcia-Diaz

A combined project selection-for-investment and allocation-for-development model is formulated for a transportation agency to maximize the value of benefits derived by users of a highway system subject to budget constraints, using Mahalanobis distances. Projects are developed by in-house engineers or private contractors. An overview of the solution procedure is given.

5 - Refining Engagement: A Team Process Model

Amy Sommer, Assistant Professor, HEC Paris, 1 Rue de la Liberation, Jouy-en-Josas, 78351, France, Sommera@hec.fr, Lisa Stickney, Deanna Kennedy

Team engagement is herein considered through task and relational engagement dimensions. We discuss the link of antecedents to task and relational engagement, team processes, and outcomes. This framework can enhance the way engagement is used for team selection, training, outcomes, and employee retention.

■ TA30

Hilton- Union Sq 10

Vacation and Online Scheduling

Cluster: Scheduling and Project Management

Invited Session

Chair: Marc Posner, Professor, Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, posner.1@osu.edu

1 - Makespan Minimization Subject to Machine Unavailability and Total Completion Time Constraintsi

Yumei Huo, Associate Professor, CUNY at Staten Island, Staten Island, NY, United States of America, yumei.huo@csi.cuny.edu

In this research, we study the preemptive bi-criteria scheduling problems on m parallel machines with machine unavailable intervals. The goal is to minimize the makespan subject to the constraint that the total completion time is minimized. We study the model where each machine can have multiple unavailable intervals, but at any time, there is at most one machine unavailable. We show that there is an optimal polynomial time algorithm for this model.

2 - Minimizing Total Completion Time in Flowshop with an Unavailable Interval on the First Machine

Hairong Zhao, Associate Professor, Purdue University at Calumet, Hammond, IN, 46323, United States of America, hairong@purduecal.edu

We study the problem of minimizing total completion time in 2-stage flowshop with an unavailable interval on the first machine. The problem is NP-hard in the strong sense even if both machines are always available. With availability constraint, many papers have studied the makespan minimization problem, but no research is done on total completion time minimization. Our paper is the first attempt to investigate the problem and our goal is to develop an efficient branch-and-bound algorithm.

3 - Online Production Planning and Information Purchase to Maximize Market Share

Marc Posner, Professor, Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, posner.1@osu.edu, Chris Potts, Nicholas G. Hall

We consider a production planning problem with complete information about current orders. Additional orders become available at a known time. Prior to this time, costly information about these orders may become available. We maximize the proportion of orders completed by their due dates, minus information cost, if purchased. We describe an asymptotically best possible algorithm that maximizes the value of information. Further, we study the sensitivity of performance to decisions.

■ TA31

Hilton- Union Sq 11

Analytics in Cloud

Sponsor: Service Science

Sponsored Session

Chair: Rahul Ghosh, IBM, 3039 Cornwallis Road, Durham, NC, 27709, United States of America, rghosh@us.ibm.com

1 - Statistics @ Scale

Chiranjit Mukherjee, Statistician, Google, 1600 Amphitheatre Pkwy, Mountain View, CA, 94043, United States of America, chiranjitmukherjee@gmail.com

This presentation focuses on available statistical tools and techniques available on/for popular cloud computing environments.

2 - On Outlier Detection and Workload Forecasting for Contact Centers

Rahul Ghosh, IBM, 3039 Cornwallis Road, Durham, NC, 27709, United States of America, rghosh@us.ibm.com, Gyana Parija, Sudhanshu Singh, Santosh Srivastava

Long term forecasting for contact centers with high accuracy is an issue of great importance since it triggers capacity planning, scheduling, hiring and training activities for the contact center. Forecasting for businesses with outliers is more difficult because outliers add an extra layer of randomness to the historical data. We propose a method for forecasting that identifies various kinds of outliers and allows users to assess their impact for analysis and forecasting.

3 - Resource Allocation in Cloud Storage

Ioannis Papapanagiotou, Assistant Professor, Purdue University, 401 N Grant Street, West Lafayette, IN, 47907, United States of America, ipapapan@purdue.edu, Zhihao Yao

Cloud storage solutions have gained immense popularity as a paradigm for the dynamic provisioning of storage services deployed on Backend systems. In this work, we present our vision and discuss the research challenges in the volume request allocation in Cloud storage systems with multiple backend systems. We will present efficient policies that can provide efficient and fast allocation of the volume requests, and can also provide a guaranteed Quality of Service.

4 - Gaining Deeper Insights from Text: Unsupervised Learning Methods Perform Better

Abhinav Shashank, Co-Founder & CEO, InnovAccer, D-66 First Floor, Sector 63, Noida, UP, 201301, India, abhinav@innovaccer.com, Kanav Hasija

Machine Learning techniques with training corpus are useful in extracting entities, objects, emotions, personalities, and other characteristics from text, although are highly context-biased. We, in this paper, present techniques to perform such exercises which are context independent. Good data corpus and re-iteratively tested algorithms are building blocks for these techniques.

■ TA32

Hilton- Union Sq 12

Team Performance

Cluster: Workforce Management and Engineering

Invited Session

Chair: Gretchen A. Macht, Pennsylvania State Unviersity, State College, PA, United States of America, gretchen.macht@gmail.com

1 - Interpersonal Skills, Communication, and Team Performance

Gretchen A. Macht, Pennsylvania State University, State College, PA, United States of America, gretchen.macht@gmail.com, David A. Nembhard, Robert M. Leicht

We consider the degree to which mixed Emotional Intelligence (EI) characteristics of interpersonal skills predict team performance. When specifically examining intellectual tasks the literature demonstrates that interpersonal skills, how individual understand others' emotions, were not significant with engineering project team's performance. This study utilized structural equation models to examine the direct and indirect effects of interpersonal skills on team performance. The current results contribute to the literature by adding further understanding of the mediating variable, such as communication, that exist within the emotional intelligence-performance team dynamic.

2 - The Effect of Task Complexity on Deadline Rush in Individual and Team Performance

Ji-Eun Kim, Pennsylvania State University, State College, PA United States of America, blessedpond@gmail.com

"Deadline rush" occurs when work rate increases as a deadline approaches. Using an Anti-Air Warfare Coordinator (AAWC) task, we show that task complexity is associated with higher deadline reactivity of for both individual and team work. The current result highlights the importance of task complexity in managing and forecasting human behaviors in the presence of deadlines.

3 - Some Effects of Deadline Proximity on Work Performance

David A. Nembhard, Pennsylvania State University, State College, PA, United States of America, dan12@psu.edu, Kenneth Doerr

Deadlines have been known for some time to influence human behavior. However, the management of people and associated deadlines poses unanswered questions. How do deadlines affect individual work rate variability? What role does communication play in team performance in the presence of deadlines? These questions are important to aid managers in making operational and policy decisions regarding deadlines. Results indicate evidence that communication has an effect on performance in the presence of deadlines, and also has some impact on the variability of performance.

■ TA33

Hilton- Union Sq 13

Product Design and Manufacturing

Cluster: New Product Development

Invited Session

Chair: Gulru Ozkan, Clemson University, Department of Management, 120B Sirrrine Hall, Clemson, SC, 29634, United States of America, gulruo@clemson.edu

1 - Product Design in a Decentralized Supply Chain: Value of Information Asymmetry

Narendra Singh, Georgia Tech, Atlanta, GA, United States of America, Narendra.Singh@scheller.gatech.edu, Stelios Kavadias, Ravi Subramanian

We study an OEM's optimal product design and sourcing strategies in a supply chain consisting of an OEM, who has a less-efficient alternative sourcing option, and a more-efficient supplier with the power to dictate contract terms. We show that if the competitiveness of the OEM's alternative source is sufficiently low, the first-best quality is chosen. Further, we show that asymmetric information about the OEM's cost structure may lead to higher profits for both the OEM and the supplier.

2 - Problem-Solving Effort and Success in Innovation Contests: The Role of National Wealth and Culture

Cheryl Druehl, George Mason University, 4400 University Drive, Fairfax, VA, United States of America, cdruehl@gmu.edu, Jesse Bockstedt, Anant Mishra

Innovation contests allow firms to harness specialized skills from diverse participants. We examine the implications of diversity,in terms of national wealth and culture, in such contests on problem-solving effort and success. Also, we examine whether "home bias" effects exist. Using a large dataset from an online logo-design contest and country-level archival data, we find that diversity in wealth and culture do impact problem-solving effort and find evidence of "home bias" effects.

3 - A Behavioral Analysis on the Use of an Intermediary in Manufacturing Outsourcing

Qiong Chen, Clemson University, 100 Sirrine Hall, Clemson University, Clemson, SC, 29631, United States of America, qiongc@g.clemson.edu, Aleda Roth, Gulru Ozkan, Fred Switzer

In this paper, we examine how the perceived capability of the intermediary, perceived costs, time pressure and the type of manufacturing outsourcing decision act to systematically influence manager's decision to outsource production either directly or indirectly through an intermediary. We present a behavioral operations model, constructs and empirically validated measures.

■ TA35

Hilton- Union Sq 15

Risk Analysis Models for Critical Infrastructure and Service Systems

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Joost Santos, Assistant Professor, George Washington University, 1776 G St NW, Suite 101, Washington, DC, 20052, United States of America, joost@gwu.edu

1 - The Strive for Financial Accountability and its Impact on the Utility Created by an NGO

Christian Burkart, WU Vienna University of Economics and Business, Welthandelsplatz 1, D1.4106, Vienna, 1020, Austria, christian.burkart@wu.ac.at, Tina Wakolbinger, Fuminori Toyasaki, Michael Fearon

Financial accountability measures including administrative cost ratios are increasingly employed by donors to quantify aid agencies' performance. Typically lower administrative costs are seen as preferable ignoring possible positive effects. In this paper, we develop an optimization model that analyzes the influence of the consideration of administrative costs on the decision-making behavior and utilities of NGOs, beneficiaries and donors.

2 - Risk Mitigation in a Supply Chain Infrastructure Using Fault-Tree Optimization

Mike Sherwin, Mississippi State University, Mississippi State, MS 39732, United States of America, mds539@msstate.edu, Hugh Medal, Steven Lapp

This paper presents a quantitative approach to improve decisions related to risk mitigation within a supply chain infrastructure using a combination of fault-tree analysis and mathematical optimization. A fault-tree is analyzed to determine the optimum mitigation and resource allocation plan that reduces the probability of an event given budgetary constraints.

3 - Analysis of Drought Mitigation Strategies using Dynamic Input-Output Modeling and Event Trees

Joost Santos, Assistant Professor, George Washington University, 1776 G St NW, Suite 101, Washington, DC, 20052, United States of America, joost@gwu.edu

Climate change is expected to increase the frequency and intensity of droughts in many parts of the world. The adverse effects of droughts can propagate through regional sectors as a result of their inherent interdependencies. In this work, we evaluate three drought management strategies by combining economic input-output modeling with event tree analysis: (i) reducing the initial level of water supply disruption, (ii) managing water consumption, and (iii) prioritizing water-use dependencies.

4 - Estimating the Effects of Utility Disruption on Household Well-being During Hurricane Sandy

Pallab Mozumder, International Hurricane Research Center, Florida International University, Miami, FL, 33199, United States of America, mozumder@fiu.edu, Sisi Meng

Intense winds and flooding brought widespread interruptions to public utility services along Hurricane Sandy's path in the Northeastern US. Using household survey data, we provide an initial estimate of the household damages due to disruption in utility services (electricity, water, gas, telecommunication and public transportation). Understanding major determinants of damages caused by utility disruptions and its impact on household well-being can provide key inputs for disaster management.

■ TA36

Hilton- Union Sq 16

Telecommunications Network Flows and Design

Sponsor: Telecommunications

Sponsored Session

Chair: Stanko Dimitrov, University of Waterloo, 200 University Avenue West, Waterloo, Canada, sdimitro@uwaterloo.ca

1 - Assessing Vulnerability of Wireless Telecommunications Networks

Ozgur Kabadurmus, Assistant Professor, Yasar University, Bornova, Izmir, Turkey, ozk0001@tigermail.auburn.edu

In telecommunications network design problems, survivability and reliability are well known QoS metrics to mitigate service disruptions. In this study, wireless telecommunications network designs obtained by optimization for capacitated resilience and well known network reliability/survivability metrics (k-terminal reliability and traffic efficiency) are compared in terms of their performance (and vulnerability) in network attacks and random failure scenarios.

2 - Compact Formulation of the Network Design Problem: An Empirical Study

Eli Olinick, Associate Professor, Southern Methodist University, Dallas, TX, 75205, United States of America, olinick@lyle.smu.edu, Adam Colley

We present a new formulation for network flows in undirected graphs yielding significantly smaller LP's than those derived from the node-edge or edge-path formulations. This characterization of network flow yields a more compact formulation allowing more efficient solutions including instances either too large or too time consuming to solve by the standard edge-path and node-edge formulations, and is applied to the network design problem in an empirical study.

3 - Generating OSPF Weights from Computed Routing Polices that Account for Active Queue Management

Stanko Dimitrov, University of Waterloo, 200 University Avenue West, Waterloo, Canada, sdimitro@uwaterloo.ca, Jiaxin Liu, Laura Sanita

We present work on generating OSPF weights from routing policies computed for backbone networks that account for active queue management (AQM). We show that for a given all-pairs routing policy, finding bounded integer edge weights such that the given routing policy can be derived using shortest paths is NP-Hard. We test the realizability of OSPF policies accounting for AQM on a set of backbone networks and compare the performance of our generated policies with the policies currently used.

■ TA37

Hilton- Union Sq 17

Public-Private Partnership and Performance Based Logistics Contract Design

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Amir Reza KashaniPour, University of Maryland, College Park, College Park, United States of America, akashani@umd.edu

1 - Bilateral Contract Design for Wind Energy Projects under Uncertainty

Xinyuan Zhu, Graduate Research Assistant, University of Maryland, College Park, University of Maryland, College Park, MD, 20742, United States of America, zxyemily@umd.edu, Qingbin Cui

This paper proposes a stochastic program to design the long-term Power Purchase Agreement (PPA) for wind energy projects. The long-term risks and cash flow volatility are considered through the metric of Conditional Value at Risk (CVaR), and a chance constraint is proposed to depict the electricity buyer's non-regret attitude. The model is applied to the Cape Wind offshore project in US as the case study, and the optimized PPA of the project is discussed through an out-of-sample analysis.

2 - Maintenance Enterprise Resource Planning (MERP): A Budget Simulation for PBL

Rogers Ascef, Lt Col - PhD Candidate, 905 Spruance Rd, Monterey, CA, 93940, United States of America, rascef@nps.edu

One of way to manage Maintenance Supply Chain (MSC) is to use Performance Basic Logistic. One of more arduous tasks of PBL management is to know how much I have to pay to match an operational availability. The research proposes to build a simulation using a proposed model called Maintenance Enterprise Resource Planning (MERP) to predict the budget based in the service level and the quantity of usage of equipment. Also, this simulation can be used to negotiate contracts using PBL.

3 - A Non-cooperative Lease Contract

Maryam Hamidi, Session Chair, University of Arizona, 1127 E. James E. Rogers Way, Room 111, P.O. Box 210020, Tucson, AZ, 85721, United States of America, mhamidi@email.arizona.edu, Ferenc Szidarovszky, Haitao Liao

Here a game-theoretic model is developed to study the process by which the owner (lessor) leases certain equipment to a user (lessee) under a lease contract. The lessor and lessee need to jointly decide on optimal lease period, usage rate and preventive maintenance policy of the leased equipment. The non-cooperative Nash equilibrium is studied to solve this problem and the structural properties of the optimal strategies are investigated and an algorithm is provided to search for the equilibria.

4 - Stockout Compensation: Joint Inventory and Price Optimization in Electronic Retailing

Hement Bhargave, UC Davis, Graduate School of Management, One Shield Avenue, Davis, CA, 95616, United States of America, hemantb@ucdavis.edu, Daewon Sun, Susan Xu

We analyze the effect of offering a lower price during stockout to compensate for a customer's waiting time, using an EOQ-type inventory-modeling framework but solving simultaneously for both the optimal prices and the lengths of the in-stock and stockout periods. The optimal stockout-compensation policy is to choose period lengths and prices such that the two periods have equal effective prices. Compared with a backorder policy without compensation, the stockout compensation policy improves profits and social welfare but at the expense of consumer surplus.

■ TA38

Hilton- Union Sq 18

Health Care Modeling Optimization I

Contributed Session

Chair: Guven Kaya, PhD Student, Industrial Engineering-University of Houston, E222 Engineering Building 2, Houston, TX, 77204, United States of America, gkaya@central.uh.edu

1 - Modeling and Analysis of Primary Care Delivery System

Xiang Zhong, Research Assistant, University of Wisconsin Madison, 1513 University Avenue, Madison, WI, 53705, United States of America, oliver040525@gmail.com, Molly Williams, Jingshan Li, Sally Kraft

In this work, we introduce an analytical model to characterize the general primary care delivery system. A Markov chain model is built to study the in-room services. The in-room processes are aggregated to a single server and the variation of such process is evaluated. A G/G/1 queuing model with general patient arrival and general service distribution is developed to evaluate the patient length of stay and resource utilization.

2 - Outpatient Appointment Scheduling: Challenges and Opportunities in Korea

KwonGi Mun, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, kwongmun@pegasus.rutgers.edu, Yao Zhao, Endre Boros

The rate of growth in health spending in Korea was more than twice the average across OECD countries. We first review the Korean insurance system, and also start to review previous papers that explain mathematical approaches for reducing the waiting time of patients' queue. A main contribution is that a newly designed mathematical method will help hospitals optimize both profit and patients' satisfaction.

3 - Add-on Surgical Case Scheduling with Multiple Objectives and Stochastic Case Durations

Ashkan Hassani, PhD Student, Wayne State University, 4815 Fourth Street, Detroit, MI, United States of America, ashkan.hassani@wayne.edu, Hakimuddin Neemuchwala, Alper Murat

We study the problem of scheduling add-on cases in a multi-OR facility. Perfect information of all add-on cases is available before the start of day. We formulate a multi-criteria stochastic mixed-integer program and develop an efficient algorithm. Objective is to minimize deviations from planned schedule considering resource constraints. Model and results are verified using data from the Detroit VAMC.

4 - A Benders Decomposition Approach for Beam Angle Optimization (BAO) Problem

Guven Kaya, PhD Student, Industrial Engineering-University of Houston, E222 Engineering Building 2, Houston, TX, 77204, United States of America, gkaya@central.uh.edu, Gino Lim, Wenhua Cao

In radiation therapy treatment planning problems, computational effort grows significantly with data and model size. Benders decomposition technique is useful to overcome memory problem. It divides the problem into many smaller problems, so solving small problems can be more effective than solving a single large problem. We apply Benders method to beam angle optimization (BAO) problem. We use fluence map optimization (FMO) model as subproblem. Prostate cancer case is used to show results.

5 - Optimal Time Planning for Hospital Operating Rooms and Surgery Blocks Allocation under Uncertainty

Qiqi Zhang, University of Windsor, 401 Sunset Avenue, Windsor, ON, N9B 3P4, Canada, zhang1be@uwindsor.ca, Yifei Zhang, Guoqing Zhang

To improve hospital operating room (OR) efficiency, we propose both deterministic and stochastic optimization models for hospital surgery allocation and ORs time planning. The objective of the models is to minimize the sum of fixed OR cost, normal operating cost, and overtime operating cost. Different from existing models, we integrate time allocation for each surgery with OR time planning in the stochastic model. Numerical experiments are conducted to test the results for the two models.

■ TA39

Hilton- Union Sq 19

Optimization in Radiation Therapy and Epidemic Control

Sponsor: Health Applications

Sponsored Session

Chair: Hamed Yarmand, Massachusetts General Hospital and Harvard Medical School, Proton Therapy Center, MGH, 30 Fruit Street, Boston, MA, 02114, United States of America, hamedyarmand@gmail.com

1 - A Clinical Approach to Beam Angle Optimization in Radiation Therapy

Hamed Yarmand, Massachusetts General Hospital and Harvard Medical School, Proton Therapy Center, MGH, 30 Fruit Street, Boston, MA, 02114, United States of America, hamedyarmand@gmail.com, David Craft

In current clinical systems for radiation therapy treatment planning optimization the beams are selected manually and the intensities are then optimized. We investigate the potential benefits of incorporating automated beam selection into such clinical systems using our in-house developed algorithm to generated quality-guaranteed treatment plans which use the minimum number of beams.

2 - Interfacing GAMS and MATLAB for Large-scale Optimization

Jagdish Ramakrishnan, Post-doctoral scholar, University of Wisconsin-Madison, Wisconsin Institute for Discovery, Madison, WI, 53715, United States of America, jramakrishn2@wisc.edu, Steven Dirkse, Michael Ferris

For many applications, modeling languages (e.g. GAMS) provide easy prototyping and linking to optimization solvers while statistical software (e.g. MATLAB) provide much better data analysis ability. We developed a faster data transfer tool for large indexed data between GAMS and MATLAB, now part of the latest GAMS distribution. We illustrate its usefulness by solving a large-scale radiotherapy problem and visualizing the results in CERR, a MATLAB based radiotherapy visualization tool.

3 - Cost-effectiveness Assessment of Influenza Control Strategies using an Agent-based Model

Seyed Hossein Moosavi, Concordia University, 1455 Boulevard de Maisonneuve Ouest, Montreal, QC, H3G2B7, Canada, moosavi.hossein@gmail.com, Elnaz Karimi, Ali Akgunduz, Ketra Schmitt

We assess costs associated with a university influenza control policy and compare these to the costs of illness. Probability assessments are derived from an agent-based model which simulates individual behavior in an university population using a variety of intervention strategies. We then conduct a cost-effectiveness analysis to find the best combination of interventions to control the spread of influenza in the target population.

■ TA40

Hilton- Union Sq 20

Healthcare Delivery Optimization

Sponsor: Health Applications

Sponsored Session

Chair: Bryan A. Norman, Associate Professor, University of Pittsburgh, 1033 Benedum Hall, Pittsburgh, PA, 15261, United States of America, banorman@pitt.edu

1 - Integrated Storage and Shelf-space Allocation via Integer Programming

Nazanin Esmaili, PhD Student, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, nae22@pitt.edu, Jayant Rajgopal, Bryan A. Norman

We address the joint allocation of storage and shelf-space, motivated by the management of inventory items that are dispensed at outpatient clinics. We present an integer programming formulation for selecting the items to be stocked, along with their shelf space allocations, in order to maximize the total value which is based on the desirability of stocking items. We propose several valid inequalities in order to improve computational performance and also present a heuristic algorithm.

2 - Using Optimization-Based Techniques to Reduce the Supply of Surgical Instruments

Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, amycohn@med.umich.edu, Daniel Hazlett

We consider the case of building "trays" or "sets" of surgical instruments — all of the instruments needed by a specific surgeon to perform a specific surgery. We investigate ways to reduce the overall need for excessive/redundant levels of instrument inventory by finding a reduced set of tray definitions that still meet each surgeon's needs.

3 - Peri-operative Healthcare Inventory Management in the Real World

James Benneyan, Director, Healthcare Systems Engineering Institute, 360 Huntington Ave, Boston, MA, 02115, United States of America, j.benneyan@neu.edu, Dayna Martinez, Adam Perruzzi

Typical inventory policies can be difficult to implement in many healthcare settings for a variety of reasons, including culture, physician autonomy, and unavailable or inaccurate data. We summarize several recent projects to improve perioperative inventory management practices and reduce associated costs, including establishing PAR levels, replenishment policies, and processed for updating and maintaining accurate preference cards.

4 - Day-of-Discharge Planning at Acute Care Hospitals

Nicholas Ballester, Wright University, Department of Biomedical, Industrial and Human Factors Engineering, Dayton, OH, 45435, United States of America, Ballester.2@wright.edu, Pratik Parikh, Kylie Bertsch, Nan Kong

We explore the tradeoffs within inpatient discharge processes, which affect the steadiness of intra-departmental inpatient flow, through a simulation study. Our focus is specifically on the sequence of events on the day-of-discharge and its effects on discharge time distribution and upstream boarding. Data collected from a local hospital are used to develop and validate our model. We evaluate a variety of discharge strategies and conduct statistical comparisons on process-related metrics.

■ TA41

Hilton- Union Sq 21

Workload, Quality, and Staffing

Sponsor: Health Applications

Sponsored Session

Chair: Wen-Ya Wang, San Jose State University, One Washington Square, San Jose, CA, United States of America, wenya.wang@sjsu.edu

1 - Improving Emergency Medical Services (EMS) with Time-Region-Specific Cruising Ambulances

Jiun-Yu Yu, Assistant Professor, National Tawain University, No. 1, Section 4, Roosevelt Road, Da-An, Taipei, Taiwan - ROC, jyyu@ntu.edu.tw

EMS refers to both patient transport and medical support solution for people with illness or injuries. Recent clinical evidence shows that time spent by the ambulance to arrive at the scene is critical. To reduce the response time, a time-region-specific ambulance cruising policy is proposed. Analytics and GIS are applied to generate the joint time-region distributions to identify high frequency grids. Simulation models are built to examine various ambulance cruising policies.

2 - Behavior-Aware Nurse Staffing

David Cho, Indiana University, Operations & Decision Technologies Dept, Kelley School of Business, Bloomington, IN, 47405, United States of America, ddcho@indiana.edu, Kyle Cattani, Alex Mills, Kurt Bretthauer

This paper presents nurse staffing models that incorporate quality of patient care and workforce behavior, issues often ignored in current research. For example, we consider behavioral issues such as temporary nurse speedup and its impact on patient length-of-stay. We study the question of whether hospitals can simultaneously reduce costs while achieving better patient outcomes.

3 - Physician Panel Design
Wen-Ya Wang, San Jose State University, One Washington Square, San Jose, CA, United States of America, wenya.wang@sjsu.edu, Diwakar Gupta

This study focuses on the physician panel design problem of determining the patient composition (i.e. panel size and types of patient) for physician panels. We investigate how clinics would allocate a heterogeneous pool of patients who have different propensity for requesting urgent appointments to physicians to balance physician workload and cost of serving patients in a timely manner.

4 - Cross-sector Collaboration in a Population Health Framework
Sandra Potthoff, Associate Professor, University of Minnesota, 420 Delaware Street SE, Mayo Mail Code 510, Minneapolis, MN, 55455, United States of America, potth001@umn.edu

The former mayor of Kansas City was surprised when its county health rankings were dead last in the state in spite of the presence of a premier health system. Population health entails more than a highly functioning healthcare system. It requires collaboration across institutional sectors. As healthcare moves to a population health focus, a cross-sector systems approach is needed with new performance metrics of quality and outcomes. This talk describes early efforts to move in this direction.

■ TA42

Hilton- Union Sq 22

Inventory Management in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Hossein Abouee Mehrizi, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, haboueemehrizi@uwaterloo.ca

1 - Blood Platelet Inventory Management with Protection Levels
Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu, Itir Karaesmen, Ismail Civelek

We consider ordering and allocation of a perishable product with demand for different ages, such as blood platelets. If demand is satisfied with inventory of a different age, a cost is incurred. We propose a simple replenishment and inventory allocation heuristic to minimize the expected total cost that has superior performance compared to existing heuristics in the literature, particularly if supplies are limited.

2 - Optimal Inventory Policy for Perishable Products with Regular and Optional Expedited Replenishmt
William Pierskalla, Professor, UCLA Anderson School, Los Angeles, CA, United States of America, william.pierskalla@anderson.ucla.edu, Lawrence Leung, Deming Zhou

Platelets have a mere three-day life span in U.S. A periodic review inventory system for such a perishable product under two replenishment modes is analyzed. Regular orders are placed at the beginning of a cycle. Within the cycle, the manager has an option of placing an expedited order. For this platelet inventory problem, we prove the existence and uniqueness of an optimal policy that minimizes the expected cost and develop an algorithm to obtain the optimal inventory levels.

3 - Optimal Multi-specialty Surgery Scheduling under Operating Resource and Hospital Bed Constraints
Shrutivandana Sharma, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, shrutivandana@sutd.edu.sg, Hossein Abouee Mehrizi

We consider a bed scheduling problem, where the decision is to schedule surgeries of two different types over a finite horizon. The number of surgeries of each type that can be performed in any period is bounded by the availability of operating resources for that type, as well as the total availability of beds. We formulate the problem as a multi-period capacitated inventory problem, and characterize the optimal solution.

4 - Better Intermediation in Two-Sided Markets
Mustafa Akan, Tepper School of Business; Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, akan@andrew.cmu.edu

This paper proposes a mechanism to maximize the total number of successful matchings by improving the recommendation scheme the intermediaries follow. These recommendations play a crucial role because they shape the beliefs of the agents on the receiving end of the market about the other side.

■ TA43

Hilton- Union Sq 23

Issues Related to Large-scale Data Mining

Sponsor: Computing Society

Sponsored Session

Chair: Philipp Baumann, University of Bern, Department of Business Administration, Schuetzenmattstrasse 14, Bern, 3012, Switzerland, philipp.baumann@pqm.unibe.ch

1 - Sparse Computation for Large-scale Data Mining with Pairwise Affinities
Dorit Hochbaum, Professor, University of California, Berkeley, IEOR Department, Etcheverry Hall, Berkeley, CA, 94720, United States of America, hochbaum@ieor.berkeley.edu, Philipp Baumann

Supervised normalized cut and k-nearest neighbors are two effective classification techniques that employ pairwise affinities. This takes quadratic time and space to generate. Unlike existing sparsification techniques that process the full matrix and round down some of the entries to zero, sparse-computation computes only the high similarity pairs and requires at most linear time. It is demonstrated that sparse-computing delivers dramatic reductions in run times while maintaining high accuracy.

2 - Construction of Index-tracking Portfolios using Data Mining and Linear Programming
Oliver Strub, University of Bern, Department of Business Administration, Schuetzenmattstrasse 14, Bern, 3012, Switzerland, oliver.strub@pqm.unibe.ch, Norbert Trautmann, Philipp Baumann

Index tracking is a popular investment strategy because of the low management and transaction costs. The construction of a tracking portfolio includes selecting an appropriate subset of index constituents, which is computationally expensive. We apply data mining techniques to determine a promising subset in short running time, and linear programming to determine the portfolio weights. This novel approach compares favorably to existing ones in terms of out-of-sample performance and running time.

3 - A Computational Comparison of Machine Learning Methods and the Supervised Normalized Cut
Philipp Baumann, University of Bern, Department of Business Administration, Schuetzenmattstrasse 14, Bern, 3012, Switzerland, philipp.baumann@pqm.unibe.ch, Yan Yang, Dorit Hochbaum

We present a computational study evaluating the binary classification performance of ten machine learning methods. The study includes, for the first time, variants of the recently proposed method of supervised normalized cut. The performance is evaluated in terms of prediction accuracy and run time on various datasets from the UCI Machine Learning Repository. The results demonstrate that k-nearest neighbors, support vector machine and supervised normalized cut perform best in terms of accuracy.

4 - Clustering Categories in Support Vector Machines
Dolores Romero-Morales, Professor in Operations Research, Copenhagen Business School, Denmark, drm.eco@cbs.dk, Emilio Carrizosa, Amaya Nogales Gomez

We propose the Cluster Support Vector Machines (CLSVM) methodology to reduce the complexity of the SVM classifier in the presence of categorical features. Four strategies for building the CLSVM classifier are presented based on solving: the original SVM formulation, a QCQP formulation, and an MIQP formulation as well as its continuous relaxation. We illustrate that our methodology achieves comparable accuracy to that of the SVM with original data but with a dramatic decrease in complexity.

■ TA44

Hilton- Union Sq 24

Energy Information Systems

Sponsor: Information Systems

Sponsored Session

Chair: Wolf Ketter, Professor, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, wketter@rsm.nl

1 - Managing Smart Home Energy Consumption through Intelligent Decision Support

Konstantina Valogianni, PhD Candidate, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, KValogianni@rsm.nl, Wolf Ketter, John Collins, Dmitry Zhdanov

We present a decision support algorithm for smart homes equipped with household appliances and electric vehicles. The presented algorithm is implemented through an intelligent agent, representing the household. We use reinforcement learning and dynamic programming to provide personalized consumption recommendations to household prosumers and evaluate the results under competitive energy markets conditions. By using the algorithm we observe benefits both for the prosumers and the smart grid.

2 - Facilitating Appropriate Compensation of Electric Energy and Reserve through Standardized Contracts

Deung-Yong Heo, PhD Student, Department of Economics, Iowa State University, 260 Heady Hall, Ames, IA, 50011, United States of America, dyheo@iastate.edu, Leigh Tesfatsion

The current design of wholesale power markets makes it difficult to ensure appropriate compensation for many important load-balancing services, such as flexibility in power attributes. This study examines the possibility of facilitating appropriate compensation through the introduction of standardized contracts (SCs) with swing (flexibility) and demonstrates how SCs can be supported by two settlement system permitting efficient load balancing under system constraints and reserve requirements.

3 - Impact of Information Transparency and Social Value Orientation on Smart Grid Balancing

Laurens Rook, TU Delft, Jaffalaan 5, Delft, 2628BX, Netherlands, L.Rook@tudelft.nl, Sudip Bhattacharjee, Xu Han, Wolf Ketter

We tested and found that smart grid balancing under information transparency (where consumers are aware of collective actions for the whole population in different periods) has a better outcome than under no information. We further posited that this effect would be moderated by social value orientation (SVO; the weight people attach to their own benefits relative to those of others).

4 - AgentUDE: The Success Story of the Power TAC 2014's Champion

Serkan Ozdemir, PhD Candidate, University of Duisburg-Essen, DAWIS, Universitat Duisburg-Essen, Schützenbahn 70, Essen, 45127, Germany, serkan.oezdemir@icb.uni-due.de, Rainer Unland

Future smart grid will bring new actors and features such as local producers, storage units and interruptible consumers to the current electricity grid. Power Trading Agent Competition (Power TAC) provides a comprehensive simulation platform to enable various smart grid studies as well as an annual competition in which autonomous brokers trade in the power markets and gain profits. AgentUDE won the 2014 games as the newest participant of the competition utilizing an adaptive and reactive agent.

■ TA45

Hilton- Union Sq 25

Behavior in Supply Chains and Procurement

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Ruth Beer, PhD Candidate in Technology and Operations, Ross School of Business, University of Michigan, 701 Tappan Street, R4421, Ann Arbor, MI, 48109, ruthbeer@umich.edu

1 - Does the Retailer Lie about Sales Under a Revenue Sharing Contract? An Experimental Investigation

Yinghao Zhang, Assistant Professor, Salisbury University, Perdue Hall 333, 1101 Camden Avenue, Salisbury, MD, 21804, United States of America, YXZHANG@salisbury.edu, Tianjun (TJ) Feng

We investigate whether the retailer will truthfully report the sales data to the supplier under a revenue sharing contract, and how the retailer's truth-telling (or lying) behavior may influence the supplier's contract decisions. Our theory shows that a profit maximizing retailer will always report "zero" sales, leading the supplier in favor of a wholesale price contract. The lab experiment, however, suggests otherwise.

2 - Sourcing Decisions Leading Up To and Following High Impact, Low Probability Disruptions

Kyle Goldschmidt, Pennsylvania State University, 426A Business Building, University Park, PA, 16802, United States of America, khg116@psu.edu, Doug Thomas, Chris Craighead, Mirko Kremer

We examine decision-making regarding supply base diversification when threatened by high impact, low probability (HILP) supply chain disruptions.

3 - Decision Making and Cognition in Multi-Echelon Supply Chains: An Experimental Study

Brent Moritz, Assistant Professor, Penn State University, 469 Business Building, University Park, PA, 16802, United States of America, bmoritz@psu.edu, Arunachalam Narayanan

Individual decision making contributes to the bullwhip effect. Using a large experiment, the cognitive profile of decision-makers results in substantial differences in cost and order quantity variance. We report subject-level decision heuristics: The degree of the underweighting the supply line is linked to an individual's level of cognitive reflection.

4 - The Impact of Decision Rights and Long Term Relationships on Innovation Sharing

Ruth Beer, PhD Candidate in Technology and Operations, Ross School of Business, University of Michigan, 701 Tappan Street, R4421, Ann Arbor, MI, 48109, ruthbeer@umich.edu, Hyun-Soo Ahn, Stephen Leider

We study a supplier's incentives to share an innovation with a buyer when sharing the innovation increases efficiency but makes the supplier vulnerable to the buyer sharing it with other suppliers. We show, both theoretically and experimentally, that the supplier's optimal decision depends on the length of the relationship and in particular, on how the buyer allocates decision rights among its employees.

■ TA46

Hilton- Lombard

Non-traditional Topics in Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu

1 - Isomorphism Pruning on General Integers

Jim Ostrowski, Assistant Professor, University of Tennessee, 525K John D. Tickle Building, 851 Neyland Drive, Knoxville, TN, 37996, United States of America, jostrows@utk.edu, Jeff Linderoth, Francois Margot

Isomorphism pruning helps solve highly symmetric integer programming problems by using symmetry to fix variables and prune branch-and-bound nodes. Implementing isomorphism pruning on general integers has been difficult. In past work, branching on a variable with k many possible values required k-many children. We show how to drop this restriction and allow for a traditional 2-child branching strategy.

2 - Fast Column Generation for Submodular Minimization

Andrew Orso, University of Michigan, 1102 Maiden Lane Ct, Apt 112, Ann Arbor, MI, 48105, United States of America, orso@umich.edu, Siqian Shen, Jon Lee

We present a practical column generation algorithm for the general submodular minimization problem together with computational results demonstrating that our algorithm performs well on a diverse set of instances.

3 - Strengthened Sparse Approximations for Polytopes

Andres Iroume, Georgia Tech, Atlanta, GA, United States of America, airoume3@gatech.edu, Santanu Dey, Marco Molinaro

When MIP-solver use cuts to separate fractional solutions, the preferred option is sparse cuts (those with only a small number of non-zero coefficients). A natural question, recently addressed by Dey, Molinaro and Wang, is; how well can we approximate a polytope P only using sparse cuts. In this talk we address the problem of allowing a limited number on dense cuts (on top of the sparse ones) to strengthen approximate P.

4 - Approximating Sparse Covering Integer Programs Online

Viswanath Nagarajan, University of Michigan, Ann Arbor, MI, United States of America, viswa@umich.edu, Anupam Gupta

We study covering integer programs (CIPs) in an online setting, where the constraints arrive over time. We give an O(log k log L)-competitive randomized online algorithm for solving CIPs. Here k and L denote the row and column sparsity of the constraint matrix. Our algorithm is based on the online primal-dual paradigm, where a novel ingredient is to allow dual variables to increase and decrease throughout the course of the algorithm.

■ TA47

Hilton- Mason A

Robust and Prior-free Optimization – Theory and Applications

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Chaithanya Bandi, Kellogg School of Management, Northwestern University, Evanston, IL, United State of America, c-bandi@kellogg.northwestern.edu

1 - Data-driven Learning in Dynamic Pricing using Adaptive Optimization

Phebe Vayanos, MIT Sloan School of Management, 50 Memorial Dr., Cambridge, MA 02142, United States of America, pvayanos@mit.edu, Dimitris Bertsimas

We consider the pricing problem faced by a retailer endowed with a finite inventory of a product offered to price-sensitive customers. The parameters of the demand curve are unknown to the seller who has at his disposal a history of sales data. We show that the seller's problem can be formulated as an adaptive optimization problem with decision-dependent uncertainty set. We obtain a conservative approximation in the form of mixed-binary conic optimization problem that is practically tractable.

2 - A Tractable Analysis of the Transient Behavior of Queues

Nataly Youssef, MIT, 20 Palermo St., Cambridge, MA 02141, United States of America, youssefn@mit.edu, Dimitris Bertsimas, Chaithanya Bandi

We propose a tractable approach for studying the transient behavior of multi-server queues. We model the queueing primitives via polyhedral uncertainty sets inspired by the limit laws of probability. Our approach provides qualitative insights via closed form expressions and produces accurate numerical predictions of transient waiting times for heavy traffic queues with various interarrival and service time distributions, heavy tail coefficients and number of servers.

3 - Resourceful Contextual Bandits

Ashwinkumar Badanidiyuru, Google Research Scientist, Google, 707 Continental Circle, Apt 927, Mountain View, CA, 94040, United States of America, ashwinkumarbv@gmail.com

We study contextual bandits with constraints on resources, which are common in applications such as choosing ads or dynamic pricing of items. We design the first algorithm for solving these problems that improves over a trivial reduction to the non-contextual case. We consider very general settings for both contextual bandits (arbitrary policy sets, Dudik et al. (UAI'11)) and bandits with resource constraints (Badanidiyuru et al. (FOCS'13)), and prove a regret guarantee which is near-optimal.

4 - Algorithmic Linear Regression via Modern Optimization Methods

Angela King, MIT, 77 Massachusetts Ave, E40-129, Cambridge, MA, 02139, United States of America, aking10@mit.edu, Dimitris Bertsimas

Linear regression is one of the most widely applied statistical methods. Some properties of a good model include a parsimonious fit, statistically significant variables, robustness to uncertainty in data, and interpretability. Obtaining a model with all these properties is typically done by trial and error. We algorithmize the process of fitting linear regression models using tools from integer, continuous, and robust optimization and provide evidence that this outperforms standard techniques.

■ TA48

Hilton- Mason B

Network and Graphs 3

Contributed Session

Chair: Patrick O'Reilly, PhD Candidate, Mineral and Energy Economics, Colorado School of Mines, P.O. Box 11, Golden, CO, 80402, United States of America, poreilly@mines.edu

1 - Fast Community Detection Method for Social Network

Cheng-Bang Chen, Penn State University, 445 Waupelani Dr. Apt.K18, State College, PA, 16801, United States of America, czc184@psu.edu

Analyzing the network structure is a powerful tool in studying entity relationships. There are lots of community detection methods, but most of them function just through the network structure. We develop a community detection algorithm with both structure and extra node information which is useful in social network.

2 - Evolution of Market Process in Reverse Supply Chains as Rapidly-Exploring Random Trees

Patrick O'Reilly, PhD Candidate, Mineral and Energy Economics, Colorado School of Mines, P.O. Box 11, Golden, CO, 80402, United States of America, poreilly@mines.edu

Seeing markets as networks is neither new, nor standard. Capturing market emergence has been elusive, yet something that can be characterized with network models, minimally as supply chains, and more extensively as rapidly-exploring random trees (a random graph). Where markets are thought to be missing, they may be emergent, if not already in a less visible, but mature speculative existence. The case of reverse supply chains in durable goods is offered as a timely example.

3 - A New Method to Evaluate the Deterioration-Effect Multi-state Flow Network Reliability

Wei-Chang Yeh, National Tsing Hua University, No.101, Sec. 2, Guangfu Rd., East Dist., Hsinchu City, Taiwan - ROC, weichang.yeh@gmail.com, Yi-Yun Chang

The arcs and nodes of multistate flow network (MFN) are obey the flow conservation law but sometimes arcs would had deterioration-effect. For example, signal transform will decrease if the transmission distance is too great. The deterioration-effect of arcs MFN model called MFNde. An example presented to illustrate how the proposed algorithm that use MP to calculate the deterioration-effect d-minimal path and evaluate the reliability of an MFNde model.

4 - Social Network Formation Modelling

Song Chew, Associate Professor, Southern Illinois University Edwardsville, IL, 62026, United States of America, schew@siue.edu

We present a model for social network formation. In this model, a new born node attaches to a random number of randomly chosen existing nodes. We study the node degree distribution for this model.

5 - A Biased Random-key Genetic Algorithm to Maximize the Accepted Lightpaths in WDM Optical Networks

Celso Ribeiro, Universidade Federal Fluminense, Departamento de CIÍncia da Computaçao, Niteroi, 24210-240, Brazil, celso@ic.uff.br, Julliany Brand„o, Thiago Noronha

Routing and wavelength assignment in optical networks consists in routing a set of lightpath requests, such that lightpaths with common links are assigned to different wavelengths. The goal is to maximize the number of requests that may be accepted, given a set of available wavelengths. We propose a biased random-key genetic algorithm for solving this problem. Computational results show that the average optimality gaps obtained with this heuristic are smaller than 4% for literature instances.

■ TA49

Hilton- Powell A

Network Interdiction Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Hugh Medal, Assistant Professor, Mississippi State University, 260F McCain Hall, Mississippi State, MS, 39762, United States of America, hugh.medal@msstate.edu

1 - Experimental Evaluation of Network Robustness against Multi-Strategy Greedy Attacks

Mario Ventresca, Assistant Professor, School of Industrial Engineering, Purdue University, 315 N Grant St, West Lafayette, IN, 47907, United States of America, mventresca@purdue.edu, Dionne Aleman

The robustness of networks versus an attacker who sequentially selects from a number of different strategies, each of which removes one node from the network is investigated. We analyze four robustness measures and six network centrality measures form the set of strategies at the disposal of the attacker. A comparison to single-strategy attack is also performed. Betweenness attacks often outperform random and greedy multi-strategy selection, the latter often becoming trapped in local optima.

2 - Optimal Deployment of Security Resources: Analyzing the Damage and Intervention Cost Tradeoff

Apurba Nandi, Mississippi State University, 1120 East Lee Blvd, Apt 160, Starkville, MS, 39759, United States of America, akn77@msstate.edu, Hugh Medal

The high degree of dependency of today's firms on information systems means that they are highly vulnerable to information theft and sabotage through different forms of security breaches. In this paper, we find the optimal intervention strategies, which minimize the objectives: 1) the loss due to security breaches and 3) the cost of intervention. We formulate the problem as a mixed-integer linear program and develop exact and heuristic solution algorithms.

3 - A Bi-Level Programming Model for the Wireless Network Jamming Placement Problem

Venkata Surya Vadlamani, Mississippi State University, 205 Lynn Ln, Apt# 5F, Starkville, MS, 39759, United States of America, vv66@msstate.edu, Hugh Medal, Burak Eksioglu

We study a network interdiction problem on a multi-hop multi-channel wireless network in which an attacker places jamming devices to minimize the expected throughput of the network. We model the problem as a bi-level attacker-defender mixed integer program. The attacker locates a limited number of jamming devices, and the defender determines an optimal channel hopping strategy. The defender seeks to maximize the equilibrium network throughput, and the attacker seeks to minimize it.

■ TA50

Hilton- Powell B

Optimization, Network 2

Contributed Session

Chair: Fatih Mutlu, Qatar University, MIE Department, Doha, 2713, Qatar, fatihmutlu@qu.edu.qa

1 - An Optimization Model for A Multi-Tier Ring Based Design of a Greenfield Transport Optical Network

Fatih Mutlu, Qatar University, MIE Department, Doha, 2713, Qatar, fatihmutlu@qu.edu.qa, Karam Al-Shorbassi

We develop a multi-tier ring based design for a greenfield transport optical network. Each demand node is assigned to one of the potential nodes and nodes will form a 3-tier ring network structure. The network consists of one tier-1 ring, and multiple tier-2 rings, each of which is connected to two tier-1 nodes, and multiple tier-3 rings, each of which is connected to two different tier-2 nodes. We develop an MIP formulation for the design problem and a construction heuristic.

2 - Age-based Preventive Maintenance in Multi-component Systems: An Integer Programming Approach

Khatereh Ahadi, University of Arkansas, 1601 North Leverett, Apt 20, Fayetteville, AR, 72701, United States of America, khatereh.ahadi@gmail.com, Kelly Sullivan

In this study, we consider a multi-component system in which components become less reliable over time. For this system, we seek to schedule component replacements over a finite time horizon in order to minimize the cost due to component and system failures and replacement of the components. We present a new class of integer programming models derived from a network-based linear programming formulation that represents the system reliability.

3 - Finding Optimal Mean-Risk Routes in Dynamic Stochastic Networks: a Stochastic Dominance Approach

Xing Wu, Assistant Professor, Lamar University, 4400 MLK Parkway, Cherry Engineering RM 2032, Beaumont, TX, 77706, United States of America, xing.wu@lamar.edu

The mean-risk model is widely used in the stochastic routing problems in networks for its compact and easy-to-understand form. The risk is usually defined as the standard deviation of the route travel time. Previous studies solve this model by assuming link travel times following normal distributions and employing the central limit theorem. This study relaxes this constraint and aims to find a general approach to solve this model in dynamic networks based on the stochastic dominance theory.

4 - Stochastic Random Projection Algorithm for Stochastic Network Design Problem

Umit Tursun, Postdoctoral Research Associate, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave. B-14, Urbana, IL, 61801, United States of America, utursu2@illinois.edu, Rakesh Nagi

We consider a comprehensive random projection algorithm for stochastic network design problems under uncertain demand, where the objective and constraints are defined by convex functions and integrality restrictions are imposed on a subset of the decision variables. A stochastic convex random projection optimality algorithm for lower bound and a stochastic random projection feasibility algorithm for upper bound are used in succession converging to the solution set almost surely.

■ TA51

Hilton- Sutter A

Network Flow & Nonlinear Optimization

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Emre Tokgoz, Quinnipiac University, 275 Mount Carmel Ave., Hamden, CT, 06518, United States of America, emre.tokgoz-1@ou.edu

1 - Transportation Network Flow Problems on Manifolds

Emre Tokgoz, Quinnipiac University, 275 Mount Carmel Ave., Hamden, CT, 06518, United States of America, emre.tokgoz-1@ou.edu

Research problems in the network flow theory are mainly in the Euclidean space setting. In this talk, transportation problems will be considered on manifold settings with applications.

2 - Using Neural Networks to Optimize Blood Transfers among US Regions in a Simulated Natural Disaster

Hussein Ezzeldin, ORISE Fellow, OBE, CBER, FDA, 10903 New Hampshire Ave, WO71 room 1009C, Silver Spring, MD, 20993, United States of America, hussein.ezzeldin@fda.hhs.gov, Richard Forshee, Arianna Simonetti

We present a model of the US blood supply network, where the daily blood transfers among regions are optimized by using a Dynamic Neural Networks Heuristic (DNNH). The DNNH is capable of modeling a complex non-linear function of quotidian and forecasted regional factors to optimize the holistic performance of the network. In support of planning for emergency preparedness, blood transfers during normal operational conditions are compared with those simulated for a natural disaster.

3 - A Study on Cascading Failure Phenomenon of Interdependent Supply Chain Networks

Liang Tang, Southeast University, No.2, Sipailou Campus, Nanjing, Nanjing, China, tangericliang@gmail.com, Jie He, Ke Jing

To analyze the robustness of complex interdependent supply chain networks composed of a cyber-layer network and a physical-layer network while the supply chain system suffers from disruption events, a cascading failure model is presented. Through a giant component function and one-to-one directed interdependence relation, time-varied functional equations are constructed to reveal the robustness of supply chain networks. A numerical simulation shows the fragility of such interdependent networks.

■ TA52

Hilton- Sutter B

Conic Optimization

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: John Mitchell, Professor, Rensselaer Polytechnic Institute, 325 Amos Eaton, Math Sciences, 110 Eighth St, Troy, NY, 12180, United States of America, mitchj@rpi.edu

1 - Strengthening a Second Order Cone Relaxation for Binary Quadratic Polynomial Problems

Julio César Göez, Postdoctoral Fellow, GERAD, Montreal, QC, Canada, jgoez1@gmail.com, Miguel Anjos

This work builds on the second order cone relaxation for binary quadratic problems proposed by Ghaddar, Vera and Anjos (2011) who used a polynomial optimization approach. We explore how this relaxation can be strengthened using additional constraints. In particular, we explore the combination of disjunctive conic cuts with this relaxation. We present computational results on a test set containing various types of binary quadratic polynomial problems.

2 - Using Disjunctive Conic and Cylindrical Cuts in Solving Quantitative Asset Allocation Problems

Sertalp B. Cay, PhD Candidate, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, sec312@lehigh.edu, Julio Göez, Tamas Terlaky

The novel methodology of disjunctive conic and cylindrical cuts (DCC) was developed recently to solve mixed integer second order cone optimization (MISOCO) problems. First steps are made in implementing this powerful methodology in a Branch-and-Conic-Cut software package. In this study, we explore the use of this novel methodology in solving asset allocation problems. Preliminary numerical results show that DCC have significant positive impact when solving a set of realistic problem instances.

3 - Relaxing Nonconvex Quadratic Functions by Multiple Adaptive Diagonal Perturbations

Hongbo Dong, Assistant Professor, Washington State University, Neill 103, Pullman, WA, 99164, United States of America, hongbo.dong@wsu.edu

We propose a novel cutting surface procedure to derive strong convex quadratic relaxations for a set defined by a nonconvex quadratic function and some separable constraints. Our relaxations do not use a large number of lifted variables. We design a specialized coordinate minimization algorithm to solve the separation. Computational results show that our approach has potential to be successful in a branch-and-bound approach to solve general mixed-integer quadratically constrained programs.

4 - Completely Positive Reformulations for Optimization Problems

with Complementarity Constraints

John Mitchell, Professor, Rensselaer Polytechnic Institute, 325 Amos Eaton, Math Sciences, 110 Eighth St, Troy, NY, 12180, United States of America, mitchj@rpi.edu, Lijie Bai, Jong-Shi Pang

We derive equivalent convex completely positive reformulations for several classes of nonconvex optimization problems defined over convex cones, including rank-constrained semidefinite programs and quadratically constrained quadratic programs (QCQPs). The first part of the reformulation is to cast the problem as a conic QCQP with just one nonconvex constraint with a special structure. Our results do not make any boundedness assumptions on the feasible regions of the problems considered.

■ TA53

Hilton- Taylor A

Operations - Finance Interface

Cluster: Optimization in Finance

Invited Session

Chair: Dan Iancu, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, daniancu@stanford.edu

1 - How Fast Should You Grow? Balancing Growth and Survival in a Cash Constrained Firm

Vishal Gaur, Cornell University, Johnson School, Ithaca, NY, United States of America, vg77@cornell.edu, Yasin Alan

We analyze the optimal investment policy of a cash constrained firm and compare it to different heuristics commonly used in practice. Through this, we develop practical insights into the relationship between firm growth and probability of survival.

2 - Supply Function Equilibrium in Electricity Markets

John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Nur Sunar

Many financial markets, such as those for electricity, include supply and demand offers that result in the equilibrium prices and quantities. In commodity markets, the actual supply can be uncertain, implying changes in the nature of the equilibrium. This talk will present models for these functions and implications for electricity markets.

3 - Operationalizing Financial Covenants

Gerry Tsoukalas, Wharton, Walnut Street, Philadelphia, PA United States of America, gtsouk@wharton.upenn.edu, Dan Iancu, Nikos Trichakis

We study the interplay between the design of financial covenants and the operational decisions of a retailer that obtains financing through secured (asset-based) lending contracts. While it is widely held that covenants serve to protect lenders, the ways in which a retailer can adapt his operations in response have not been studied. Endogenizing this effect, we show that the retailer can use operational levers (such as "fire sales") to diminish or even circumvent covenant effectiveness.

4 - Impact of Input Price Variability in Stochastic Inventory Systems

David Chen, University of Minnesota, 111 Church Street, Minneapolis, MN, 55455, United States of America, chen2213@umn.edu, Saif Benjaafar, William Cooper

We examine the impact of input price variability and correlation in the context of inventory system with stochastic demand and stochastic input prices. For a general class of such systems, and for a wide range of assumptions regarding price evolution, we show that that higher input price variability leads to lower expected cost.

■ TA54

Hilton- Taylor B

Stochastic Modeling in Financial Engineering

Sponsor: Financial Services Section

Sponsored Session

Chair: Rafael Mendoza-Arriaga, McCombs School of Business, University of Texas at Austin, 1 University Station, Austin, TX, 78712, United States of America, rafael.mendoza-arriaga@mccombs.utexas.edu

Co-Chair: Lingfei Li, Assistant Professor, The Chinese University of Hong Kong, 608 William M.W.Mong Engr Bld, Shatin, Hong Kong - PRC, lfli@se.cuhk.edu.hk

1 - Sticky Reflecting Ornstein-Uhlenbeck Processes and Interest Rate Modeling with Zero Lower Bound

Yutian Nie, Northwestern University, 2145 Sheridan Rd, Evanston, IL, 60208, United States of America, YutianNie2016@u.northwestern.edu, Vadim Linetsky

We study sticky reflecting Ornstein-Uhlenbeck processes which are solutions to SDEs with sticky boundary conditions. We construct sample paths of the solution by means of time change and represent the transition semigroups in terms of spectral expansion. As an application, we propose a Markovian short rate model with zero lower bound based on sticky OU processes under which zero coupon bond and interest rate derivative prices have analytical solutions though eigenfunction expansion.

2 - Long Term Risk and Ross Recovery: A Martingale Approach

Likuan Qin, PhD Candidate, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, LikuanQin2012@u.northwestern.edu, Vadim Linetsky

We start with a pricing kernel in the semimartingale asset pricing framework and study existence of the long-term forward measure. We show that in the ergodic Markovian environment the Hansen-Scheinkman factorization of the pricing kernel into the permanent and transitory components naturally emerges, and Ross recovery emerges as the special case. The strength of our semimartingale approach is that we naturally extend these concepts to non-Markovian models and, in particular, treat HJM models.

3 - Additive Subordination and its Applications in Finance

Rafael Mendoza-Arriaga, McCombs School of Business, University of Texas at Austin, 1 University Station, Austin, TX, 78712, United States of America, rafael.mendoza-arriaga@mccombs.utexas.edu, Lingfei Li

Applications in finance often require the use of time-inhomogeneous Markov processes. This paper studies additive subordination, which we show is a useful technique for constructing time-inhomogeneous Markov processes with analytical tractability. Additive subordination is the natural time-dependent generalization of the classical Bochner's subordination. We develop an analytical tractable formula for pricing crack spread options, as an application example.

4 - Modeling Electricity Prices: A Time Change Approach

Zhiyu Mo, The Chinese University of Hong Kong, Hong Kong - PRC, zymo@se.cuhk.edu.hk, Rafael Mendoza-Arriaga, Lingfei Li, Daniel Mitchell

We develop a new framework for modeling electricity spot prices by time changing the basic affine jump diffusion, which successfully captures seasonal spikes. Our model is easy to estimate from data and it is tractable for pricing electricity derivatives.

■ TA55

Hilton- Van Ness

Improved Methods for Solving Special Classes of MINLP

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Francisco Trespalacios, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ftrespal@andrew.cmu.edu

1 - A New Non-convex Quadratic Programming Approach for Mixed Integer Programming

Jaehwan Jeong, York College of Pennsylvania, 211 Willman Business Center, York, PA, 17402, United States of America, jjeong@ycp.edu, Chanaka Edirisinghe

We present an efficient approach for mixed integer quadratic optimization models based on the iterative use of our previously developed solution method for nonconvex quadratic programming. The method is tested with large-scale investment portfolio selection problems and compared with the MIQP solver in CPLEX.

2 - Logic-based Outer-approximation for the Global Optimization of Generalized Disjunctive Programs

Francisco Trespalacios, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ftrespal@andrew.cmu.edu, Ignacio E. Grossmann

An alternative way to represent MINLP problems is Generalized Disjunctive Programming (GDP) that involves algebraic equations, disjunctions and logic propositions. In this work we present a logic-based outer-approximation algorithm to find the global solution of non-convex GDPs. The algorithm solves a master MILP and an NLP subproblem. The basic algorithm is improved with three main features: a novel derivation of a new type of cuts, a two-stage partition, and a parallelization of subproblems.

3 - A New Class of Minimum Triangle Inequalities (MINTI) for 0-1 QCQPs
Jitamitra Desai, Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, jdesai@ntu.edu.sg

We present a new class of minimum triangle inequalities (MINTI) for 0-1 QCQPs. We prove that these inequalities are superior to the traditionally used triangle inequalities, and offer several variations of these new cutting planes. We also present an improved branch-and-bound algorithm that incorporates certain properties from the MINTI cuts, and prove the efficacy of these cuts via our computational results.

4 - The Extended Supporting Hyperplane Algorithm for Convex MINLP Problems
Andreas Lundell, Abo Akademi University, Biskopsgatan 8, Turku, 20500, Finland, andreas.lundell@abo.fi, Jan Kronqvist, Tapio Westerlund

The extended supporting hyperplane (ESH) algorithm can be used to solve convex mixed-integer nonlinear programming (MINLP) problems as sequences of linear and mixed-integer linear programming problems. It is based on the extended cutting plane (ECP) algorithm, however instead of cutting planes, supporting hyperplanes are utilized. In addition, it includes a preprocessing step based on solving linear problems to efficiently obtain a tight linear relaxation of the nonlinear feasible region.

■ TA56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - MATLAB: An Environment for Operations Research and Data Analytics
Seth DeLand, MathWorks, robin@mathworks.com

MATLAB is a platform for analysis, visualization, simulation, and optimization. You can access and analyze real-world data and develop customized algorithms that scale to your largest problems. Join us to see how MATLAB can help you explore data, develop algorithms, and integrate analytics into enterprise applications. You'll also learn about new features including mixed-integer linear programming, machine learning, and working with Big Data.

2 - MOSEK ApS - What's New in MOSEK 7.1
Andrea Cassioli, Product Manager, MOSEK ApS, andrea.cassioli@mosek.com

MOSEK 7.1 has just been released! We will show what's new: an improved MIP solver; a simplified interface to some BLAS functions; an extended support for MPS and the new CBF formats; a new automatic conic reformulation tool for quadratic problems; and an overall update of the Fusion API.

■ TA57

Hilton- Golden Gate 1

Assessment Techniques

Sponsor: INFORM-ED

Sponsored Session

Chair: Dionne Aleman, Associate Professor, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, aleman@mie.utoronto.ca

1 - Does the Structure of a Capstone Design Course Matter?
Anita Vila-Parrish, North Carolina State University, Raleigh, NC, United States of America, arvila@ncsu.edu, Renata Konrad, Adrienne Hall-Phillips

The goal of this research is to explore how differing capstone course designs and structures impact student learning and related industry workforce needs. We outline the rationale, study methods, approaches to course organization, structure, and delivery used across two institutions with Industrial Engineering departments.

2 - Final Results of Reliability Testing on Georgia Tech's Oral Presentation Scoring System
Judith Norback, Georgia Tech, Atlanta, GA, United States of America, judith.norback@isye.gatech.edu

We will describe the in- depth reliability testing of the Norback/Utschig Oral Presentation Scoring System and its use at Georgia Tech. Then we will cover implementation of the scoring system in OR/ MS settings. Instructional materials will be distributed.

3 - Crowdmark: An Online Utility for Improved Grading Processes and Engineering Accreditation Review
Dionne Aleman, Associate Professor, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, aleman@mie.utoronto.ca

Crowdmark (CM) is an online utility that allows for collaborative grading and instant delivery of feedback and class statistics to students. We analyze the process of grading via CM v. traditional grading, and find that CM presents significant time-savings and is more conducive to leaving detailed feedback for students. We investigate how CM can automatically collect and analyze assessment data for engineering accreditation review, standardizing and streamlining a typically harrowing process.

■ TA58

Hilton- Golden Gate 2

Production and Scheduling 1

Contributed Session

Chair: Gregory DeYong, Assistant Professor, Southern Illinois University, Rehn Hall 207C, Mail Code 4627, 1025 Lincoln Drive, Carbondale, Il, 62901, United States of America, gdeyong@siu.edu

1 - A Behavioral Perspective on Workload Control Concepts: Setting the Workload Norm for Order Release
Anita Klotz, Research Assistant, University of Innsbruck, Universitaetsstrasse 15, Innsbruck, 6020, Austria, anita.klotz@uibk.ac.at, Hubert Missbauer

Most of the research on production planning and control (PPC) is linked to control structures, mathematical models and algorithms without explicitly considering human behavior. For the implementation of a behavioral perspective on a PPC concept including workload control, we investigate the effect of changing the workload norms on human behavior in a laboratory experiment. Our contribution is to stress the importance of considering behavioral aspects in the specification of workload norms.

2 - Transient Analysis of Bernoulli Serial Production Line with Perishable Products
Feng Ju, University of Wisconsin Madison, 1513 University Avenue, Room 3235, Madison, WI, 53706, United States of America, fju2@wisc.edu, Jingshan Li

In this presentation, a serial production line with Bernoulli reliability model machines, finite buffers and perishable products will be presented. Analytical formulas are derived to evaluate transient performance in two-machine case. In addition, a computationally efficient aggregation-based procedure is introduced to estimate the performance in longer production lines.

3 - Optimal Control of Kanban Systems: Impact of Production and Consumption Rates
Gregory DeYong, Assistant Professor, Southern Illinois University, Rehn Hall 207C, Mail Code 4627, 1025 Lincoln Drive, Carbondale, Il, 62901, United States of America, gdeyong@siu.edu

The traditional kanban control equations ignore the effect of production and consumption rates. Instead, for purposes of cost calculation, production and consumption are considered to be instantaneous events. By modifying the traditional kanban control equations, we are able to evaluate kanban policies more effectively by improving the representation of production and consumption.

4 - A Decomposition Algorithm for the Multi-level Capacity Constrained Lot Sizing Problem
Xue Lu, London Business School, Sussex Pl, London, NW1 4PT, United Kingdom, xlu@london.edu, Zeger Degraeve

Multi-level capacity constrained lot sizing problem (MLSLCP) has high application value, but solving the problem to optimality remains daunting. We decompose the MLCLSP on the time horizon and the multi-level product structure. Computational results show that our algorithm provides a tighter lower bound than all the existing models. We also demonstrate the generality of the decomposition algorithm by extending it to the production routing problem (PRP).

■ TA59

Hilton- Golden Gate 3

Joint Session JFIG/ENRE: Optimization Methods for Invasive Species Control

Sponsor: Junior Faculty Interest Group & Energy Natural Resources and the Environment

Sponsored Session

Chair: Esra Buyuktahtakin, Assistant Professor, Wichita State University, Wichita, KS, United States of America, esra.b@wichita.edu

1 - Cost-effective Acceptance Sampling Plans for U.S. Live Plant Imports Inspection

Robert Haight, USDA Forest Service Northern Research Station, 1992 Folwell Ave, St. Paul, MN, 55108, United States of America, rhaight@fs.fed.us, Cuicui Chen, Rebecca Epanchin-Niell

We address the design of plant import inspections to prevent the introduction of quarantine organisms that threaten U.S. crops and forests. We derive an expression for expected number of accepted infested units (slippage) based on shipment size, infestation rate, sample size, and inspection efficacy. Then, we determine sample sizes for sets of shipments of unknown quality to minimize total expected slippage cost subject to inspection capacity. Optimal plans are compared with current practice.

2 - Optimal Eradication of Invasives: Complications from Structure and Species Interactions

Alan Hastings, Distinguished Professor, Department of Environmental Science & Policy, University of California, One Shields Avenue, Davis, Davis, CA, United States of America, amhastings@ucdavis.edu

I will describe the problem of eradicating an invasive species in an optimal way (minimizing budget or time). Using approaches based on linear programming to look at solutions in a deterministic setting, I will focus on the importance of stage or spatial structure in determining the optimal approach. I will then focus on problems where interactions with other species lead to constraints that change the optimal solution.

3 - An Age-, Density-, and Frequency-Structured Bio-Economic Model for Controlling Invasive Species

Esra Buyuktahtakin, Assistant Professor, Wichita State University, Wichita, KS, United States of America, esra.b@wichita.edu, Eyyüb Kibis, Greg Houseman, Tanner Lampe, Halil Cobuloglu

We present an optimization model to control a biological invasion over time with an objective of minimizing the cost of damage. The age-structured population model includes the seed bank and predicts multi (bi)-logistic rather than simple logistic growth, which may contribute to the lag response in population spread. Additionally, given budget constraints, utilizing control measures every 2-3 years is found to be more effective than yearly control because of the time to reproductive maturity.

■ TA60

Hilton- Golden Gate 4

INFORMS Undergraduate Operations Research Prize

Cluster: INFORMS Undergraduate Operations Research Prize

Invited Session

Chair: Tuncay Alparslan, tuncay.alparslan@american.edu

1 - INFORMS Undergraduate Operations Research Prize

Tuncay Alparslan, tuncay.alparslan@american.edu

The Undergraduate Operations Research Prize Competition is held each year to honor a student or group of students who conducted a significant applied project in operations research or management science, and/or original and important theoretical or applied research in operations research or management science, while enrolled as an undergraduate student. The prize is given each year at the Annual Meeting.

2 - Robust Demand Response Portfolio Management under Operational Uncertainty

Hongfan Chen, Georgia Institute of Technology, Industrial and Systems Engineering, Atlanta, GA, United States of America, Andy Sun, Shijie Deng

In this paper, we consider the demand response (DR) portfolio management problem in an electricity market environment. We particularly study the optimal management of a large number of commercial and industrial resources. We first construct a new mixed-integer optimization model to describe the dynamics of such DR resources. Then, we propose a robust optimization formulation with a new type of uncertainty sets that model the uncertainty in the demand reduction realized by DR resources. An efficient algorithm is proposed to solve the resulting nonlinear mixed integer problem. Computational experiments show the behavior and advantages of the robust optimization model.

3 - Dynamic Resource Allocation Problems with Nonstationary Customer Arrivals: Two-class Case

Chao Qin, University of Michigan, Industrial and Operations Engineering, Ann Arbor, MI, United States of America, umsjtuqc@umich.edu, Cong Shi, Cheng Hua, Huanan Zhang

We study a two-class dynamic resource allocation problem under uncertainty, with the objective of maximizing the expected revenue. The demand for each class of customers is modeled as a nonhomogeneous Poisson process, in which the instantaneous arrival rates can be nonstationary (time-dependent) and correlated, which captures realistic features such as demand seasonality and forecast updating mechanism. We devise an efficient admission control policy, called regret-balancing policy, to solve this class of problems. The key idea is to balance the regret (defined as the difference between the current cost and the hindsight optimal cost) associated with each acceptance or rejection decision. We show that our policy admits a constant worst-case performance guarantee of 2 in terms of regret. We also demonstrate through a comprehensive numerical study that our proposed policy perform consistently near-optimal, with a maximum performance error below 3%. We believe that the key ideas developed in this paper can be broadly applied to other core resource allocation or revenue management problems.

4 - Cash Management System Design for a Major Bank in Turkey

Muberra Ozmen, Middle East Technical University, Industrial Engineering Department, Ankara, Turkey, Engin Yildiz, Gamze Yagiz, Sidika Tunc, Selen Yildirim

An applied project made for a bank is discussed. There is a tradeoff between operational costs and the cost of keeping idle cash at the facilities. To minimize the overall costs while keeping the customer satisfaction at a high level, first the location decisions of the central cash offices (CCOs) and related assignment decisions are considered. Then the cash management system of ATMs is considered. The developed approaches are implemented for a geographical region. The results lead to important savings. A user interface is also developed that allows an easy updating of decisions when there are changes in the system.

5 - Impact of Sensor Measurement Errors in Sensor Positioning in Water Quality Monitoring Networks

Jisu Park, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, United States of America, jpark361@gatech.edu, Chuljin Park, Yongsoon Eun, Mustafa Aral, Seong-Hee Kim

We study the impact of sensor measurement errors in the problem of determining sensor locations in water quality monitoring networks. We develop a probabilistic model for sensor measurement errors and find sensor locations that minimize the expected time until spill detection subject to the reliability of detecting a spill is greater than a pre-specified threshold. Randomness in a contaminant spill and rain events is considered with various levels of bias and variability in sensor measurements.

■ TA61

Hilton- Golden Gate 5

MAS Tutorial Session. Management Innovation to Transform The Department of Defense Logistics Enterprise: An Update

Sponsor: Military Applications Society

Sponsored Session

Chair: Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@knology.net

1 - Management Innovation as a Strategic Technology

Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@knology.net

Using descriptive, prescriptive, and predictive analytics, the concept of "management innovation as a strategic technology" (MIST) is introduced and applied to DoD's materiel enterprise. Cutting-edge supply chain theory, powerful analytical methods, and innovative planning concepts are applied to this national security resource challenge. The complementary power of OR, advanced analytics, and management innovation for dramatic performance improvement and cost savings is demonstrated.

■ TA64

Parc- Cyril Magnin I

Optimal Policies - Supply Chain Applications

Sponsor: Applied Probability Society

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, ananth@engr.wisc.edu

1 - A Stochastic Control Approach to Operationalizing Offshore Production Decisions

Taimaz Soltani, Doctoral Student, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, T.Soltani@tue.nl, Arun Chockalingam, Jan C. Fransoo

We consider a firm that can offshore a portion of its production. The firm can change the proportion of offshored production at any point in time. This change incurs both fixed and proportional costs, and the firm faces a time lag between the decision time and the time the change actually occurs. We formulate this problem as a stochastic impulse control problem, and derive optimal control policies that dictate what proportion of production should be offshored at any point in time.

2 - Exploiting Structural Properties to Analyze High Dimensional Multi-Product Manufacturing Systems

Sanket Bhat, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, sbhat2@wisc.edu, Ananth Krishnamurthy

We analyze a resource allocation problem for multi-product manufacturing systems by formulating a dynamic program. We solve the large dimensional Markov decision process through approximate linear programming approach. By exploiting the structure of the transition probability matrix, we reduce the constraints from exponential to polynomial in number of products. Through numerical studies, we demonstrate the value of divisibility in resources under seasonal demands.

3 - Dynamic Pricing and Inventory Management under Fluctuating Procurement Costs

Renyu Zhang, Olin Business School, Washington University in St. Louis, Campus Box 1156, 1 Brookings Drive, St. Louis, MO, United States of America, renyu.zhang@wustl.edu, Guang Xiao, Nan Yang

We study a periodic review joint pricing and inventory control model under procurement cost fluctuation. The firm adopts the dynamic pricing and dual-sourcing strategy to mitigate the cost fluctuation risk. We characterize the optimal policy and the impact of cost fluctuation upon the optimal decisions. Finally, we conduct extensive numerical experiments that quantify the significant value of dynamic pricing and dual-sourcing in the presence of fluctuating procurement costs and uncertain demand.

4 - Competition Risk in Sourcing Strategies for Assembled Products

Ashesh Kumar Sinha, University of Wisconsin - Madison, 2130 University Ave Apt 77, Madison, WI, 53726, United States of America, asinha4@wisc.edu, Ananth Krishnamurthy

We analyze a system where a product is assembled from multiple components sourced from vendors. The components are classified as core, intermediate, and standard in terms of their design. Using stochastic models we analyze tradeoffs and determine sourcing strategies to mitigate risks of divulging product knowledge while meeting costs and service level objectives.

■ TA65

Parc- Cyril Magnin II

Stochastic Analysis in Games

Sponsor: Applied Probability Society

Sponsored Session

Chair: Ramesh Johari, Stanford University, Huang 311, Stanford, United States of America, ramesh.johari@stanford.edu

Co-Chair: Gabriel Weintraub, Columbia Business School, gyw2105@columbia.edu

1 - Network Security and Contagion

Asuman Ozdaglar, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, asuman@mit.edu, Daron Acemoglu, Azarakhsh Malekian

We present a model of investments in security in a network of interconnected agents. The network connections introduce the possibility of cascading failures depending on exogenous or endogenous attacks and the profile of security investments by the agents. We provide a characterization of equilibrium and optimal investments as a function of the network structure and position, which is captured in terms of new network centrality measures defined through bottleneck nodes of the network.

2 - Approximations for Repeated Auctions with Budgets

Gabriel Weintraub, Columbia Business School, Columbia University, New York, NY 10027, United States of America, gyw2105@columbia.edu, Santiago Balseiro, Omar Besbes

In this talk we provide novel approximation results for the notion of Fluid Mean Field Equilibrium (FMFE) introduced to study the dynamic bidding strategies of budget-constrained agents in repeated auctions. This setting arises in online advertising markets. First, using a natural scaling, we prove that FMFE provides a good approximation to the rational behavior of agents as markets become large. Second, we show that FMFE provides a good approximation even in small markets with few players.

3 - Unbalanced Random Matching Markets: The Stark Effect of Competition

Itai Ashlagi, MIT, 100 Main st., Cambridge, MA, United States of America, iashlagi@mit.edu, Jacob Leshno, Yash Kanoria

We characterize the core in random matching markets with unequal numbers of men and women. We find that even the slightest imbalance leads to harsh competition on the long side. With high probability the core is small, in the sense that a vanishing fraction of agents have multiple stable partners. Further, under any stable matching, approximately, the short side ``chooses" and the long side is "chosen". Simulations show that these features are observed even in small markets.

4 - A Mean Field Approach to Dynamic Matching Markets

Ramesh Johari, Stanford University, Huang 311, Stanford, United States of America, ramesh.johari@stanford.edu, Nick Arnosti, Yash Kanoria

We present a mean field limit theorem for a certain class of dynamic random matching markets. In our model buyers and sellers dynamically arrive over time, and live for unit lifetime. Upon arrival, sellers apply to a subset of buyers present; upon exit, buyers can screen and/or make offers to applicants. Using a contraction argument, we provide a mean field approximation for this system when the number of buyers and sellers becomes large.

■ TA66

Parc- Cyril Magnin III

Smart Monitoring of Complex Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Shuai Huang, Assistant Professor, University of Washington, Industrial and Systems Engineering, Seattle, WA, United States of America

Co-Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, WI, United States of America, kliu8@wisc.edu

1 - Monitoring Wind Turbine Vibration Based on SCADA Data

Zijun Zhang, Assistant Professor, City University of Hong Kong, SEEM Department, P6600, 6/F, Academic 1, Kowloon Tong, Hong Kong - PRC, zijzhang@cityu.edu.hk

Three data-driven models for detecting abnormalities of wind turbine vibrations reflected in time domain are discussed. The k-means clustering algorithm was applied to develop the first monitoring model. The other two monitoring models for detecting abnormal wind turbine vibration were developed by using the concept of a control chart. The performance of the monitoring models for detecting abnormalities of wind turbines reflected in vibration data was validated with the SCADA industrial data.

2 - Multi-dimensional Dynamic Network Modeling and Change Detection

Jing Li, Associate Professor, Arizona State University, jing.li.8@asu.edu, Na Zou

In many areas involving network data, such as social network analysis and communication network modeling, network entities interact through a variety of channels or the interaction is measured by multiple dimensions. The interaction is also dynamic in nature, i.e., the baseline is changing. In this study, we propose a method based on Kalman filter and Gaussian process models to model multi-dimensional network evolution and detect changes.

3 - Dirichlet Process Gaussian State Machine for Change Detection in Nonlinear Nonstationary Processes

Zimo Wang, Texas A&M University, 1301 Barthelow Dr. 21C, College Station, TX, 77840, United States of America, zimowang@neo.tamu.edu, Satish Bukkapatnam, Wayne Hung

We present a nonparametric Dirichlet Process Gaussian State Machine (DPGSM) model and a hypothesis test to discern incipient changes in dynamic intermittency, which is one of the most common types of nonlinear nonstationary behaviors. Extensive experimental investigations suggest that DPGSM can detect incipient surface damage in sensor-integrated ultraprecision manufacturing processes almost two magnitudes of time earlier compared to any other method tested.

4 - Statistical Microstructure Modeling and Reconstruction of Dual Phase Steels
Nailong Zhang, Wayne State University, 5200 Anthony Wayne Dr, Apt 413, Detroit, Mi, 48202, United States of America, eo9364@wayne.edu, Qingyu Yang

Microstructure modeling and reconstruction of dual phase steels has attracted increasing attention in recent years. However, most of the existing methods only consider a single microstructure sample/image so that the randomness of different samples is ignored. In this study, we propose a new modeling and reconstruction method that captures the variation across different microstructure samples. A case study is conducted by applying the proposed method to the dual phase steel DP 980.

■ TA67

Parc- Balboa

Statistical Approaches to Personalized Healthcare II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abe Zeid, Northeastern University, 360 Huntington Ave, Boston, MA, United States of America, zeid@coe.neu.edu

1 - Healthcare Analytics – Predicting Patient Stay through ED Admissions
Yi-Shan Sung, Research Asistant, Penn State, 425 Waupelani Dr., Apt. 509, State College, PA, 16801, United States of America, yqs5097@psu.edu, Paul Griffin, Soundar Kumara, Priyantha Devapriya, Cheng-Bang Chen

With the introduction of 2-mid night rule it is increasingly becoming important to predict patient stay through Emergency Department Admissions. Using admission attributes, clinical parameters and past encounters we develop statistical and graph analytics based techniques to estimate individual patient's expected stay. Results from these in turn will help in developing models for better resource utilization.

2 - Provider Strategic Responses to the Affordable Care Act
Zhongyuan Yu, Stevens Institute of Technology, 1 Castle Point Terrace, Hoboken, NJ, 07030, United States of America, annie.yzy@gmail.com, William Rouse

Healthcare providers are uncertain about how they should best respond to the Affordable Care Act. We present a list of investment strategies and develop a "rich" agent-based approach. By "rich", we mean much richer rule sets and information sources including agents' financial statements and operational performance to address a variety of what-if scenarios. The model, as well a large-scale interactive visualization, facilitates gaining insights important to decision making processes.

3 - Bed Allocation to Reduce Overflow
Jingui Xie, Associate Professor, University of Science and Technology of China, Jinzhai Road 96, Hefei, 230026, China, xiej@ustc.edu.cn, Mabel Chou, Marcus Ang, David Yao

Patients who wait close to six hours are assigned to any available beds in the internal wards. As a consequence, patients are overflowed everywhere, and physicians have to walk all day long to see their patients. To address this issue, we build up an analytical model, and propose different implementable polices. We use the real data from a Singapore hospital and a simulation model to test the proposed polices.

■ TA68

Parc- Davidson

Data Analytics in Simulation

Sponsor: Simulation

Sponsored Session

Chair: Canan Gunes Corlu, Boston University, 808 Commonwealth Avenue, Boston, MA, United States of America, canan@bu.edu

1 - On the Price of Correlation Parameter Uncertainty in Simulation Optimization
Alp Akcay, Assistant Professor, Bilkent University, Ankara, 06800, Turkey, alp.akcay@bilkent.edu.tr, Bahar Biller, Canan Gunes Corlu

We consider a simulation with correlated inputs. We use a multivariate input model for representing the inputs but the correlation parameters of this model are estimated from finite data. In certain cases, the high variability around the correlation parameter estimates increases the value of the expected cost function of the simulation optimization. We discuss the minimization of the expected cost of correlation parameter uncertainty with examples from data-driven inventory management.

2 - Statistical Uncertainty Analysis for Stochastic Simulation with Dependent Input Models
Wei Xie, Rensselaer Polytechnic Institute, 110 8th Street, Center for Industrial Innovation 5207, Troy, NY, 12180-3590, United States of America, xiew3@rpi.edu, Barry Nelson, Russell Barton

When we use simulation to estimate the performance of a stochastic system, the simulation often contains input models with dependent components that were estimated from real-world data. We generalize a metamodel-assisted bootstrapping approach to quantify the impact of dependent input model and simulation estimation error on system performance estimates. Our approach is supported with both theoretical analysis and an empirical study.

3 - Comparing Simulated System Designs under Input Parameter Uncertainty
Bahar Biller, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, billerb@andrew.cmu.edu, Canan Gunes Corlu

We study the problem of comparing simulated systems designs under input parameter uncertainty while aiming for a probability of correct selection that exceeds some user-specified value. Using asymptotic normality approximation and Bayesian simulation replication algorithm for capturing parameter uncertainty in the simulation output data, we demonstrate the effectiveness of our comparison procedures as a function of data length, number of replications and number of alternative system designs.

4 - Simulation of Non-Stationary Queueing Systems
Mohammad Mousavi, Stanford University, Stanford, CA, United States of America, mousavi@stanford.edu, Peter Glynn

We discuss the challenges that arise in the planning simulations of systems with time dependent arrival and service rates. Estimating how far back in time a simulation must be initialized is an essential problem in planning simulations. We propound using reflected Brownian motion (RBM) with time-dependent drift and volatility as a guide for estimating this initialization time. We develop the first exact simulation method for RBM with time-dependent drift and volatility.

■ TA69

Parc- Fillmore

Biofuel Supply Chain and Market

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Guiping Hu, Assistant Professor, ISU, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu

1 - Bi-level Programming Model and Algorithm for Decentralized Biofuel Supply Chains
Fengqi You, Assistant Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, you.fengqi@gmail.com, Dajun Yue

We develop a Stackelberg game modeling and optimization framework for biofuel supply chains with multiple players. The supply chain design problem with leader-follower relationship is formulated as a bi-level programming model, which is reformulated into a single level mixed-integer nonlinear program (MINLP) based on the KKT conditions of the followers' problems. We also develop a tailored branch-and-refine algorithm for the efficient global optimization of the resulting non-convex MINLP.

2 - A Bottom-up Equilibrium Model for Emerging Advanced Biofuel Market
Leilei Zhang, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, leileizh@iastate.edu, Yihsu Chen, Guiping Hu

We develop a bottom-up equilibrium model to study the interactions among the stakeholders along the supply chain of the emerging biofuel market considering different levels of substitution among a variety of advanced biofuels. We analyze the effects of substitution of biofuels on famers' land allocation, biofuel production, biofuel blending, and market prices under a variety of market structures. Policies impacts are analyzed on biofuel markets and social welfares.

3 - A Capacitated Lot-Sizing Model for Biofuel Production with Environmental Consideration
Esra Büyüktahtakin, Wichita State University, Wichita, KS, United States of America, Esra.Buyuktahtakin@wichita.edu, Halil Cobuloglu, Alperen Burak Kantas

In this paper, we present a multi-objective mixed-integer programming model for capacitated ethanol production from switchgrass, sugarcane, corn, and wheat. The model minimizes the production cost while considering tax credits and penalties for excessive carbon emission and water consumption. Sensitivity analysis is conducted on its application to a real biorefinery project in Kansas.

■ TA70

Parc- Hearst

Analytics in the Petrochemical and Petroleum Industries

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Marlize Meyer, Principal Operations Researcher, Sasol, 1 Klasie Havenga street, Sasolburg, 1947, South Africa, marlize.meyer@sasol.com

1 - A Heuristic Approach using Multi-phase Decomposition to Solve IRP Occurring in Bulk Gas Distribution

Tejinder Singh, AIR LIQUIDE, 12800 W. Little York Rd, Houston, TX, 77041, United States of America, tejinder.singh@airliquide.com, Jeffrey Arbogast

This paper solves the inventory routing problem (IRP) occurring in industrial gas distribution where liquefied industrial gases in bulk are distributed to customers with cryogenic tanks for storage. It considers a multi-period IRP with multiple products assuming constant demand rates. The paper details a multi-phase approach based on decomposing the original problem into different sub-problems. Each sub-problem is then solved with a heuristic method applying neighborhood search strategy.

2 - Cooperative Game Theory for Collaborative Logistics in Forestry and Petroleum Industries

Mario Guajardo, Assistant Professor, NHH Norwegian School of Economics, Helleveien 30, Bergen, N-5045, Norway, Mario.Guajardo@nhh.no, Mikael Rönnqvist

We formulate Operations Research models for collaborative logistics arising in forestry and petroleum industries. In the forestry case, the opportunities for collaboration relate to better transportation planning, timber exchange and volume assignments. In the petroleum case, they relate to pooling inventory of spare parts for off-shore platforms. We address coalition structure and cost allocation problems in these cases, using cooperative game theory concepts.

3 - The Effect of Combining RAM Modelling and Stochastic Simulation Modelling on Production Efficiency

Jacques Van Der Westhuizen, RAM Specialist, Sasol, 1 Klasie Havenga Road, Sasolburg, 1947, South Africa, jacques.vanderwesthuizen1@sasol.com

Reliability Availability and Maintainability (RAM) uses Monte-Carlo simulation models to assess key units in the production process and reduce downtime. Sasol has developed an innovative technique that combines RAM with stochastic discrete-event simulation models to assess production risk to its complex gas to liquids value chain. The value of these models has been repeatedly shown through improvements to the bottom line for existing and new plants.

■ TA71

Parc - Lombard

Bidding and Behavior in Procurement Markets

Cluster: Auctions

Invited Session

Chair: Michael N. Katehakis, Rutgers University, Newark, NJ, United States of America, mnk@rutgers.edu

1 - An Empirical Study of Electronic Reverse Auction (ERA) Project Outcomes and Satisfaction

Willem Standaert, Willem.Standaert@UGent.be, Steve Muylle

We develop and empirically test a structural model, which hypothesizes positive relationships between organizational and project antecedents, financial, operational, and strategic ERA project outcomes, and buyer satisfaction. Based on a global field study with 180 purchasing professionals, we found that operational and strategic outcomes were positively related with ERA project satisfaction, while price savings were not.

2 - A Behavioral Model for Overbidding in Sealed-Bid Multi-Attribute Procurement Auctions

Bernardo Quiroga, Pennsylvania State University, State College, PA, United States of America, bernie@psu.edu, Brent Moritz, Daniel Guide, Jr.

In sealed bid auctions, the empirical presence of over-aggressive bidding has been widely documented. Using a laboratory experiment under the independent private values paradigm, we provide a behavioral explanation of this phenomenon. We use a structural estimation of implicit latent private types and their corresponding probability density. We provide results in different contexts, including price-only, quasi-linear-scores, and 'beauty-contest' auctions including dimensions other than price.

3 - Adaptive Bidding in Repeated Auctions

Michael N. Katehakis, Rutgers University, Newark, NJ, United States of America, mnk@rutgers.edu, S. Karti Puranam

We consider the problem of a firm that procures items by bidding in repeated simultaneous auctions. We study adaptive dynamic bidding strategies for the firm that optimize measures of short and long term valuation.

■ TA72

Parc- Stockton

Energy II

Contributed Session

Chair: Mengqi Hu, Mississippi State University, PO Box 9542, Mississippi State, MS, United States of America, mhu@ise.msstate.edu

1 - How Long Do People Keep Reducing Electricity Consumption after Public Pressures?

Shigeharu Okajima, Waseda University, 1-6-1 nishi waseda Shinjyuku ku, Tokyo, Japan, shigeharu.okajima@gmail.com

Japanese media campaigns have begun to support for limiting electricity consumption after the Fukushima nuclear accident. We investigate whether Japanese media campaigns affect Japanese electricity consumption. We found that the commercial sector has reduced electricity consumption, while the residential sector has not changed electricity consumption.

2 - Financial Risk Management of a Lignocellulosic Biorefinery: A Stochastic Programming Approach

Lingfeng Cheng, PhD Student, Cornell University, 111 Wing Dr., Ithaca, NY, 14850, United States of America, lc674@cornell.edu, C. Lindsay Anderson

Bioethanol is a promising fuel alternative. However, given carbon tax constraints and ethanol price uncertainty, how much to produce and how to schedule production is a problem largely neglected. To solve this, we formulate a two-stage stochastic program. In the first stage, a process model is built with carbon tax constraints to determine the optimal production. In the second stage, a scheduling problem is formulated integrating forward contract and CVaR constraints to decrease financial risk.

3 - Collaborative Operation Strategies for Multiple Buildings with CCHP Systems

Mengqi Hu, Mississippi State University, PO Box 9542, Mississippi State, MS, United States of America, mhu@ise.msstate.edu, Rui Dai

To the best of our knowledge, most of the existing research about combined cooling, heating, and power (CCHP) systems focuses on a single building. In this study, we investigate the collaborative operation decisions for multiple buildings with CCHP systems which are allowed to freely share energy and exchange information. A collaborative decision model is presented to determine the optimal strategies that aim to minimize operational cost, primary energy consumption and carbon dioxide emission.

4 - NGL-NA: A New Model of the NGL Market of North America

Robert Brooks, President, RBAC, Inc., 14930 Ventura Blvd, Suite 210, Sherman Oaks, CA, 91403, United States of America, rebrooks@rbac.com

The last decade's "shale gas revolution" has not just recreated the US natural gas industry. It has also revitalized the markets for natural gas liquids and petrochemicals. NGL-NA is a multi-commodity model of the North American market for natural gas liquids. NGL-NA uses optimization techniques to compute flows and prices for each of the various NGL commodities through existing and prospective infrastructure. The presentation will describe the model and results from recently run scenarios.

5 - Equilibrium Investment Strategies in Renewable Portfolio Standards under Uncertainty

Yuta Kamobayashi, Tokyo University of Science, 2641 Yamazaki, Noda-shi, Chiba, Japan, 7414609@ed.tus.ac.jp, Ryuta Takashima

Recently renewable portfolio standard (RPS) has been introduced due to further penetration of renewable energies. In this paper, we propose a two-period competition model in an oligopolistic electricity industry with uncertain demand in order to consider investment behaviors for firms in a framework of the PRS. We analyze an effect of the RPS on investments in renewables and non-renewables. Additionally, we show how a percentage of production from renewables affects the market equilibrium.

■ TA73

Parc- Mission I

Optimization for Critical Infrastructure Resilience

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Feng Qiu, Argonne National Laboratory, 9700 S. Cass Av., Argonne, IL, 60439, United States of America, fqiu@anl.gov

1 - Large-scale Stochastic Power Grid Islanding Operations by Line Switching and Load Shedding

Mehdi Golari, Graduate Research Assistant, University of Arizona, Systems and Industrial Engineering Department, Tucson, AZ, 85719, United States of America, golari@email.arizona.edu, Jianhui Wang, Neng Fan

Under certain contingency states with some failed components or in the process of restoration of a failed power grid, islanding is an efficient method to isolate the failed part to prevent cascading blackout and supply the electricity to the other parts of the power system. We present a large scale stochastic MIP model as well as efficient algorithms to solve the islanding problem.

2 - Assessing and Improving Resilience of Infrastructures to both "Worst Case" and "Most Likely" Events

Dave Alderson, Associate Professor, Naval Postgraduate School, United States of America, dlalders@nps.edu, Jason Ross, Matt Carlyle

Recent events have shown our critical infrastructure systems to be vulnerable to both non-deliberate hazards (e.g., extreme weather, technological failure) and deliberate threats (e.g., terrorist attacks). These events often point to different parts of an infrastructure system as critical, leaving policy makers in a quandary about how to invest a limited budget to increase system resilience. Using a historical example, we contrast and reconcile these views under a common risk-based perspective.

3 - Power System Restoration with Integrated Sectionlization and Generator Start-up Sequencing

Feng Qiu, Argonne National Laboratory, 9700 S. Cass Av., Argonne, IL, 60439, United States of America, fqiu@anl.gov

The restoration process of the bulk power system after a partial or complete blackout relies on generating units with black-start capabilities. In the normal build-up restoration process, the system is sectionalized first into a set of subsystems (islands) in which the generators are started afterwards. In this work, we integrate the two problems into a single model that minimizes the restoration duration for the overall system.

4 - Modeling Disruption Impacts to National Critical Infrastructure

Julia Phillips, Argonne National Laboratory, phillipsj@anl.gov, Stephen Folga

Understanding impacts of disruptions to systems of nation critical infrastructure is a crucial component of national security. The IAC has created a series of linear models for select infrastructure systems that simulate immediate impacts of disruptions to these systems. Outputs include GIS representation of the impacts, as well as information to inform decision makers on critical areas to focus protection or resilience activities towards. Creating links between the models is currently underway

■ TA74

Parc- Mission II

Renewable Energy Integration and Trading in Electricity Markets

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Nur Sunar, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States of America, Nur_Sunar@kenan-flagler.unc.edu

1 - Supply Function Bidding with Uncertain Supply and Demand: Electricity Markets with Renewables

Nur Sunar, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States of America Nur_Sunar@kenan-flagler.unc.edu, John Birge

Despite the high penetration of renewable energy in the electricity generation mix, surprisingly, the implications of supply uncertainty for equilibrium market outcomes and generators' production schedules have not yet been fully analyzed.Using the differential equation theory, our paper shows that if renewable generators strategically bid in electricity markets, the supply uncertainty may have unexpected consequences for equilibrium day-ahead market prices and generators' production schedules.

2 - New Models for Risk Trading

Eddie Anderson, Professor, University of Sydney Business School, University of Sydney, Sydney, Australia, edward.anderson@sydney.edu.au

We introduce a new model for pricing derivatives in a wholesale electricity market, where players trade both to hedge risks and to make profit. The usual analysis derives the forward price from a stochastic model of the underlying dynamics (allowing for risk preferences). We consider a model in which prices arise from market clearing where each player has private information about the underlying price, different degrees of confidence in that information, and different risk preferences.

3 - Competition and Coalition Formation of Renewable Power Producers

Baosen Zhang, Postdoc, Stanford University, 473 Via Ortega, Y2E2 Building, Room 242, Stanford, CA, 94305, United States of America, zhangbao@stanford.edu, Ramesh Johari, Ram Rajagopal

We investigate group formation and strategic behavior of renewable power producers in electricity markets. It has been suggested that renewable producers should form large groups to take advantage of spatial diversity to reduce the uncertainty in their output. We characterize the trade-off between market power and generation uncertainty as a function of group size: there is a sweetspot where groups are large enough to achieve uncertainty reduction, but small enough to have any market power.

4 - SMART-ISO – A Stochastic Model of PJM for Renewables with Robust Cost Function Approximations

Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu, Hugo Simao

SMART-ISO is a carefully calibrated stochastic model of the PJM energy markets and grid which closely matches the PJM decision process with day-ahead unit commitment, intermediate (30 minutes) unit commitment and real-time economic dispatch. We then introduce the idea of a robust cost function approximation policy for unit commitment, which formalizes the approach used by ISOs today. We show that a robust CFA can be tuned to handle relatively high penetrations of off-shore wind.

■ TA75

Parc- Mission III

Simulation and Optimization III

Contributed Session

Chair: Jelmer Van der Gaast, Erasmus University Rotterdam, Burgemeester Oudlaan 50, Rotterdam, Netherlands, jgaast@rsm.nl

1 - Analysis of a Polling System for Dynamic Order Picking

Jelmer Van der Gaast, Erasmus University Rotterdam, Burgemeester Oudlaan 50, Rotterdam, Netherlands, jgaast@rsm.nl

In a dynamic order picking system (DPS), an order picker picks orders in batches that arrive in real-time during its picking cycle, which subsequently changes the order picker's current picking route. We model a DPS as a polling system with batch arrivals and determine the waiting time distribution of an individual order line, as well as, the expected order throughput time. Results show that dynamic order picking lead to short order throughput times compared to traditional batch picking systems.

2 - Simulation-based Robust Revenue Maximization of Complex Truck-Shovel Systems in Surface Coal Mines

Saisrinivas Nageshwaraniyer, University of Arizona, 1502 E 10th St 134, Tucson, AZ, 85719, United States of America, ngsaisrinivas@gmail.com, Young-Jun Son

A robust simulation-based optimization approach is proposed for surface coal mines to maximize revenue. A highly detailed simulation model of a real mine is constructed for case study. Response Surface Methodology is then applied to obtain variance of revenue under the influence of uncontrollable factors such as truck haul times, which are later applied as constraints in optimization. The proposed approach results in higher and robust revenues compared to non-robust optimization formulation.

3 - Labor Capacity Assignment Model for Remanufacturing Environments

Osman Aydas, PhD Student / Research Assistant, University of Wisconsin - Milwaukee, 3202 N. Maryland Ave., Milwaukee, WI, 53211, United States of America, otaydas@uwm.edu, Anthony Ross, Wilkistar Otieno

Study evaluates the performance of labor capacity assignment models of remanufacturing environments characterized by stochastic order arrivals and dynamic labor assignment policies. We consider multiple tiers of repair lead time, seasonality in product flows and different employee skill set requirements for a multistage remanufacturing process. A simulation model is developed to investigate alternatives to achieving the performance targets.

4 - A Comparative Study of TOPSIS, GRA and VICOR Based Taguchi Methods for Optimization of FMS

Berna Dengiz, Professor, Baskent University, Eskisehir Road 20th. km, Ankara, 06510, Turkey, bdengiz@baskent.edu.tr, Yusuf Tansel Ic, Orhan Dengiz, Gozde Cizmeci

This study presents a case study of an FMS considering a multi-response simulation optimization using TOPSIS, GRA and VICOR based Taguchi methods. While reducing simulation experiments with Taguchi design, TOPSIS, GRA and VICOR procedures are used to combine multiple FMS responses into a single response. Optimal configuration is obtained for the FMS with improved performance. Results show that TOPSIS and GRA-based Taguchi methods are better than VIKOR-based Taguchi methods.

■ TA76

Parc- Embarcadero

Succeeding with Revenue Management

Sponsor: The Practice Track

Sponsored Session

Chair: Warren Lieberman, President, Veritec Solutions, 824 Miramar Terrace, Belmont, CA, 94002, United States of America, Warren@veritecsolutions.com

1 - Revenue Management in the Big Data Era

Alex Dietz, Principal Industry Consultant, SAS Institute, SAS Campus Drive, Cary, NC, 27513, United States of America, alex.dietz@sas.com

In the era of Big Data, an impressive array of data has become available to support RM decisions, including competitive prices, customer reviews, and even web logging information. This piece will delve into the practical applications, value, and limitations of this data, based on both research and real-world experience.

2 - Models and Methods

Warren Lieberman, President, Veritec Solutions, 824 Miramar Terrace, Belmont, CA, 94002, United States of America, Warren@veritecsolutions.com

Based on our work in several dozen industries, we have found that certain modeling characteristics can increase the effectiveness of Revenue Management decision support tools. In addition, we have found that organizational structures can significantly affect the quality of Revenue Management/Dynamic Pricing decisions. In this session, we explore the impacts of models and methods on the success of revenue management implementations.

3 - Revenue Management at Disney Cruise Line

Erin Clark, Director, Revenue Management, Disney Cruise Line, 210 Celebration Place, Kissimmee, FL, 34747, United States of America, Erin.Clark@Disney.com

Although relatively small in comparison to many other cruise lines, Disney Cruise Line (DCL) has been a leader in the industry with respect to implementing critical Revenue Management strategies and tactics. While Revenue Management models have certainly been important, so too have DCL's organizational and business process decisions. Our presentation will highlight a variety of aspects of our Revenue Management approach.

■ TA77

Parc- Market Street

Joint Session Analytics/HAS: Topics of Healthcare Analytics II

Sponsor: Analytics & Healthcare

Sponsored Session

Chair: Issac Shams, University of Michigan-Ann Arbor, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, issacsh@umich.edu

1 - An Analytics Approach to Designing Patient Centered Medical Homes

Saeede Ajorlou, University of Michigan-Ann Arbor, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, saeede@umich.edu

This talk presents an analytics approach to design a Patient Centered Medical Home from an operations management point of view. Aggregating multiple data tables for patient attributes, provider characteristics, and station and division variables, we first developed statistical models with variable selection routines to predict annual portfolio healthcare demands. Then, using these models we proposed stochastic optimization models that assign patients to a set of PCMH teams.

2 - A Simulation-based Approach to Estimate the Proportion of Tuberculosis Recent Transmission

Parastu Kasaie, Postdoctoral Fellow, The Johns Hopkins Bloomberg School of Public Health, 3231 Bishop St, Cincinnati, OH, 45220, United States of America, kasaiept@mail.uc.edu, David W. Dowdy, W. David Kelton

Accurate estimation of the proportion of TB from recent vs. remote transmission is critical to disease-control policy. Existing cluster-analysis approaches of TB strains in studies of molecular epidemiology are crude and prone to bias. We study, via simulation, the accuracy of such estimates in relation to disease incidence, underlying reactivation rate, sampling coverage and duration, and develop a more accurate estimator for the true proportion of incidence due to recent transmission.

3 - Predicting Daily Negative Moods of Young Adults using an Elastic-Net Regularized Model

Fan Wang, University of Arkansas, 4207 Bell Engineering, Fayetteville, AR, 72701, United States of America, fxw005@uark.edu, Shengfan Zhang

Depression and stress are two common negative moods in young adults. This study establishes a logistic regression model to predict daily depression and stress for university students. The explanatory variables involve a variety of personal attributes, such as flu symptoms, daily cellphone use and life style. The elastic-net regularization is used to handle the collinearity problems and estimate the best prediction model. Multiple resampling techniques are used to tune the elastic-net parameters.

■ TA78

Parc- Mason

The Past, Present and Future of Teaching Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Ali Abbas, Professor, University of Southern California, Industrial and Systems Engineering, Price School of Public Policy, Los Angeles, CA, United States of America, aliabbas@illinois.edu

1 - Teaching Decision Making with Social Networks

Ali Abbas, Professor, University of Southern California, Industrial and Systems Engineering, Price School of Public Policy, Los Angeles, CA, United States of America, aliabbas@illinois.edu

Teaching decision making with social networks is a new and fun reverse-classroom setting that provides hands-on training and enables students to see immediate benefits of the decision tools they learn in class. This talk summarizes the learning of teaching decision making with Ahoona, a free decision making social network.

2 - DQ 101: An introduction to Decision Quality

Carl Spetzler, Chairman and CEO, SDG, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

This session will review the content of the free MOOC that provides a basic understanding of the elements of DQ. The course requires about 15 hours of effort over five weeks and uses short (3-15 minutes) lectures in a team based online platform. We will also share our experience after having given the course four times.

3 - Innovative Methods and Tools to Teach DA/DQ and Provide On-Demand Decision Support

Mazen Skaf, Managing Director, Strategic Decisions Group, 745 Emerson St, Palo Alto, CA, 94301, United States of America, mskaf@sdg.com

We present innovative tools aimed at teaching the basic principles and methods of DA/DQ, promoting the use of DA, and providing decision support for organizational as well as personal decisions.

4 - Teaching While Doing – Will Universities Join or Get Out of the Game?

Jim Matheson, Chairman, SmartOrg, Inc., 855 Oak Grove Ave Ste 202, Menlo Park, CA, 94025, United States of America, jmatheson@smartorg.com

I began DA in 66-7, and teaching at SU from 68. By mentoring PhD Students, an internship requirement by Bill Linvill, fostered their interest and practical skills. IDs were invented! This year I taught Frontiers in DA by one-day flights and web meetings. Now, SmartOrg is embedding Decision Systems in real organizations, and for the summer has taken on four interns, who will learn much. The future may flip back to internships with mentors and web classes to share experience and learn theory.

5 - Teaching with Ron
Brad Powley, Consultant, SDG, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, bpowley@sdg.com

For many graduate students, being a teaching assistant is a means of funding. Those who served as teaching assistants for Ron Howard's classes will attest that the job itself was one of the most important learning experiences of their university education. This talk will explore Ron's approach to teaching through the unique perspective of his teaching assistants.

6 - What's Past is Prologue: Lessons from Howard Raiffa's Pioneering Multimedia Courses
Patrick Noonan, Professor & Assoc. Dean, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States of America, patrick.noonan@emory.edu

The terms "decision analysis" and "multimedia" are both celebrating 50th anniversaries. Early in the history of both, Howard Raiffa started experimenting with unorthodox blends of print, audio and eventually early PC tools to teach DA. Some of these works shine today, not only as important artifacts of DA history and wonderful, still-relevant examples of his gift for explanation, but as guides for how DA education can thrive in an era of ubiquitous Internet, apps, flipped classes and MOOCs.

■ TA79

Parc- Powell I

Medical Applications in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Jeff Stonebraker, Assistant Professor, North Carolina State University, Campus Box 7229, Raleigh, NC, 27695, United States of America, jsstoneb@ncsu.edu

1 - Medical Technology Applications
Phil Beccue, White Deer Partners, 2228 Knollcrest Pl, Westlake Village, CA, 91361, United States of America, Phil@WhiteDeerPartners.com

Medical products are often perceived as the orphan sister to the glamorous drug industry, yet they include essential elements of modern medical care, from CT scanners to robots used by surgeons. With their unique regulatory and financial pressures, product managers have relied on Decision Analysis methods to help navigate the path to success. We discuss the enhanced value that DA is bringing to this business in a number of recent applications.

2 - Implementation of Decision Analysis for Claims Management at Stanford Medical Center
John Celona, Principal, Decision Analysis Associates, 505 Vista Ave, San Carlos, CA, 94070, United States of America, jcelona@sbcglobal.net

Stanford University Medical Center self-insures and manages claims and lawsuits. Beginning five years ago, we developed and implemented a process to enable routine decision analysis of all lawsuits and claims to drive case management strategy and to set reserves for the captive insurance companies. We present the methods and the results, which to date are far superior to the results from previously used actuarial methods.

3 - Implementing Decision Analysis in a Healthcare Information Technology Company
Elayne Ko, Director, Portfolio and Decision Analysis, Pfizer, Inc., Collegeville, PA, United States of America, Elayne.ko@pfizer.com, Tom Stone

The presentation explores the journey and learning of implementing decision analysis in a healthcare information technology (HIT) company. In HIT, the relationship between specific product investment and return is much less direct compared to the typical industries where decision analysis is more prevalent, e.g., pharmaceutical, oil & gas, mining. This poses challenges in evaluating HIT product investments and decision-making, requiring unique approaches to valuation and risk assessment.

4 - Modeling Latent Therapeutic Demand
Jeff Stonebraker, Assistant Professor, North Carolina State University, Campus Box 7229, Raleigh, NC, 27695, United States of America, jsstoneb@ncsu.edu

This presentation discusses a new medical application area of decision analysis. Decision analysis has been applied extensively in medical decision making for the prevention of, diagnosis of, and the treatment of diseases. There are, however, diseases that can't be prevented. These diseases are often under-supplied where treatment is scarce and uncertain and, consequently, suboptimal for patients. We use decision analysis to model the number of people with the disease and how they are treated.

■ TA80

Parc- Powell II

Real Options in Business Strategy

Sponsor: Decision Analysis

Sponsored Session

Chair: Dharma Kwon, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 South Sixth Street, Champaign, United States of America, dhkwon@illinois.edu

1 - Technological Change: A Burden or a Chance
Verena Hagspiel, Norwegian University of Science and Technology, Industrial Economics and Technology Mgt., Trondheim, Norway, verena.hagspiel@iot.ntnu.no, Peter Kort, Claudia Nunes, Pedro Jesus

This paper considers a firm that faces a declining profit stream for its established product. The firm has the option to invest in a new technology with which it can produce an innovative product while having the option to exit as well as suspend operations at any point in time. Besides timing the firm also has to decide about the size of investment.

2 - The Value of Reducing Lead Time under Non-Stationary Demand
Isik Bicer, Mr., University of Lausanne, Quartier UNIL-Dorigny, B,timent Anthropole, Lausanne, 1015, Switzerland, isik.bicer@unil.ch, Suzanne De Treville, Verena Hagspiel

We build newsvendor model on real-options theory and investigate the value of lead-time reduction under the risk of sudden and abnormal changes in demand forecasts. We use a "jump-diffusion" model and apply an Edgeworth series expansion to explore the impact of sudden changes in demand forecasts on the value of lead-time reduction. We show that the value of lead-time reduction increases substantially in the intensity and/or the magnitude of jumps.

3 - Multi-item Search with Holding Costs
Steven Lippman, slippman@anderson.ucla.edu, Sheldon Ross

We consider a multi-item search problem with a holding cost that is linear in the number of unsold items wherein the seller optimally sells n items. Suppose instead that there are n sellers each with one unit to sell. We show that the return to the n sellers in the decentralized problem is the same as the return to the single seller with n units to sell.

4 - Stochastic Dynamic Game of Principal-Agent under Asymmetric Information with Unobservable Action
Youngsoo Kim, University of Illinois, Chicago, IL, United States of America, ykim180@illinois.edu, Dharma Kwon

We study a dynamic game between an employer and an employee. The employer cannot observe the employee's type and effort, but the employer can observe the employee's performance, which is a Brownian motion with drift governed by the employee's type and effort. The employer learns about the employee's type to either dismiss or promote the employee, and the employee reacts by putting an effort. We find Markov Perfect Bayesian equilibria and compare equilibrium strategies for each type of employees.

■ TA81

Parc- Divisadero

Joint Session Data/AI/HAS: Big Data Analytics and Smart Health III

Sponsor: Data Mining, Artificial Intelligence, & Healthcare

Sponsored Session

Chair: Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com

1 - Strategic Lean Implementation in Healthcare
Yong Taek Min, Boston University, Boston, MA, United States of America, ytmin@bu.edu, Jay Kim, Joseph Restuccia, Michael Shwartz

We assess if there are different lean implementation strategies in hospitals and how effective they are in improving quality and efficiency performance. Lean implementation patterns are identified based on hospitals' differing degree of emphasis on lean principles. Quality and efficiency performance of each hospital is analyzed by using CMS database.

2 - Infectious Disease Facility Location and Outbreak Response Strategies for Africa

Neil Desnoyers, Assistant Clinical Professor, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, ndesnoyers@drexel.edu

The 2013-2014 outbreak of Zaire ebolavirus demonstrates, "Örapid, reliable diagnostic procedures must be implemented Ö closer to endemic [areas] so that local public health officials Ö need [not] rely on distant reference laboratories."(NEJM doi:10.1056/NEJMp1405314) For Ebola and Lassa viruses, diagnostic procedures must be carried out in a BSL-4 laboratory: Two such exist in Africa. We explore facility location and outbreak response strategies using decision modeling techniques.

3 - Data Fusion of 9-axis Inertial Measurement Unit (IMU) From Modern Pedometer for Health Application

Liang Zhou, LiangZhou@savvysherpa.com

Pedometers use built-in accelerometer to count steps. Along with the additional gyroscope and magnetometer sensors, a modern pedometer is able to capture 9-axis data in real-time. In our study, a data fusion method is developed to integrate the outputs from 3 sensors, and a model based activity classification framework is introduced to identify certain types of ADLs (Activities of Daily Living). Some potential health applications will be discussed.

4 - Modeling and Analysis of Multiple Patient Rapid Response Process

Xiaolei Xie, Tsinghua University, Shunde Building, Beijing, 100084, China, xiexiaolei0209@gmail.com, Jingshan Li, Colleen Swartz, Paul DePriest

Improving efficacy of hospital rapid response operations is crucial, which are designed and implemented to treat deteriorating patients. We present an analytical model with a multi-patient network to characterize such a process and evaluate the mean decision time, which is strongly correlated with care quality. Medical resource sharing issue is addressed using a two-level iteration method. Finally, the impact of other factors, such as time variability of patient in normal status, is studied.

■ TA82

Parc- Haight

Behavioral Issues in Adversarial Preference Modeling

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Gilberto Montibeller, London School of Economics, Houghton Street, London, United Kingdom, G.Montibeller@lse.ac.uk

1 - A Multiple-Target Defensive Resource Allocation Game with Quantal-Response Attacking Strategies

Jun Zhuang, University at Buffalo, 317 Bell Hall, Buffalo, NY, 14260, United States of America, jzhuang@buffalo.edu, Yan Wang

This research studies a new attacker-defender game over multiple targets, where the attacker is bounded rational and assumed to use quantal-response strategies. We validate the model using real data from both terrorism and counterterrorism databases.

2 - Adaptive Security Resource Allocation for Protecting Wildlife and Fisheries

Milind Tambe, USC, 3737 Watt Way, PHE 410, Los Angeles, CA United States of America, tambe@usc.edu

While previous works have deployed applications with a game-theoretic approach for counter-terrorism, protecting wildlife and fisheries are important domains presenting new research challenges related to learning behavioral models from collected poaching data. We address this challenge and develop a new algorithm that adaptively improves the security resource allocation strategy against the learned behavioral model.

3 - Framing Value-driven Decision Models for Different Classes of Cyber Adversaries

Richard John, Associate Professor, University of Southern California, RTH 310, University Park, Los Angeles, CA, 90089, United States of America, richardj@usc.edu, Heather Rosoff, Detlof von Winterfeldt

Cyber attackers generally have multiple and conflicting objectives that underlie their motivations. Attackers have evolved from single individuals to organized groups, some state-sponsored, with advanced capabilities to attack U.S. cyber systems. For different classes of cyber adversaries, we demonstrate diversity in values and objectives, attitudes toward risk, trade-offs among conflicting objectives, and uncertainty about the outcomes for alternative attack strategies.

4 - On the Behavioral Validity of Adversaries' Judgments in Count-terrorism Models

Sumitra Sri Bhashyam, Houghton Street, wc2 2ae, London, United Kingdom, S.Sribhashyam@lse.ac.uk, Gilberto Montibeller

In adversarial models, terrorist are seen as rational agents that maximize expected utility, as consequentialist decision makers who have clear objectives and stable preferences, and as being capable of appraising dispassionately the decision context. Here we will scrutinize these assumptions, with evidence available from the terrorism and behavioral decision research literatures, and suggest ways that judgments in counter-terrorism models can be modelled to improve their behavioral validity.

■ TA83

Parc- Sutro

Quality and Statistical Decision Making in Health Care Applications

Sponsor: Data Mining

Sponsored Session

Chair: Shuai Huang, Assistant Professor, University of Washington, Industrial and Systems Engineering, United States of America, shuaihuang@usf.edu

1 - Outcome and State Transition Modeling for Adaptive Interdisciplinary Pain Management

Aera Leboulluec, Adjunct Professor, University of Texas at Arlington, 500 West First Street, 420 Woolf Hall, P.O. Box 19017, Arlington, TX, 76006, United States of America, aerakim77@yahoo.com, Victoria Chen, Li Zeng

This research develops a process based on the inverse probability of treatment weighted method to address the endogeneity while estimating state transition and outcome models. First, a method is developed for independent treatments then a general method is developed for correlated treatments.

2 - Development of Clinical Nutrition Staffing Models Based on Patients Electronic Health Records

Kai Yang, Director, Healthcare Systems Engineering Group, Wayne State University, 4815 4th street, Detroit, MI, 48201, United States of America, kai.yang@wayne.edu, Saeede Ajorlou

The objective of this study is to develop clinical workload models for nutritionists based on patients' electronic health records. A comprehensive multilevel database for inpatient admissions and outpatient visits is first assembled that involves patient, clinical, and case-mix risk factors. Then a hierarchical additive model with a feature selection algorithm that determines a subset of the most relevant factors is used to predict nutritional staffing requirements.

3 - Recursive Reconstruction Method for Time Varying Sparse Signal from Noisy Undersampled Measurements

Kaveh Bastani, Virginia Tech, kaveh@vt.edu, Zhenyu Kong

We study the recursive reconstruction of time varying sparse signal from noisy undersampled measurements. This type of problem has been seen in many signal processing applications, like real-time dynamic MRI. We propose a reconstruction method by estimating the global support set of the signal from the covariance matrix of time series measurements. Then, the recursive reconstruction method is proposed based on sparsity analysis of the truncated signal from spike-and-slab prior model.

4 - A Joint Spectral Decomposition Method for Time-dependent Network Data

Shuai Huang, Assistant Professor, University of Washington, Industrial and Systems Engineering, United States of America, shuaihuang@usf.edu, jing li

The network spectral decomposition method has been widely adopted as a critical enabler in many exiting network analysis methods. Considering that existing spectral decomposition method was built for static network, we develop a general methodology for conducting spectral decomposition on time-dependent network data. The proposed methodology is thoroughly evaluated on two important applications that involve time-dependent network data, e.g., the network prediction and network monitoring.

Tuesday, 11:00am - 12:30pm

■ TB01

Hilton- Golden Gate 6

Mission Planning II

Sponsor: Military Applications Society

Sponsored Session

Chair: Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - UAV Route Planning using Stochastic Dynamic Programming
Aaron Williams, PhD Student, University of Illinois at Champaign-Urbana, 1014 W. Church St., Apt2, Champaign, IL, 61821, United States of America, amwilli2@illinois.edu

We consider the problem of route planning with multiple UAVs with varying degrees of communication on a single map. We present multiple stochastic dynamic programming algorithms to deal with these varying degrees of communication. The stochastic dynamic programming approach has advantages in computational complexity, essential for onboard route planning. We measure the amount of information lost at each communication level.

2 - Sensor Tasking for Unmanned Aerial Vehicles with Limited Communications Bandwidth
Chase Murray, Auburn University, 3301 Shelby Center, Auburn, AL, United States of America, CCM0022@auburn.edu

This talk will explore a sensor tasking problem, where directional sensors operating in multiple modalities must be allocated to time sensitive targets. The system operates in a communications bandwidth-limited environment, such that part of the problem involves deciding the resolution of the data captured as well as the delay between the capture and the broadcast of data. A novel solution approach, making use of the underlying mixed integer linear programming formulation, is presented.

3 - An Exact Method for the Peace-Time Convoy Movement Problem to Minimize Civilian Traffic Disruption
Azar Sadeghnejad Barkousa, University At Buffalo, Industrial & Systems Engineering, Buffalo, NY, 14260, United States of America, azarsade@buffalo.edu, Moises Sudit, Rajan Batta

We seek optimal routing for convoys, with specific time windows and blocking/overtaking constraints, in order to minimize civilian traffic disruption. We offer an exact algorithm based on k shortest path and maximum clique problems. Numerical testing on random networks is performed. CPLEX fails to solve even 6 convoy problems on a 24 node network in 4 hrs. Our method finds an optimal solution for such problems in less than 1 second. A realistic case study from Colombia is our next step.

4 - Measuring the Price of Anarchy for UAV teams
Hector Ortiz-Pena, CUBRC, CUBRC, Buffalo, United States of America, Hector.Ortiz-Pena@cubrc.org, Michael Hirsch, Moises Sudit, Mark Karwan

We develop a formulation to maximize the information gain from a team of autonomous unmanned vehicles (UxVs) to support Intelligence, Surveillance and Reconnaissance (ISR) mission objectives. The formulation is used to evaluate the Price of Anarchy.

■ TB02

Hilton- Golden Gate 7

Business Ecosystem, Networks and Innovation

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Jianxi Luo, Assistant Professor, Singapore University of Technology & Design, 20 Dover Drive, Singapore, SG, Singapore, luo@sutd.edu.sg

1 - Modeling the Evolution of Generativity and the Emergence of Digital Ecosystems
Jason Woodard, Assistant Professor, Singapore Management University, School of Information Systems, 80 Stamford Road, Singapore, 178902, Singapore, jwoodard@smu.edu.sg, Eric Clemons

Agent-based computational modeling offers a powerful tool for studying decentralized innovation and the emergence of digital business ecosystems. We have created a series of models that show how key features of these ecosystems can evolve, including core components and reusable parts. We find that boundedly rational designers without coordination or foresight can generate ecosystems that satisfy diverse consumer preferences and exhibit robustness to changes in these preferences over time.

2 - Using Transaction Networks to Describe the Structure of Sectors
Margaret Dalziel, University of Waterloo, 200 University Avenue West, Waterloo, Canada, mdalziel@uwaterloo.ca, Xiangyang Yang

Today's products are created by the combined efforts of numerous firms linked together by transactions into vast networks known as sectors. Using a novel dataset of the major transactions in the US economy, we analyze the structure of sectors.

3 - Knowledge Discovery for Business Ecosystem Intelligence
Hyunwoo Park, Georgia Institute of Technology, 85 5th St NW, Atlanta, GA, 30308, United States of America, hwpark@gatech.edu, Rahul Basole, Brandon Barnett

We develop and apply a computational knowledge discovery approach for understanding and visualizing innovation, coopetition, and convergence in business ecosystems.

4 - Transaction Cycle Participation, Vertical Integration, and Innovation: An Empirical Network Analysis
Jianxi Luo, Assistant Professor, Singapore University of Technology & Design, 20 Dover Drive, Singapore, SG, Singapore, luo@sutd.edu.sg

A firm's architecture of participation in the business ecosystem may affect its innovation performance. We analyze the transaction network positions and performances of 227 Japanese electronics firms. The results show that, a firm's participation in inter-firm transaction cycles, instead of sequential transactional relationships, has a positive impact on its innovation performance for vertically-integrated firms, but a negative impact for vertically-specialized firms.

■ TB03

Hilton- Golden Gate 7

IS Research with Policy Implications

Sponsor: eBusiness

Sponsored Session

Chair: Min-Seok Pang, Assistant Professor, Temple University, Philadelphia, PA, United States of America, mins.pang@gmail.com

1 - An Economic Analysis of Shared IT Services in Public Sector
Min Chen, George Mason University, 4400 University Drive, Fairfax, VA, 22030, United States of America, mchen15@gmu.edu, Min-Seok Pang

In this study, we build a simple, stylized economic model to analyze the decisions for developing and pricing of a shared IT service, which is a unique phenomenon in the public sector. Governments collectively share enterprise IT services for public services in order to save costs and to improve their bargaining power vis-a-vis IT vendors. We derive implications for the private-sector IT industries.

2 - Gamification Doesn't Work: The Effect of Virtual Rewards and Reputation on User Contributions
Wei Chen, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA, 92093, United States of America, Wei.Chen@rady.ucsd.edu, Xiahua (Anny) Wei, Kevin Zhu

This study examines the effect of two gamification mechanisms, virtual rewards and reputation, on voluntary user contributions in online communities. We analyze panel data from a knowledge sharing platform, and find that surprisingly, neither virtual rewards nor reputation induce user contributions. It is the relative reputation (ranking) that plays a role. These findings highlight the importance of social comparison in the incentive design of online communities.

3 - An International Investigation of the Market Value Impacts of Energy and Carbon Management Systems
Daniel Rush, University of Michigan, R4431 Ross School of Business, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, danrush@umich.edu, Nigel Melville

Energy and Carbon Management Systems (ECMS) are a new type of information system that enable organizations to measure and manage their energy, carbon dioxide, and other greenhouse gases. Companies world-wide are adopting ECMS to comply with regulations, further organizational goals, and respond to their stakeholders. Despite this increased adoption, the financial impacts of these systems are not well understood. This international event study thus investigates the market value impacts of ECMS.

4 - The Internet and Hate Crime: Offline Spillovers from Online Access
Jason Chan, NYU, Stern School, New York, NY, United States of America, jchan@stern.nyu.edu, Anindya Ghose, Robert Seamans

In this paper, we empirically investigate the effect of the Internet on racially-driven hate crimes. To understand the link, we study the extent to which broadband availability affects racial hate crimes in the US from 2000-2008. We deploy a set of econometric techniques to account for estimation biases. We find strong evidence that broadband availability increases racial hate crimes and its effects are stronger in areas with higher levels of racism, income inequality, and education attainment.

■ TB04

Hilton- Continental 1

Empirical Supply Chain Studies

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu

1 - Supply Chain Disruptions and the Role of Information Asymmetry

William Schmidt, Assistant Professor, Johnson Graduate School of Management, 314 Sage Hall, Ithaca, NY, 14853-6201, United States of America, wschmidt@cornell.edu, Ananth Raman

Disruptions have been found to damage firm value. This may induce (1) managers to behave strategically in revealing operational disruptions and (2) the market to respond differently to disruptions when managers can behave strategically. Both factors distort the true economic impact of disruptions on firm value. Our research sheds light on these tangled relationships.

2 - Risk Propagation in Supply Network

Yixin (Iris) Wang, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, United States of America, iriswang@umich.edu, Jun Li, Ravi Anupindi

The goal of this research is to assess interdependency of risks in supply network and to understand the process of risk propagation using firm-level supplier relationship data and risk event data. We focus on high-tech industry and concentrate on impacts of disruptions on interrelated firms through supplier-buyer relationship or more broadly, through sharing common suppliers/customers. We aim to help firms manage risks more efficiently and acknowledge sub-tier importance.

3 - Systematic Risk in Supply Chain Networks

Nikolay Osadchiy, Assistant Professor, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30309, United States of America, nikolay.osadchiy@emory.edu, Vishal Gaur, Sridhar Seshadri

The demand uncertainty faced by a firm can be caused by idiosyncratic factors or systematic economic factors. We investigate how systematic risk propagates through supply chain networks using industry-level data for the manufacturing, wholesale trade, and retail trade sectors of the U.S. economy. We find that the systematic risk increases from retailers to wholesalers and manufacturers, and the increase in systematic risk is driven by the aggregation of orders over customers and time.

4 - Supply Chain Network Structure and Firm Returns

Jing Wu, PhD Student, University of Chicago Booth School of Business, 5050 S Lake Shore Dr 3417S, Chicago, IL, 60615, United States of America, wujing@chicagobooth.edu, John Birge

This paper investigates the effects of supply chain connections on firm performance, as reflected in stock returns, at two interaction levels, first-order from directions and second-order from systemic exposures through the network.

■ TB05

Hilton- Continental 2

Dynamic Learning and Decision Making

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Hao Zhang, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, hao.zhang@sauder.ubc.ca

1 - Generalization and Exploration via Randomized Value Functions

Zheng Wen, Stanford University, 555 W Middlefield Rd, Apt. A304, Mountain View, CA, United States of America, wenzheng.ee@gmail.com, Benjamin Van Roy

We consider reinforcement learning problems in which an agent must generalize from past experience and explore to reduce uncertainty. We propose an approach to explore based on randomized value functions and an algorithm — randomized least-squares value iteration (RLSVI) — that embodies this approach. We explain why algorithms using Boltzmann or epsilon-greedy exploration can be highly inefficient and present computational results that demonstrate dramatic efficiency gains enjoyed by RLSVI.

2 - Weakly Coupled Dynamic Program: Information and Lagrangian Relaxations

Fan Ye, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, fye8@gatech.edu, Enlu Zhou, Helin Zhu

"Weakly coupled dynamic program" consists of multiple controlled stochastic processes that evolve independently but subject to a set of linking constraints on the controls. It decouples into lower-dimensional dynamic programs via Lagrangian relaxation on the linking constraint, which also yields a bound on the optimal value. Based on the Lagrangian relaxation, we utilize the information relaxation approach and propose a computationally tractable method to obtain a tighter dual bound.

3 - Learning to Optimize Via Information-Directed Sampling

Daniel Russo, Stanford University, 218 Ayrshire Farm Lane, Apt. 102, Stanford, CA, 94305, United States of America, dan.joseph.russo@gmail.com, Benjamin Van Roy

We offer a fresh, information-theoretic, perspective on the exploration/exploitation tradeoff and propose a new algorithm—information-directed sampling—for a broad class of online optimization problems. We establish a general expected regret bound and demonstrate strong simulation performance for the widely studied Bernoulli, Gaussian, and linear bandit problems. Simple analytic examples show information-directed sampling can dramatically outperform Thompson sampling and UCB algorithms.

4 - Exact Solution to a Dynamic Learning and Decision Making Problem

Hao Zhang, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, hao.zhang@sauder.ubc.ca

Dynamic decision making is about choosing the best sequence of actions under sequential observations. It is especially challenging when the underlying state (of the machine, patient, customer, etc.) is unobservable. For a large class of problems, e.g. Bayesian learning and sequential hypothesis testing, the underlying state does not change over time. We discuss a general approach for solving such problems, and present an exact solution in the two-state case with interesting structural results.

■ TB06

Hilton- Continental 3

Practice-Based Research in Humanitarian Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Alfonso Pedraza-Martinez, Assistant Professor, Kelley School of Business, Indiana University, 1309 E 10th Street, Kelley School of Business, IU, Bloomington, IN, 47405, United States of America, alpedraz@indiana.edu

1 - Understanding Fundraising in Humanitarian Supply Chains

Laura Turrini, PhD Student, Kühne Logistics University, Grofler Grasbrook 17, Hamburg, Germany, Laura.Turrini@the-klu.org, Maria Besiou, Joern Meissner

Donations are generally the main income of humanitarian organizations and are central to their successful operations. Due to their voluntary nature, they are difficult to predict, but they can be stimulated, when needed, by the means of fundraising appeals and advertising. But how much should an organization spend in fundraising? And is it always worth it? We model the fundraising activity using data from humanitarian organizations in order to help answering these fundamental questions.

2 - Mitigating the Unintended Impacts of Generosity: The Case of Unsolicited Donations after Disasters

Miguel Jaller, Research Associate, Rensselaer Polytechnic Institute, 306 Gold St. Apt 3B, Brooklyn, NY, 11201, United States of America, jallem@rpi.edu, Johanna Amaya, Jose Holguin-Veras, Luk Van Wassenhove

This presentation introduces a donations management system designed to reduce the impacts of unsolicited donations after disasters. The authors take advantage of empirical work to estimate the flow of donations to be sent after large disasters and strategically manage the flow of information to be sent to the possible donors.

3 - ICT and Humanitarian Supply Chains

Ioanna Falagara Sigala, Vienna University of Economics and Business, Welthandelsplatz 1, Vienna, 1020, Austria, ioanna.falagara.sigala@wu.ac.at, Tina Wakolbinger, William Kettinger

This paper aims to explore the role of information systems in supporting humanitarian organizations in efficiently and effectively delivering humanitarian aid and essential medicines to the people in need. First, we look at the current implementation of an ERP system at different humanitarian organizations.Second, we use agent-based modeling and simulation to highlight how the technology adoption will spread throughout the organization, where points of resistance might exist.

4 - Horizontal Coordination in Humanitarian Operations
Mahyar Eftekhar, Assistant Professor, W.P. Carey School of Business, ASU, BA 440, 300 E Lemon Street, Main Campus, Tempe, AZ, 85287, United States of America, eftekhar@asu.edu, Hongmin Li

Despite their resource and financial limitations and despite the considerable level of demand uncertainty they face, Humanitarian Organizations (HOs) do not typically share resources. In this paper, using both empirical and analytical methods, we consider the potential barriers to resource pooling, as well as its costs and benefits for individual agencies. We find out the circumstances in which resource pooling could yield higher benefits for individual HOs.

■ TB07

Hilton- Continental 4

Cloud Computing

Cluster: Tutorials

Invited Session

Chair: Stefan Voss, University of Hamburg, IWI - Von-Melle-Park 5, Hamburg, 20146, Germany, stefan.voss@uni-hamburg.de

1 - Cloud Computing and Decision Analytics
Stefan Voss, University of Hamburg, IWI - Von-Melle-Park 5, Hamburg, 20146, Germany, stefan.voss@uni-hamburg.de, Leonard Heilig

Cloud computing offers a variety of flexible, on-demand and highly-scalable computing services. The associated flexibility and cost-effectiveness make it a valuable option. We present a classification of decision analytics in the area of cloud computing (e.g., to choose best options and to make predictive statements under uncertainty and information asymmetry). We review related problems, models and techniques applied to support cloud computing oriented decision making. Case studies are given.

■ TB08

Hilton- Continental 5

Joint Session Social Media/MAS: Social Media in Disaster Response

Cluster: Social Media Analytics & Military Applications Society

Invited Session

Chair: Christopher Smith, Director, TRAC-MTRY, U.S. Army, 700 Dyer Road, Monterey, CA, 93943, United States of America, cmsmith1@nps.edu

1 - Using Social and Semantic Network to Analyze a Disaster Response Online Forum
Gail Thomas, Associate Professor, Graduate School of Business & Public Policy, NPS, 555 Dyer Road, Monterey, CA, 93943, gthomas@nps.edu, Jessica Neff, Kimberlie Stephens

Large-scale disaster response often requires the synchronization of military heavy lift and humanitarian assistance. Our study analyzes the actual messages from an online social media forum to determine the dynamic interactions and properties of a knowledge system. We use social network analysis to examine how the search for expertise evolves during the early weeks of the response. Semantic network analysis maps the emergent nature of the communication discourse.

2 - Overview of ISIL's Twitter Communication Network
Gregory Freeman, Naval Postgraduate School, CORE Lab, 589 Dyer Rd. RO-107, Monetery, CA, 93943, United States of America, gsfreema@nps.edu, Rob Schroeder

Twitter accounts associated with the Islamic State of Iraq and the Levant (ISIL) have been prolific propagandists. This presentation overviews how ISIL spreads its messages online and how it is resilient against disruption.

3 - Tweeters of the Storm: Local government use of Social Media during Hurricane Sandy
Rob Schroeder, Naval Postgraduate School, CORE Lab, 589 Dyer Rd. RO-107, Monterey, CA, 93943, rcschroe@nps.edu, Gregory Freeman

While individuals and companies have learned how to effectively use Twitter, how can local governments best leverage the new capability? During Hurricane Sandy many local government groups informally communicated with the public using Twitter, we analyze these local government accounts during the storm in order to compare government use and measure effectiveness.

4 - Looking for Flu Patterns in Twitter Data
Samuel Buttrey, Associate Professor, Department of Operations Research, Code OR/Sb, Naval Postgraduate School, Monterey, CA, 93943, United States of America, buttrey@nps.edu

We examine about 18 months' worth of a 1% sample of Twitter messages for incidence of the words "flu" or "influenza" in English-language tweets originating in the United States. This incidence rate is compared to the actual prevalence of flu as reported by the Centers for Disease Control. Our sample occupies thousands of files and perhaps 5TB of disk space. Some of the practical difficulties associated with handling and analyzing data of this magnitude are addressed.

■ TB09

Hilton- Continental 6

Crowdsourcing and the Cloud

Cluster: Special Sessions

Invited Session

Chair: Charles Weber, Associate Professor, Portland State University, PO Box 751 ETM, Engineering and Technology Management, Portland, OR, 97207, United States of America, webercm@gmail.com

1 - The Role of ICT-based Informal Communication in International R&D Networks
Vesna Babaja, Doctoral Student, Wirtschaftsuniversitaet Wien, Welthandelsplatz 2, Vienna, A-1020, Austria, Vesna.Babaja@wu.ac.at

Informal communication has been shown to help with building trust, reducing uncertainty and transferring tacit knowledge. However, in geographically dispersed R&D collaborations providing space for the development of informal communication may be cost-prohibitive. This study looks at the effectiveness of ICT in this setting by exploring advanced research collaborations between CERN and its academic and industrial partners from all over the world.

2 - Which Incentives Increase the Motivation to Participate in Technology Transfer Projects?
Manuel Burger, Doctoral Student, Wirtschaftsuniversitaet Wien, Welthandelsplatz 2, Vienna, A-1020, Austria, m.burger@wu.ac.at

The explorative study focuses on the researcher as an individual actor in the technology transfer process. The research project deals with motivational structures behind scientists¥ engagement in technology transfer. In particular a case study will be conducted at CERN to explore technology transfer from fundamental research to industry.

3 - Determining the Locus of Influence Online: A Case from High Tech
Charles Weber, Associate Professor, Portland State University, PO Box 751 ETM, Engineering and Technology Management, Portland, OR, 97207, United States of America, webercm@gmail.com, Nitin Mayande

What determines the locus of influence online? A case from a high tech industry identifies structural factors and factors pertaining to information flow

■ TB10

Hilton- Continental 7

Economics of Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Kenan Arifoglu, Assistant Professor, University College London, Gower Street, London, WC1E 6BT, United Kingdom, k.arifoglu@ucl.ac.uk

1 - Remanufacturing Strategies for OEMs without Remanufacturing Capabilities
Anton Ovchinnikov, Assistant Professor, University of Virginia, 100 Darden Blvd, Charlottesville, VA, United States of America, AOvchinnikov@darden.virginia.edu, Yu Xiong, Yu Zhou

We discuss two strategies for how an OEM without remanufacturing capabilities could interact with independent remanufacturers: outsourcing and relicensing. Factoring in the possibility of unauthorized remanufacturing and the resultant incentive compatibility concern, we discuss which strategy should be used and when. We present analytical results and numerical illustrations with behaviorally-estimated parameters. We then quantify the benefits of bringing remanufacturing in-house.

2 - Licensing Contracts in Conspicuous Markets
Prateek Raj, PhD Student, University College London, Gower Street, London, WC1E 6BT, United Kingdom, p.raj.12@ucl.ac.uk, Kenan Arifoglu

We study licensing in conspicuous markets where, in addition to product's functionality, customers also value brand exclusivity. We consider a brand-owning firm that sells its primary product to conspicuous customers, and also licenses its brand name to a licensing firm selling in a noncompeting market. Contrary to previous literature, we find that royalty contract may perform better than fixed-fee contract. We also develop a mixed contract that improves total profit and coordinates the system.

3 - On Contests with Heterogenous Agents
Ersin Korpeoglu, Tepper School of Business at Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ekorpeog@andrew.cmu.edu, Soo-Haeng Cho

In a contest in which heterogeneous agents make efforts to develop solutions, existing theory predicts that agents will reduce their efforts as more participants compete for a prize. However, a recent empirical study found that high-ability agents raise their efforts with more participants. This paper offers new explanation for the empirical finding by proposing and analyzing a novel model of a contest. We also characterize when a free-entry contest (open innovation or crowdsourcing) is optimal.

4 - Hedge against Shortages: Supply and Demand Uncertainty Reduction and Comparison Analysis
Mehmet Begen, Ivey Business School - Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, mbegen@ivey.uwo.ca, Xinghao Yan, Hubert Pun

Shortages are widely observed and their consequences are costly in many industries. A main driver of shortages is the uncertain nature of supply and demand. To hedge against shortages and to reduce uncertainties, more information about supply and demand can be obtained by exerting some effort. We perform analysis of the (supply and demand) uncertainty reduction and comparison with and without efforts.

■ TB11

Hilton- Continental 8

Procurement

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Zhixi Wan, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 S Six Street, Champaign, IL, 61820, United States of America, wanzhixi@illinois.edu

1 - Knowledge-Based View on the Use of an Agent in Manufacturing Outsourcing: A Game Theoretic Model
Qiong Chen, Clemson University, 100 Sirrine Hall, Clemson, SC, 29631, United States of America, qiongc@g.clemson.edu, Gulru Ozkan, Aleda Roth, Shouqiang Wang

We evaluate the buyer's dynamic choice of outsourcing channels: directly through in-house procurement department or indirectly through an intermediary agent. Using a two-period game-theoretical model, we demonstrate the critical yet interesting role of outsourcing knowledge therein. In particular, we highlight the effects of direct and indirect learning on the change of buyer's strategies over time.

2 - Optimal Procurement Auction under Multi-Stage Supplier Qualification
Wei Chen, The University of Texas at Dallas, 800 West Campbell Rd, Richardson, TX, 75080, United States of America, wxc103020@utdallas.edu, Milind Dawande, Ganesh Janakiraman

A firm is soliciting price bids from N symmetric suppliers for a sourcing contract. The contract can only be awarded to a supplier who passes multiple stages of qualification test, which must be performed simultaneously in each stage. We obtain the optimal mechanism for the buyer and show that the optimal admission policy in each stage is based on non-uniform reserve prices. We extend our results to a special case of asymmetric suppliers. A descending-meter implementation is also presented.

3 - Favoritism and the Right-of-First-Refusal in Procurement Auctions
Manu Goyal, Assistant Professor, University of Utah, College Of Business, Salt Lake City, UT, United States of America, Manu.Goyal@business.utah.edu, Ali Pilehvar, Wedad Elmaghraby

Long-term relationships with suppliers have several benefits, but these can create inefficiencies and lock-ins which raise procurement costs. Classical procurement auctions lower costs, but result in unsteady short-term relationships with suppliers. The Right-of-First-Refusal can harmoniously resolve this tension: A buyer can lower procurement costs and yet strike steady relationships with preferred suppliers through auctions with the Right-of-First-Refusal granted to the preferred supplier.

4 - Contracting for Capacity under Renegotiation
Eda Kemahlioglu-Ziya, Assistant Professor, Poole College of Management at the University of North Carolina, Raleigh, NC United States of America, ekemahl@ncsu.edu

Two original equipment manufacturers (OEMs) sign fixed-quantity contracts with a contract manufacturer (CM) prior to demand realization. The contracts are renegotiated after demand realization. We aim to understand how an OEM's expected post-renegotiation profit is affected by her ability to negotiate a low wholesale price in the initial contract as well as the ability of the other OEM to do the same. Finally, we identify when the OEMs prefer to leave the CM out of the renegotiation.

■ TB12

Hilton- Continental 9

Regulation Issues in Sustainable Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Gal Raz, Associate Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, razg@darden.virginia.edu

1 - Valuable E-Waste: Implications for Extended Producer Responsibility
Gokce Esenduran, Ohio State University, OH, United States of America, esenduran.1@osu.edu, Atalay Atasu, Luk Van Wassenhove

In a market regulated with take-back legislation, if recycling is profitable then producers have to compete with third-parties in collecting and recycling end-of-life (EoL) products. We answer the question of whether increased collection or recycling targets lead to better environmental or economic outcomes in a competitive market for EoL products.

2 - Firm and Nonprofit Levers to Improve Supplier Environmental Performance
John Khawam, Operations Strategy Lead, Google Inc., 1600 Amphitheatre Parkway, Mountain View, CA, 94043, United States of America, johnkhawam@google.com, Ozgen Karaer, Tim Kraft

We examine how a firm can induce higher environmental quality from a supplier under varying cost and market sensitivity conditions. We consider two methods: supplier competition and cost sharing. Our research is based on our work with an nonprofit as it markets to industries a tool to safely share chemical information.

3 - Competitive Response to Environmental Tax Incentives for Green Technology Adoption
Dmitry Krass, Professor, Rotman School of Management, Univ. of Toronto, 105 St. George st., Toronto, ON, M5S 3E6, Canada, krass@rotman.utoronto.ca, Anton Ovchinnikov

We consider operational aspects of how an industry composed of heterogeneous firms responds to an environmental tax by choosing production quantities and emissions-reducing technologies. We show the existence and uniqueness of the "market-only equilibrium" (with fixed technology choices) and demonstrate its many interesting properties. We then discuss the technology-and-market equilibria under different structural assumptions.

4 - The Environmental Impact of Product Design Choices in Primary and Secondary Markets under Regulation
Vered Blass, Tel Aviv University, Tel Aviv, Tel Aviv, Israel, vblass@post.tau.ac.il, Gal Raz, Cheryl Druehl

This paper examines the impact of DfE innovations of a firm selling new products in a primary market and refurbished products in a geographically distinct secondary market. The firm determines use stage innovation and design-for-refurbishing, its primary and secondary market prices, and its product collection decision. The paper shows the consequences of Extended Producer Responsibility (EPR) and Use stage regulations on the firm's profits and its environmental impact in both markets.

■ TB14

Imperial B

Panel Discussion: Philosophy of Hiring and Advising Graduate Students

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Erick Moreno-Centeno, Assistant Professor, Texas A&M University, 3131 TAMU, College Station, TX, 77845, United States of America, e.moreno@tamu.edu

1 - Philosophy of Hiring and Advising Graduate Students

Moderator: Erick Moreno-Centeno, Assistant Professor, Texas A&M University, 3131 TAMU, College Station, TX, 77845, United States of America, e.moreno@tamu.edu, Panelists: Panos Pardalos, Sheldon Jacobson, Mark Lawley, Suvrajeet Sen

Critical to the success of junior faculty is the success of his/her PhD Students. Here, the panelists will share their proven hiring and advising philosophies. All panelists have a track record of training successful PhDs who now hold academic positions at prestigious institutions. This panel was inspired by the Graduate Students & Faculty Relationship Workshop organized by the INFORMS student chapter at Texas A&M. Panelists: Sheldon Jacobson, Mark Lawley, Panos Pardalos, and Suvrajeet Sen.

■ TB15

Hilton- Exec. Boardroom

Data Envelopment Analysis 1

Contributed Session

Chair: Ya Chen, University of Science and Technology of China, No. 96, JinZhai Road, Hefei, China, ychen10@mail.ustc.edu.cn

1 - Considering Favourability Indices as Part of the Malmquist Index

Kwaku Ohene-Asare, Lecturer, University of Ghana Business School, RT16 LG78, Legon Ghana, Legon, Ghana, kohene-asare@ug.edu.gh

Recently, Asmild and Tam (2007) defined a Global Malmquist Index. The present paper contributes to the extant productivity literature by defining a further decomposition of the global frontier shift, into favourability index and favourability change indices. This is interesting when analysing if technology changes over time affects some observations more than others. The indices have potentially interesting policy implications which we show using empirical data set on Ghanaian banks.

2 - The Performance Measurement of Municipal Governments in Mexico using the Data Envelopment Analysis

Mariana Flores-Serralde, Universidad Nacional Autonoma de Mexico, Av. Universidad No. 3000, Col. UNAM, Del. Coyoacan, Mexico, D.F., 04510, Mexico, mathiana_9@hotmail.com, Oscar Olvera-Neria

The quantification of the public administration performance constitutes a new scenario for the control of the government efficiency. In this study, the Data Envelopment Analysis is used to measure the efficiency of municipal governments in Mexico. The municipalities were stratified by population density. The most efficient municipalities (~0.8 efficiency) are in the north and center of Mexico, which corresponds with regions with major cultural, economic and social development.

3 - Network Data Envelopment Analysis for Sustainable Performance in Brazilian Gas Station

Claudia Francisco, Professor, Federal University of Rio Grande do Norte, Rua Senador Salgado Filho, 3000, Campus Universiterio, Natal, 59000000, Brazil, claudiacacf@hotmail.com, Mariana Almeida, Djalma Silva

In this study, we present a quantitative model Network Data Envelopment Analysis associated with Sustainable Balanced Scorecard for mensure the sustainable performance of fuel stations in Brazil. This results indicate an average performance of 69.42%. With a efficiency decomposition, it can provide a set of recommendations to support the decision making of firms and regulators.

4 - DEA Efficiency Research of High Technology Industries

Liang Gao, University of Science and Technology of China, The School of Public Affairs, Hefei, China, gaol3016@mail.ustc.edu.cn

By construction of two stages network DEA, to evaluate high-tech industrial technology introduction of digestion, absorption and innovation efficiency in China, and put forward the development strategy of the various provinces and cities.

5 - An Extension on Super-efficiency Approach for Slacks-based Measure

Ya Chen, University of Science and Technology of China, No. 96, JinZhai Road, Hefei, China, ychen10@mail.ustc.edu.cn, Yongjun Li

Fang et al. [Fang, H.H., Lee, H.S., Hwang, S.N., & Chung, C.C., 2013. A slacks-based measure of super-efficiency in data envelopment analysis: An alternative approach. Omega, 41, 731-734] develop a slacks-based version of the super slacks-based measure (SBM) and propose a two-stage approach to calculate both super-efficiency score by the super SBM model and efficiency score by the SBM model. In this paper, we extend their approach to consider continuity of efficiency scores.

■ TB16

Hilton- Franciscan A

Revenue Management and Pricing of Multiple Products and Assortments

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ozge Sahin, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21231, United States of America, ozge.sahin@jhu.edu

1 - Repricing Algorithms in E-Commerce

Dana Popescu, Assistant Professor, INSEAD, 1 Ayer Rajah Ave, Singapore, 138676, Singapore, dana.popescu@insead.edu

We analyze a duopoly where sellers compete using repricing algorithms, which have a built in demand function and use specific pricing rules. We compare the revenues obtained when both sellers use the same software provider with the revenues obtained when the sellers use different providers, for various pricing rules, demand forecast accuracies and frequency of updating.

2 - Strategic Pricing of Ancillary Services: To Bundle or to Unbundle?

Yao Cui, PhD Candidate, University of Michigan, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, cuiyao@umich.edu, Izak Duenyas, Ozge Sahin

We consider a firm that sells a main service (e.g., air travel) and an ancillary service (e.g., baggage delivery) to multiple consumer segments (e.g., business travelers and leisure travelers). We study the firm's strategic decision of whether to bundle the ancillary service into the main service or to unbundle. We investigate several factors that affect this decision, including forward-looking vs. myopic consumers, firm's main service price discrimination, and selling through intermediaries.

3 - Real-time Optimization of Personalized Assortments

Hamid Nazerzadeh, Marshall School of Business, University of Southern California, Los Angeles, CA, United States of America, nazerzad@marshall.usc.edu, Negin Golrezaei, Paat Rusmevichientong

Motivated by the availability of real-time data on customer characteristics, we study personalization of the assortment of products for each arriving customer. Using actual sales data from an online retailer, we demonstrate that personalization based on each customer's location can lead to over 10% improvements in revenue. We propose a family of index-based policies that coordinate the assortment decisions with the backend inventory constraints and achieve an optimal competitive ratio.

4 - Pricing Assortments for Online Travel Agents

Ozge Sahin, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21231, United States of America, ozge.sahin@jhu.edu, Ruxian Wang

In this paper we study the assortment selection and pricing problem of online travel agents. We first show that the assortment selection problem is NP complete. Next, we study the pricing problem under both monopoly and competitive scenarios.

■ TB17

Hilton- Franciscan B

Contact Centers

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Noah Gans, OPIM Department, Wharton - University of Pennsylvania, Philadelphia, PA, United States of America, gans@wharton.upenn.edu

1 - Service Times in Call Centers: A Data-Based Perspective
Rouba Ibrahim, University College London, London, United Kingdom, rouba.ibrahim@ucl.ac.uk, Haipeng Shen, Pierre L'Ecuyer

We carry out a large-scale data-based study of service times in a call center with heterogeneous agents and multiple call types. We find that the service-time distribution depends strongly on the agent and on time, and that service times are correlated. We develop models that account for these facts. We compare our models to ones commonly used in practice. We find that the goodness-of-fit is much better for our models than for the simplified ones, both in-sample and out-of-sample.

2 - Fluid Models for Customer Service Chat Systems with General Service and Patience Times
Tolga Tezcan, Professor of Operations Management, Simon School of Business, University of Rochester, 3-345 Simon Hall. Simon Business School, Rochester, NY, 14627, United States of America, tolga.tezcan@simon.rochester.edu, Jiheng Zhang

We study customer service chat systems where service and patience times are generally distributed. We propose a framework involving measure-valued processes to model the system dynamics. Deterministic fluid models are developed to provide first-order approximations for system performance. The invariant state of the fluid models provides simple approximations for various performance measures in steady state. Numerical experiments show that these approximations are fairly accurate.

3 - Telephone Call Centers: Asymptotic Optimality of Myopic Forecasting-scheduling Scheme
Han Ye, University of Illinois at Urbana-Champaign, College of Business, Champaign, IL, United States of America, hanye113@gmail.com, Noah Gans, Yong-Pin Zhou, Haipeng Shen

We determine workforce schedules for call center arrivals that are doubly stochastic. Period-by-period arrival rates follow a hidden AR(1) process, and only arrival counts are observed. We formulate stochastic programs to minimize long-run average staffing costs, subject to a long-run average constraint on abandonment. We show that, in steady state, repeated, myopic solution of the single-period problem is stable, has low cost, and meets the abandonment constraint.

4 - Dynamic Scheduling in a Many-Server Two Class System with Service Guarantees and Abandonments
Amy Ward, Professor, USC, Marshall School of Business, BRI401H, Los Angeles, CA, 90089-0809, United States of America, amyward@marshall.usc.edu, Ramandeep Randhawa, Jeunghyun Kim

We study how different models for customer impatience affect scheduling decisions. We do this in the context of a many-server queue with two classes of customers that are distinguished by their patience distribution. Our objective is to minimize the abandonment percentage for one class subject to a promised service level for the other class. For large systems, we characterize the optimal policy structure as a function of the patience distribution.

■ TB18

Hilton- Franciscan C

Revenue Management in Retail

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Kris Johnson, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, krisdj@mit.edu

1 - Incorporating Buyer's Paralysis into the MNL Choice Model
Rene Caldentey, Professor, New York University, 44 West Fourth Street, 8-77, New York, NY, 10012, United States of America, rcaldent@stern.nyu.edu, Anisha Patel, Srikanth Jagabathula

We empirically investigate the notion of choice paralysis (i.e., the idea that too many options can paralyze a consumer and make them more prone to not purchasing) and its implications on assortment and inventory decisions. We also propose a modification to the existing MNL model that aims to capture this choice paralysis.

2 - Estimating Willingness to Pay and Willingness to Sell from Negotiations Data
Garrett van Ryzin, Columbia University, 412 Uris Hall, Columbia University, New York, NY, 10027, gjv1@columbia.edu, Robert Phillips, A. Serdar Simsek

In many businesses, the final sales price is the result of a negotiation between buyer and seller - e.g. real estate, autos, consumer finance and B2B commerce. We discuss results on a novel method for estimating willingness-to-pay and willingness-to-sell distributions from negotiations transactions data.

3 - Analytics for an Online Retailer: Demand Forecasting and Price Optimization
Kris Johnson, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, krisdj@mit.edu, David Simchi-Levi, Bin Hong Alex Lee

We present our work with Rue La La, an online retailer who offers limited-time discounts on designer apparel. One of their main challenges is revenue management for new products. We use machine learning techniques to build a demand prediction model, the structure of which poses challenges on creating a pricing policy. We develop new theory around multi-product price optimization and use this to create and implement a pricing decision support tool. Results show significant increases in revenue.

■ TB19

Hilton- Franciscan D

Choice and Pricing Models in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Sumit Kunnumkal, Indian School of Business, AC4 Level 1 4116, Hyderabad, India, Sumit_Kunnumkal@isb.edu

1 - Modeling Dynamic Choice Behavior of Customers
Srikanth Jagabathula, New York University, 44 West Fourth St, New York, NY, 10012, United States of America, sjagabat@stern.nyu.edu, Gustavo Vulcano

The effectiveness of pricing/product assortment decisions in retail operations relies heavily on accurate demand predictions. Motivated by this, we consider the setting in which retailer has access to panel data — sales transactions tagged by customer id. Given this rich data, we present techniques to (a) predict the purchase likelihood for each customer as a function of offer set and promotions and (b) develop a prescription for personalizing promotions.

2 - The Cross Moment Choice Model
Karthik Natarajan, Associate Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, natarajan_karthik@sutd.edu.sg

In this talk, I will discuss a new class of discrete choice models that assumes mean and covariance information on the utilities. We show that the choice probabilities for the distribution that maximises expected user utility is efficiently computable with convex optimization. We will provide evidence that the model is a practical alternative to Multinomial Probit in a few applications. The talk is based on joint work with Li Xiaobo, Selin Damla Ahipasaoglu, Rudabeh Meskarian and Tom Magnanti.

3 - Upper Bounds for Choice Network RM
Sumit Kunnumkal, Indian School of Business, AC4 Level 1 4116, Hyderabad, India, Sumit_Kunnumkal@isb.edu, Kalyan Talluri

The deterministic LP is a simple heuristic that obtains an upper bound on the choice network RM value function. The affine and the piecewise linear approximations are more sophisticated methods that obtain tighter bounds than the deterministic LP. We establish analytical limits on how much these methods can further tighten the deterministic LP bound.

4 - Dynamic Pricing versus Fixed Prices in Revenue Management
Alper Sen, Bilkent University, Department of Industrial Engineering, Bilkent, Ankara, 06800, Turkey, alpersen@bilkent.edu.tr

We consider the problem of selling a fixed stock of items over a finite horizon. Arrivals follow a Poisson process. We obtain a general lower bound on the performance of using a fixed price which is 63.2% for one unit of inventory and improves as the inventory increases. For one unit, we obtain tight bounds: 89.8% for constant elasticity and 96.9% for linear price response functions. We also suggest a new dynamic pricing heuristic which performs better than 99.8% in a large number of problems.

■ TB20

Hilton- Yosemite A

Facility Logistics II

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: Soondo Hong, Assistant Professor, Pusan National University, 2, Busandaehak-ro 63beon-gil, Geumjeong-gu, Pusan, 609-735, Korea, Republic of, soondo.hong@pusan.ac.kr

1 - Setting Cutoff Times for Order Fulfillment Systems with Capacity Degradation

Kevin R. Gue, Professor, Auburn University, Shelby Center, Auburn, AL, 36849, United States of America, guekevi@auburn.edu

In many order fulfillment settings, orders received before a cutoff time are guaranteed to be shipped that evening to meet next-day or two-day service promises. In a system that batches orders for more efficient picking tours, the control system must determine how large a batch pickers can handle as the deadline approaches. The nearer the deadline, the smaller the batch size and the lower the effective capacity. We show how to set the latest possible cutoff time in such a setting.

2 - Technology Infrastructure in Third Party Logistics (3PL) Warehouses: Status, Barriers, and Future

Michael Ogle, Assistant Professor and Undergraduate Director, UNC Charlotte, 9201 University City Blvd., CARC 220, Charlotte, NC, 28223, United States of America, Mike.Ogle@uncc.edu

The rate of technology infrastructure adoption within Third Party Logistics (3PL) warehouses lags behind that of private dedicated facilities owned and operated by manufacturers, retailers and distributors. Despite the lack of scale-enabling automation solutions, third-party logistics continues to grow faster than the U.S. GDP. What are the challenges associated with automating 3PLs and how might they be overcome as projected growth continues for 3PLs? This session addresses those questions.

3 - Bulk Tank Allocation for Industrial Gas Distribution: Heuristic Approach for a Multi-Period Model

Leily Farrokhvar, PhD Candidate, Virginia Tech, Industrial & Systems Engineering (0118), Blacksburg, VA, 24061, United States of America, leily@vt.edu, Kimberly Ellis

We study the bulk tank allocation (BTA) problem for industrial gas distribution. The BTA problem determines the preferred size of bulk tanks to assign to customer sites to minimize total cost, including the initial tank installation costs and the net present value of distribution costs occurring in multiple periods. The problem is modeled as a mixed-integer program and then solved using a heuristic approach which incorporates a two-phase decomposition approach.

4 - Order Batching with Time Constraints in a Parallel-aisle Warehouse: A Multiple-policy Approach

Soondo Hong, Assistant Professor, Pusan National University, 2, Busandaehak-ro 63beon-gil, Geumjeong-gu, Pusan, 609-735, Korea, Republic of, soondo.hong@pusan.ac.kr, Brett Peters, Andrew Johnson

This study analyzes an order batch operation with limited vehicle capacity and specified deadlines to complete orders. We develop a model which partitions orders to batches to minimize the total travel time such that each trip meets the time constraint and capacity limit and determine a suitable operational policy. Each policy is characterized by routing method and associated speed, capacity, and pick time. The proposed model groups orders and selects a best policy among possible policy choices.

■ TB21

Hilton- Union Sq 1

Innovative Solutions for Congestion Mitigation II

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Yafeng Yin, University of Florida, Gainesville, FL, United States of America, yafeng@ce.ufl.edu

Co-Chair: Siriphong (Toi) Lawphongpanich, University of Florida, Industrial and Systems Engineering, Gainesville, FL, 32611, United States of America, Lawphong@ise.ufl.edu

1 - Dedicated Bus Service in London, Towards Better Transit and Traffic

Guangzhi Zhang, Tsinghua University, Room 615, Shunde Building, Beijing, 100084, China, zgz11@mails.tsinghua.edu.cn, Lefei LI

Dedicated Bus Service (DBS) is a new urban transit service that bridges bus/metro and private vehicles. By directly connecting high-demand OD pairs, the DBS is expected to alleviate traffic congestion and provide better commuting experiences. We build a simulation model for London traffic network based on TRANSIMS. Experiment result shows that a properly designed DBS can lead to better traffic and transit services. We also investigate the contract design problem for a better performance of DBS.

2 - Optimization-based Methods for Hybrid Transit System

Yihuan (Ethan) Shao, University of Southern California, Industrial and Systems Engineering, 3715 McClintock Avenue, Los Angeles, CA, 90089, United States of America, yihuansh@usc.edu, Fernando Ordonez, Xiaoqing Wang

Considering the traffic congestion in megacity, we propose a new hybrid transit system, which combines a ridesharing system with a fixed-route public transit system. The main idea behind this new system is to take advantage of the flexibility of ridesharing and the low cost of public transit. We developed optimization-based methods to solve the routing problem for the shared vehicles under this system. Computational experiments for these methods expose some interesting results.

3 - Pricing of Parking Games with Atomic Players

Yafeng Yin, University of Florida, Gainesville, FL, United States of America, yafeng@ce.ufl.edu, Fang He, Zhibin Chen

This paper considers a parking competition game where a finite number of vehicles from different origins compete for the same number of parking spaces in a downtown area to minimize their own parking costs. We first define and formulate equilibrium and system optimum assignments of spaces to vehicles, and then discuss various parking pricing schemes to reduce total cost of the parking competition game.

■ TB22

Hilton- Union Sq 2

Designing, Modeling and Managing Disrupted Transportation Networks

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Kash Barker, Assistant Professor, University of Oklahoma, 202 W Boyd St, Rm. 124, Norman, OK, 73019, United States of America, kashbarker@ou.edu

1 - Large-scale Evacuation Routing and Scheduling Optimization with Uninterrupted Traffic Flow

Xuechi Zhang, University of Maryland, 0147C Engineering Lab Building, University of Maryland, College Park, MD, 20742, United States of America, zhangxc90@gmail.com, Ali Haghani

This paper develops a two-stage optimization framework for large-scale vehicular evacuation. In the first phase, a mixed integer programming model, with the objectives of minimizing the network clearance time and total in-network time is developed to determine an optimal routing plan. In the second phase, a simulation-based Heuristic is proposed to dynamically generate the time-dependent departure rates. Case study of Maryland Eastern Shore is conducted by using the proposed model.

2 - Fortification of a Transportation Network against Disruptions

Mustafa Y. Sir, Antalya International University, Üniversite Cad. No:2 07190, Dö emealtı, Antalya, Turkey, mustafa.sir@antalya.edu.tr, Gokhan Karakose

Usage of critical structures (e.g., bridges) in a transportation network might get disrupted due to natural disasters such as earthquakes. Previous work defines component-specific vulnerability indices, which do not capture the change in network performance due to multiple simultaneous disruptions. A scenario-based method is proposed to fortify a transportation network against simultaneous disruptions by allocating maintenance resources over critical structures to minimize the economic impact.

3 - Multi-objective Optimization for Scheduling of Contraflow Evacuation

Yingyan Lou, Assistant Professor, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, yingyan.lou@asu.edu, Peiheng Li

Contraflow evacuation scheduling problem is formulated as a multi-objective optimization in this research, with total system travel time and operation cost as two individual objectives. The problem is solved with an enhanced nondominated sorting genetic algorithm that also incorporates adaptive random search based on response surface methodology. Multiple scenarios are investigated using a simulation-based contraflow planning tool. Optimal Pareto sets of scheduling solutions are provided.

4 - Multi-regional Vulnerability Analysis of Freight Transportation Network
Mohamad Darayi, PhD Student, University of Oklahoma, 202 W Boyd St, Rm. 124, Norman, OK, 73019, United States of America, mdarayi@ou.edu, Kash Barker

Oklahoma's central location and economic anchors within the state enforce a special attention given to the multimodal freight transportation network as a connector between business and markets in Oklahoma and the United States. This network is prone to natural/man-made disruptive events which might disable any of the network components. Vulnerability analysis of freight transportation network in a multi-regional, multi-industry interdependent economic context is pursued in this research.

■ TB23

Hilton- Union Sq 3

Inventory Routing Models

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Kevin Furman, ExxonMobil, 1545 US 22 E, Annandale, NJ, United States of America, kevin.c.furman@exxonmobil.com

1 - An Inventory Routing Problem for Liquefied Natural Gas Distribution Model with Net Present Value Approach
Yousef Ghiami, Technische Universiteit Eindhoven, Eindhoven, 5600 MB, Netherlands, y.ghiami@tue.nl, Tom Van Woensel

Due to its environmental characteristics, Liquefied Natural Gas (LNG) is becoming a more attractive fuel in the energy market. We develop an inventory routing model incorporating the deterioration property of LNG with a net present value approach, followed by numerical analysis.

2 - A Matheuristic for the Multi-vehicle Inventory Routing Problem
M.Grazia Speranza, Professor, University of Brescia, C.da S.Chiara 50, Brescia, Italy, grazia.speranza@unibs.it, Natashia Boland, Claudia Archetti

The Multi-vehicle Inventory Routing Problem (MIRP) is the problem of determining for each time of a discrete horizon the quantities to deliver to customers and the routes at minimum total cost. No stock-out is allowed and the vehicle capacity must be satisfied. We present a matheuristic where mathematical programming models are embedded in a heuristic scheme. Computational results are presented for a large set of benchmark instances that prove the effectiveness of the algorithm.

3 - Inventory Routing and Freight Consolidation of Perishable Goods
Weihong Hu, Georgia Tech, Department of ISyE, Atlanta, GA, United States of America, weihongh@gatech.edu, Alejandro Toriello, Maged Dessouky

We investigate a model of combined inventory routing and freight consolidation with perishability constraints. We design efficient solution methods that utilize the problem structure, including transportation-inventory decomposition, perishability parameter based heuristics, etc. The algorithms are tested with real data from the cut flower supply chain practice in California.

4 - On-Board Blending in Multiproduct Maritime Inventory Routing
Kevin Furman, ExxonMobil, 1545 US 22 E, Annandale, United States of America, kevin.c.furman@exxonmobil.com, Jin-Hwa Song, Myun-Seok Cheon

We introduce a practical problem for simultaneous optimization of ship routing, inventory management and on-board blending of multiple bulk products. In addition to traditional ship routing characteristics, this problem involves variable product value based on blend specifications, time dependent costs, cargo draft limits at ports and allowing routes with multiple pick-ups and drop-offs. We develop a discrete time optimization model and practical solution approaches which address these various real-world issues.

■ TB24

Hilton- Union Sq 4

ITS Best Presentation Award Session

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Stephen Boyles, Assistant Professor, University of Texas at Austin, 301 E Dean Keeton St Stop C1761, Austin, TX, 78712, United States of America, sboyles@mail.utexas.edu

1 - Modeling the Spatiotemporal Propagation of Information in Vehicle-to-Vehicle Communications
Yong Hoon Kim, West Lafayette, IN, 47907, United States of America, kim523@purdue.edu, Srinivas Peeta, Xiaozheng He

This study proposes an analytical model for the spatiotemporal propagation of information in large-scale vehicle-to-vehicle (V2V) communications. The information propagation is described by embedding a propagation model with an analytical traffic flow model. Insights are illustrated using numerical experiments.

2 - Entropy Weighted Average Method for the Determination of Unique Path-Flow Solution for Static Deterministic User Equilibrium Traffic Assignment Problem
Amit Kumar, Purdue University, West Lafayette, IN, United States of America, kumar44@purdue.edu, Srinivas Peeta

This study formulates entropy weighted user equilibrium (EWUE) to determine a unique path-flow solution to the static deterministic user equilibrium traffic assignment problem. The implementation simplicity of the EWUE represents an important benefit over the maximum entropy user equilibrium (MEUE) models proposed in the past. Computational experiments illustrate the characteristics of the EWUE solution.

3 - A Simulation Based Approach for Optimal Road Network Demand Modification
Evan Fields, Massachusetts Institute of Technology, 77 Massachusetts Ave., Boston, MA, United States of America efields@mit.edu, Carolina Osorio

A road network operator may have some capacity to modify demand. We present two contributions to the problem of finding optimal magnitude and location of reduction. First, we use an analytic queueing model to demonstrate several important features of the problem. Second, we present a case study of using simulation based optimization to solve the optimal demand modification problem on a subnetwork of Lausanne.

4 - Fine-grained Modeling of Arterial Traffic: A Data Fusion and Information Integration Approach
Zhanbo Sun, RPI, Troy, NY, 12180, United States of America sunz3@rpi.edu, Peng Hao, Xuegang (Jeff) Ban

In this research, a data fusion and information integration approach is proposed to model and interpret the straffic along urban arterial corridors based on heterogeneous data sources. The method captures variables such as data accuracy, travel time, lane choice and traffic merging at a corridor-level. Results from the method can be directly applied to estimate individual corridor travel times and vehicle trajectories.

■ TB25

Hilton- Union Sq 5

Public Transportation - Railroad

Contributed Session

Chair: Rebecca Scott, University of North Texas, 1155 Union Circle #311396, Denton, TX, 76203, United States of America, rebecca.scott@unt.edu

1 - Modeling the Residual Useful Life of Railroad Bearing Grease
Douglas Timmer, Professor, University of Texas - Pan American, Manufacturing Engineering Department, 1201 West University Dr, Edinburg, TX, 78539, United States of America, timmer@utpa.edu

This research will develop an analytical model or models to predict the residual useful life of railway bearing grease. Modeling techniques to be employed include mechanistic or first principles models based upon process kinetics and empirical models including physics-based reliability models, non-linear regression and neural networks. The analytical model will provide users the ability to predict residual life based upon operational characteristics.

2 - Rescheduling Railway Timetables in Presence of Passenger Transfers Between Lines Within a Transportation Network
Miguel Angel Pozo, Universidad de Sevilla, Facultad de Matematicas, Calle Tarfia s/, Sevilla, 41012, Spain, miguelpozo@us.es, Juan Antonio Mesa, Francisco A. Riejos, Justo Puerto

The problem of coordinating transfers consists of determining timetables which ensure the transfer of passengers between trains from different lines. This paper considers a transit line where a train fleet circulates according to a predetermined timetable. Passengers arrive at according to an assumed deterministic model of arrivals. In this scenario, a service rescheduling forced by an incidence is determined in order to minimize the loss of passengers who require transfers between lines.

3 - Planning for Protection in Rail-Truck Intermodal Transportation
Hassan Sarhadi, PhD Student, Memorial University of Newfoundland, 57 Allandale Road, PO BOX 534, St.John's, NL, A1B 3S7, Canada, hassan.sarhadi@mun.ca, Manish Verma, David Tulett

Railway intermodal transportation is one of the main sources of revenue for major U. S. railways. Due to such an importance, railway companies should make sure that their intermodal chain is working properly. In this presentation, a mathematical model for protection planning of rail-truck intermodal transportation infrastructure facing intentional disruptions will be presented. Then, the model will be applied to an intermodal chain in U. S. to find the best way of protecting its infrastructure.

4 - Causal Loop Simulation Model of Public Transportation Decision Making Factors
Rebecca Scott, University of North Texas, 1155 Union Circle #311396, Denton, TX, 76203, United States of America, rebecca.scott@unt.edu

A causal loop simulation examines the decision making factors that influence the use of public transportation. Factors are visually represented in the developed model that allows evaluating the importance of the optimal decision making factors. Implications are reported in an effort to provide insight for increasing public transportation use.

5 - Combining Cost-benefit Analysis and Transport Optimization
Arnt-Gunnar Lium, Senior Research Scientist, SINTEF, SINTEF Technology and Society Applied Ec, SP. Andersensvei 5, Trondheim, NO-7465, Norway, arnt-gunnar.lium@sintef.no, Marte Fodstad, Truls Flatberg, Michal Kaut

We present a model for long term strategic investments in railroad infrastructure were the traditional cost-benefit analysis is integrated in an optimization setting. We also discuss challenges related to the handling of uncertainty and transportation choice modelling for a real life problem for the Norwegian railroad infrastructure manager (Jernbaneverket).

■ TB26

Hilton- Union Sq 6

Facility Planning and Design

Contributed Session

Chair: Yue Zhang, University of Toledo, 2801 West Bancroft St., Toledo, OH, 43615, United States of America, yue.zhang@utoledo.edu

1 - A Metaheuristic for the Layout and Scheduling Problem in a Job Shop Environment
Eva Selene Hernandez-Gress, Researcher, Autonomous University of Hidalgo, Pachuca-Tulancingo Road km. 4.5, Pachuca, Mexico, evah@uaeh.edu.mx, Mary Carmen Reyna Amador, Juan Carlos Seck Tuoh Mora, Hector Rivera Gómez, Oscar Montaño Arango

We propose in this paper a new approach that jointly addresses the layout of a facility and the scheduling of a sequence of jobs. In real production, these two problems are interrelated. However, they are treated separately in the literature. Our approach is an extension of the job shop problem with transportation delay, where the location of the machines is selected among possible sites. The model minimizes the makespan, combining the travel salesman problem with genetic algorithms.

2 - Block Layout Design on the Foundations of a Circular Flow Pattern under Flexible Bay Structures
Hossein Jahandideh, PhD Student, UCLA, 110 Westwood Plaza, Los Angeles, CA, 90024, United States of America, hossein.jahandideh.1@anderson.ucla.edu, Ardavan Asef-Vaziri

In this paper we develop a procedure for the concurrent design of block layout, material handling network, and pick-up and drop-off stations. We first develop a set of heuristics and a genetic algorithm based on efficient approximations to configure block layouts based on loop flow patterns. The unidirectional loop and station locations are then designed on the chosen layout. A set of improvement algorithms finally integrates the best loop and layout.

3 - Optimal Capacity Investment with Time-Sensitive Demand
Yue Zhang, University of Toledo, 2801 West Bancroft St., Toledo, OH, 43615, United States of America, yue.zhang@utoledo.edu

The research concerns optimizing capacity investment for a single firm or two competing firms facing time-sensitive demand. After studying two basic models for a single firm, we focus on two competitive models, where two competing firms operating a single server are to enter a market sequentially or simultaneously. We obtain the conditions under which the two firms would enter the market and the optimal capacity investment for each firm to maximize its profit if entering.

4 - Locating Charging Facilities for Electric Vehicles
Kiana Roshan Zamir, Graduate Research Assistant, University of Maryland, Dept .of Civil and Environmental Eng., 1173 Glenn Martin Hall, College Park, MD, 20742, United States of America, Kianarz@umd.edu, Ali Haghani

Using new alternative fuels than fossil fuels for motorized transportation vehicles has become more and more popular with the growing concerns on the limitation of fossil fuels and environmental degradation. One of the major challenges for the owners of electric vehicles is lack of charging infrastructures and limited range of these vehicles. In this paper, a model is developed for optimal placement of these facilities along the network.

5 - 1-Refueling Location Problem on a Continuous Tree Network
Sang Jin Kweon, PhD Student, Pennsylvania State University, 232 Leonhard Building, University Park, PA, 16802, United States of America, svk5333@psu.edu, Seong Wook Hwang, Jose A. Ventura

In this talk, we consider a location problem for 1-refueling station on a tree network. We aim to locate the station anywhere on the network, including along the edge. Our objective is to locate a 1-refueling station to maximize the total traffic flow covered in round trips. For this, we derive reduction properties regarding the problem size and optimality conditions. Then, we develop an exact algorithm to determine the set of optimal locations for the refueling station.

■ TB27

Hilton- Union Sq 7

Rail System Performance

Sponsor: Railway Applications

Sponsored Session

Chair: Bo Zou, University of Illinois at Chicago, 2073 Engineering Research Facility, 842 West Taylor Street, Chicago, IL, 60607, United States of America, bzou@uic.edu

1 - A Column Generation Approach for Designing Dynamic Train Service Network
Xuesong Zhou, Associate Professor, Arizona State University, School of Sustainable Engineering, Tempe, AZ, United States of America, xzhou74@asu.edu, Lingyun Meng

This talk presents a holistic modeling approach for integrating transportation demand, train service and infrastructure networks. We develop integer programming models for a train dispatching problem on an N-track network by means of simultaneously rerouting and rescheduling trains. A space-time path reformulation can provide an efficient decomposition mechanism through modelling track capacities and trip demand as side constraints in a Lagrangian relaxation solution framework.

2 - Capacity of Single-Track Railway Lines with Short Sidings to Support Operation of Long Trains
Ivan Atanassov, University of Illinois at Urbana-Champaign, 205 N. Mathews Ave., Urbana, IL, 61801, United States of America, atanass1@illinois.edu, Christopher PL Barkan, Tyler Dick

The use of distributed power locomotives has allowed for greater efficiencies through longer trains, but is complicated by the inadequate length of many existing passing sidings. This research seeks to characterize and analyze the interaction between siding lengths and the length of trains, and its effect on track utilization and train-delay. The analysis includes a discussion of the existing problem, as well as practical implications of the results on planning siding extension programs.

3 - Analysis of Rail Line Capacity on Shared Corridors with Multiple Freight Train Types
Mei-Cheng Shih, Graduate Research Assistant, University of Illinois, Urbana-Champaign, 205 North Mathews Ave. B118, Urbana, IL, 61801, United States of America, mshih2@illinois.edu, Tyler Dick

Expanding rail network line capacity through efficient planning requires an understanding of how traffic mixture affects line capacity and the delay incurred by various classes of trains. This study analyzed the interaction of three different types of trains using simulation. A general transformation between delay and throughput was also developed.

4 - Integrated Network Performance in Denmark
Steven Harrod, Associate Professor, Technical University of Denmark, Room 109A, Building 116, Kgs. Lyngby, 2800, Denmark, stehar@transport.dtu.dk

DTU Transport is investigating how to measure and direct railway services for the benefit of the larger, multimodal transport network. This presentation will present the recommendations of the Danish Congestion Commission and discuss their implications for management of the Danish railway services. Further, the common data foundation managed by the DTU Transport Model Center and its application to analysis of railway performance will be explained.

■ TB28

Hilton- Union Sq 8

Airline Choice-based Pricing and Revenue Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Emmanuel Carrier, Delta Airlines, 30 Delta Boulevard, Atlanta, GA, 30354, Georgia, Emmanuel.Carrier@delta.com

1 - The Impact of Advance Purchase Deadlines on Airline Customers' Search and Purchase Behaviors

Laurie Garrow, Georgia Institute of Technology, School of Civil Engineering, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu, Susan Hotle, Matthew Higgins

Few studies have investigated how individuals respond to advance purchase deadlines and price uncertainties induced by these deadlines. We model individuals' search and purchase behaviors using an instrumental variable approach that corrects for price endogeneity. We find search increases just prior to an advance purchase deadline and that some consumers who want to travel just after an advance purchase deadline are willing to travel a day or two later in order to avoid paying a higher fare.

2 - Willingness to Pay Forecaster for Airline Demand Forecasting

Abinav Rameesh, Associate Scientist, PROS, 8333 Braesmain Drive, Apartment 1416, Houston, TX, 77025, United States of America, arameesh@pros.com, Wei Wang

Forecasting models are evolving to incorporate a market of price sensitive customers, looking for the cheapest available fare. As customers "buy down" to the lowest available class they reveal their true "Willingness to Pay". The Willingness to Pay model holds that a customer's true willingness is greater than the paid fare and is derived from the distribution of paid fares. At PROS, we have conducted simulations to explore the behavior of this model and its impact on demand forecasting.

3 - Implementation of MNL Choice Models in PODS Network D6: First Steps

Emmanuel Carrier, Delta Airlines, 30 Delta Boulevard, Atlanta, 30354, Georgia, Emmanuel.Carrier@delta.com, Larry Weatherford

This presentation summarizes results of Passenger Origin Destination Simulator (PODS) research on how to implement our MNL choice model in a large "domestic" network with two airlines competing in 482 O&D markets. Based on the choice model parameter estimates, a new MNL path forecast is created. Revenue results are presented when comparing this new MNL forecaster vs. classic methods like leg standard, path standard and hybrid forecasting, under both leg and network optimization.

4 - Discrete Choice and Semi-supervised Learning for Air Travel Shopping Data

Jie Yang, Graduate Student, Northwestern University, 2145 Sheridan Road, Evanston, IL 60208, Evanston, Il, 60208, United States of America, jieyang2011@u.northwestern.edu, Diego Klabjan, Sergey Shebalov

Travel agents get itineraries from global distribution systems. The resulting air travel shopping data consists of requests and return itineraries but not bookings. We combined discrete choice modeling and semi-supervised learning to estimate bookings. We report findings based on real world data from a major global distribution system provider.

■ TB29

Hilton- Union Sq 9

Project Management 2

Contributed Session

Chair: Vishwanath Hegde, Professor, California State University East Bay, 25800 Carlos Bee Blvd, Hayward, CA, 94542, United States of America, vish.hegde@csueastbay.edu

1 - A Two-Phase Algorithm of DCF Maximisation for the Milestone-Settled Project

Piotr Lebkowski, Professor, AGH Univ. of Science and Technology, al. Mickiewicza 30, Krakow, PL 31-059, Poland, plebkows@zarz.agh.edu.pl, Marcin Klimek

The paper presents a RCPSP settled by contractual milestones. The criterion analysed here is the maximisation of aggregate discounted cash flows from the contractor's perspective, known as an RCPSP problem with Discounted Cash Flows. The cash flows analysed here cover the contractor's cash outflows, related to the commencement of individual activities, and cash inflows after the fulfilment of individual milestones. The authors propose a two-phase algorithm for solving the problem defined.

2 - Bi-objective Resource-constrained Project Scheduling with Net Present Value and Robustness

Yangyang Liang, HuaZhong University of Science and Technology, HUST University of Wuhan,China, Wuhan, China, yangliang0419@sina.com, Nanfang Cui

This paper involves the RCPSP problem with discounted cash flows, the objective is to build a robust schedule that maximize the project net present value and minimize the stability cost, simultaneously. The tabu search algorithm is used to obtain a satisfying solution based on STC scattered buffer method. Finally a comprehensive computational experiment is performed to confirm the availability and feasibility of the algorithm.

3 - Determining Project Duration in Project Portfolio Environments

Vishwanath Hegde, Professor, California State University East Bay, 25800 Carlos Bee Blvd, Hayward, CA, 94542, United States of America, vish.hegde@csueastbay.edu, Zinovy Radovilsky

In this paper, we examined resource allocation patterns across projects and the project duration in a portfolio of projects over eleven years. We identified the variables that impact project duration in multiple project settings. The resource allocation and duration estimation approaches were contrasted between multiple project and the single project management environments.

4 - Robust Optimization of the Resource Allocations in Projects Networks

Nasim Nezamoddini, State University of New York at Binghamton, 13 Goethe St., Binghamton, NY, United States of America, nnezamo1@binghamton.e, Sarah Lam

In this research, project resource planning has been addressed when some activities may fail due to the unexpected events. Failures are expressed in terms of delays that system will face and it is assumed that failure probability of each activity will be decreased with allocating more resource. To identify the most critical activities that need to be protected, two stage stochastic model with objective of minimizing resource allocation cost and expected delay penalties has been presented.

■ TB30

Hilton- Union Sq 10

Supply Chain Scheduling and Optimization

Cluster: Scheduling and Project Management

Invited Session

Chair: Shengbin Wang, Assistant Professor, North Carolina A&T State University, 1601 East Market Street, Merrick 116, Greensboro, NC, 27411, United States of America, swang@ncat.edu

1 - Remanufacturing Scheduling Systems: A Comparison of Academic Progress with Industry Practice

Roger Gagnon, Director-Master of Science in Management, North Carolina A& T State University, 1601 E. Market Street, 312 Craig Hall, Greensboro, NC, 27411, United States of America, gagnonr@ncat.edu, Shona Morgan

We review the academic progress made in remanufacturing scheduling systems and compare this to the practices in industry. We report on academic advancements made in scheduling system methodologies, objective functions, and complexities. We survey members of ARPA to learn the techniques used to schedule remanufacturing operations and the difficulties encountered. Survey results are compared with academic progress in remanufacturing scheduling and the results of previous industry surveys.

2 - A Continuous-time Model and Meta-heuristic Algorithm for the Aluminum Scheduling Problem

Qingxin Guo, The Logistics Institute, Northeastern University, NO. 3-11, Wenhua Road, Heping District, Shenyang, China, guoqingxin@ise.neu.edu.cn, Lixin Tang

We consider a short-term scheduling problem of aluminum industry. The characterization of aluminum production process are a bit different from the steel or chemical engineering industries. The proposed problem is formulated by a continuous-time model. We develop a meta-heuristic algorithm to solve this model. The proposed approach is compared with a well-known optimization software. The computational results show the efficiency and effectiveness of the proposed formulation and approach.

3 - An Adaptive Partitioning Algorithm for Solving Supply Chain Optimization Problems
Weiwei Chen, Assistant Professor, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, wchen@business.rutgers.edu

Many supply chain optimization problems, such as inventory control problem, can be expressed as sequential decision making problems. When the problem size becomes large, derivative-free random search algorithms have been popularly used to solve the problem. In this talk, an adaptive partitioning algorithm is developed to exploit derivative information to speed up the search for optimal policy. Numerical tests on an inventory control problem show the effectiveness of the proposed algorithm.

4 - Disaster Relief Operations Scheduling with Multiple Resources
Yuan Hong, Assistant Professor, University at Albany, SUNY, 1400 Washington Ave., Albany, NY, 12222, United States of America, hong@albany.edu, Shengbin Wang

We study an operations scheduling problem commonly encountered in the process of providing relief, support and assistance in affected areas after a disaster or a humanitarian catastrophe occurs. Each operation requires multiple resources from a set of distribution centers with an independent fleet. We consider the operations/transportation costs as well as a penalty cost if missing the pre-specified deadline. An approximation solution to minimize the total cost is proposed and analyzed.

5 - A Two-stage Stochastic Integer Linear Programming (SILP) Model for Phlebotomist Scheduling
Laquanda Leaven, Assistant Professor of Supply Chain Management, North Carolina Agricultural and Technical State University, 1601 East Market Street, 337 Merrick Hall, Greensboro, NC, 27411, United States of America, ltleaven@ncat.edu

A Two-Stage Stochastic Integer Linear Programming (SILP) Model was formulated to determine better phlebotomist schedules for the preanalytical stage in hospital laboratories. The objective is to balance phlebotomist workload between and within shifts. By implementing the recommendations of this study, hospital laboratories should see significant improvements in patient satisfaction, workload balance, and resource utilization, which are all considered cost savings strategies.

■ TB31

Hilton- Union Sq 11

Overcoming Business Impact Uncertainty

Sponsor: Service Science

Sponsored Session

Chair: Genady Grabarnik, St Johns University, 8000 Utopia Parkway, Queens, Ne, 11439, United States of America, grabarng@stjohns.edu

1 - On Exact Estimate in the Palm Khinchin Theorem
Genady Grabarnik, St Johns University, 8000 Utopia Parkway, Queens, NY, 11439, United States of America, grabarng@stjohns.edu, Larisa Shwartz, Haim Michlin

In the services science requests are described by discrete distribution, and in many cases we may consider that a number of requests' streams are merged to create load on service provider. The Palm-Khinchin theorem states that merging a large number of independent identical discrete distributions will generate distribution with exponential time between event (requests) arrivals. We provide estimates for merge of finite number of distributions to be close exponential distribution.

2 - Hierarchical Multi-Label Classification over Ticket Data using Contextual Loss
Larisa Shwartz, IBM TJ Watson Research, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, lshwart@us.ibm.com, Genady Grabarnik

This paper models a determination of a ticket type as a hierarchical multi-label classification problem. A loss function is proposed by considering the contextual miss-classification information to the hierarchy of labels to support different scenarios in IT environments. An optimal prediction rule is developed. We introduced a greedy algorithm to predict the multiple labels of a ticket, without violating the hierarchy consistence. Extensive empirical studies over the ticket data are conducted.

3 - Performance Measurements of IT Service Associates under Random Load
Haim Michlin, Technion, Technion City, Haifa, Israel, yefim@technion.ac.il, Genady Grabarnik, Larisa Shwartz

We used sequential test (SPRT) to assess effects of innovation for a case when load of the service teams being constant over time. The method works with random arrival of service requests. We design performance test based on concepts of Repeated Significance Test (RST), which allowed us to take into account variable number of SAs. We show superiority of the test in comparison to fixed sample size test (FSST) in ASN. We also compare RST with SPRT when size of service team is constant.

4 - Non-statistical Representation of Uncertainty: A Topological Approach
Victor Tang, Research Scientist, MIT, 55 Deerfield Lane South, Pleasantville, NY, 10570, United States of America, victor.w.tang@gmail.com

Risk and Uncertainty are conflated by even academic researchers. Risk can be characterized statistically; uncertainty cannot. Risk has drawn the lion's share of research attention. We concentrate on what lions have neglected. We characterize uncertainty using set theory and topology. We discuss the social-technical systems design and management implications of this approach. We focus specifically on the uncertainty of unknown-unknown's. We present a prescriptive framework for decision analysis.

5 - Business Driven Optimization of Cloud-based IT Services
Mauro Tortonesi, Assistant Professor, University of Ferrara, Via Saragat 1, Ferrara, FE, 44122, Italy, mauro.tortonesi@unife.it, Genady Grabarnik

Through virtualized resources, dynamic pricing schemes, and federated environments, Cloud Computing allows seamlessly reconfigurable IT architectures. This enables service providers to dynamically optimize their infrastructure to match customer request load while minimizing operational costs. Our work focuses on business driven optimization of Cloud-based IT services, proposing a resource allocation model, ILP and computational intelligence based optimization, and a decision support tool.

■ TB32

Hilton- Union Sq 12

Workforce Planning II

Cluster: Workforce Management and Engineering

Invited Session

Chair: Michael Hewitt, Loyola University Chicago, 820 N. Michigan Ave, Chicago, IL, 60611, United States of America, mhewitt3@luc.edu

1 - Allocating Inflexible Labor Costs in Dynamic Markets
Aaron Chonko, Captain, Naval Postgraduate School, Monterey, CA, United States of America, awchonko@nps.edu, Kenneth Doerr, Robert Eger, Travis Rudge

We explore the way demand forecasts impact cost competitiveness by driving labor costs. At the distribution center we study, markets are dynamic, but labor costs are relatively static. Forecasts of demand and workload are used to determine capacity (number of workers). Either an inaccurate forecast, or an inaccurate method of predicting workload from a forecast, can leave a distribution center with a mismatch between their costs and market prices. This mismatch is problematic in environments such as the one in our field study, where labor cost has little flexibility relative to the competition.

2 - Stochastic Assignment with Individual Learning
Silviya Valeva, University of Iowa, Iowa City, IA, United States of America, silviya-valeva@uiowa.edu, Barrett Thomas, Michael Hewitt

We consider the problem of assigning workers to a series of tasks, the completion of which yields a finished product. We seek to maximize the expected revenue generated from sales of the finished product while facing uncertain future demand and taking into account the workers' learning abilities. We formulate the problem as a two-stage stochastic integer program. Results demonstrate the value of modeling learning as well as the trade-off between cross-training and inventory.

3 - Workforce Staffing and Planning Models that Recognize Human Learning
Michael Hewitt, Loyola University Chicago, 820 N. Michigan Ave, Chicago, IL, 60611, United States of America, mhewitt3@luc.edu, Barrett Thomas

When hiring for a team or project, organizations must balance the experience and aptitude of their hires against a budget. In this research, we extend previous work that enabled us to solve large-scale scheduling problems that include non-linearities associated with quantitative models of human learning to include workforce selection. With a computational study, we derive insights into how to compose a workforce for various budget levels.

4 - The Flexible Break Assignment Problem for Hierarchical Tour Scheduling Problems
Ferdinand Kiermaier, Technical University of Munich, Arcisstrafle 21, Munich, Germany, ferdinand.kiermaier@tum.de, Markus Frey, Jonathan Bard

Many personnel scheduling problems require the explicit assignment of shifts and days-off to individual employees taking into account information such as skills and overtime balances while incorporating break regulations. We present a decomposition that includes hierarchical skills and the possibility to use different break regulations. Moreover, we provide a classification scheme for breaks regulations discussed in literature and show the merits of using flexible break regulations.

■ TB33

Hilton- Union Sq 13

Operations/Finance Interface 1

Contributed Session

Chair: Yunpeng Pan, Assistant Professor, South Dakota State University, Mathematics&Statistics, Box 2220, Brookings, SD, 57007, United States of America, yunpeng.pan@sdstate.edu

1 - A Valuation Framework Using Real Options and Big Data for Selecting Cloud Data Center Sites

Yunpeng Pan, Assistant Professor, South Dakota State University, Mathematics&Statistics, Box 2220, Brookings, SD, 57007, United States of America, yunpeng.pan@sdstate.edu, Zhiguang Wang, Carrie Steinlicht

We develop a valuation framework based on real options and Big Data for selecting cloud computing data center sites. The model takes into account costs and customer proximity as well as industry factors such as fiber paths and population reach. Optimization of data center operations is embedded in the model. Both service providers and local/regional governments with the intent to recruit data centers can use our valuation framework to assess the impact of their strategic policy decisions.

2 - The Midas Touch: The Effect of Gold Hedging on Inventory and Profit Variance

Panayotis Markou, IE Business School, Calle Maria de Molina 11, Madrid, Spain, pmarkou.phd2016@Student.ie.edu, Daniel Corsten

We empirically investigate the effects of risk management practices on firm operational variables. Specifically, we test the impact of financial hedging on inventory and profit variance by leveraging a unique and novel database highlighting the amount of gold hedged by mining companies. Our results show that hedging has a significant influence on firm inventory levels and profit variance, and also provide initial support for analytical models in the Operations field.

3 - Aggregate Production Planning under Financial Constraints

Maxim Bushuev, Assistant Professor, Kent State University, 1835 Beacon Hill Cir #21, Cuyahoga Falls, OH, 44221, United States of America, mbushuev@kent.edu

The research focuses on Aggregate Production Planning (APP) problem with financial elements which is modeled as convex stochastic dynamic programming model. The APP problem is concerned with determining the production rate and work force level over a given horizon in order to meet the demand and minimize the expected cost. Financial elements include bankruptcy cost and capital structure which is an additional decision variable. Three demand forms are used: constant, trend, and seasonality.

4 - Access to Pre-shipment Finance: Does Buyer's Guaranty Help?

Boray Huang, National University of Singapore, 1 Engineering Drive 2, E1A-06-25, Singapore, SG, 117576, Singapore, borayhuang@nus.edu.sg, Andy Wu, David Chiang

This paper studies a Buyer-Backed Purchase Order Financing (BPOF) scheme in a simplified supply chain with one main manufacturer buying from two sources: A low-cost but unreliable SME supplier, and the high-cost but reliable spot market. We identify the properties of the buyer's optimal joint sourcing and credit-guarantee decisions under different risk-free interests in the capital market. Through numerical experiments, BPOF is shown to significantly improve the manufacturer's profitability.

■ TB34

Hilton- Union Sq 14

Models for Emergency Medical Services

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Laura McLay, Associate Professor, University of Wisconsin-Madison, 1513 University Ave, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - Optimizing Compliance Tables for Ambulance Repositioning

Armann Ingolfsson, University of Alberta, School of Business, Edmonton, AB, T6G2R6, Canada, aingolfs@ualberta.ca, Ramon Alanis, Fernanda Campello, Bora Kolfal

Compliance tables are commonly used to specify ambulance repositioning policies. We study multiple methods for performance evaluation and optimization of compliance tables, ranging from a greedy heuristic combined with a realistic Markov chain model, to an integer program combined with much simpler performance evaluation. We use stochastic ordering to show that the integer program can be used to obtain bounds on performance. We study how "nesting" and "doubling up" impact performance.

2 - A Stochastic Programming Approach for Real-time Ambulance Redeployment with Restricted Workload

Shakiba Enayati, North Carolina State University, 111 Lampe Dr., Raleigh, NC, 27695, United States of America, senayat@ncsu.edu, Maria Mayorga, Osman Ozaltin

Ambulance redeployment is a strategy to potentially help to increase coverage when some ambulances become unavailable. However, redeployment may not always be possible or practical due to EMS providers' workload restrictions. Moreover, excessive ambulance relocation can cause emergency service providers to have undesirable fatigue and back pain. This paper presents a stochastic programming approach, implemented in real time to maximize expected coverage subject to provider workload restrictions.

3 - The Vehicle Mix Decision in Emergency Medical Service Systems

Kenneth Chong, Cornell University, 257 Rhodes Hall, Ithaca, NY, 14853, United States of America, kcc66@cornell.edu, Shane Henderson, Mark Lewis

We consider the problem of selecting the number of Advanced Life Support (ALS) and Basic Life Support (BLS) unitsó the vehicle mixó to deploy in an ambulance fleet. To this end, construct an optimization-based framework under which quantitative comparisons can be made, that takes into account the effects of the vehicle mix decision on how ambulances are assigned to bases and dispatched in real time. We test our models via numerical experiments on a large-scale emergency medical service system.

4 - Spatial Queueing Models of Wildfire Evolution

James MacGregor Smith, Professor, University of Massachusetts, 874 North Pleasant Street, Amherst, MA, 01002, United States of America, jmsmith@ecs.umass.edu, Alexander Stepanov

We develop a stochastic wildfire model based upon a discretized random flow process with state dependent queueing models. Utilizing a tesselated landscape data base of Voronoi polygons for thirteen different fuel types, we develop a state dependent queueing model algorithm for predicting the expected flow time of the wildfire. The advantage of the state dependent model is that general rates of spread can be utilized to model the path of the fire through the network of Voronoi polygons.

■ TB35

Hilton- Union Sq 15

Joint Session SPPSN/Minority Issues: Panel Discussion- Publishing Community and Humanitarian Operations Research in High-Impact Journals

Sponsor: Public Programs, Service and Needs & Minority Issues Forum

Sponsored Session

Chair: Michael Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu

Co-Chair: Emmett Lodree, University of Alabama, 361 Stadium Drive, Tuscaloosa, AL, United States of America, ejlodree@cba.ua.edu

1 - Panel Discussion: Publishing Community and Humanitarian Operations Research in High-Impact Journals

Michael Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu, Panelists: Vedat Verter, Stefanos Zenios, Emmett Lodree, Roman Slowinski

Journal quality rankings are often used by academic units to make important assessments regarding faculty performance including tenure and promotion decisions. This criterion can be problematic for researchers in the community and humanitarian operations areas because "top-tier" journals are often not the most appropriate outlets for this type of research. This panel will attempt to articulate the characteristics papers that are likely to be successful in top-tier titles, and discuss other strategies for justifying research quality in these areas. Confirmed participants (so far): - Vedat Verter (Socio-Economic Planning Sciences) - Stefanos Zenios (Operations Research) (we're likely to get either Stephen Graves or Pinar Keskinocak of Manufacturing and Services Operations Management) Sponsoring subdivisions: Minority Issues Forum; Section on Public Programs, Services and Needs

■ TB36

Hilton- Union Sq 16

Optimization Techniques for Reliable Operation of Mobile Communication Systems

Sponsor: Telecommunications

Sponsored Session

Chair: Albena Mihovska, Associate Professor, Center for TeleInfrastruktur-Aalborg University, Fredrik Bajers Vej 7C1, Aalborg, 9000, Denmark, albena@es.aau.dk

1 - Mathematical Model for Optimized Node Selection in Resource-Constrained Environments

Albena Mihovska, Associate Professor, Center for TeleInfrastruktur-Aalborg University, Fredrik Bajers Vej 7C1, Aalborg, 9000, Denmark, albena@es.aau.dk

A main concern related to Internet of Things (IoT) research efforts is the realization of autonomous decision-making and communications between the resource-constrained nodes, part of a dynamic topology. This contribution proposes a novel mathematical model to define the node interactions in a resource-constrained environment and optimize the selection of a partner for the most reliable communication depending on the needs of the service required.

2 - The Next Billion of Devices and Beyond: Getting Ready for Machine-to-Machine (M2M)

Rasmus Nielsen, Cisco Systems, 855 Tasman Dr, San Jose, United States of America, rhnielsen@ieee.org, Mahbubul Alam

The next wave of connectivity will consist of Machine-to-Machine (M2M) devices with usage patterns much different from what is currently seen from the human-driven network traffic. This paper investigates the challenges of connecting this large number of devices and supporting their specific requirement while proposing ways and methods to addresses these challenges in the form of optimizing networks specific to such devices in terms of scalability, performance, security and reliability.

3 - Topological Optimization of Reliable Networks under Dependent Failures

Javiera Barrera, Universidad Adolfo Ibañez, Faculty of Engineering, Santiago, Chile, javiera.barrera@uai.cl, H Cancela, Eduardo Moreno

We address the design problem of a reliable network. Previous work assumes that link failures are independent. We discuss the impact of dropping this assumption. We show that under a common-cause failure model, dependencies between failures can affect the optimal design. We also provide an integer-programming formulation to solve this problem. Furthermore, we discuss how the dependence between the links that participate in the solution and those that do not can be handled. Other dependency models are discussed as well.

■ TB37

Hilton- Union Sq 17

Data Mining and Machine Learning

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Dave Choi, Carnegie Mellon University, Hamburg Hall 2101C, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, davidch@andrew.cmu.edu

1 - Data-driven Individual and Joint Chance-Constrained Optimization via Kernel Density Estimation

Bruno A. Calfa, Graduate Student, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, bacalfa@gmail.com, Ignacio E. Grossmann, Scott J. Bury, John M. Wassick, Anshul Agarwal

We propose a data-driven, nonparametric approach to reformulate (conditional) individual and joint chance constraints with right-hand side uncertainty into algebraic constraints. The approach consists of using Kernel Density Estimation (KDE) to approximate unknown "true" continuous probability density/distribution functions. We propose a new way of specifying the phi-divergence tolerance based on point-wise standard errors of the smoothing estimates with respect to the asymptotic distribution.

2 - Approximate Formulations for Chance Constrained Problems

Gabriela Martinez, Postdoctoral Associate, Cornell University, 319 Riley-Robb Hall, Ithaca, NY, United States of America, mgm256@cornell.edu, C. Lindsay Anderson

We propose an approximate formulation for chance constrained optimization models with ambiguous probability distribution of the random parameters of the optimization model. In this work, the uncertainty of the distribution is described by confidence regions constructed from order statistics of historic data of the uncertain parameters.

3 - Ensemble Recommendation and Segmentation for Large Datasets

Jorge Silva, SAS, 100 SAS Campus Dr, Cary, NC, United States of America, jorge.silva@sas.com, Jared Dean, Susan Haller, Patrick Hall, Ilknur Kabul

Recommender systems are a growing application of data mining and machine learning. We describe a recommendation and segmentation framework based on an ensemble of models, leveraging parallel computation. We employ a flexible factorization machine model, using not only recorded user-item access but also side information. Using a parallel Monte-Carlo procedure, the learned factors are clustered under multiple hypotheses, producing robust and interpretable ensemble estimates for large datasets.

■ TB38

Hilton- Union Sq 18

Health Care Modeling Optimization II

Contributed Session

Chair: Srinivasa Puranam, La Salle University, 1900 W Olney Ave, Philadelphia, PA, 19102, United States of America, kartys.here@gmail.com

1 - Appointment Scheduling of Outpatient Surgical Services in a Multistage Operating Room Department

Payman Jula, Associate Professor, Simon Fraser University, 8888 University Drive, Burnaby, BC, V5A 1S6, Canada, pjula@sfu.ca

We address the appointment scheduling of multistage operating room departments with stochastic service times serving multiple patient types. We discuss many challenges, such as the limited availability of multiple resources (e.g., staff, operating rooms, surgeons, and recovery beds), and the compatibility of patient and surgeon types. Simulation-based optimization methods have been proposed to minimize the patients' wait time, patients' completion time, and number of surgery cancellations.

2 - Coordinating Contracts in Value-Based Healthcare Delivery

Tannaz Mahootchi, PhD Candidate, Wilfrid Laurier University, 75 University Ave. West, Waterloo, ON, N2L 3C5, Canada, tmahootchi@wlu.ca, Ignacio Castillo, Logan McLeod

Value-based healthcare delivery requires reforms to different components of the healthcare system including organizational structure, outcome/cost measurement, and reimbursement. This study looks at coordinating contracts between healthcare purchasers and healthcare providers in this context. A dynamic principal-agent model is used to model the interactions between treatment strategy and health outcomes where there is a single responsible entity for both the health outcomes and costs of care.

3 - Robust Post-donation Blood Screening Strategies under Prevalence Rate Uncertainty

Hadi El Amine, PhD Candidate, Virginia Tech, 1228 University City Blvd., Apt F67, Blacksburg, VA, 24060, United States of America, hadi@vt.edu, Ebru Bish, Douglas Bish

Blood product safety, in terms of being free of transfusion-transmittable infections, is crucial. Under prevalence rate uncertainty, various objective functions, including minimization of a mean-variance objective and minimization of the maximum regret, were considered in order to determine a "robust" post-donation blood screening strategy that minimizes the risk of releasing an infected unit of blood into the blood supply. Efficient and exact algorithms are provided.

4 - On the Determination of Optimal Ordering Policies for Blood Products with Blood Transfers

Srinivasa Puranam, La Salle University, 1900 W Olney Ave, Philadelphia, PA, 19102, United States of America, kartys.here@gmail.com, David Novak, Marilyn Lucas

We investigate the determination of optimal order policies for blood products when blood transfers exist from other hospitals. We develop an analytical model to propose simple decision rules and compare these rules to existing policies - relying on real-world data from the Blood Bank of a local hospital.

5 - The Mahalanobis Distance Approach to Minimization of Kidney Discard Rate

Philip Appiah Kubi, PhD Candidate, Ohio University, 14 Pine St., Apt # 1B, The Plains, OH, 45780, United States of America, pa809911@ohio.edu, Park Namkyu

In 2011 over 5,000 people died on the kidney waitlist while the discard rate also increased from 12.7% in 2002 to 17.9% in 2011. This paper discusses the prospects of minimizing the kidney discard rate by applying the Mahalanobis distance (MD) model to kidney allocation. This approach will offer candidates with kidneys of virtually the same quality over time, hence are presented with minimal incentive to reject a kidney offer.

■ TB39

Hilton- Union Sq 19

Managing Capacity and Demand in Healthcare Services

Sponsor: Health Applications

Sponsored Session

Chair: Craig Froehle, University of Cincinnati, 2925 Campus Green Dr, Lindner College of Business, Cincinnati, OH, 45221-0130, United States of America, craig.froehle@uc.edu

1 - A Queuing Evaluation of Partial Flexibility in Healthcare Systems with Multi-priority Patients

Elham Torabi, University of Cincinnati, 2925 Campus Green Dr, Lindner College of Business, Cincinnati, OH, 45221-0130, United States of America, torabiem@mail.uc.edu, Yann Ferrand, Michael Magazine, Uday Rao, Craig Froehle

Resource flexibility can improve responsiveness to customers/jobs in different priority groups. Using the context of an emergency department, we develop queueing models to determine the ideal degree of flexibility based on number of resources and uncertainty in various system parameters, such as arrival and service rates for each priority group.

2 - The Impact on LOS of a Reduction in ED Ultrasound Order Processing Time

Anita Tucker, Harvard Business School, Morgan Hall, Soldiers Field, Boston, MA, 02163, United States of America, atucker@brandeis.edu, Jillian Berry Jaeker, Michael Lee

We use a process change at two EDs to test whether increasing capacity increases wait times due to additional services being provided. We find that an increase in capacity for ultrasounds (U/S) resulted in an 11.5% increase in the probability of an U/S being ordered, and the increased demand for U/S resulted in longer times to return other tests. Consequently, the average length of stay for increased by nearly 30 minutes, and the waiting time to enter the ED increased by 26 minutes.

3 - Quality & Efficiency Implications of Interruptions & Information Overload on Decision-Making

Lauren Laker, University of Cincinnati, 2925 Campus Green Dr, Lindner College of Business, Cincinnati, OH, 45221-0130, United States of America, lakerln@mail.uc.edu, Craig Froehle

Research suggests that the timing of interruptions during a cognitive task can affect the quality and timeliness of decision-making in knowledge-intensive work environments. We hypothesize that providing framing, or directed learning, beforehand can improve decision-making by reducing information overload, partly mitigating the effects of interruptions. We evaluate these effects through controlled experiments. Initial findings are presented.

4 - Improving Service Levels in Hospital Porter Services

Ken Klassen, Professor, Brock University, Goodman School of Busin, 500 Glenridge Ave, St. Catharines, ON, L2S 3A1, Canada, kklassen@brocku.ca, Sean Brown

Causes of poor porter services can be difficult to identify. The hospital under study was experiencing such long wait times that all calls were reported as urgent ("STAT") and patients were often not ready when the porter arrived because arrival times were uncertain. The hospital had different systems for segregated sets of porters, and workloads were unequal. This study uses multiple quantitative and qualitative techniques to understand and analyze the system and to provide recommendations.

■ TB40

Hilton- Union Sq 20

Stochastic Modeling in Healthcare Delivery

Sponsor: Health Applications

Sponsored Session

Chair: Nan Liu, Assistant Professor, Columbia University, 600 W. 168th St., 6th floor, New York, NY, 10032, United States of America, nl2320@columbia.edu

Chair: Pengyi Shi, Assistant Professor of Operations Management, Purdue University, Krannert School of Management, West Lafayette, IN, United States of America, shi178@purdue.edu

1 - A Simulation Algorithm to Staff for Time-varying Arrivals and Multiple Customer Classes

Leon Cui, University of Rochester, 620 University Park, Rochester, NY, United States of America, leon.cui@Simon.Rochester.edu, Tolga Tezcan, Ozlem Yildiz

We propose a data-driven heuristic algorithm to find the minimum staffing level required in a queueing system with time-varying arrivals and multiple customer classes, given a service level criterion for each customer class. Our algorithm has been implemented by the transportation department of a local research hospital. Its validity is supported by results from the hospital, and by numerical experiments.

2 - OptiCare: An Outpatient Capacity Planning Tool for Integrated Care Access

Jivan Deglise-Hawkinson, University of Michigan, 820 S First Street Apt 2, Ann Arbor, MI, 48103, United States of America, jivan@umich.edu, Jonathan Helm, Thomas Rohleder, Mark Van Oyen, Todd Huschka, David Kaufman

Our capacity planning model seeks to meet targets on the access to an initial/root appointment by patient type and plan for a patient mix. A root visit usually generates a series of other appointments in both the initial department and in other medical areas. Our approach uses integer programs to optimize a booking plan that is also sensitive to utilization and incorporates stochastic models of future return visits and downstream appointments generated to follow up on the initial visit.

3 - Overflow Policies for Emergency Department Patients Awaiting Inpatient Beds

Pengyi Shi, Assistant Professor of Operations Management, Purdue University, Krannert School of Management, West Lafayette, IN, United States of America, shi178@purdue.edu, Jim Dai

Emergency department patients who wait to be admitted to inpatient wards sometimes have to be overflowed to a non-primary ward when they wait too long. Overflowing patients may alleviate the system congestion temporarily, but could reduce the quality of care delivered. We study a queueing system to gain insights into the impact of overflow policies on various performance measures. We also evaluate how different factors such as the bed capacity and discharge timing affect the overflow rate.

■ TB41

Hilton- Union Sq 21

OR/MS in Healthcare Quality and Patient Safety

Sponsor: Health Applications

Sponsored Session

Chair: Laila Cure, Western Michigan University, 1903 W. Michigan Ave, Kalamazoo, MI, 49008-5336, United States of America, laila.cure@wmich.edu

1 - Optimized Dual Shewhart-EWMA Statistical Control Charts for Hospital-acquired Infection Surveillance

Salah Haridy, Northeastern University, 360 Huntington Avenue, Boston, MA, United States of America, s.haridy@neu.edu, Dayna Martinez, James Benneyan, Arthur Baker, Deverick Anderson

Early detection of hospital-acquired infection (HAI) outbreaks remains an important problem across the U.S. We develop an optimized dual Shewhart-EWMA approach that minimizes the expected number of additional HAIs by allocating detection power between two sets of control limits under random outbreak sizes. Numerical testing and application to 10 years of infection surveillance data across 40 community hospitals outperformed traditional methods by 20-to-360% reductions in additional HAIs.

2 - Informing Resuscitation Decisions in Acute Care by Capturing Provider-specific Model Uncertainty

Muge Capan, North Carolina State University, 400 Daniels Hall, College of Engineering, Raleigh, NC, United States of America, mcapan@ncsu.edu, Jeanne Huddleston, Julie Ivy

Modeling physiological deterioration to inform resuscitation decisions involves the challenge of specification of the input parameters. Specifically, cost parameters require translation of provider preferences. We develop analytical models for determining optimal patient-specific resuscitation policies. We consider care providers' risk-sensitive behavior to capture model uncertainty due to subjective cost parameters, and variability in the value of providers with different expertise.

3 - Impact of the Disease Surveillance System in Epidemiologic Characterization of Pandemic Outbreaks

Eric Meisheri, Western Michigan University, 4601 Campus Drive, Kalamazoo, MI, 49008, United States of America, eric.r.meisheri@wmich.edu, Diana Prieto, Peter Holvenstot, Richard VanEnk

In the U.S., most of the information about a developing influenza pandemic comes from data collected by State viral surveillance systems. This study explores the effect of surveillance system, and behavioral factors on the accuracy of pandemic trend prediction. The authors used a specimen submission and testing simulation developed over an existing agent based disease spread model. The results were analyzed to determine the most significant factors and interactions.

4 - Modeling and Analysis of Inpatient Care Rounds
Laila Cure, Western Michigan University, 1903 W. Michigan Ave, Kalamazoo, MI, 49008-5336, United States of America, laila.cure@wmich.edu, Ewing Tiong

We study the problem of planning patient care rounds in a shift by a healthcare provider assigned to a specific set patients within an inpatient care unit, when personnel has been scheduled and resources have been allocated. This research investigates inpatient care work planning decisions and proposes an OR- based model to study such decisions. The model will help identify needs and challenges in developing decision-support tools for the provision of high quality care using available resources.

■ TB42

Hilton- Union Sq 22

Joint Session HAS/QSR/Analytics: Advanced Predictive Analytics for Health and Wellness Assurance

Sponsor: Health Applications, Quality, Statistics and Reliability, & Analytics Section

Sponsored Session

Chair: Trung Le, Texas A&M, College Station, TX United States of America, trung.le@tamu.edu

Co-Chair: Satish Bukkapatnam, Texas A&M University, College Station, TX, United States of America, satish@tamu.edu

1 - Personalized Prognostics of Cardiorespiratory Disorders: A Case Study for Obstructive Sleep Disorder
Trung Le, Texas A&M, College Station, TX, United States of America trung.le@okstate.edu, Satish Bukkapatnam

A personalized prognosis method based on a nonparametric statistical (Dirichlet Process Mixture Gaussian Process-DPMG) model to estimate the state evolution from a normal to an anomalous state and hence the distribution of the time till impending disorders has been reported. Validations using data from ECG Apnea Database-Physionet suggest that the model can predict the time till the onset of a disorder (apnea episode) to within 15% of the actual observed times 1-45 minutes ahead of inception.

2 - Statistical Shape Analysis and Prediction of Soft Tissue Insertions on the Tibial Plateau
Cao (Danica) Xiao, PhD Student, University of Washington, Seattle, 3900 Northeast Stevens Way, Mechanical Engineering Building, room G6, Seattle, WA, 98195, United States of America, danicaxiao@gmail.com, Liying Zheng, W. Art Chaovalitwongse, Xudong Zhang

Our study characterized the soft tissue insertion centroids and outlines on the tibial plateau and their inter-relationships with tibia outlines. We use coordinates conversion, outline detection, and windowing to extract 36 features from tibia outlines. Then we use KNN with three different measures to predict soft tissue locations(centroid and outlines) based on tibia outline features. Results show high prediction accuracy.

3 - Penalized Estimation of DAGs from Partial Orderings
Ali Shojaie, University of Washington, F646 Health Sciences Building, Department of Biostatistics, Seattle, WA, 98195, United States of America, ashojaie@uw.edu

Directed acyclic graphs (DAGs) are widely used to define causal relationships among variables, and play a critical role in diverse application areas. Although, learning DAG structures from observational data is very challenging, it can be efficiently performed if the causal ordering among the variables is known. In this talk, we will extend discuss estimation of DAGs from partial or set orderings, and present an efficient algorithm for learning the structure of high dimensional DAGs.

■ TB43

Hilton- Union Sq 23

Data Analysis

Sponsor: Computing Society

Sponsored Session

Chair: Jason Sauppe, PhD Candidate, University of Illinois at Urbana-Champaign, 201 North Goodwin Avenue, Urbana, IL, 61801, United States of America, sauppe1@illinois.edu

1 - The Role of Optimization and Covariate Balance in Observational Studies
Jason Sauppe, PhD Candidate, University of Illinois at Urbana-Champaign, 201 North Goodwin Avenue, Urbana, IL, 61801, United States of America, sauppe1@illinois.edu, Sheldon Jacobson

Observational, or non-random, data exist in many areas of study. However, such data require the use of appropriate methods of adjustment in order to derive unbiased causal estimates. Matching methods have long been used for this purpose, but improvements in computational power and optimization techniques now allow for the use of more general adjustment methods based on covariate balance measures. This talk will explore several assumptions and models related to these adjustment methods.

2 - Second-Order Cone Programming for Nonnegative Regression with P-Spline
Yu Xia, Assistant Professor, Lakehead University, Business Administration, 955 Oliver Rd., Thunder Bay, ON, P7B 5E1, Canada, yxia@lakeheadu.ca, Farid Alizadeh

We consider regression by B-splines with a penalty on high-order finite difference of the coefficients of adjacent B-splines. The penalty prevents overfitting. The underlying function is assumed to be nonnegative. The model is casted as a second-order cone programming problem, which can be solved efficiently by modern optimization techniques. The method is implemented in MATLAB.

3 - Cooperative Data Analysis in Supply Chains Using Selective Information Disclosure
Michael Hahsler, SMU, P. O. Box 750123, Dallas, TX, 75275, United States of America, mhahsler@lyle.smu.edu

Many modern products (e.g., consumer electronics) consist of hundreds of complex parts sourced from a large number of suppliers. In such a setting, finding the source of defects in the final product becomes more difficult and may be hampered by limited information disclosure between parties. In this work we investigate the effectiveness of strategies of selective information disclosure in order to perform cooperative data analysis in a supply chain context.

■ TB44

Hilton- Union Sq 24

Economics of Information Systems

Sponsor: Information Systems

Sponsored Session

Chair: Marius Florin Niculescu, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree St. NW, Atlanta, GA, 30308, United States of America, Marius.Niculescu@scheller.gatech.edu

1 - Influence of Social Media in Flash Sales: An Exploratory Study
Karthik Babu Nattamai Kannan, PhD Student, Scheller College of Business, Georgia Institute of Technology, 800 West Peachtree NW, Office # 4277, Atlanta, GA, 30308, United States of America, KarthikBabu.NK@scheller.gatech.edu, Yu Jeffrey Hu, Sridhar Narasimhan

In this study, we explore the role played by social media activities in promoting sale of products sold in flash sales. We collected both sales and aggregate social media data for new products launched by a popular e-commerce firm. We use this data to evaluate how Facebook likes, Pinterest pins and internal social media activities impact sales.

2 - Economics of Online Distribution of Video Content
Marius Florin Niculescu, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree St. NW, Atlanta, GA, 30308, United States of America, Marius.Niculescu@scheller.gatech.edu, Hemant Bhargava

In this study, we explore the strategic decision faced by video content aggregators whether to release fresh content for binge or staggered consumption. We consider various video content consumption patterns as well as different types of content.

3 - What is the Relationship between Market Structure and Digitized Customer Experience?
Philipp Herrmann, University of Paderborn, Warburger Strafle 100, Paderborn, Germany, Philipp.Herrmann@wiwi.uni-paderborn.de, Mohammad Rahman

We study the relationship between local market structure and digitized customer experience in the form of online ratings. We find a small negative correlation between market size and the average of the digitized customer experience. Also, larger markets allow for a substantially broader range of qualities. These relationships are best explained by a model were the provisioning of a higher quality increases marginal costs but does not affect fixed costs.

4 - Electronic Commerce and Spatial Arbitrage
Hemang Subramanian, PhD candidate, Information Technology and Management, Georgia Institute of Technology, 800 W Peachtree Street, Atlanta, GA, 30308, United States of America, Hemang.Subramanian@scheller.gatech.edu, Eric Overby

The lack of market efficiency creates opportunities for spatial arbitrage in which an arbitrageur purchases products in low-priced locations and resells them in high-priced locations. We study spatial arbitrage in a wholesale used vehicle industry, where two e-channels operate i.e. a webcast and a standalone e-market. Overall, using a quasi-natural experiment, we find that arbitrage reduced as e-commerce diffused, while some arbitrage shifted from the physical market to the standalone e-market.

■ TB45

Hilton- Union Sq 25

Modeling Human Behavior in OM

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Karen Zheng, Massachusestts Institute of Technology, Sloan School of Management, Cambridge, MA, 02142, United States of America, yanchong@mit.edu

1 - Newsvendor Selling to Loss Averse Consumers with Stochastic Reference Points
Sami Najafi-Asadolahi, Assistant Professor, Santa Clara University, Leavey School of Business, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, snajafi@scu.edu, Opher Baron, Ming Hu, Qu Qian

We study a newsvendor who repeatedly sells a single perishable product to two types of consumers: regular consumers, who have a given consumption utility and whose market size is uncertain, and bargain hunters, who have a low valuation and are abundant. The regular consumers are loss averse with random reference levels that represent their beliefs about possible price and availability. We show the impact of loss aversion on the newsvendor's inventory and pricing decisions.

2 - Bounded Rationality in Supply Chain Interactions
Basak Kalkanci, Associate Professor, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, Basak.Kalkanci@scheller.gatech.edu, Georgia Perakis

We investigate the impact of a retailer's bounded rationality in a two-tier supply chain. We show that the supplier's and retailer's profit are not necessarily monotone in the retailer's rationality. We quantify the value of using minimax regret criterion when the retailer's rationality is not known.

3 - The Design of Experiential Services with Acclimation and Memory Decay
Uday Karmarkar, UCLA, 110 Westwood Plaza, Gold Hall, Suite B-512, Los Angeles, CA, 90066, United States of America, uday.karmarkar@anderson.ucla.edu, Aparupa Das Gupta, Guillaume Roels

In this talk, we study how to schedule activities and allocate duration to them in a service encounter so as to maximize ex-post customer satisfaction, when customers are subject to acclimation and memory decay. We show that, when considered individually, memory decay and acclimation yield the same encounter designs, whereas when they are considered jointly, they act as opposing forces.

4 - Pricing with Anticipation
Javad Nasiry, Assistant Professor, HKUST, LSK Building, HKUST, Hong Kong, Hong Kong - PRC, nasiry@ust.hk, Ioana Popescu

We study a market where customers derive emotional utility from anticipating pleasurable purchase outcomes, but experience disappointment if outcomes fall short of what they anticipated. In this context, we show that firms can profit by adopting randomized pricing policies.

■ TB46

Hilton- Lombard

Recent Advances in Conic Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

1 - Techniques in Convexification of Separable Polynomial Inequalities
Mohit Tawarmalani, Professor, Purdue University, 403 W. State Street, West Lafayette, IN, United States of America, mtawarma@purdue.edu, Jean-Philippe P Richard

We develop convexification techniques for inequalities defined using a separable polynomial. Within this framework, we discuss various decomposition results in convexification. We highlight the important role played in convexification by transformations to positive-homogeneity. We discuss their merits vis-à-vis concavifying transformations. We provide explicit convex hull descriptions when variables are unbounded and discuss their use with bounded variables.

2 - How to Convexify the Intersection of a Second Order Cone and a Nonconvex Quadratic
Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu, Samuel Burer

We study sets defined by the intersection of a second-order-cone representable (SOCr) constraint, a single homogeneous nonconvex quadratic and an affine hyperplane. Under mild conditions, we derive simple, computable convex relaxations given by a new SOCr constraint. Under further conditions, we prove that our relaxations capture precisely the corresponding convex hull. Our approach unifies and extends previous results, and we illustrate its applicability and generality with many examples.

3 - The Power of a Negative Eigenvalue: Aggregation Cuts for Nonlinear Integer Programming
Sina Modaresi, Graduate Research Assistant, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, sim23@pitt.edu, Juan Pablo Vielma

Aggregation technique is a cut generating procedure which can be used to obtain general intersection cuts. However, it might fail to yield convex constraints or closed form expressions even in the quadratic case. We study an extension of the aggregation technique which is to relax the convexity requirement on the implied inequality and allow one negative eigenvalue. We then show that convex hull of any set described by two quadratic inequalities (convex or not) is conic quadratic representable.

4 - A Computational Study on Non-convex QCQP's
Gonzalo Munoz, Columbia University, 500 W. 120th Street, New York, NY, 10027, United States of America, gonzalo@ieor.columbia.edu, Daniel Bienstock

In this talk we present experimental results solving difficult QCQP instances using a variety of nonstandard formulations, branching and cutting plane techniques. Joint work with D. Bienstock.

■ TB47

Hilton- Mason A

Risk-Averse Dynamic Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Andrzej Ruszczynski, Distinguished Professor, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08550, United States of America, rusz@business.rutgers.edu

1 - Dynamic Risk Measure for Controlled Discrete-Time Stochastic Processes with Application to POMDP
Jingnan Fan, PhD Student, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, kellyfjn@gmail.com, Andrzej Ruszczynski

We consider dynamic risk measures for general controlled discrete-time stochastic processes. We introduce the condition of stochastic conditional time-consistency. We prove that the risk measure must have a special structure involving a risk transition mapping as a law-invariant risk measure on the state space. Then we apply the results to two classes of problems: controlled fully-observable Markov processes and controlled partially-observable Markov processes.

2 - Methods for Solving Infinite-Horizon Risk-Averse Dynamic Programming Problems
Andrzej Ruszczynski, Distinguished Professor, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08550, United States of America, rusz@business.rutgers.edu, Ozlem Cavus

The total cost problem for discrete-time controlled Markov models is considered. The objective functional is a Markov dynamic risk measure of the total cost. Two solution methods, value and policy iteration, are proposed, and their convergence is analyzed. In the policy iteration method we analyze a version of the nonsmooth Newton's for policy evaluation. The results are illustrated on a credit limit control problem.

3 - Risk-averse Dynamic Programming for Clinical Trial Design
Curtis McGinity, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, curtis.mcginity@gmail.com, Andrzej Ruszczynski

We consider the problem of optimal dose escalation for early stage clinical trial design. We formulate the risk-averse dynamic programming problem, develop dynamic programming equations, and compare the risk of several myopic and look-ahead optimal policies under dynamic measures of risk.

4 - Time-consistent Approximations: Empirical Results for the Dow Jones Industrial Average
Tsvetan Asamov, Post-doctoral associate, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, tasamov@princeton.edu, Andrzej Ruszczynski

We use dynamic time-consistent formulations to approximate problems having a single coherent risk measure applied to the aggregated costs over all time periods. The dual representation of coherent risk measures is used to create a time-consistent cutting plane algorithm. Additionally, we also develop methods for the construction of universal time-consistent upper bounds. The performance of the techniques is tested using monthly return data for the components of the Dow Jones Industrial Average.

■ TB48

Hilton- Mason B

Optimization, Combinatorial 1

Contributed Session

Chair: Daniele Catanzaro, Professor, Rijksuniversiteit Groningen, Nettelbosje 2, Groningen, 9747 AE, Netherlands, d.catanzaro@rug.nl

1 - Flow Shop Machines Just-in-Time Scheduling
Muminu Adamu, Dr, University of Lagos, Akoka Yaba, Lagos, Nigeria, madamu@unilag.edu.ng

In this paper, the scheduling to maximize the weighted number of Just-In-Time (JIT) jobs on flow shop machines is considered. This problem is known to be NP Complete for due dates involving interval in time. The problem formulation is suggested, two greedy heuristics are proposed for solving the problem. A numerical example to illustrate its use and extensive computational experiments performed with promising results are presented. Likely areas of extensions are provided.

2 - A Catalog of ILP Formulations for the Job Sequencing and Tool Switching Problem
Daniele Catanzaro, Professor, Rijksuniversiteit Groningen, Nettelbosje 2, Groningen, 9747 AE, Netherlands, d.catanzaro@rug.nl

We investigate the a particular version of path dependent Traveling Salesman Problem, called the Job Sequencing and Tool Switching Problem. We develop new integer linear programming formulations for the problem and we prove theoretically and computationally that they are better than the alternative ones currently described in the literature.

3 - Two-dimensional Bin Packing Problem with Hatch Constraint
Takashi Imamichi, Researcher, IBM Research - Brazil, Av. Pasteur 138/146, Botafogo, Rio de Janeiro, RJ, 222700-50, Brazil, tima@br.ibm.com, Bruno da Costa Flach

Two-dimensional bin packing problem asks us to find a layout of a set of given rectangular items into a set of given rectangular bins. The objective is to minimize the number of bins. In this talk, we introduce an additional "hatch constraint" that requires finding a sequence of items to place into the bin through the "hatch". The hatch constraint arises from the ship hold packing problem as a real-world application. We introduce a heuristic approach and preliminary computational results.

4 - Optimal Assignment for In-Air Training
Yasaman Khodadadegan, Consultant, American Airlines, 1920 W University Dr, Tempe, AZ, 85281, United States of America, Yasaman.Khodadadegan@aa.com, Xin Liu, Tuell Green

When it comes to training pilots on a different aircraft type, time is money. The quicker the pilot can get fully qualified on the new aircraft type, the sooner the pilot will be available for productive work. Using the existing flight sequences, required training hours and cycles, pilot start date, instructor availability, and air operation rules, we determine the schedule for the pilots and instructors that minimizes the time required to complete the air-operation training.

■ TB49

Hilton- Powell A

Social and Economic Network Models

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Alexander Nikolaev, University at Buffalo (SUNY), 312 Bell Hall, Buffalo, NY, 14260, United States of America, anikolae@buffalo.edu

1 - Potential Games with Exogenous Uncertainty
Harikrishnan Sreekumaran, Doctoral Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, harikrishnan@purdue.edu, Andrew Liu

Potential games are a class of games in which best response dynamics can be proven to converge to Nash equilibria. In this work, we analyze potential games with exogenous uncertainty under common knowledge assumptions. We show that sampling-based approximation schemes can be combined with decentralized algorithms to compute the equilibria of such games. Numerical results will be presented with the proposed approach applied to several application examples such as network design games.

2 - Stochastic Optimization Model for Capacity Expansion in Transportation Networks
Areesh Mittal, Graduate Student, University of Texas at Austin, 2900 Cole Street, #202, Austin, TX, 78705, United States of America, areeshmittal@utexas.edu, Jennifer Duthie, Bismark Singh, David Morton

We consider the problem of selecting links for capacity expansion in a transportation network, when the budget is uncertain, with the goal of minimizing expected total system travel time. To obtain nested solutions for increasing values of budget, we build a two-stage stochastic optimization model in which links are prioritized in the first stage and then selected in the second stage according to that priority list. We demonstrate our work on the Sioux Falls network.

3 - Interdicting Social-Functional Networks
Paul (Lee) Ewing, Research Associate Professor, Operations Research, Naval Postgraduate School, 1411 Cunningham Rd., Monterey, CA, 93943, United States of America, plewing@nps.edu, Matt Carlyle, Peter Nesbitt

We offer a targeting tool that quantitatively analyzes the effects of interdicting managers in a network constructed from disparate sources. We model the adversary with a bi-level optimization model to include the managers, resources and processes necessary to its function. This model delivers a quantitative assessment of an adversary's ability to achieve its goals and suggests interdiction plans to delay the adversary's activities.

4 - A Subjective Evidence Model for Influence Maximization in Social Networks
Mohammadreza Samadi, Graduate research Assistant, University at Buffalo (SUNY), 327 Bell Hall, Buffalo, NY, 14260, United States of America, msamadi@buffalo.edu, Alexander Nikolaev, Rakesh Nagi

We introduce a new model of subjective evidence propagation in social networks. Investigations with the model in the presence of competition shed light on the phenomena of belief reinforcement and viral spread of products/technologies. The NP-Hard influential seed selection problem is first solved as an MIP. Second, an efficient Lagrangian Relaxation heuristic with guaranteed bounds is designed. Third, problem-specific iterative seed selection procedures are explored via extensive testing.

5 - Understanding the Emergence of Power Laws in Empirical Data
Sushant Khopkar, University of Buffalo (SUNY), Buffalo, NY, United States of America, skhopkar@buffalo.edu, Alexander Nikolaev, Rakesh Nagi

Many online social network account owners have lots of connections, surpassing the Dunbar number of 150. We present a model that explains tie formation by bridging the gap between small and scale-free worlds. It explains how the information about a person may propagate from friends to the masses. It shows that a power law emerges, by the principles that are different from those of preferential attachment. It provides a means for evaluating how likely a talented individual is to become popular.

■ TB50

Hilton- Powell B

Optimization Methodologies 1

Contributed Session

Chair: Firdevs Ulus, Princeton University, Princeton University ORFE, Sherrerd Hall 322, Princeton, NJ, 08544, United States of America, fulus@princeton.edu

1 - Building Collaborative Optimization Model of the Electric Vehicles Business Ecosystem

Chunyan Duan, Doctoral Student, 1. Tongji University, School of Economics and Management; 2. University of Washington, Department of Industrial & Systems Engineering;, 1. A403, Sino-French Center, Tongji University, No.1239, Siping Road, Shanghai, 200092, China, duanchunyan77@163.com, Jianxin You

Recently, the industrialization and commercialization of the electric vehicles are urgent for more and more countries in the world. However, the current research mainly focuses on the framework and the definition of the concept. In this paper, we build collaborative optimization model of the electric vehicles business ecosystem by using the method of collaborative optimization, and finally propose the strategies and policy suggestions.

2 - Parametric Simplex Algorithm for Linear Vector Optimization Problems

Firdevs Ulus, Princeton University, Princeton University ORFE, Sherrerd Hall 322, Princeton, NJ, 08544, United States of America, fulus@princeton.edu, Birgit Rudloff, Robert Vanderbei

We propose a parametric simplex algorithm for linear vector optimization problems; it works for any dimension. In each iteration, it provides a set of inequalities, which defines the current partition of the parameter space. In addition to the simplex arguments, one needs to eliminate the redundant inequalities. This is similar to the vertex enumeration procedure, used in most of the objective space based algorithms. However, this algorithm doesn't require to solve a LP in each iteration.

3 - Nonlinear Time Series Generation Model Change Estimation for Individual and Business Service

Jianjun Lu, Associate Professor, College of Economics and Management, China Agricultural University, No. 17, Qinghuadong Road, Haidian Distri, Beijing, 100083, China, ljjun@cau.edu.cn

We deal with the individual and business service prediction by using the method of estimation of changes in nonlinear time series generation model. Particle Filters(PF) is applied to determine the best description of the time-varying nonlinear system based on the measure of likelihood, Genetic Programming(GP) is applied for online detection of changes in models and the estimation of functional forms of dynamics by assuming that the state equation is modified from the current functional form.

4 - Government's Fund Allocation to Small Medium Size Businesses After Disaster Hits: Optimization Model

Saba Pourreza, University of North Texas, 1155 Union Circle #311160, BLB. 399A, Denton, TX, 76203, United States of America, saba.pourrezajourshari@unt.edu, Cigdem Kochan, Brian Sauser

Access to government funding is an effective way to enhance the resilience for disturbed small medium size businesses (SMB). This study constructs an optimization model to maximize the community impact of SMBs. The model finds the optimum quantity that each SMB needs to create enough number of jobs and productions. KEYWORDS:Resource allocation, Resilience, Government funding, Mathematical modeling, Optimization model, Small medium size firm, Disaster relief

■ TB51

Hilton- Sutter A

Data-driven Methods for Decision Making

Sponsor: Optimization

Sponsored Session

Chair: Nathan Kallus, MIT, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu

Chair: Dimitris Bertsimas, Professor of Operations Research and Statistics, Massachusetts Institute of Technology, Massachusetts Institute of Technology, Sloan School of Management, E40-147, Cambridge, MA, 02139, United States of America, dbertsim@mit.edu

1 - From Predictive to Prescriptive Analytics

Nathan Kallus, MIT, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu, Dimitris Bertsimas

We construct novel predictive-prescriptive mechanisms that optimize decisions based directly on historical data and predictive observations. We prove almost-sure convergence to the prescient policy even when data is not IID but rather observations from an evolving system like a market or social network. We consider real-world examples in inventory management.

2 - Recent Progress on the Power of Static-robust Solutions

Vineet Goyal, Columbia University, New York, NY United States of America, vgoyal@ieor.columbia.edu, Brian Lu

In this talk, I will present recent progress on the performance of static robust solutions for two-stage adjustable robust linear programs under constraint-coefficient uncertainty. Our analysis provides important insights for developing near-optimal solution policies for adjustable robust linear optimization problems.

3 - Decomposable Markov Decision Processes: A Fluid Optimization Approach

Velibor Misic, Massachusetts Institute of Technology, 77 Massachusetts Ave E40-149, MIT ORC, Cambridge, MA, 02139, United States of America, vvmisic@mit.edu, Dimitris Bertsimas

Decomposable MDPs are problems where the system and its dynamics can be decomposed along multiple components. We propose a fluid optimization approach for such problems that achieves tractability by exploiting decomposability. We show that this approach achieves strong performance in restless bandit problems, optimal stopping problems and network revenue management.

■ TB52

Hilton- Sutter B

Linear Programs and Generalizations

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: John Mitchell, Professor, Rensselaer Polytechnic Institute, 325 Amos Eaton, Math Sciences, 110 Eighth St, Troy, NY, 12180, United States of America, mitchj@rpi.edu

1 - A Polynomial-time Rescaled von Neumann Algorithm for Linear Feasibility Problems

Dan Li, ISE Department, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, dal207@lehigh.edu, Kees Roos, Tamas Terlaky

We propose a rescaled von Neumann algorithm with complexity O(n^5size(A)). This is the first polynomial-time variant of the von Neumann algorithm. It is based on Chubanov's so called Basic Procedure, whose outcome is an evidence that the solution has at least one small coordinate so that we are able to rescale the linear system without changing the problem. Some numerical experiments are presented as well. We also improve the performance of Chubanov's method.

2 - Steplength Thresholds for Invariance Preserving of Discretization Methods of Dynamical Systems

Yunfei Song, PhD Student, Lehigh University, 337 S. New St. Apt. 202, Bethlehem, PA, 18015, United States of America, yus210@lehigh.edu, Zoltan Horvath, Tamas Terlaky

Steplength thresholds for invariance preserving of two discretization methods on a polyhedron are considered. For Hilton- Taylor Approximation type methods, we prove that a valid threshold can be obtained by finding the first positive zeros of a finite number of polynomial functions. Furthermore, an efficient algorithm is proposed to compute the threshold. For rational function type methods, we derive a valid threshold, which can be computed by using the analogous algorithm, for invariance preserving.

3 - Iteration-Complexity for IPMs Based on the Central Path Curvature

Murat Mut, Lehigh University, 200 W. Packer Ave, Bethlehem, PA, United States of America, mhm309@lehigh.edu, Tamas Terlaky

This talk centers around the theoretical iteration-complexity of certain interior-point algorithms in Linear Optimization. I highlight two curvature measures of the central path relevant to the complexity, the geometric and Sonnevend's curvature. Based on the new research by Mut-Terlaky 2013-2014, I discuss future research problems and the possibility of attempting to relate the two curvatures in a general setting and its further implications for IPMs.

4 - Worst-case Linear Optimization under Uncertainties

Jiming Peng, University of Houston, Houston, TX United States of America, jopeng@uh.edu

In this talk, we consider the so-called worst-case linear optimization (WCLO) with uncertain data. Particularly, we consider a scenario where the uncertainty arises in the right-hand-side of the constraints. When the generic L_2 norm is used to define the uncertain set, the WCLO is NP-hard. We then discuss how to obtain a lower bound to WCLO via tractable non-convex relaxation and when the relaxation is exact. preliminary numerical results will be reported as well.

■ TB53

Hilton- Taylor A

Economics/ Finance

Contributed Session

Chair: Abul Jamal, Professor, Southeastern Louisiana University, College of Business, Hammond, LA, 70402, United States of America, ajamal@selu.edu

1 - A Study of the Behavior of the Peso/USD Exchange Rate

Abul Jamal, Professor, Southeastern Louisiana University, College of Business, Hammond, LA, 70402, United States of America, ajamal@selu.edu, Yu Hsing

This Study examines the movements of the Peso/USD exchange rate based on the monetary model. It assumes that the purchasing power parity holds and that the nominal exchange rate is equal to the relative prices in the two countries. We will compare the Frankel, Bilson and the Dornbusch models. The estimates based on time series data were adjusted for autocorrelaton and heteroskedasticity. Results show the relationship of the exchange with relative money supply, interest rates, inflation and GDP.

2 - Are Targets for Renewable Portfolio Standards Too Low? A Complementarity-Based Policy Analysis

Afzal Siddiqui, University College London, Gower Street, London, United Kingdom, afzal.siddiqui@ucl.ac.uk, Makoto Tanaka, Yihsu Chen

We compare optimal renewable portfolio standards targets under a benchmark central planning setting with those under deregulated ones with and without market power. The latter two are formulated as bi-level problems. We show that setting a renewable portfolio standards target without considering the market structure could lead to sub-optimal market outcomes.

3 - How do Investor Relations Related Disclosures on Facebook Contribute to the Information Environment?

Tawei Wang, University of Hawaii at Manoa, 2404 Maile Way, BUSAD E602C, Honolulu, HI, 96822, United States of America, twwang@hawaii.edu, Ju-Chun Yen, Hsiao-Lun Lin

This paper focuses on how investor relations related disclosures on Facebook contributes to a firm's information environment. We first explore what investor relations related disclosures are made on Facebook by S&P 1500 firms in the one year period from October 2012 to September 2013. Then we investigate the association between such disclosures and a firm's information environment. Implications are discussed.

4 - The Stock Market Effects of Implementing ERP: Evidence from China

Xia Pan, Associate Professor, Sun Yat-sen University, Lingnan College, Guangzhou, Ch, 510275, China, panxia@mail.sysu.edu.cn, Yongqin Xie, Liujie Xu

We collect data on the events that Chinese publicly listed companies implement ERP systems and investigate the reaction on these companies' stock prices. Following the methodology that was used in financial research, we did an event study to test if the implementation ERP system has positive effect on the companies' stock market performance.

5 - Is the Ranking from Data Envelopement Analysis Useful for Stock Selection?

Liujie Xu, Student, Sun Yat-sen University, Lingnan College, Sun Yat-sen University, Guangzhou, 510275, China, panxpapers@gmail.com, Xia Pan

We applied Data Envelopement Analysis on a input and output data from publicly listed companies of retail industry. After the ranking results obtained from DEA, we compare the results with measures of the companies stock. We found out that DEA selection is partially useful in stock selection for investments.

■ TB54

Hilton- Taylor B

Tutorials in Financial Services

Sponsor: Financial Services Section

Sponsored Session

Chair: Ning Cai, Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, ningcai@ust.hk

1 - Asset-Liability Management

John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

This tutorial will present theory and computational approaches to asset-liability management over time. The emphasis will be on dynamic approaches including updates for estimates of trend and volatility and the incorporation of transaction costs.

2 - Portfolio Choice with Learning

Andrew Lim, Professor, National University of Singapore, 15 Kent Ridge Drive, Singapore, 119245, Singapore, andrewlim@nus.edu.sg

I survey methods from computational Bayesian statistics and discuss recent methods for applying these algorithms to solving high dimensional dynamic portfolio choice problems with learning and generalizations of the Black-Litterman model.

■ TB55

Hilton- Van Ness

Euclidean Distance Geometry Problems

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Marcia Fampa, Universidade Federal do Rio de Janeiro, PESC/COPPE- Cidade Universitaria, Centro de Tecnologia, Bloco H, Sala 319, Rio de Janeiro, Brazil, fampa@cos.ufrj.br

1 - Solving Euclidean Steiner Tree Problems in n-space

Marcia Fampa, Universidade Federal do Rio de Janeiro, PESC/COPPE- Cidade Universitaria, Centro de Tecnologia, Bloco H, Sala 319, Rio de Janeiro, Brazil, fampa@cos.ufrj.br, Wendel Melo, Jon Lee

The Euclidean Steiner tree problem in n-space is defined as follows: Given a set of points in R^n, find a tree of minimal Euclidean length that spans these points, using or not additional points in its construction. We present a branch-and-bound framework for solving this NP-Hard problem, with procedures to improve upper and lower bounds at the nodes of the enumeration tree, as well as a procedure to avoid the evaluation of symmetric solutions.

2 - Exploiting Symmetry in the Discretizable Molecular Distance Geometry Problem

Carlile Lavor, Associate Professor, University of Campinas, IMECC - UNICAMP, Campinas, Brazil, clavor@ime.unicamp.br, Leo Liberti

The Discretizable Molecular Distance Geometry Problem (DMDGP) is a subset of the Distance Geometry Problem, where the search space can be represented by a binary tree that can be explored by employing a Branch & Prune (BP) algorithm. This binary tree may contain several symmetries, which are directly related to the total number of solutions of the DMDGP. We will show how these symmetries can be used to speed up the BP algorithm.

3 - Euclidean Hub-and-Spoke Networks

John Carlsson, Assistant Professor, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, jgc@umn.edu

We consider the problem of designing an optimal hub-and-spoke network in Euclidean space: the "spokes" of the network are distributed continuously over a service region, and our objective is to determine the optimal number of hubs and their locations. We consider seven different backbone network topologies for connecting the hub nodes, namely the Steiner and minimum spanning trees, a TSP tour, a star network, a capacitated vehicle routing tour, a complete bipartite graph, and a complete graph.

4 - Some Challenges in n-dimensional Euclidean Distance Geometry Problems
Rosiane deFreitas, Professor PhD, Institute of Computing - UFAM, Av. Rodrigo Otavio, 3000, Aleixo, Campus, Campus Setor Norte, Bl. IComp, Manaus, AM, 69077-000, Brazil, rosiane@icomp.ufam.edu.br, Jayme Szwarcfiter, Nelson Maculan, Bruno Raphael Dias, Clarice Santos

The relationship between Euclidean distance geometry and graph theory will be explored, where some operational research problems will be considered, involving theoretical models and computational techniques proposed for channel allocation problems in wireless networks, and determining of the structure of protein molecules. Implicit enumeration algorithms will be presented, addressing issues of feasibility and optimality of solutions, with emphasis on the method of branch-prune-and-bound.

■ TB56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Analytic Solver Platform: Integrated Data Mining, Simulation and Optimization in Microsoft Excel
Daniel H. Fylstra, Frontline Systems Inc., Incline Village, NV, United States of America, daniel@solver.com

Analytic Solver Platform in Microsoft Excel has everything you need for forecasting and data mining, Monte Carlo simulation and risk analysis, and conventional and stochastic optimization -- where its solving power actually surpasses “enterprise” analytic software costing far more. See how you can use it to build your own analytic expertise and teach others, leveraging what you already know, build and solve industrial-scale models with the world’s best Solvers, and effectively communicate business results.

2 - Gurobi Optimization, Inc. - Distributed Optimization Including Concurrent and Parallel MIP
Ed Rothberg, Gurobi Optimization, Inc., Houston, TX, United States of America, rothberg@gurobi.com

In this tutorial you’ll learn about the expanded distribution algorithm capabilities in the new Gurobi 6.0 release. In addition to distributed tuning and distributed concurrent optimization, the new release also includes a distributed MIP solver, which allows you to use multiple machines to solve a MIP model faster. We’ll talk about the design of this new capability, give details on how to use it, and present performance results.

■ TB57

Hilton- Golden Gate 1

Flipped Classrooms

Sponsor: INFORM-ED

Sponsored Session

Chair: Patrick Noonan, Professor & Assoc. Dean, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States of America, patrick.noonan@emory.edu

1 - The Flipped Classroom of Operations Management: A Not-For-Cost-Reduction-Platform
Ardavan Asef-Vaziri, Professor, California State University Northridge, 18111 Nordhoff Street, Northridge, CA, 91330-8245, United States of America, ardavan.asef-vaziri@csun.edu

By delivering lectures via screen capture technology, the class time is no longer spent on teaching basic concepts, but rather on more value-added activities. A flipped classroom is an online course because its online components must outperform the best of the online courses. It is also a traditional course because not even a single class session is cancelled while all the lectures are delivered online.

2 - Flipping Engineering Probability and Statistics – Lessons Learned
Rick Olson, Assoc. Dean, Shiley-Marcos School of Engineering, University of San Diego, 5998 Alcala Park, San Diego, CA, 92110, United States of America, r_olson@sandiego.edu

This paper summarizes the lessons learned while teaching Engineering Probability and Statistics using the Flipped Classroom strategy. Compared to earlier offerings, the material was covered in less time and test scores on a common final exam increased. Class organization is described. The preparation of online materials is summarized. Student performance is analyzed and compared to previous offerings. Course evaluations are examined to gain insight into student attitudes to flipped classes.

3 - Flipping through the Field: Guiding Real-World Projects
Patrick Noonan, Professor & Assoc. Dean, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States of America, patrick.noonan@emory.edu

Working on real problems with real clients can provide students with rich learning opportunities. However, they can be train wrecks for everyone: students who gain only frustration; clients disappointed with return on investment; faculty who struggle to provide the right guidance to all. Faculty can steer students and clients toward success by drawing on a toolkit of best practices of the consulting profession.

■ TB58

Hilton- Golden Gate 2

Production and Scheduling 2

Contributed Session

Chair: Liang Zhang, University of Connecticut, 371 Fairfield Way, Ellington, CT, 06269, United States of America, liang@engr.uconn.edu

1 - Operation Control in Bernoulli Production Lines to Reduce Energy Consumption
Liang Zhang, University of Connecticut, 371 Fairfield Way, Ellington, CT, 06269, United States of America, liang@engr.uconn.edu, Zhiyang Jia, Jorge Arinez, Guoxian Xiao

In this work, we study the performance evaluation and control of Bernoulli serial lines to reduce energy consumption in the system. Specifically, the Markov chain model of the system is derived and closed-form formulas for calculating the performance measures are provided. Then, based on these formulas, properties of the performance measures as functions of system and control parameters are investigated. The efficacy of the analysis is demonstrated by numerical examples.

2 - Real-time Capable Heuristics for the Capacitated Lot-sizing and Scheduling Problem
Rudolf Bauer, University of Wuppertal, Gauflstrafle 20, Wuppertal, 42119, Germany, rbauer@winfor.de, Stefan Bock

Motivated by a real-world application, we consider the capacitated lot-sizing problem with linkage, sequence dependency and backorders. In order to tackle the problem, a variable neighborhood search and a genetic algorithm are applied. Moreover, dynamic events, such as incoming requests or machine breakdowns, have to handled. Therefore, we propose a new real-time approach that is based on a rolling-horizon scheme. First results of applying our procedure to real-world instances are presented.

3 - Risk-based Capacity Planning for Biotherapeutic Production Operations
Martin Wortman, Professor, Texas A&M Unversity, Dept of ISEN, College Station, TX, 77843-3131, United States of America, wortman@tamu.edu, Cesar Malave

Commitment and expansion of production capacity in the manufacture of biotherapeutics presents challenges that are dissimilar to traditional productions operations. We report a risk-based approach to capacity planning that is particularly useful in exploring the impact of emerging single-use systems as a technology for biotherapeutic production.

4 - A Preventive Maintenance Framework in Dairy Production Operations
Hiram Moya, Assistant Professor, The University of Texas-Pan American, 1201 West University Drive, Edinburg, TX, 78539, United States of America, MoyaH@utpa.edu, Maria Fernanda Vargas Zuluaga

Dairy plant operations suffer frequent downtime due to cleaning operations and different adjustments. This highly perishable product is delivered daily to different locations regionally; and any downtime reduces production capacity and limits operations. This work proposes a troubleshooting process to identify causes of downtime and minimization of operation disruptions by applying a combination of heuristics and linear programming to improve preventive maintenance and standardization.

5 - A Production Model with a Flexible Period of Order Satisfaction
Cristian Palma, Assistant Professor, Universidad del Desarrollo, Avda Sanhueza 1750, Concepcion, Ch, 4040418, Chile, cristianpalma@ingenieros.udd.cl

Customers demand multiple products in what is known as a production order. Optimization models for production planning aggregate different orders and meet product demands by periods based on the orders deadlines. We present a model that explicitly considers production orders rather than products, and provides the flexibility of completing an order before its deadline, allowing a more flexible use of resources when possible. The formulation of the model and its benefits are discussed.

■ TB59

Hilton- Golden Gate 3

Panel Discussion: Academic Leadership

Sponsor: Women in OR/MS

Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu

1 - Panel Discussion: Academic Leadership

Moderator: Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu, Panelists: Alice E. Smith, Vicki Bier, Canan Bilen-Green, Julie Higle

WORMS panelists will share their stories and paths to academic leadership, lessons learned from being female leaders, work-life balance, and satisfactions of taking administrative roles. They not only have successful career but also mentored many academicians. The panel will solicit feedback and discussion in lieu of long presentations.

■ TB60

Hilton- Golden Gate 4

Inventory Management I

Contributed Session

Chair: Nicholas Leifker, Asst. Professor, St. John Fisher College, 3690 East Ave., Rochester, NY, 14618, United States of America, nleifker@sjfc.edu

Chair: Bhavin Shah, Assistant Professor, Indian Institute of Management Indore, Faculty Block C, First Floor,, Prabandh Shikhar, Rau-Pithampur Road,, Indore, MP, 453556, India, bhavinj@iimidr.ac.in

1 - Nonperishable Inventory Control when Demand is Unknown

Tingting Zhou, Rutgers Business School, 1003B, 1 Washington Park, Newark, NJ, 07102, United States of America, tingzhou@pegasus.rutgers.edu, Michael N. Katehakis, Jian Yang

We study the periodic control of a nonperishable product inventory when demand is i.i.d. with an unknown distribution. In the backlogging case, we find that the regret will not grow much over time when we use the newsvendor formula on the empirical demand distribution. We also plan to address lost sales with demand censoring and various other topics.

2 - Optimal Ordering Policy for Brownian Inventory Models with Quantity-dependent Set-up Costs

Dacheng Yao, Assistant Professor, Chinese Academy of Sciences, No.55, Zhong Guan Cun East Road, Haidian District, Beijing, 100190, China, dachengyao@amss.ac.cn, Shuangchi He, Hanqin Zhang

We study a stochastic inventory system whose demand is modeled as a Brownian motion with a positive drift. When the system manager places an order to replenish the inventory, a setup cost that depends on the order quantity is incurred. Assuming the holding and shortage cost to be a convex function of the inventory level, we investigate the optimal ordering policy that minimizes the long-run average cost. We prove that the optimality can be achieved by an (s; S) policy with s<=S.

3 - Dynamic Inventory Control using Leading Economic Indicators

Benjamin Roujas, Master's Degree Candidate, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, broujas@gmail.com, Wanshan Zhu

We consider a single item, finite horizon, periodic review inventory system where the demand is forecasted by Bayesian Linear Regression. The explanatory variables in the regression are leading economic indicators that are assumed to be independent and identically distributed. We study the impact of the indicators on the optimal policy, and evaluate the value of observing them. Finally, to reduce the computational complexity , we compare several heuristics .

4 - An Integrated Model of Optimization of the Final Order of Spare Parts

Nicholas Leifker, Asst. Professor, St. John Fisher College, 3690 East Ave., Rochester, NY, 14618, United States of America, nleifker@sjfc.edu, Philip Jones, Timothy Lowe

At the end of a product's life cycle, companies may place a final order of spare parts to satisfy all future demand for the part. Determining the optimal policy can be complicated when products contain multiple types of parts in which the failure rates of the parts and products are not independent; in such cases, the optimal final order quantities for all part types must be determined simultaneously. We explore the concavity properties of this optimization problem, and present a solution method.

5 - Multimodularity of Industrial Ecosystem with a Generalized Serial Multi-Echelon Inventory System

Wei Yang, Associate Professor, Long Island University at Post, 720 Northern Blvd, Brookville, NY, 11545, United States of America, wei.yang@liu.edu, Youyi Feng, Baichun Xiao

We study the sustainability and multimodularity of an industrial ecosystem where there exists a generalized serial multi-echelon inventory system with multiple locations. Each location creates a main product to serve its external demand and a byproduct as the input to its immediate downstream location.

■ TB61

Hilton- Golden Gate 5

DIME/PMESII 2

Sponsor: Military Applications Society

Sponsored Session

Chair: Dean Hartley, Principal, Hartley Consulting, 106 Windsong Ln, Oak Ridge, TN, 37830, United States of America, DSHartley3@comcast.net

1 - Influence by Design

Karen Guttieri, Professor, Naval Postgraduate School, 3642 Arbutus Ave, Palo Alto, CA, 94303, United States of America, karen.guttieri@gmail.com

Military Information Support Operations inform and influence behavior of foreign populations. Doctrine takes a linear problem-based approach to develop products (pamphlets, messages) to address ill-defined problems in dynamic media environments. Alternatively, design thinking is an iterative, solution-based approach. Using mock examples, the paper demonstrates the use of visual analogies, redefining problems, coding requirements to build products, and the development and testing of prototypes.

2 - Incorporating the Rule of Law In Resiliency Analyses

John Hummel, Argonne National Laboratory, 9700 S. Cass Avenue/DIS-221, Argonne, IL, 60440, United States of America, jhummel@anl.gov, L. Paul Lewis, Ignacio Martinez-Moyana

The "Rule of Law" is a critical feature of stable countries. There is no definition for the rule of law, but its core relates to the influence and authority of law within society and the constraints it creates on the behavior of officials and the general population. We will focus on how rule of law assessment data can be incorporated into regional resiliency assessments and address some of the challenges associated with the data and how the contexts behind the data can be captured and assessed.

3 - Engineering an IW Model using the IW Ontology

Dean Hartley, Principal, Hartley Consulting, 106 Windsong Ln, Oak Ridge, TN, 37830, United States of America, DSHartley3@comcast.net

Using the IW Ontology, discussed in an earlier presentation, we will see how one can "engineer", rather than "dream up", IW models. I will use analogies with LegoÆ modeling and HO gauge railroad modeling to illustrate the concept and connect these concepts to the elements of the IW Ontology.

■ TB64

Parc- Cyril Magnin I

Scheduling of Queues

Sponsor: Applied Probability Society

Sponsored Session

Chair: Douglas Down, McMaster University, 1280 Main Street West, Hamilton, ON, Canada, downd@mcmaster.ca

1 - Approximations and Optimal Control for State-dependent Limited Processor Sharing Queues

Varun Gupta, Assistant Professor, University of Chicago, 5807 S Woodlawn Avenue, Chicago, IL, 60637, United States of America, varun.gupta@chicagobooth.edu, Jiheng Zhang

We study the problem of control of a processor sharing (PS) server where the service rate depends on the number of jobs occupying the server. Our principle contributions are: (1) We propose an axiomatic approach to derive a state-dependent drift function starting from a discrete system we desire to control. This drift function is used to formulate a diffusion control problem. (2) We propose a novel numerical algorithm, average cost iteration, to solve the resulting diffusion control problem.

2 - Scheduling and Job Assignment in Server Farms with Setup Delays
Esa Hyytia, Docent, Senior Research Scientist, Aalto University, Department of Communications and Network, P.O.Box 13000, Aalto, 00076, Finland, esa.hyytia@aalto.fi, Samuli Aalto, Rhonda Righter

We consider the job assignment problem to heterogeneous parallel servers, that can be switched off to save energy. Costs include energy related running costs and performance related mean response times. Servers have a setup delay and they process jobs according to FCFS, PS or LCFS, among which LCFS turns out to be the most robust discipline under the presence of setup delays. It is insensitive to job size distribution and works especially well when service times are highly variable.

3 - Stragglers and Phase Overlapping in Mapreduce Systems
Adam Wierman, California Institute of Technology, 1200 E California Blvd, Pasadena, CA, United States of America, adamw@caltech.edu, Xiaoqi Ren, Ganesh Ananthanarayanan, Minlan Yu, Micheal Chien-Chun Hung

MapReduce is a scalable parallel computing framework for big data processing. It exhibits multiple processing phases, and thus an efficient job scheduling mechanism is crucial for ensuring efficient resource utilization. This talk will discuss scheduling techniques for mitigating the impact of stragglers and optimizing the overlapping between phases in MapReduce systems.

4 - Control of Energy-Aware Servers
Vincent Maccio, McMaster University, 1280 Main Street West, Hamilton, Canada, macciov@mcmaster.ca, Douglas Down

We consider routing customers to servers that are energy aware, i.e. they can be turned on or off according to a particular policy. We show that it is in general preferable to configure the queues differently. We then present initial results on how queues should be configured when there are multiple servers and a single queue (i.e. no routing decision is required on arrival).

■ TB65

Parc- Cyril Magnin II

Academic Job Search Panel

Cluster: INFORMS Career Center

Invited Session

Chair: Pelin Pekgun, Assistant Professor, University of South Carolina, 1014 Greene Street, Moore School of Business, Columbia, SC, 29208, United States of America, pelin.pekgun@moore.sc.edu

1 - Academic Job Search Panel
Pelin Pekgun, Assistant Professor, University of South Carolina, 1014 Greene Street, Moore School of Business, Columbia, SC, 29208, United States of America, pelin.pekgun@moore.sc.edu, Panelists: Garrett van Ryzin, Mark Daskin, Beril Toktay, Margaret Brandeau

Please join us for an informative discussion on the academic job search process. Senior faculty from business and engineering schools will discuss key points on academic interviews and do's and don't's associated with the job search.

■ TB66

Parc- Cyril Magnin III

Technometrics Invited Session: Novel Statistical Methods with Interesting Applications

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Peihua Qiu, Professor, University of Florida, 2004 Mowry Road, 5th Floor CTRB, Gainesville, FL, 32611-7450, United States of America

1 - Modeling Conditional Distributions For Functional Responses, With Application to Traffic Monitoring
Kehui Chen, Assistant Professor, University of Pittsburgh, 2706 Cathedral of Learning, Pittsburgh, PA, 15260, United States of America, Khchen@pitt.edu, Hans-George Mueller

Motivated by problems involving a traffic monitoring system in which trajectory data are obtained from GPS-enabled mobile phones, we propose a novel approach to functional regression, where the mean and covariance function of the response are assumed to depend on predictors. We demonstrate the method by constructing predicted curves and corresponding prediction regions for traffic velocity trajectories for a future time period, using current traffic velocity fields as predictor functions.

2 - Dynamic Factor Model Applied to Hourly Electricity Price Analysis
Jesus Juan, Professor, Universidad Politécnica de Madrid, C/ José Gutierrez Abascal, 2, Madrid, 28006, Spain, jesus.juan@upm.es, Jaime Carpio, Damian Löpez

Exponential smoothing has become a popular technique to forecast time series. In this work we show the advantages of its multivariate version and present some properties of the model which allows us to perform a dynamic factor analysis. The practicality of the method is demonstrated by its application to hourly electricity price predictions in some day-ahead markets, such as Omel, Powernext, and Nord Pool markets.

3 - Statistical Methods for Degradation Data with Dynamic Covariates & an Application to Weathering Data
Yili Hong, Associate Professor, Department of Statistics, Virginia Tech, 213 Hutcheson Hall, Blacksburg, VA, 24060, United States of America, yilihong@vt.edu, Deborah Stanley, Xiaohong Gu, Yuanyuan Duan, William Meeker

Degradation data are widely used to obtain reliability information. It is common nowadays to dynamically record usage and other environmental variables (e.g., temperature and humidity). We introduce a class of models for analyzing degradation data with dynamic covariate information. We use general path models with random effects to describe degradation paths. The proposed methods are illustrated with an application for predicting life of organic coatings in a complicated dynamic environment.

■ TB67

Parc- Balboa

Complex Process Modeling and Monitoring

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, kbwang@tsinghua.edu.cn

Co-Chair: Chia-Jung Chang, Assistant Professor, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16802, United States of America, cchang@psu.edu

1 - Statistical Monitoring of the Hand, Foot and Mouth Disease
Peihua Qiu, Professor, University of Florida, 2004 Mowry Road, Gainesville, FL, 32610, United States of America, pqiu@ufl.edu

To prevent the outbreak of infectious diseases like the Hand, Foot and Mouth Disease (HFMD), effective disease surveillance systems would be especially helpful to give signals of disease outbreaks as early as possible. In this paper, we propose a three-step procedure for analyzing disease surveillance data, and our procedure is demonstrated using the HFMD data collected during 2008-2009 in China.

2 - Simultaneous Monitoring of Process Mean and Covariance Matrix via Penalized Likelihood Estimation
Arthur Yeh, Professor, Bowling Green State University, Dept. of Applied Stats and ORs, Bowling Green, OH, 43403, United States of America, byeh@bgsu.edu, Kaibo Wang, Bo Li

The advantage of utilizing the penalized likelihood estimation in constructing multivariate control charts is that it produces sparse and more focused estimates of the unknown population parameters which can improve the performance of the resulting charts. We propose new penalized likelihood estimation based control charts for simultaneously monitoring the mean vector and the covariance matrix. The performance of the proposed charts is assessed by Monte-Carlo simulations and a real example.

3 - Information Sources Selection in Multi-Mode Statistical Process Monitoring
Hila Chalutz Ben-Gal, Afeka College of Engineering, Industrial Engineering, Tel Aviv, Israel, hilab@afeka.ac.il, Marcelo Bacher

We consider a monitoring of multi-mode dynamic systems, where data gathered from multiple distributed sensors do not represent unequivocally the mode the system is operating in. A major goal is to identify in which mode the system is operating and distinguish between a situation of gradual deviation from a mode, which is a classical SPC task, and a situation of a sudden change from one operation mode to another, which is a clustering task.

4 - Fast Output Analysis via Sparse Grid Experimental Designs
Matthew Plumlee, Georgia Institute of Technology, Atlanta, GA, United States of America, mplumlee@gatech.edu

Random field models are widely employed to develop a predictor of an expensive function based on observations. In high dimensional settings, the traditional framework for developing a predictor is often too computationally expensive to be practical. We demonstrate that when sparse grid experimental designs are employed the resulting optimal predictor is quick to compute and has reasonable accuracy.

■ TB68

Parc- Davidson

Learning in Optimization and the Exploration/Exploitation Tradeoff

Sponsor: Simulation

Sponsored Session

Chair: Peter Frazier, Assistant Professor, Cornell University, 232 Rhodes Hall, Ithaca, NY, 14853, United States of America, pf98@cornell.edu

1 - Parallel Bayesian Global Optimization, with Application to Metrics Optimization at Yelp

Jialei Wang, PhD Student, Cornell University, Frank HT Rhodes Hall, 292, Ithaca, NY, 14853, United States of America, jw865@cornell.edu, Scott Clark, Eric Liu, Peter Frazier

We consider parallel global optimization of expensive-to-evaluate functions, and propose an efficient method based on stochastic approximation for implementing a conceptual Bayesian optimization algorithm proposed by Ginsbourger et al. (2010). We also introduce an open-source software implementation of this algorithm, called Metrics Optimization Engine, developed in collaboration with engineers at Yelp, Inc. and used internally at Yelp to optimize prediction models and performance metrics.

2 - Learning in Combinatorial Optimization: What and How to Explore

Sajad Modaresi, PhD Candidate, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, sajad.modaresi@duke.edu, Juan Pablo Vielma, Denis Saure

We study sequential combinatorial optimization under model uncertainty. We show resolving implied exploration vs. exploitation trade-off efficiently is related to solving an Optimality Cover Problem (OCP) which simultaneously answers the questions of what information to collect and how to do so. We develop a policy that adaptively constructs and solves OCP at a decreasing frequency and show it is efficient. We extensively test performance against relevant benchmark in both long- and short-terms.

3 - Parallel Bayesian Policies for Finite-Horizon Multiple Comparisons with a Known Standard

Weici Hu, PhD Candidate, Cornell University, 295 Rhodes Hall, Ithaca, NY, 14853, United States of America, wh343@cornell.edu, Peter Frazier

We consider the problem of multiple comparisons with a known standard, in which we allocate simulation effort across a finite number of alternatives, so as to determine which alternatives have mean performance above a known threshold. We assume parallel computing resources and a fixed simulation budget. We consider this problem in a Bayesian setting. We provide tractable upper bounds on the value of the Bayes-optimal policy, and a heuristic index policy motivated by the upper bounds.

4 - Bayesian Optimal Learning with Discrete Prior Resampling

Si Chen, Princeton University, Sherrerd Hall, Charlton Street, Princeton, NJ, 08544, United States of America, sichen@princeton.edu, Kristofer Reyes, Warren Powell

We propose a knowledge-gradient policy based on a small set of discrete priors sampled from a multi-dimensional nonlinear parametric model. At each time step, the policy utilizes the value of information and Bayesian statistics to make decisions, and resamples the discrete priors according to their assigned weights. We present an application to solve a Bayesian optimal search program in material science, namely discovering the set of controllable parameters to match a specific release profile.

■ TB69

Parc- Fillmore

Socially-Responsible Operations Management

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Mili Mehrotra, University of Minnesota, 321 19th Ave South, Minneapolis, MN, United States of America, milim@umn.edu

1 - The Impact of Buyer-Manufacturer Interaction on Energy Efficiency Investments

Jason Nguyen, Carlson School of Managment, University of Minnesota, Minneapolis, MN, United States of America nguy1762@umn.edu, Mili Mehrotra, Karen Donohue

We investigate the equipment-focused EE investment decision in the context of a supply chain where a capital constrained manufacturer sets the investment level and its buyer sets contract prices. We solve for the investment level and pricing strategy both when the buyer is and is not informed of the EE improvement opportunities. We delineate the impact of the buyer's awareness and different contracting mechanisms on the optimal investment level as well as the resulting profit levels.

2 - Design Implications of Extended Producer Responsibility: Durable or Recyclable Products?

Ximin (Natalie) Huang, PhD Student, Georgia Institute of Technology, Atlanta, GA, United States of America, ximin.huang@scheller.gatech.edu, Beril Toktay, Atalay Atasu

We consider a monopolist who has two product design options to manage the end-of-life costs/revenues associated with its products: making products more durable or recyclable. We explore how the recyclability and durability choices are affected by the requirements of take-back legislation.

3 - Sustainability Planning for Healthcare Information Exchanges

Tharanga Rajapakshe,University of Florida, Gainesville, FL, United States of America, tharanga.rajapakshe@warrington.ufl.edu, Chelliah Sriskandarajah, Subodha Kumar

Even though there has been a substantial federal funding since 2010, very few Healthcare Information Exchanges (HIEs) are currently operational. A key obstacle faced by HIEs is long-term financial sustainability. Motivated by this observation, our focus in this work is to understand the operational decisions of an HIE and provide insights that would ensure the long term survival.

4 - Promoting Clean Technology Products: To Subsidize Consumers or Manufacturer?

Guangrui Ma, The Hong Kong University of Science and Technology, Room 3208, Dept. of IELM, Clear Water Bay, Kowloon, Hong Kong - PRC, magr@ust.hk, Ho-Yin Mak, Michael Lim, Zhixi Wan

We study the dynamic adoption process of Clean Technology Products (e.g., electric vehicles, solar panels), which is often hampered by the chicken-and-egg dilemma: firms are reluctant to invest in support infrastructure before sufficient adoption; in contrast, consumers hesitate to adopt CTPs without such infrastructure. We study how the government interventions such as subsidies (either to the firm or consumers) and mandated information disclosure can help or harm the CTP adoption.

■ TB70

Parc- Hearst

Natural Resources

Contributed Session

Chair: Bruno da Costa Flach, Research Staff Member, IBM Research - Brazil, Av. Pasteur 138/146, Botafogo, Rio de Janeiro, RJ, 222700-50, Brazil, bflach@br.ibm.com

1 - Incorporating Covariates in Hierarchical Deterministic Models

Edward Boone, Associate Professor of Statistics, Virginia Commonwealth University, 1015 Floyd Ave, Richmond, VA, 23112, United States of America, elboone@vcu.edu

Deterministic models, such as differential equations, are common to understand complex relationships through time. An additional complexity is introduced when covariates that drive parameters are employed. We present a Bayesian approach using a hierarchical model structure to incorporate covariates in these models. This is illustrated using an environmental example concerning fish in the Murray-Darling River.

2 - Intertemporal Fairness and the Exploitation of Nonrenewable Resources

Thomas Weber, Associate Professor, Ecole Polytechnique Federale de Lausanne, EPFL CDM MTEI OES, ODY 3 01, Station 5, Lausanne, 1015, Switzerland, thomas.weber@epfl.ch

The multitude of possible rules and the lack of justification for any single one of them renders the sharing of resources across generations difficult and subjective. We propose a notion of intertemporal fairness, in discrete and continuous time, which is robust, as it singles out an allocation that is 'simultaneously best' relative to all feasible Lorenz-undominated allocations. For exhaustible resources, the resulting fair allocation ensures positive consumption by all future generations.

■ TB71

Parc - Lombard

Auctions and Mechanism Design

Cluster: Auctions

Invited Session

Chair: Rudolf Müller, Maastricht University, Maastricht, Netherlands, r.muller@maastrichtuniversity.nl

1 - Cake Cutting Algorithms for Piecewise Constant and Piecewise Uniform Valuations

Chun Ye, PhD Candidate, Columbia University, 500 West 120th Street, IEOR Department Rm 315, New York, NY, 10027, United States of America, cy2214@columbia.edu, Haris Aziz

Cake cutting is one of the most fundamental settings in fair division and mechanism design without money. In this work, we consider different levels of three fundamental goals in cake cutting: fairness, Pareto optimality, and strategy-proofness. We identify maximal subsets of properties that can be attained by certain cake cutting algorithm and minimal subsets of properties that are incompatible with each other.

2 - Optimal Mechanisms with Simple Menus

Pingzhong Tang, Assistant Professor, Tsinghua University, Beijing, China,, kenshinping@gmail.com, Zihe Wang

We consider revenue-optimal mechanism design for one buyer and two independent items. We obtain two categories of structural results on the optimal mechanisms. The first category of results states that, under a certain condition, the optimal mechanism has a monotone menu. The second category of results states that, under certain conditions, the optimal mechanisms have few menu items.

3 - A Dynamic Mechanism Design for Scheduling with Different Use Lengths

Ryuji Sano, Kyoto University, Yoshida-Honmachi, Sakyo-ku, Kyoto, Japan, 606-8501,sano@kier.kyoto-u.ac.jp

This paper considers a dynamic allocation problem in which many perishable goods are allocated at each period. Agents want to keep winning goods for a long time, and the necessary lengths are private information. We characterize incentive compatibility and analyze the efficient and optimal mechanisms.

4 - Multi-item Auctions with Exclusivity Margin

Rudolf Müller, Maastricht University, Maastricht, Netherlands, r.muller@maastrichtuniversity.nl, Greg Csapo, Hemant Bhargava

We study the problem of finding the profit-maximizing multi-item mechanism that is deterministic, individually rational, and incentive compatible in a setting, where bidders attach additional value for getting the item exclusively, thus hold two-dimensional private information. We design simple and practical mechanisms for a modest sacrifice on revenue. Their performance is demonstrated by approximation guarantees via provable upper bounds on the optimal revenue and by numerical simulations.

■ TB72

Parc- Stockton

Energy - Optimization

Contributed Session

Chair: Heungjo An, Assistant Professor, King Fahd University of Petroleum & Minerals, KFUPM POBox 167, Dhahran, 31261, Saudi Arabia, hjan@kfupm.edu.sa

1 - An Acceleration Technique for Solving Non-linear Problems in the Chemical Industry

Heungjo An, Assistant Professor, King Fahd University of Petroleum & Minerals, KFUPM POBox 167, Dhahran, 31261, Saudi Arabia, hjan@kfupm.edu.sa

This paper provides an acceleration technique of distributive recursion to solve a large-scale planning problem which involves the non-linear pooling problem. The embedded structure of a linearized problem can be transformed to a generalized flow problem in a cyclic network. This study proposes an effective dynamic programming algorithm to solve the generalized flow sub-problem under Column Generation scheme. Computation tests evaluate the efficacy of the approach and analyze solvability.

2 - A Mixed-integer Linear Program for the Optimal Design of Human-powered Fitness Facilities

Kristopher Pruitt, Assistant Professor of Mathematics, US Air Force Academy, 2354 Fairchild Dr. Ste 6D-222, USAFA, CO, 80840, United States of America, kristopher.pruitt@usafa.edu

We present an optimization model with distributed-energy applications in the health and fitness industry. The mixed-integer linear program determines the blend of memberships, facility size, and equipment (power generating, neutral, and consuming) that maximizes profit (membership revenue less capital and operational costs) subject to the demands for floor space, power, and equipment-types. The presentation includes both analytical conditions for economic viability and a numerical case study.

3 - A Combined Approach of Simulations and DP to Value Storage Facilities

Marcus Hildmann, Doctoral Student, ETH Zurich, Physikstrasse 3, ETL G 24.2, Zurich, 8092, Switzerland, hildmann@eeh.ee.ethz.ch, Sebastiano Rossi

Large scale deployment of renewable energy increase the need for storage. Then again, the market conditions become less and less profitable for storage plants. We present an algorithm to value storage participating at several markets, such as day-ahead, real time and ancillary services markets simultaneously. We use a combined approach of simulations and dynamic programming to value the plant as a set of convex optimization problems. This allows to determine the revenue streams from the markets.

4 - Deadline and Quantity-differentiated Pricing of Energy Services

Florian Salah, PhD Student, Institute of Information Systems and Marketing, KIT, Englerstr. 14, Karlsruhe, 76131, Germany, florian.salah@kit.edu, Christoph Flath

Demand side flexibility is key to stable and cost-efficient integration of variable energy resources. Current energy-only transactions in power markets fail to properly incentivize this flexibility. Consequently, new market designs and transaction objects are required. To this end, quality-of-service concepts can play an important role. We present an extended deadline-differentiated pricing model facilitating both temporal and quantity-based service differentiation.

■ TB73

Parc- Mission I

Multilevel Optimization Problems in Energy I

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N Charles St, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu

1 - Network Expansion to Mitigate Market Power

Daniel Huppmann, German Institute for Economic Research (DIW Berlin), Mohrenstrafle 58, Berlin, Germany, dhuppmann@diw.de, Alexander Zerrahn

Lack of transmission capacity hampers the integration of the electricity market and thereby precludes reaping the full benefits of competition. We investigate the extent to which transmission grid expansion promotes competition, efficiency and welfare. This work proposes a three-stage model for grid investment, endogenizing the trade-off between costs of grid investment and benefits from reduced market power potential.

2 - Modeling Decisions of Plug-in Electric Vehicle (PEV) Aggregators: An MPEC Approach

Sonja Wogrin, Comillas Pontifical University, Calle Alberto Aguilera 23, Madrid, Spain, sonja.wogrin@iit.upcomillas.es, Tomas Gómez, Ilan Momber

Coordinated charging schedules of plug-in electric vehicles (PEVs) by an aggregator may lead to increased system efficiency in allocating resources in generation, transmission and distribution. Hence, we propose an MPEC to optimize the PEV aggregator's decisions in different electricity markets, using indirect load control by determining optimal retail prices for the PEV. Results of a case study indicate that the aggregator's profits depend on providing the right price signals to the customers.

3 - Optimizing Wind and Hydropower Systems with Bi level Stochastic Dynamic Programming

Christine Shoemaker, Professor, Cornell University, 210 Hollister Hall, CEE, Ithaca, NY, 14853, United States of America, cas12@cornell.edu, Kyle Perline, Sue Nee Tan

We present a bi level Stochastic Dynamic Programming for managing interconnected wind and hydropower systems, based on data from Bonneville Power Authority. Computational effort is reduced with a response surface approximation of the future value function. The decisions in the upper level are day-ahead market commitments and in the lower level are related to the volume of water released to produce power. The stochastic factor is the wind energy produced by the system over a short time step.

4 - Strategic Bidding of a Large Electricity Consumer: A Complementarity Approach

Jalal Kazempour, Postdoctoral fellow, Johns Hopkins University, 3400 N Charles St. Mechanical Eng. Dep., Latrobe 223, Baltimore, MD, 21218, United States of America, skazemp1@jhu.edu, Antonio J. Conejo, Carlos Ruiz

We describe a complementarity model to assist an electricity consumer in making bidding decisions to alter pool prices to its own benefit. The strategic behavior of this consumer is represented through a bilevel model: the upper-level problem represents strategic bidding actions while the lower-level problems represent pool clearing. Uncertainties on actions of producers and other consumers are characterized through of scenarios. The resulting model is a large-scale mixed-integer LP problem.

■ TB74

Parc- Mission II

Accounting for Risk in Investments in Electric Power Systems

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Fernando de Sisternes, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, ferds@mit.edu

Co-Chair: John Parsons, Senior Lecturer, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, jparsons@mit.edu

1 - Conditional CAPM Models in Capacity Investment Equilibrium Models

Andreas Ehrenmann, GDF Suez, Bruxelles, Belgium, Andreas.Ehrenmann@gdfsuez.com, Gauthier De Maere, Yves Smeers

Investment decisions are commonly based on the CAPM model in practice. We consider different formulations of conditional CAPM as stochastic discount rate that we use in capacity expansion models. These formulations are meant to account for the impact of renewable penetration in the European power market. The models are of the equilibrium type and formulated as complementarity problems. We discuss their properties and implementation.

2 - Risk Adjustment in Stochastic Investment Planning Models

Gauthier De Maere, GDF Suez, Bruxelles, Belgium, gauthier.demaeredaertrycke@gdfsuez.com, Andreas Ehrenmann, Daniel Ralph, Yves Smeers

We consider a stochastic version of the standard capacity expansion model with risk averse agents with behaviour represented by the so called "Good Deal" risk measure. We consider two counterfactuals for representing risk trading: no risk trading and a complete risk trading. We apply the model to a real situation of decommissioning of conventional plants in the European power market.

3 - A Dynamic Model for Risk Pricing in Generation Investments

Fernando de Sisternes, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, ferds@mit.edu, John Parsons

We show how to incorporate standard risk pricing principles into the popular Monte Carlo simulation analysis. Using this new framework we illustrate how different risk premia can be naturally derived from first principles for different electricity generation technologies, and how the risk attributable to each technology depends on the electricity price level at the time that the investment takes place.

4 - Risk Aversion in Transmission Infrastructure Planning using Two-Stage Programming

Harry van der Weijde, Vrije Universiteit Amsterdam, Department of Spatial Economics, De Boelelaan 1105, Amsterdam, 1081HV, Netherlands, h.vanderweijde@gmail.com, Ben Hobbs, Francisco Munoz

In the context of applications to the UK and WECC regions, we discuss how explicit consideration of risk aversion in transmission planning can affect optimal first stage investments in a large two-stage planning model. We consider risk-neutral, risk-averse, and min max regret formulations and results, considering long run technological, economic, and policy uncertainties. Theoretical and practical challenges include generator risk aversion and solving large-scale nonlinear models.

■ TB75

Parc- Mission III

Stochastic Processes

Contributed Session

Chair: Fikri Kucuksayacigil, Iowa State University, 240 Raphael Avenue, Unit 15, Ames, IA, 50014, United States of America, fksayaci@iastate.edu

1 - Modeling the Electricity Supply Stack with Time-changed Processes

Vishwakant Malladi, Doctoral Student, UT Austin, 1 University Station B65000, McCombs School of Business, Austin, TX, 78712, United States of America, vishwakant@gmail.com, Stathis Tompaidis, Rafael Mendoza-Arriaga

We present a framework for modeling the supply stack of electricity generators using time-changed processes. We demonstrate how the use of time-changed processes can be adapted to a factor structure that allows to model for correlated outages across generator types, locations, and links to the transmission network. Results of the calibration of the models using real data are presented.

2 - Monotonicity Properties of Processor Sharing Queues with Abandonments

Dwi Ertiningsih, PhD Student, Leiden University, Niels Bohrweg 1, Leiden, Netherlands, dwiertiningsihd@math.leidenuniv.nl, Flora Spieksma

Consider a processor sharing queue with abandonments and retrials. This can be modelled as a process on a two-dimensional state space. The service time distribution is not required to be exponential and the immediate cost is assumed linear. The aim is to study properties of the average and discounted cost value functions. By a coupling argument we show that the value function is convex and supermodular.

3 - Hybrid Kriging Optimization Using Gradient Estimation

Sayak Roychowdhury, Graduate Research Associate, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, roychowdhury.6@osu.edu, Theodore Allen

In stochastic black box optimization, we aim to reach the optimal solution using fewer number of evaluations. In our proposed hybrid algorithm, we are determining the next best point of evaluation using alternatively the expected improvement function and gradient decent. Then, we prove convergence of the hybrid method to a KKT point under general assumptions. Performances of various gradient estimation methods are compared on a number of test functions.

4 - Malmquist Productivity Index Analysis Based on StoNED: Case of Norwegian Electricity Distribution Company

Xiaomei Cheng, Norwegian School of Economics, Department of Business and Management, Science, NHH, Helleveien 30, Bergen, 5045, Norway, xiaomei.cheng@nhh.no, Endre Björndal, Mette Björndal

In the study of regulating electricity distribution utilities, estimates of the past productivity performance play a key role in the future requirements. The main purpose of this paper is to construct a Malmquist productivity index based on stochastic non-parametric envelopment of data (StoNED) to study the recent productivity change in terms of 123 Norwegian electricity distribution companies during 2004-2012.

5 - Revenue Management: A Continuous-time Application to Airport Carparks

Andreas Papayiannis, Post-Doctorate Researcher, The University of Manchester, Flat 502, The Lock Building, Manchester, M1 5BD, United Kingdom, andreas.papayiannis@manchester.ac.uk, Paul Johnson, Dmitry Yumashev, Peter Duck

We investigate the revenue management (RM) problem encountered in airport carparks, where spaces are sold in advance online. Currently, most RM practices in this sector are simple adjustments to those developed for hotels, exploiting the strong similarities of the two industries. However, unlike in hotels where the day of the week strongly affects the price of a room, a distinct setting appears where the daily price of a parking space depends heavily on the length-of-stay of the booking.

■ TB76

Parc- Embarcadero

Joint Session CPMS/Analytics: Panel Discussion: What is Industry Looking for in Analytics Hires?

Sponsor: CPMS, The Practice Section & Analytics Section

Sponsored Session

Chair: Jeffrey Camm, Head of the Department of Operations, Business Analytics, and Information Systems, The University of Cincinnati, 2925 Campus Green Dr., Cincinnati, OH, 45221, United States of America, cammjd@UCMAIL.UC.EDU

1 - Panel Discussion: What is Industry Looking for in Analytics Hires?

Moderator: Jeffrey Camm, Head of the Department of Operations, Business Analytics, and Information Systems, The University of Cincinnati, 2925 Campus Green Dr., Cincinnati, OH, 45221, United States of America, cammjd@ucmail.us.edu, Panelists: Melissa Bowers, Jeff Winters, Russ Labe, Goutam Chakraborty, Pooja Dewan

Panel Discussion: What is Industry Looking for in Analytics Hires? In this session, panelists will discuss the results of several studies whose aim is to ascertain the characteristics and skill sets of positions that come under the umbrella of analytics. The studies are the on-going work of a subcommittee of the INFORMS Masters in Analytics Committee.

■ TB77

Parc- Market Street

Applications and Spreadsheets

Sponsor: Analytics

Sponsored Session

Chair: Thomas Groleau, Business Division Chair, Carthage College, 2001 Alford Park Drive, 210 Clausen Center, Kenosha, Wi, 53140, United States of America, tgroleau@carthage.edu

1 - Leveraging Analytics to Drive Business Decisions in Agriculture

Vardges Ter-Hovhannisyan, Strategic Scientist, Monsanto, 800 N Lindbergh, St. Louis, MO, 63167, United States of America, vardges.ter-hovhannisyan@monsanto.com, Naveen Singla, Nalini Polavarapu, William Leeds, Paul Skroch

An analytics strategy is an essential part of any data-driven business. We present an integrated analytics platform designed to drive business decisions and provide prescriptive solutions for an agricultural R&D pipeline. The main pillars of the platform (OR, predictive analytics, and geospatial modeling) are leveraged to solve real-life complex problems in agriculture. We discuss the scientific approach of the analytics platform and the resulting business impact provided to our organization.

2 - Growth Model for a Large Medical Center

Dustin Kuchera, Operations Manager, Mayo Clinic, 626 8th St SW, Rochester, MN, 55902, United States of America, Kuchera.Dustin@mayo.edu

This model depicts a complex medical center as many small components, including outpatient appointments, surgeries, and inpatient stays. A decision-maker can adjust these components in the model and estimate the impact on resources throughout the larger system.

3 - Pimp My Spreadsheet

Thomas Groleau, Business Division Chair, Carthage College, 2001 Alford Park Drive, 210 Clausen Center, Kenosha, Wi, 53140, United States of America, tgroleau@carthage.edu

There are many user-developed spreadsheets in use that work well for their designed purpose but, like early computer programs, are poorly documented and difficult for anyone other than the original developer to understand. We will show before and after examples of spreadsheets that were revised for improved usability.

■ TB78

Parc- Mason

Spatial Analysis for Multicriteria Decisions

Sponsor: Decision Analysis

Sponsored Session

Chair: Jay Simon, Assistant Professor, Naval Postgraduate School, Monterey, CA, United States of America, jrsimon@nps.edu

1 - Decision Analysis with Geographically Varying Outcomes: Preference Models and Applications

L. Robin Keller, Professor, Operations & Decision Technologies, The Paul Merage School of Business, University of California, Irvine, University of California, Irvine, Irvine, CA, United States of America, lrkeller@uci.edu, Craig Kirkwood, Jay Simon

We present decision analysis methodology for decisions based on data from geographic information systems. We discuss conditions that may conform with the decision maker's preferences over a set of alternatives, and we present specific forms for value or utility functions that are implied by these conditions. The methodology is applied to 2 hypothetical urban planning decisions involving water use and temperature reduction in regional urban development, and fire coverage across a city.

2 - Multi-criteria Spatial Risk Analysis

Valentina Ferretti, Dr. PhD, Technical University of Turin, Corso Castelfidardo 30/A, Turin, 10138, Italy, valentina.ferretti@polito.it, Gilberto Montibeller

There is a broad literature on spatial multi-criteria evaluation in the environmental domain, and some attempts of conducting risk analysis in this context. Most of these attempts neither employ a proper risk analytical framework nor provide a clear conceptual framework for allocating resource on mitigating actions. To address these weaknesses, in this paper we conceptualize a multi-criteria spatial risk analysis assessment to support spatial environmental decision-making processes.

3 - D2M2: Multi-Objective, Spatial Optimization for Regional Material Management

Matthew Bates, Research Environmental Engineer, US Army Corps of Engineers, 696 Virginia Rd, Concord, MA, 01742, United States of America, Matthew.E.Bates@usace.army.mil, Kelley Philbin, Igor Linkov, Todd Bridges

The D2M2 (Dredged Material Management Decisions) software model brings transparency, flexibility, and mathematical rigor to regional material management by analyzing thousands of combinations of source and placement sites to allocate material along various possible routes. We demonstrate optimization for economic and multiple impact objectives for dredging planning in the Long Island Sound region of NY/CT, based on site distribution, equipment, transportation links, storage availability, etc.

4 - Markov Cost-Effectiveness Analysis for Cancer Treatment

Jiaru Bai, University of California-Irvine, Irvine, CA, United States of America, jiarub@uci.edu, L. Robin Keller

We present a way to build a Markov decision tree to model cancer progression and cost-effectiveness analysis for two or more cancer treatments. We propose several problems researchers can encounter in this kind of research and provide possible solutions. The method is used for a clinical study comparing two cervical cancer treatments.

■ TB79

Parc- Powell I

Organizational Challenges in Decision Making

Sponsor: Decision Analysis

Sponsored Session

Chair: John Lehman, Galway Group, LP, 3050 Post Oak Boulevard, Suite 1300, Houston, TX, 77056, United States of America, johnlehman@att.net

1 - Making Collaborative Decisions

Daniel Owen, Managing Director, Stretegic Business Processes, Inc., 146 Windward Way, Indian Harbour Beach, FL, 32937, United States of America, owendl@aol.com

Combining the work of four noted authors has provided a theoretical framework for collaborative decisions built on the foundation of decision analysis. The resulting collaborative process aggregates, rather than compromises, the understandings of decision makers at four steps. The value increase from the collaborative process is typically fifty to one-hundred percent.

2 - Auditing Decisions: How to Check for Build-in Decision Quality
Roberto Ley-Borras, Director, Consultoria en Decisiones, Orizaba, Orizaba, Veracruz, Mexico, rley@decidir.org

Since the quality of a decision is given by the quality of the decision process it is derived from, we can audit the decision's quality by verifying that the decision frame was well selected, the set of fundamental objectives is complete and pertinent, alternatives are creative and span the whole range of possibilities, and similarly verifying key aspects of the remaining DA process. This talk presents a nine-factor decision quality audit approach that is easy to apply yet fairly comprehensive.

3 - The Collaborative Design Process
Stephen Barrager, Publisher, Baker Street Publishing, San Francisco, CA, 94123, United States of America, steve@bakerstreetpublishing.com

Most big decisions involve many people: decision makers, stakeholders, and experts. Typically the people involved have different motives, different cultures, different experience, and differenct educational backgrounds. What are the norms for decision making in these situations? This talk reviews several group process and learning norms. We discuss how the Collaborative Design process supports these norms. It provides a normative framework for applying both hard and soft tools.

4 - What the Mating Behavior of Birds Can Teach Us about Corporate Decision Making
John Lehman, Galway Group, LP, 3050 Post Oak Boulevard, Suite 1300, Houston, TX, 77056, United States of America, johnlehman@att.net

The combination of technology and theory has failed to produce the dramatic improvement in the quality of corporate decisions that some predicted. In this presentation I suggest that this failure comes in part because too little attention has been paid to the environment in which decisions are made. Specifically, I propose that organizational decision processes are not constructivist rational, but rather resemble the ecological rationality of biological systems shaped by natural selection.

■ TB80

Parc- Powell II

Behavioral Decision Theory

Sponsor: Decision Analysis

Sponsored Session

Chair: Enrico Diecidue, INSEAD, Bd de Constance, Fontainebleau, France, Enrico.Diecidue@insead.edu

1 - Beta-Delta or Tau-Delta? A New Parameterization of Quasi-Hyperbolic Discounting
Han Bleichrodt, Professor, Erasmus University, 3000 DR Rotterdam, Netherlands, bleichrodt@ese.eur.nl

In the quasi-hyperbolic (beta, delta) model, beta is commonly taken as an index of time inconsistency. We show that beta is not suited for this purpose because it interacts with delta. We propose a proper index of time inconsistency, which has a natural interpretation as the time period over which the decision maker is vulnerable to dynamic inconsistencies. We give an empirical illustration of our index by reanalyzing the data from Tanaka et al. (2010).

2 - Testing for Excess Movement in Beliefs
Ned Augenblick, University of California, Berkeley, 545 Student Services Building, 1900, Berkeley, CA, 94720-1900, United States of America, ned@haas.berkeley.edu, Matthew Rabin

We develop a new method to test if belief streams are consistent with Bayesian updating, with an emphasis on whether beliefs move around too much or too little to reflect rational use of information. Our tests do not make any a priori assumptions about the informational structure by taking advantage of a universal property of any Bayesian process: in expectation, the sum of squared changes of beliefs must equal the change in uncertainty. We apply the test to three belief datasets.

3 - Measuring Ambiguity Aversion: Experimental Tests of Subjective Expected Utility
Charlie Sprenger, Assistant Professor, Stanford University, Landau Economics Building, Stanford, CA, United States of America, cspreng@stanford.edu

The canonical model of decisionmaking under subjective uncertainty, Subjective Expected Utility (SEU), is routinely rejected by the phenomena first introduced by Ellsberg (1961), wherein behavior between two subjective bets is inconsistent. We return to the consistency implications of SEU to consider another form of inconsistency: incoherent treatment of a single subjective bet when mixing with objective outcomes.

4 - Delayed Resolution of Uncertainty: a Measurement
Enrico Diecidue, INSEAD, Bd de Constance, Fontainebleau, France, Enrico.Diecidue@insead.edu

We report the results of an experiment measuring preferences for delayed resolution of uncertainty. We detect a systematic effect: decision makers are willing to reduce their probability of winning a prize in a lottery in order to resolve the uncertainty at an earlier stage. In addition we model the impact of resolution of uncertainty under prospect theory. Implications are discussed.

■ TB81

Parc- Divisadero

Analytics for Network and Text Data

Sponsor: Data Mining

Sponsored Session

Chair: Shawn Mankad, Assistant Professor, University of Maryland, 4316 Van Munching Hall, College Park, MD, 20742, United States of America, smankad@rhsmith.umd.edu

1 - Charting Collections of Connections in Social Media: Creating Maps and Measures with NodeXL
Marc Smith, Chief Social Scientist, Social Media Research Foundation, 2617 Hallmark Drive, Belmont, CA, 94002, United States of America, marc.smith.email@gmail.com

Social media can be a bewildering stream of comments, a daunting fire hose of content. With better tools and a few key concepts from the social sciences, the social media swarm can be brought into clearer focus to reveal key people, topics and sub-communities. The Social Media Research Foundation's NodeXL project makes analysis of social media networks accessible to most users of the Excel spreadsheet application. With NodeXL, network charts become as easy to create as pie charts.

2 - Large Exposure Estimation with Automatic Business Group Identification
Margrét Bjarnadöttir, University of Maryland, 4324 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu, Sigridur Benediktsdottir

Empirical evidence suggests that large exposure rules are difficult both for regulators to enforce and for financial institutions to implement. We present a data-driven analytical network model that automatically and algorithmically creates groups of related parties, highlights missing critical information, and identifies unreported business partners. We include a case study highlighting large exposure violations and systemic risk leading up to the banking crash in 2008.

3 - Measuring Influence in Social Networks through Information Diffusion Modeling
George Michailidis, University of Michigan, Ann Arbor, MI, United States of America, gmichail@umich.edu

A key question in many social platforms is to determine who are the most influential members in such networks. We modify a popular rank prestige algorithm, by modeling the weights used to reflect users' activity, as opposed to users connectivity. Such activity is captured through the information they post, rebroadcast or comment on and modeled as multivariate interacting counting processes. We discuss estimating the model parameters and illustrate the results on a real data set from Twitter.

4 - Structural Topic Models
Margaret Roberts, molly.e.roberts@gmail.com, Brandon Stewart, Edoardo Airoldi

Social scientists often want to make inference about social processes that drive discourse. We develop a topic model which supports this type of research by modeling the relationships between observed covariates and topics. In our model, topical prevalence and content are specified as a generalized linear model with arbitrary numbers of document covariates. We apply to model to news reports about China, where we allow the prevalence of topics to evolve over time and vary across newswires.

■ TB82

Parc- Haight

Advances in Multiobjective Programming

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Margaret Wiecek, Clemson University, Mathematical Sciences, Clemson, SC, United States of America, wmalgor@clemson.edu

1 - The Triangle Splitting Method for Biobjective Mixed Integer Programming

Natashia Boland, Unversity of Newcastle, University Drive, Newcastle, Australia, natashia77@gmail.com, Hadi Charkhgard, Martin Savelsbergh

We present the first criterion space search method, the triangle splitting method, for finding all nondominated points of a biobjective mixed integer program. The algorithm maintains, at any point in time, a diverse set of nondominated points, and is ideally suited for fast approximation of the nondominated frontier.

2 - Efficient Storage of Nondominated Data in Biobjective Mixed Integer Programming

Nathan Adelgren, Graduate Assistant, Clemson University, E-1a Martin Hall, Clemson University, Clemson, SC, 29634, United States of America, nadelgr@g.clemson.edu, Pietro Belotti, Akshay Gupte

Branch-and-bound (BB) methods for biobjective mixed-integer linear programs (BOMILP) use upper and lower bound sets for fathoming, so it is desirable to efficiently store the data which defines these sets. To this end, we present a new data structure in the form of a modified binary tree. The structure takes points and line segments as input and stores the nondominated subset of the input. Experimental results show that use of the structure improves the performance of BB.

3 - New Polyhedral Cone Models for Pointwise Preferences in Variable Domination Structures

Alexander Engau, Assistant Professor, University of Colorado Denver, 1250 14th Street, Denver, CO, 80202, United States of America, alexander.engau@ucdenver.edu

We present several new results and models for variable preferences in multiobjective programming and multiple-criteria decision-making. Unlike a few related approaches in the existing literature, our new preference models can be characterized by classes of polyhedral ordering cones , which facilitate their use both for modeling and computational optimization. A detailed analysis of the underlying cones will be given, and a few computational consequences and preliminary results will be addressed.

■ TB83

Parc- Sutro

Image and Functional Data Analysis: Methods and Applications

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, 30327, United States of America, kamran.paynabar@isye.gatech.edu

1 - An Adaptive Measurement Strategy for Characterizing Time Variant Surfaces using Image Data

Chenhui Shao, University of Michigan, Ann Arbor, 2350 Hayward St., Ann Arbor, MI, 48109, United States of America, chshao@umich.edu, S. Jack Hu, Judy Jin

A new adaptive measurement strategy is developed to characterize time varying tool surface conditions due to degradation. The proposed multi-scale spatial model of surface image data captures both the global degradation trend and local spatial variability of tool surfaces. The model goodness of fit, which uses residual, gradient, and spatial autocorrelation, is used to provide a systematic decision where adaptive measurements are most necessarily needed under a given accuracy requirement.

2 - Image Defect Detection with Smooth-Sparse Decomposition

Hao Yan, PhD Student, Georgia Institute of Technology, 755 Ferst Dr, NW, Atlanta, GA, 30332, United States of America, yanhao@gatech.edu, Kamran Paynabar, Jianjun Shi

Image based defect detection is popular for product inspection due to recent development in sensing technology. Existing techniques are all two-step 'first smooth then detect' approach. We propose a one-step smooth-sparse decomposition technique, which combines smoothing technique and variable selection to separate the defect region from smooth background under noisy environment. The effectiveness and efficiency of the proposed method has been tested in both simulation and case study.

3 - Sparse Particle Filtering for Modeling Space-Time Dynamics in the Stochastic Sensor Network

Yun Chen, USF, 14219 Les Palms Circle, Apt. 101, Tampa, FL, 33613, United States of America, yunchen@mail.usf.edu, Hui Yang

Wireless sensor network has emerged as a key technology for monitoring space-time dynamics of complex systems. However, traditional sensor networks demand reliable sensor readings. This paper presents a novel strategy of stochastic sensor networks that relax the hardware constraints. Experimental results demonstrated the effectiveness of sparse particle filtering to support the stochastic design and harness the uncertain information for modeling space-time dynamics of complex systems.

Tuesday, 12:30 - 2:30pm

INTERACTIVE SESSION

Interactive Session

Hilton Grand Ballroom A – B

Tuesday Interactive Session

Chair: Hari Balasubramanian, University of Massachusetts-Amherst, Amherst, MA, United States of America, hbalasub@admin.umass.edu

1 - Evaluation of Courses in a Higher Education Institution

Cesar Pandolfi - DocÍncia, Universidade do Rio Grande do Sul, Alvaro Ferreiro Porto, Caxias do Sul, Brazil, cesar.pandolfi@fsg.br

The objective is to evaluate the changes in data collection for courses evaluation in a higher education institution. It has been used the internal consistency analysis and multivariate analysis. It is characterized as a case study, applied and descriptive. It has shown that the results can be grouped into three levels of satisfaction. It serves as basis for analysis and reorganization of the practices adopted by the courses.

2 - Clustering Items on the Web through Modelling user Communities

Masssey Cashore, University of Waterloo, Waterloo, ON, Canada, jmcashor@uwaterloo.ca, Xiaoting Zhao, Peter Frazier

The challenge of discovering structure in unlabelled data is important as ever in today's society. The cornerstone problem in this setting is clustering, that is, partitioning the items in a manner that coincides with the structure of the items. In this paper we present a probabilistic model of user-item interaction that allows us to cluster items and users, taking into account both user interaction data and item content. The model hinges on the assumption that users exist in communities and items exist in clusters such that the interest of a user in an item is completely determined by the user's community membership and the item's cluster membership. We construct a Gibbs sampler for inference, and apply the Gibbs sampler to a real life dataset from arXiv.org. Comparing the community clusters to a simpler clustering methods, we see several improvements in recommendation system accuracy, and the ability to partition items based on a real-world phenomenon from arXiv.org.

3 - Delivery Vehicle Routing at the Regional Food Bank of Oklahoma

Weikao Wu, Oklahoma State University, Stillwater, OK, United States of America, weikao@ostatemail.okstate.edu, Andrea Lewis, Katie Luster

The Regional Food Bank would like to meet the needs of the growing population of hungry in Oklahoma. To do this, they have to improve the efficiency of their operations, reduce their delivery costs and increase their delivery capacity. This paper reports on our project seeking improvements in the routing of their delivery operations. We identified several improvements to their current software usage which will enable the Food Bank to better route deliveries. Resulting cost savings will allow for over 6 million additional meals to be provided annually by the Food Bank based on projections developed from the test cases.

4 - Location Optimization for AYGAZ Auto Gas Facilities

Birce Sari, Koc University, Istanbul, Turkey, birsari@ku.edu.tr, Kerem Uzun, Ceren Yavuz, Beyza Turan

A location decision for distribution centers and their service regions is often one of the most critical fundamentals for success of an organization. This project summarizes the system and dynamics of Aygaz auto gas business in Turkey and suggests the deterministic model formulation of facility location problem in order

to minimize the overall cost. Our aim is to allocate feasible number of auto gas storage facilities in different cities, creating a new supply channel for Aygaz; in addition to Aygaz's six port terminals. The results of the project will be taken into consideration by strategic management of Aygaz for prospective investments.

5 - Missed Opportunities in Preventing Hospital Readmissions: Redesigning Post-discharge Checkup Policies

Michael Hu, University of Michigan, Ann Arbor, MI, United States of America, humich@umich.edu, Xiang Liu, Jonathan E. Helm, Mariel S. Lavieri, Ted A. Skolarus, Kedi Wu

Hundreds of thousands of patients experience hospital readmissions every year, negatively impacting patients and placing a tremendous burden on the national healthcare system. Post-discharge checkup policies can reduce readmissions through early detection of health conditions, however, the methods behind designing effective checkup policies are poorly understood. Under current practice, up to 67% of patients are readmitted before the first scheduled checkup. We develop an analytical model based on delay-time analysis to identify the optimal type, number, and timing of checkups. Analyzing the structure of optimal policies, we develop schedules that avert at least 32% more readmissions than current practice.

6 - System of Systems Architecture Generation using Evolutionary Algorithms & Negotiation Strategy

Siddhartha Agarwal, Missouri University of Science and Technology, Department of Engineering Management Rolla, MO, 65401, United States of America, sa265@mst.edu

Our attempt is to present a module within integrated SoS architecting model called FILA-SoS (flexible intelligent and learning architectures for systems of systems). FILA-SoS capabilities include SoS meta architecture generation, flexible and robust architecture assessment, and final architecture implementation through simulated negotiations.The paper uses evolutionary algorithms-Fuzzy nets to generate meta-architectures.

7 - Multi-resolution Analysis (MRA): Integrating Methodologies for Today's Analytical Challenges

John Tindle, Director, Analytical Services, TASC, Inc., 1795 Jet Wing Drive, Suite 100, Colorado Springs, CO, 80916, United States of America, john.tindle@tasc.com

The premise of Multi-Resolution Analysis (MRA) is that complex domains of capability should be analyzed from different perspectives with tailored models and tools appropriate for each perspective, but with the 5 OR & DA segments of the analysis integrated to provide traceability of cause and effect for combined total impact.

8 - Optimal Bidding Strategy Based on Parametric Linear Programming Considering Incomplete Information

Feng Gao, Ventyx, an ABB Company, 451 El Camino Real, Santa Clara, CA, United States of America, feng.gao@ventyx.abb.com, Kory Hedman

Electricity market participants face risks and uncertainties associated with the changing market environment. A profit-driven bidding system is crucial for generation companies to maintain a competitive position. This paper presents an optimal bidding strategy derived by parametric linear programming and extends it to consider incomplete information. We show that the proposed algorithm is able to utilize the characteristics of piecewise staircase offer curves in contrast to existing methods.

9 - Optimization of Treatment Decision for Glycemic Control for Patients with Type 2 Diabetes

Yuanhui Zhang, Center for Disease Control and Prevention, 4770 Buford Highway, Chamblee, GA, 30341, United States of America, yuanhui.zhang@gmail.com, Nilay Shah, Steven Smith, Jennifer Mason, Brian Denton

The main objective for care of type 2 diabetes is to control the patient's glycated hemoglobin (HbA1c) to reduce the risk of the diabetes complications. Uncertainty in the progression of HbA1c and the treatment effects make treatment decisions challenging. We present a Markov decision process to maximize the patient's expected quality-adjusted life years prior to major complications. We present the structure of the optimal policy and compare it to current guidelines.

10 - A Web Tool for Model-based Decision Support

Joseph Kahn, Novartis Pharmaceuticals, 1 Health Plaza, East Hanover, NJ, 07960, United States of America, joseph.kahn@novartis.com, Richard Nixon, Peter Danenberg, Vineet Joshi, Chien-Hsun Huang, Dipika Mukherjee

Decision models yield insights for drug development, but lack of automation hampers systematic use. Hence, we developed a web-based tool, incorporating decision analysis best practices. The tool compares "strategy table" scenarios, identifying influential parameters and risks. Its uses have included trial design, and prioritizing among indications. The tool drives models in the open-source R language. By automating decision models, the tool facilitates faster insights and reduces manual errors.

11 - Evaluation of Breast Cancer Mammography Screening Policies Considering Adherence Behavior

Mahboubeh Madadi, University of Arkansas, 900 N Leverett, Fayetteville, AR, 72701, United States of America, mmadadi@email.uark.edu, Louise Henderson, Shengfan Zhang

Incorporating heterogeneity in women's adherence behavior, a randomized partially observable Markov chain model is developed to evaluate a wide range of screening mammography policies. Screening policies are compared in terms of quality adjusted life years (QALYs) and breast cancer lifetime mortality risk. Our results show that women with perfect adherence do not always experience higher QALYs. However, in terms of lifetime mortality risk women with higher adherence rate always have lower risk.

12 - Hospitalists and Hospital Productivity

Rezwan Haque, Harvard Business School, Soldiers Field Road, Boston, MA, 02163, United States of America, rhaque@hbs.edu, Robert Huckman

We investigate an important recent trend in inpatient care: the emergence of primary care doctors, known as hospitalists, who spend all of their professional time in the hospital. We find that hospitalist use is associated with reductions in length of stay for the most complex patients. This outcome could be due to the fact that hospitalists develop more process familiarity, which enables them to be better at tasks such as care coordination that are especially important for complex patients.

13 - Bank Marketing Analysis using Multivariate Techniques

Nasim Nezamoddini, State University of New York at Binghamton, 13 Goethe St., Binghamton,NY, 13905, United States of America, nasim.nezam@gmail.com

This research applies multivariate techniques to find customers willing to invest in new projects. To increase the accuracy of the predictions, different types of customers are identified using clustering techniques. Then specialized prediction models are built in terms of advertisement strategies, customers' characteristics and their attitude obtained by factor analysis.

14 - Integrating Relativity into Multi-attribute Utility Model: An Application on Product Improvements

Selin Erguncu, Doctoral Candidate, Koc University, Istanbul, Turkey, serguncu@ku.edu.tr

Building on MAUT, we propose a framework that recognizes 'relativity' effect in multi-alternative evaluations. We show that each alternative under consideration acts as a 'reference point' for others and choosing an alternative (vs. rating it) decreases its perceived utility. Applying our framework on the assessment of product improvements, we further show that improving a poor (vs. strong) attribute is a better strategy and improvements are more attractive for first-time buyers (vs. switchers).

15 - A Statistical Human Resources Planning in a Call Center

Kosuke Shaku, Tokyo Gas Co., Ltd., 5-20 Kaigan 1-chome, Minato-ku, Tokyo, Japan, shaku@tokyo-gas.co.jp, Toshinori Sasaya, Koji Takayasu

A call center is considered as a queueing network and some results from queueing theory are often applied to calculate the necessary number of agents to maintain a desired service level. However, the actual situation in a call center is complicated compared to the prerequisites of basic formulae in queueing theory such as Erlang C formula because of varieties in both inbounding calls and agent skills. We present a new statistical human resources planning to avoid such problems.

16 - Linguistic Indicators of Satisfaction and Intent in Online Text-based Customer Service Chats

Justin WIlliams, University of Arizona, 1130 E. Helen St., McClelland Hall 430, Tucson, AZ, 85721, United States of America, jwilliams@cmi.arizona.edu, Lee Spitzley

Online, text-based chat is an important way for companies to provide customer support through a web interface. It is unclear how the customer service representative's (CSR) language influences the customer's satisfaction and likelihood to recommend the product. We propose to study the language of CSRs in an online customer support scenario to identify meaningful language characteristics that have an ability to predict satisfaction and likelihood to recommend the product.

17 - Real-time Integrated Airport Surface Operations Management

Yu Zhang, Assistant Professor, University of South Florida, 4202 E. Fowler Ave, ENB 118, Tampa, FL, 33620, United States of America, yuzhang@usf.edu, Qing Wang

This paper describes a real-time integrated airport surface operations management (RTI-ASOM) that provides optimal 4-D trajectories for aircraft between gate and runway with the objective of minimizing taxi delay and maximizing runway throughput. The use of MIP formulation, Dynamic Programming for runway sequencing, and Visual Basic scripted interface solve the large-scale optimization problem instantly, with examples based on one-day track data at LaGuardia Airport (LGA).

18 - Monitoring and Predicting the Patient's Length of Stay in Hospital Using Regression Control Charts

Nasibeh Azadeh-Fard, PhD Student, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24060, United States of America, nasibeh@vt.edu, Jaime Camelio

Modified Early Warning Scoring (MEWS) system, a triage tool that is widely used by healthcare providers, can quickly determine the severity of patient's illness. The goal of this study is to assess the correlation between admission MEWS and patient's length of stay in the hospital. We utilize this correlation to further monitor the length of stay using the regression control charts. This tool can help hospital staff to predict patient's length of stay, which can lead to more effective management of patient's needs, as well as early resource allocation.

19 - Integrated Optimization on Outsourcing and Production Decisions in Global Supply Chain

Lu Zhen, Professor, Shanghai University, Shang Da Road 99#, School of Management, Shanghai, 200444, China, lzhen@shu.edu.cn

Manufacturers in China are facing decisions on supplier adoption in overseas and domestic markets, production plans for customers in the two markets. These decisions are intertwined. This paper studies an integrated optimization problem on outsourcing and production decisions under environment of global supply chain and China's export-oriented tax policies. A three stage decision model is proposed. A cross entropy based solution method is also developed for solving the three stage model.

20 - Children for Wealth- Fertility Competetion

Bumi Camara, University of Goettingen, Platz der Sieben 5, Goettingen, 37073, Germany, bcamara@uni-goettingen.de

This paper examines the inter-play between inheritance laws and poverty among women in Africa and how this interaction induces high fertility for women in polygamy. I provide evidence of fertility competition among women in polygamy. Polygamy but not monogamy is associated with high fertility if the husband is affluent. Birth spacing is much shorter and contraceptive use is less likely among co-wives whose husband owns inheritable wealth. Results imply intergenerational poverty in Africa.

21 - Salesforce Contracts Equilibrium for Inventory Optimum with Customer Loyalty Moderating Effects

Yu-Ching Chern, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, Taipei, Taiwan - ROC, d02546004@ntu.edu.tw, Gwo-Hshiung Tzeng

We present a multistage model to optimize firm's contracts which induce salesmen's productive behaviors and elicit market demand information.Our model aims to simultaneously resolve the moral hazard and the adverse selection problems.Employing the firm's equilibrium strategy and salesforce's optimal actions,the inventory cost and profits outperforms other existing compensation schemes.Results also indicate that loyal customer base act as implicit incentives to motivate salesperson's performance.

22 - Clinical Prediction of Metastatic Disease among Newly Diagnosed Prostate Cancer Patients

Maria Correa, Department of Industrial Engineering, St. Mary's University, 1 Camino Santa Maria, San Antonio, TX, 78228, United States of America, marifercorreag@hotmail.com, Brian Denton, Selin Merdan, Paul Womble, David Miller, Jianyu Liu

Computed Tomography (CT) and Bone Scan (BS) are imaging tests for detection of metastatic disease among prostate cancer patients. We performed statistical validation of predictive models for CT and BS outcomes to help physicians decide when to recommend patients for imaging. We applied several methods for internal and external validation including leave-one-out and bootstrapping. We present results from our analysis and discuss plans for implementation of the models in a smart phone application.

23 - Multi Sales Channel Competition with Product Returns: The Impact of Restocking Fee Legislation

Rita Difrancesco, WHU-Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, rita.difrancesco@whu.edu, Arnd Huchzermeier

With the explosive growth of the internet, the brick-and-mortar stores are either integrated or substituted by the online channel. We model the multiple sales channels competition with product returns and analyze the equilibrium structure. We investigate the effect of restocking fees and a new EU legislation concerning free returns.

24 - A Comprehensive Sensitivity Analysis of Travel Time Reliability

Meredith Cebelak, University of Texas at Austin, 1616 Guadalupe St., Suite 400, Austin, TX, 78701, United States of America, mcebelak@utexas.edu, Jia Li, C. Michael Walton

Travel time reliability is a key performance measure of transportation systems. This study examines the simultaneous impacts of infrastructure capacity variability due to inclement weather, incidents, and infrastructure maintenance, and demand variations due to feedback mechanisms and elasticity. A comprehensive sensitivity analysis is perform on travel time using a HCM tool and experiment design, revealing critical contributing factors on daily travel time uncertainty along freeway corridors.

25 - International Analysis of Government Strategies for Service Sector Innovation

Jessica Brooks, Science Policy Fellow, IDA - Science and Technology Policy Institute, 100 I St. SE, Washington, DC, 20003, United States of America, jnbrooks@ida.org

To observe the position of service innovation in the context of broader science and technology innovation policy, the innovation strategies of 15 nations were analyzed. Trends in policy content, including the relationship to IT innovation strategy, are described in order to understand the global landscape of service innovation policy.

26 - Flow Path Design in Automated Material Handling Systems

Kelly Bartlett, Georgia Institute of Technology, 755 Ferst Dr., Atlanta, GA, 30332, United States of America, kelly.bartlett@gatech.edu, Shabbir Ahmed, Junho Lee, George Nemhauser, Joel Sokol

In automated material handling systems, dynamic routing has been shown in improve routing efficiency over traditional static routing methods. We demonstrate via high-fidelity simulation that altering flow path design for use with dynamic routing improves routing efficiency by an additional 25%. To facilitate this analysis, we present an automated layout generation tool that allows efficient generation of thousands of potential configurations.

27 - Deductible Insurance and the Transfer of Risk

Christopher Gaffney, Stevens Institute of Technology, 1 Castle Point Terrace, Hoboken, NJ, United States of America, cgaffney@stevens.edu

We provide a mean-variance analysis of insurance demand, showing that deductible insurance is preferable to coinsurance. Furthermore, adding either a stop-loss limit or a deductible to the coinsurance model results in an optimal insurance plan equivalent to deductible insurance. An argument concerning the societal benefit of insurance is also given.

28 - A Lagrangian Decomposition Approach for Renewable Energy Investment and Operational Decision Model

Alireza Ghalebani, PhD Student, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33613, United States of America, alireza@mail.usf.edu, Tapas Das

We studied the structural property of a distributed green energy generation optimization model in order to solve it more efficient comparing to the commercial solvers. The model is an incentive based mixed integer programming optimization for design and control of grid-connected hybrid power systems. It fits well for regions with net-metering policy and time varying price of electricity.

29 - Evaluating Cost and Service Level Tradeoffs in a Production and Inventory System with Disruption

Jue Gong, Graduate Student, University of Pittsburgh, 3700 O'Hara St., Pittsburgh, PA, 15261, United States of America, jug29@pitt.edu, Louis Luangkesorn

In a production and inventory system with production disruptions, production uncertainty can be managed through setting the produce-up-to level and sizing the production capacity to provide resiliancy. But these choices result in costs for inventory holding and production capacity and the service level of the system. We develop a Markov-chain model for both periodic and continuous-review policies to explore and illustrate the tradeoffs between operating costs, capacity costs, and service level.

30 - Modeling of Emergency Management of Urban Extreme Storm Floods Based on Strong Reciprocity

Liu Gaofeng, Hohai University, No.200, North Jinling Road, Xinbei District, Changzhou, 213022, China, gaofengliu@hhu.edu.cn

Strong reciprocity theory is introduced into modeling of emergency management of urban extreme storm floods (UESF). Simulations are performed in the example of Jingdezhen city, and the results show that the government strong reciprocity helps to promote emergency cooperation. Besides, rewards and punishment, strong ability of acquiring and processing information, extensive publicity and education can all improve emergency cooperation efficiency and effectiveness of UESF.

31 - Analysis of Nonselective and Selective Advertising Strategies in an Oligopoly Setting

Chloe Fletcher, College of Charleston, 66 George Street, Charleston, SC, 29424, United States of America, fletcherca@g.cofc.edu, Jason Howell

Firms with the ability to identify customers of other firms may implement a strategy where the advertising effort towards competitors' customers differs from that towards uncommitted customers. We present dynamic models for advertising in an oligopoly with fixed market size and sales decay: a nonselective model in which the advertising effort is the same for both types of customers, and a selective model that gives firms the capability to allocate effort across the two categories differently.

32 - Food vs Biofuel: Analysis of Land-use Competition And Environmental Impacts
Halil Cobuloglu, Wichita State University, 1845 Fairmount St, Wichita, KS, United States of America, halil.cobuloglu@gmail.com, Esra Buyuktahtakin

In this study, we develop a mixed integer optimization model in order to investigate the economic and environmental tradeoffs between biofuel and food production. This model maximizes the total profit of farmers while satisfying sustainable food supply. Optimal decisions include allocation of lands to food and energy crops, seeding time, harvesting time and amount, and budget allocations to farm operations. The model is applied in Kansas by considering the production of corn and switchgrass.

33 - Re-envisioning Decision Quality at ConocoPhillips
John Hasar, Development Lead, ConocoPhillips, Rubislaw House, Anderson Drive, Aberdeen, AB15 6FZ, United Kingdom, john.hasar@conocophillips.com, Sharon Rode

ConocoPhillips is changing how and what they share around Decision Quality. Earlier emphasis focused on translating data into quantitative format. While modeling and analysis are needed, not everyone has to be an analyst. Better alternatives are reached by teams highly involved in framing the decision and communicating their knowledge.

34 - Efficient Batch Scheduling for a Petrochemical Blending Plant with a Shared Pipeline Network
Alessandro Hill, University of Antwerp, Prisstraat 13, Antwerp, 2018, Belgium, alessandro.hill@uantwerpen.be, Trijntje Cornelissens, Kenneth Sorensen

We develop an effective scheduling heuristic for realistic production planning of a multi-product, multi-BOM petrochemical blending plant with a complex shared pipeline system. The model takes takes into account component pumping, blending, intermediate storage and filling of the finished products. Our algorithm dynamically prioritizes the production orders and the used dedicated resources to optimize multiple operational objectives. We apply the algorithm to real-world scenarios.

35 - Optimization Strategies for the Best Performance of Healthcare Authority Databases using DM
Yohany Jimenez, Researcher, LOGYCA, Avenida El Dorado N∫ 92 - 32 Modulo G5 P, Bogota, Colombia, yjimenez@logyca.org, Miguel Jimenez, Lauren Castro, Laura Manotas, Diana Ramirez, Heyder Paez, Luis Ramirez

This paper deals with the application of Data Mining (DM) algorithms as an approach to optimize the performance of data processing of the healthcare authority databases, where huge amount of data is managed regarding the new affiliations to the National Healthcare System and reports on the validation of this data are done at a monthly basis. This strategies are integrated to a Decision Support System (DSS) that was implemented as part of the research project.

36 - The Impact of Security in Maintaining Reliable Distributed Control Systems
M. Eric Johnson, Professor, Vanderbilt University, Owen Graduate School of Management, Nashville, TN, 37203, United States of America, Eric.Johnson@vanderbilt.edu, Andrei Sleptchenko

We consider the role of security in the maintenance of an automated system, controlled by a network of sensors and simple computing devices. Such systems are widely used in transportation, utilities, healthcare, and manufacturing. We formulate a stochastic model to examine the repair policies for both real and suspected failures.

37 - The Impact of Multi-skilling on Personnel Scheduling in the Retail Industry
Cesar Henao Botero, PhD Student, Pontificia Universidad Catolica de Chile, Avda. Vicuña Mackenna 4860, Macul, Department of Transportation Engineering, Santiago, Chile, cahenao@uc.cl, Juan-Carlos Muñoz Abogabir, Juan-Carlos Ferrer Ortiz

Retail personnel inflexibility is one of the sources for over- and understaffing. We propose analyze the impacts of assigning multi-skilled personnel to different store departments and its potential for improving schedule efficiency. Our model determines which employees are trained to work in which departments and their assignments over a one-week planning horizon. Some multi-skilling policies are derived from data obtained from a large retail firm in South America.

38 - The Effect of Socioeconomic Inequalities on Public Education Performance in Developing Countries
Maria Cristina Gramani, Insper, Rua Quata, 300, Vila OlÌmpia, Sao Paulo, 04546042, Brazil, mariacng@insper.edu.br

The main objective of this study was to add evidence of the effects of the socioeconomic inequalities on the educational performance. The main question here is: What socioeconomic factor more influences the educational performance? How can we do better? We propose a two-stage model which includes: (1) an educational performance model and, (2) a socioeconomic-education model that identifies characteristics that differentiate the most and least efficient groups.

39 - Integrating Timetabling and Vehicle Scheduling: Tradeoff Between Transfers and The Fleet Size
Omar Ibarra, Post-doc Researcher, Pontificia Universidad Catolica de Chile, Vicuña Mackenna 4860, Macul, Santiago, Chile, oibarrar@uc.cl, Ricardo Giesen, Yasmin Rios-Solis

In transit systems there is a trade-off between the level of service and operating costs. This study presents a bi-objective integrated model for timetabling and vehicle scheduling problems that maximizes passenger transfers and minimizes the fleet size. We implement an epsilon-constraint method to solve our formulation and analyze the trade-off between the two criteria in terms of Pareto fronts. Numerical experiments show that our proposed approach can solve scenarios with up to 50 bus lines.

40 - Evaluation of Construction and Improvement Heuristics for Classification Using Markov Blankets
Daniel Gartner, TUM School of Management, Arcisstr. 21, Munich, Germany, daniel.gartner@tum.de, Rema Padman

This study examines a construction heuristic in connection with a tabu search-based improvement heuristic for classification in high dimensional data sets. Using the UCI machine learning data repository, we evaluate computation times and information about the evolution of the Markov blanket graphical models during the construction and the improvement phase. We compare the performance of the construction and improvement heuristic using classification accuracy as evaluation measure.

41 - Profiling Facebook Users' Privacy Behaviors
Bart Piet Knijnenburg, University of California, Irvine, Informatics Department, Irvine, CA, 92617, United States of America, bart.k@uci.edu, Heather Richter Lipford, Pamela Wisniewski

Social Networks users typically exploit only a subset of the available privacy controls. Using factor analysis and clustering techniques on Facebook users' privacy behaviors, we uncovered six privacy management profiles. We demonstrate that the variability in these profiles is partially due to a lack of awareness regarding the available controls.

42 - Clustering Subgraphs for Repeated Motifs
Nam Lee, Johns Hopkins University, 100 Whitehead Hall, 3400 North Charles Street, Baltimore, MD, 21214, United States of America, nhlee@jhu.edu

We consider a problem of grouping multiple graphs into several clusters using singular value thesholding and non-negative factorization. We derive a model selection information criterion to estimate the number of clusters. We demonstrate our approach using ``Swimmer data set'' as well as simulated data set, and compare its performance with two standard clustering algorithms.

43 - Are You Sure this is the Clothing Style You Defined?
Yusan Lin, PhD Candidate, Pennsylvania State University, 301D Grubb, White Course Apartments, University Park, PA, 16802, United States of America, yusan@psu.edu

When marketing clothing products, it is necessary for the sellers to be aware of the styles of their products, and the kind of consumers they are targeting. However, how does one make sure the style they define is correct? We leveraged the fashion-focused social network, lookbook.nu, and examined whether their definition of styles corresponds to the network structure.

44 - Entropy Maximization with Stochastic Dominance and Moment Constraints for Distribution Approximation
Alexander Mafusalov, PhD Student, University of Florida, 303 Weil Hall, Gainesville, FL, 32611-6595, United States of America, mafusalov@ufl.edu

Entropy maximization with linear constraints (second order stochastic dominance constraint, first and second moment constraints) is proposed for sample distribution approximation problem. Solution is a piece-wise Gaussian function. The second moment convergence implies solution convergence to sample distribution. Cross-validation with likelihood maximization is used to adjust second moment proximity.

45 - Issues in Resiliency for the Australian Food Supply Chain
Leorey Marquez, Research Scientist, CSIRO, Gate 5, Normanby Road, Clayton, VI, 3168, Australia, leorey.marquez@csiro.au, Rodolfo Garcia-Flores, Simon Dunstall

Roughly one-third of food produced for human consumption is lost or wasted globally. At the same time, food production is under threat from climate change, competing land uses, erosion and clean water shortages. This poster showcases recent work aimed at understanding key elements of resilience in the Australian food supply chain. These studies investigate points of vulnerability, the types of threats that can occur in the event of a severe emergency and the strategies needed to address them.

46 - Optimal Combination of Multiple Diagnostic Tests with Application to Prostate Cancer

Selin Merdan, Department of Industrial and Operations Engineering, University of Michigan, 1640 McIntyre Street, Ann Arbor, MI, 48109, United States of America, smerdan@umich.edu, Brian Denton, Christine Barnett

In the early detection and diagnosis of disease, multiple tests are used to discriminate between patients with and without the disease. In the context of cancer, there are several risk factors that predict the presence of the disease; however, the optimal assignment of diagnostic tests to patients based on these risk factors is not known. We present a new model to optimally classify patients for composite diagnostic testing such that false positive and false negative results are minimized.

47 - Bayesian Analysis to Determine Phase Change Time in Stem Cells

Louis Luangkesorn, Research Assistant Professor of Industrial Engineering, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara St., Pittsburgh, PA, 15261, United States of America, lol11@pitt.edu, Ali Hjaar

Understanding the dynamics of stem cell differentiation can help in using stem cells in therapeutic and other medical applications. However, measuring the change in cell samples is difficult. This makes it difficult to parameterize mathematical models. Bayesian calibration methods are useful in cases where there are few samples and measurement error. We apply Bayesian methods and show how they lead to more useful estimates of parameters relating to the stem cell reproductive cycle.

48 - A Game-theoretic Procedure for Bridge Construction Cost Allocation

Saurav Kumar Dubey, PhD Student-Department of Industrial and Systems Engineering, University of Tennessee at Knoxville, 1615 Laurel Avenue, Knoxville, TN, 37916, United States of America, skumardu@utk.edu, Alberto Garcia-Diaz, Dongju Lee

The proposed method integrates traffic capacity and load requirements to allocate bridge costs among vehicle classes, using two game-theoretic criteria known as Aumann-Shapley value and Shapley value, and an incremental allocation procedure.Players are defined as vehicle classes, axle load applications, or lanes.The gross-weight based incremental procedure determines marginal costs.

49 - Cost Estimation Method for R&D Research Fund of Government in Korea

Dong-Guen Kim, Associate Research Fellow, Korea Institute of S&T Evaluation and Planning (KISTEP), Dongwon Industry Bldg., 275 Yangjae-dong, Seoul, Korea, Republic of, dgkim@kistep.re.kr

In Korea, the preliminary feasibility study(PFS) is carried for the newly proposed large-scaled government programs. In case of a PFS on R&D programs, the estimation of project cost is needed. In this study, the method of estimation on R&D project cost are researched. Using the historical data about simliar R&D project, the distributions of R&D project costs are investigated and the methodology for estimation on parameters of project cost is developed.

50 - Multiple Criteria Simulation Optimization: Further Refinements

Esmeralda Niño, Graduate Student, University of Puerto Rico at Mayagüez, PO BOX 9000, Mayagüez, 00680, Puerto Rico, esmeralda.nino@upr.edu, Mauricio Cabrera-RÌos, Bryan Rosas

In particular, this work improves upon the use of Data Envelopment Analysis to determine the efficient frontier, as well as, the use of a single-pass algorithm previously proposed by our research group. The results show a rapid convergence to a more precise characterization of the Pareto-efficient solutions. The revised algorithm is illustrated by a series of cases in manufacturing systems simulation.

51 - Iterated Local Search for Flexible Job Shop Scheduling Problems with Resource Constraints

Dimitris Paraskevopoulos, Assistant Professor, University of Bath, Claverton Down, Bath, BA2 7AY, United Kingdom, dp465@bath.ac.uk, Christos Tarantilis, Panagiotis Repoussis

This work presents an Iterated Local Search (ILS) algorithm for flexible Job shop scheduling problems with deadlines, sequence dependent setup times, machine availabilities and most importantly resource constraints. The proposed ILS introduces new compound moves and consorts with an adaptive perturbation mechanism. Experiments on randomly generated problem instances are reported.

52 - Consumer Loan Acquisition Decisions in the Context of Economic Uncertainty

Kanshukan Rajaratnam, University of Cape Town, 4.70 Leslie Social Science Building, Rondebosch, 7700, South Africa, kanshukan@gmail.com

We incorporate forecasts of future economic conditions into acquisition decisions for scored consumer loan portfolios. The portfolio manager must choose both a cutoff score and its associated level of capitalization prior to account performance. In this research, we consider the scoring and regulatory capital decision under multiple economic scenarios. We construct the set of efficient operating points in the market-share and profit space.

53 - How to Complete Subsequent Deals? Breadth and Depth of M&A Success in Semiconductor industry

Jieun Hwang, Seoul National University, LG #59-110, Daehak-dong, Gwanak-gu, Seoul, Korea, Republic of, jieun_sara@hotmail.com, Taewoo Roh

Previous studies on M&A have neglected the importance of deal completion. Based on organizational learning theory, we find that firms can learn to complete the deal from prior success acquisition experience. We examine that intra-industry acquisition experience increases the deal completion and the deal speed in semiconductor industry. Moreover, inter-industry acquisition experience moderates the relationship.

54 - The KANBAN Gamification in a Strategic Operation Management Simulation

Felipe Reis Graeml, Centro Universitario da FEI, Departamento de Engenharia de Produçao, Brazil, fgraeml@fei.edu.br, Mauro Sampaio

This article presents the results of a simulation performed with students, using gamification to teach KANBAN in an Operations Management context. The article defends and justifies the use of "gamification" as an alternative to support theoretical classes, diminishing the effect of learning inhibits, increasing the retention of knowledge for longer period, and stimulating skills development on students.

55 - A Fuzzy Linguistic Based Decision Support System for Evaluating Remanufacturability of Products

Thomas Omwando, University of Wisconsin Milwaukee, 3200 N Cramer Street, EMS 503, Milwaukee, WI, 53211, United States of America, tomwando@uwm.edu, Anthony Ross, Wilkistar Otieno

Remanufacturing as an end of life disposal option faces challenges due to uncertainties associated with product attributes. This work presents a decision support system based on a 2-tuple fuzzy linguistic computing approach to integrate qualitative and quantitative product attributes in determining the remanufacturability of a product. The model is applied to assess the suitability of remanufacturing two products manufactured by a global industry based in the mid-west region of the USA

56 - Extending the Complexity of Covering-routing Problem Considering Maximum Returns to Critical Areas

Maria Jose Pinto Lamosa, Dra., IEAv/CTA, Trevo Cel Av. Jose A. A. do Amarante, 1, S„o José dos Campos, Brazil, maju@ieav.cta.br, MÖnica Maria De Marchi

The problem consists on determining routes with minimum costs and maximum returns to critical areas. We had solved it using a multi-objective model, but the simplifications considered in that model became difficult to apply it in real scenarios. A new model is proposed including features and limitations to the problem, as the associated time and the entity autonomy/capacity. The problem has been applied in scenarios where monitoring is required like disaster management and airspace surveillance.

57 - Predictive Dialing in the Cloud

Douglas Samuelson, InfoLogix, Inc., 8711 Chippendale Court, Annandale, VA, 22003, United States of America, infologix1@aol.com

We extend earlier methods to perform predictive dialing in a Cloud-based virtual call center, with much more flexibility of operational behaviors and consequently a more complex control problem. Big Data and Big Computing methods yield high utilization with acceptably low numbers of abandoned calls.

58 - Destructive Leadership and its Organizational Impact: A Critical Discourse Perspective

Masato Suzuki, Tokiwa University, 1-430-1,Miwa, Mito-shi, Japan, msuzuki0107@gmail.com

The purpose of this study is to investigate leaders' abuse to subordinates and its organizational impact from critical discourse perspectives. While a lot of studies have examined destructive leadership, little is known about how organizational abuse unfolds in organization. Combining dairy analysis and follow up interviews, this study shows that the impact of leaders' abuse to subordinates is not confined to a worker abused, but to behaviors which not abused employees do in organization.

59 - Deducing Patient Placement Decisions in Hospitals; An Integer Programmin Approach

Nooshin Valibeig, Northeastern University, 360 Huntington Avenue, Boston, MA, 02115, United States of America, n.valibeig@neu.edu, Jacqueline Griffin

Hospitals operations are captured in several independent information systems, resulting in lost information about underlying decision processes. We use integer programming to integrate a flow and a census data set to extract important underlying characteristics of the system. Additionally, we analyze the accuracy and robustness of the model using simulated data.

60 - Method of Characteristic Functions for Networks with Fixed Node Degrees
Vladimir Tsurkov, Head of Department, Computing Centre of Russian Academy of Sciences, Vavilov Str., 40, Moscow, 119333, Russia, tsur@ccas.ru

Classes of networks with fixed node degrees and weights of arcs and loops not exceeding a given parameter are studied. Characteristic functions are found that depend on vector components and a parameter; the non-negativeness of this parameter is the network existence criterion. The sums of arc weights on each subset after decomposition and the sum of arc weights incident upon the nodes of subsets are treated as variables. Formulas for the upper and lower bounds for these variables are obtained.

61 - Scheduling Urgent and Normal Jobs in a Two-machine Flowshop
Sang-Oh Shim, Hanbat National University, Dept of Business Administration, Hanbat, Deokmyung-Dong Yuseong-Gu, Daejeon, Ko, 305-719, Korea, Republic of, mizar0110@gmail.com

In this research,a problem of scheduling urgent and normal jobs in a two-machine flowshop is addressed to minimize total tardiness and the maximum completion time for urgent jobs and normal normal jobs, respectively. Several heuristics to obtain an feasible solution in a reasonable time are developed. To evaluate the performance of the proposed algorithms, computational experiments are done on randomly generated instances.

62 - Using Mixed-effect Models to Monitor Product Quality in Interchangeable Manufacturing Processes
Abbase Saghaei, Science and Research Branch Islamic Azad University, Hessarak, 1477893855, Tehran, Iran, a.saghaei@srbiau.ac.ir, zahra pishravian, Mehrdad Nikoo

Interchangeable Manufacturing Processes create different distributions of data, which usually the traditional methods cannot model them. This paper presents a new method for phase II monitoring geometric profiles of gears with different distributions of data. At first, a functional data clustering method is used to cluster the profiles. Then, a mixed-effect model is proposed to consider both within and between clusters variations. The proposed method has shown good performance in such processes.

63 - Stochastically Constrained Simulation Optimization on Integer-ordered Spaces
Kalyani Nagaraj, Virginia Tech, 250 Durham Hall, Blacksburg, VA, United States of America, kalyanin@vt.edu

We present a provably efficient algorithm for optimizing a system whose objective function and the functions forming the set of constraints are observable only via a stochastic simulation parameterized by a finite number of integer-ordered variables. Additionally, we present heuristics for automatically tuning the algorithm parameters that demonstrated good finite-time performance.

64 - Robust Dynamic Pricing for Oligopolistic Service Providers with Fixed Inventories
Yiou Wang, Pennsylvania State University, 244 Leonhard Building, University Park, PA, 16801, United States of America, yiw5120@psu.edu, Terry Friesz, Tao Yao, Ke Han

The problem of robust dynamic pricing of an abstract commodity with fixed inventories specified at initial time is formulated as a continuous time generalized dynamic Nash game and developed into a robust continuous time quasi-variational inequality. We then show the equivalent variational inequality and give effective algorithms based on this. Numerical examples consist of the comparison between robust and stochastic formulations and quantification of efficiency of such supply chain.

65 - Price Discount and Inventory Planning with Binding Reservation
Jianghua Wu, Associate Professor, Renmin University of China, School of Business, 59 Zhonguancun Street, Beijing, China, jwu@ruc.edu.cn

In this paper, we consider the strategy of a firm to use price discounts to implement binding reservation. The firm offers a price discount to customers in exchange for the option to fulfill their orders at the end of the selling season if there is inventory available. The firm can use the advance order information to update demand information. We derive the optimal discount and inventory decision, and then evaluate the impact of various parameters on the performance.

66 - Portfolio Optimization for Options: An Approximate Dynamic Programming Approach
Yaxiong Zeng, Northwestern University, 2145 Sheridan Road, IEMS, Evanston, IL, 60208, United States of America, yaxiongzeng2015@u.northwestern.edu, Diego Klabjan

In portfolio optimization, option has played a relatively small role with few papers discussing its potential impact. In our paper, we design a novel ADP algorithm for European option portfolio and an ADP-embedded non-standard progressive hedging algorithm for American option portfolio. We are the first to add American options into portfolios and explicitly take optimal exercise time into account. By simulation, we compare our algorithms against existing ones and conclude ours perform better.

67 - The Impact of Information Sharing and IT on Customer Service Performance
Wenjie Zhang, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an, 710049, China, wenjie363@qq.com, Gang Li

Information sharing and IT constitute an important base of competitive advantage for organizations, as they enable the level of customer service. This study proposes a model to analyze the effects of Information sharing and IT on delivery service and after sale support service,and considers the Interaction effects of Information sharing and IT. A large-scale survey was used to tests these relationships and findings provide several theoretical and practical implications for future research.

68 - Adaptive Decision Making of Breast Cancer Mammography Screening: A Heuristic Regression-Based Model
Fan Wang, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, fxw005@uark.edu, Shengfan Zhang

Mammography screening, although effective in reducing breast cancer morality, has high false-positive rates. We develop a regression-based decision model to determine if a mammogram is necessary for various women. The explanatory variables include several risk factors. The optimal decisions are expected to result in the least loss of life expectancy.

69 - From Theory to Practice: Implementation of a Resource Allocation Model in Health Departments
Emine Yaylali, Senior Service Fellow, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA, 30329, United States of America, wqq3@cdc.gov, Stephanie Sansom, Arielle Lasry

HIV resource allocation models can synthesize surveillance, programmatic and research data to guide the distribution of HIV prevention dollars among people and programs. Many theoretical models for HIV resource allocation have been developed, although few have been used and evaluated across multiple sites. We developed an HIV resource allocation model that was piloted and evaluated in four health departments. We present health departments' evaluations of their use of the model and its results.

Tuesday, 1:30pm - 3:00pm

■ TC01

Hilton- Golden Gate 6

Mission Planning III

Sponsor: Military Applications Society

Sponsored Session

Chair: Chase Murray, Auburn University, 3301 Shelby Center, Auburn, AL, United States of America, CCM0022@auburn.edu

1 - Usability Analysis of a Task-based Mission Supervisory Control Interface
Luca Bertuccelli, United Technologies Research Center, 411 Silver Lane, East Hartford, CT, 06108, United States of America, luca.bertuccelli@utrc.utc.com, Francesco Leonardi, Jeffrey Peters, Amit Surana

Task-based supervisory control enables an operator to provide a list of tasks that the vehicle team must accomplish and has been shown to have advantages over vehicle-level supervisory control, where an operator manages single vehicles. However, there is little understanding into how users make decisions while using a task-based user interface. This work presents early usability results in user interaction with a task-based user interface under varying number of total vehicles supervised.

2 - Anticipatory Routing of UAVs Using a Game Theoretic Approach
Michael Couche, University at Buffalo, 342 Bell Hall, Buffalo, NY, 14260, United States of America, mjcouche@gmail.com

The UAV routing algorithm takes advantage of game theory solution principles to predict routing in different scenarios. One of the most interesting scenarios is that in which UAVs are modeled as competitive players in the search for information. This scenario provides insights to effective search and routing when the UAVs are decentralized, over an n-step planning horizon. An in depth look into mixed strategy equilibria is also given.

3 - An Approach to Decision Making for Performance Improvement of Military Weapon Systems
Tae Bo Jeon, Professor, Kangwon National University, IE Dept,, 192-1 Hyoja 2 Dong, Chuncheon, 200-701, Korea, Republic of, tbjeon@kangwon.ac.kr

PI (Performance Improvement) is a widely accepted acquisition alternative for existing military weapon systems. A revised hierarchical model for PI has been presented in this study. Through careful examination of PI characteristics, we deducted major evaluation components - maintainability/operability, fulfillment of performance, easiness/effectiveness in PI, and battlefield environment/mission adaptability. We then drew sub-components within each category with carefully designed questions.

4 - Maximizing Autonomous Agent Connectivity
Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

In this research, we consider the problem of maximizing the connectivity for a set of autonomous agents in a mobile ad-hoc network. Each agent has a starting point and an ending point, and there are certain locations that must be visited by at least one agent. Heuristics are developed and results are presented.

■ TC02

Hilton- Golden Gate 7

Technology, Innovation Management and Entrepreneurship Section Best Paper Winner Presentation

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Sinan Erzurumlu, Associate Professor, Babson College, 231 Forest St, Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Employee Non-Compete Agreements
Matt Marx, MIT Sloan, 100 Main St., Cambridge, MA, United States of America, mmarx@mit.edu

I will review our and related work on Employee Non-Compete Agreements, including individual, firm-level, and regional implications. The status of pending legislation will be reviewed.

■ TC03

Hilton- Golden Gate 7

The Social Crowd: New Research in Social Media and Crowdsourcing

Sponsor: eBusiness

Sponsored Session

Chair: Kevin (Yili) Hong, Assistant Professor, Arizona State University, 300 E Lemon St, Tempe, AZ, 85287, United States of America, ykhong1@asu.edu

Co-Chair: Gordon Burtch, Assistant Professor, University of Minnesota, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, gburtch@umn.edu

1 - The Value of Multi-dimensional Rating Systems: An Information Transfer View
Kevin (Yili) Hong, Assistant Professor, Arizona State University, 300 E Lemon St, Tempe, AZ, 85287, United States of America, ykhong1@asu.edu, Pei-yu Chen, Ying Liu

This paper examines the value of multi-dimensional online rating systems from an information transfer perspective. Our identification hinges on a natural experiment on TripAdvisor that allowed us to identify the causal effect of adopting a multi-dimensional rating system with a difference-in-difference approach. Based on data from TripAdvisor and Yelp, we find consumers' ratings for the same restaurants are higher in TripAdvisor after its adoption of the multi-dimensional rating system.

2 - The Effect of Social Media Marketing Content on Consumer Engagement: Evidence from Facebook
Dokyun Lee, PhD Student, University of Pennsylvania, JHH 5th Floor, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, leedok@wharton.upenn.edu, Harikesh Nair, Kartik Hosanagar

We study the effect of social media content on customer engagement using data on Facebook. We do so by content-coding more than 100,000 messages with Natural Language Processing algorithms. We find that inclusion of persuasive content - like emotional content - increases engagement with a message. We find that informative content - like mentions of prices - reduce engagement when included in messages in isolation, but increase engagement when provided in combination with persuasive attributes.

3 - A Double Digital Divide? Matching Platforms and HIV Incidence among the Digitally Disadvantaged
Brad Greenwood, University of Maryland, College Park, MD, United States of America, brad.n.greenwood@gmail.com, Ritu Agarwal

We examine how platforms for the solicitation of casual sex influences the incidence rate of HIV by race, gender, and SES. Using a census of 12 million patients in Florida, we find that the largest negative effect accrues to historically at risk populations (i.e. African Americans and the socio-economic lower class) that, ironically, are also disadvantaged with respect to digital inequalities. Economically, this translates into a financial burden of $592 million in the State of Florida alone.

4 - Asymmetric Social Influence from Personalized Social Cues
Sean Taylor, Research Scientist, Facebook, 1 Hacker Way, Menlo Park, CA, 94025, United States of America, sjt@fb.com, Eytan Bakshy, Dean Eckles, Sinan Aral

We aim to characterize which social relationships transmit the most social influence. Our methodology characterizes the dyadic factors which moderate influence, conditional on exposure to peer behaviors. In our experiment, we select ad exposures where viewers could potentially be exposed to social cues involving two different peers and randomly choose one of the two peers, providing exogenous variation in the dyadic characteristics of friends displayed in the social cue component.

■ TC04

Hilton- Continental 1

Energy Markets and Demand Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Owen Wu, Indiana University, Bloomington, IN, United States of America, owenwu@indiana.edu

1 - Demand Response in Energy Markets: Voluntary and Involuntary Load Curtailment Contracts
Ruben Lobel, University of Pennsylvania, 3730 Walnut St, JMHH - Suite 500, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu, Kaitlin Daniels

As energy consumption grows, electricity grids are turning to demand response (DR) to meet peak demand and lower prices. These programs allow forgone energy consumption to be sold on the market during peak demand events. This project compares the performance of two types of DR contracts: involuntary, under which consumers relinquish control of their energy consumption in return for payment, and voluntary, which allow consumers to decide to reduce their load during each peak event.

2 - Demand Side Management Programs in Energy Markets: An Empirical Approach
Ozge Islegen, Assistant Professor of Managerial Economics and Decision Sciences, Northwestern University, Kellogg School of Management, 2001 Sheridan Road, Evanston, IL, 60208, United States of America, o-islegen@kellogg.northwestern.edu, Baris Ata

Demand side management (DSM) programs flatten or shift peak electricity demand by modifying the consumption patterns of end-consumers. These programs have become widely applicable with the introduction of "smart grids" which can communicate the consumption and price data throughout the power system. In this study, we model the decision-making process of individual electricity consumers under DSM programs and estimate the impact of these programs via a series of counterfactual analyses.

3 - Smart Homes with Price-Responsive Thermostats
Dan Adelman, Professor of Operations Management, University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, dan.adelman@chicagobooth.edu, Canan Uckun

We develop a framework for a smart home's thermal appliances to respond optimally to dynamic electricity price signals, and for assessing the resulting market price equilibrium in a large service region. We show that under certain conditions it is socially optimal for the electricity utility to pass spot prices down to consumers. We present extensive numerical results on ComEd's residential electricity service.

4 - Curtailment and Subsidies: How Renewable Energy Policies Affect Power Market Competition
Owen Wu, Indiana University, owenwu@indiana.edu, Majid Al-Gwaiz, Xiuli Chao

We study the impact of intermittent renewable generation (such as wind and solar power) on electricity market competition, with the focus on the effects of renewable energy policies. Two sets of policies are considered: the production-based subsidies and the operating policies on renewable energy curtailment. The power market competition is modeled as a supply function competition between generators with different levels of flexibility.

■ TC05

Hilton- Continental 2

Retail Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Vidya Mani, Assistant Professor, Pennsylvania State University, 461 BB, University Park, State College, PA, 16802, vmani@psu.edu

1 - Allocation of Decision Rights in Retail Supply Chains
Qingning Cao, Vanderbilt University, 401 21st Ave S, Nashville, 37203, United States of America, qingning.cao@vanderbilt.edu, Mumin Kurtulus, Sezer ‹lkü

Our paper studies the implications of allocating decision rights (retail assortment, inventory ownership) in a supply chain. In particular, we identify product and market characteristics that lead to a win-win situation for the manufacturer and the retailer, when the manufacturer takes over both the assortment and inventory decisions and the associated risks.

2 - Flexible Products and Dynamic Preferences
Karthik Ramachandran, Associate Professor, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu, Aydin Alptekinoglu

Consumers often have needs that change in a dynamic fashion over time due to physiological, mental or environmental variations. We address a product design dilemma in satisfying such dynamic preferences: should a firm offer multiple standard products, each designed for a specific purpose, or a flexible product that can be reconfigured by consumers as their preferences change?

3 - Inventory Stocking and Rationing for an Omni-Channel Retailer
Elnaz Jalilipour Alishah, PhD Student, University of Washington, Michael G. Foster School of Business, ISOM Department, Seattle, WA, 98195, United States of America, jalilipo@uw.edu, Kamran Moinzadeh, Yong-Pin Zhou

We consider a retailer operating an online and offline store with independent demand. Online demand can be satisfied using offline inventory at a cost, but not vice versa. For a given stocking level, we characterize the offline store's rationing policy; at any time, there exists an inventory threshold above which online demand will be satisfied. We develop and test heuristics to simplify implementation of rationing policy. We then extend the heuristics to retailer with multiple offline stores.

4 - Inventory Management in Online Retailing under Operational Realities
Jason Acimovic, The Pennsylvania State University, 462 Business Building, University Park, PA, 16802, United States of America, jaa26@smeal.psu.edu, Stephen Graves

Inventory management in online retailing presents new challenges. We partner with an online retailer to discover, investigate, and overcome these challenges. Specifically, we investigate how the status quo decentralized replenishment policy performs suboptimally. This is especially true under operational realities such as supply perturbations. We find evidence of these operational realities on actual data and propose a policy that is robust to them.

■ TC06

Hilton- Continental 3

Managing Supply Chain Disruptions

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Sang Kim, Yale School of Management, 165 Whitney Ave, New Haven, CT, 06511, United States of America, sang.kim@yale.edu

1 - Disruption Risk and Optimal Sourcing in Multi-Tier Supply Networks
Erjie Ang, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, erjieang@stanford.edu, Robert Swinney, Dan Iancu

We study a supply chain with three levels: Tier 2 suppliers prone to disruption risk that sell to Tier 1 suppliers who sell to a manufacturer that sells finished goods to the market. We show that as overlap in Tier 2 increases, the manufacturer should rely less on direct mitigation (procuring excess inventory and multi-sourcing from Tier 1) and rely more on indirect mitigation (inducing Tier 1 to procure excess inventory and multi-source).

2 - Global Sourcing: Impact of Sourcing Strategies on Supply Chain Resilience
Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, serguei.netessine@insead.edu, Nitish Jain, Karan Girotra

We use ship manifest data to study the impact of supply chain structure upon resilience of global supply chains.

3 - Multi-Sourcing and Miscoordination in Supply Chain Networks
Kostas Bimpikis, Assistant Professor, Stanford GSB, 655 Knight Way, Stanford, CA, United States of America, kostasb@stanford.edu, Alireza Tahbaz-Salehi, Douglas Fearing

This paper studies the endogenous formation of supply chain networks when procurement is subject to disruption risk. We argue that the presence of non-convexities in the chain (e.g., due to non-convex production technologies or financial constraints) may create a wedge in the sourcing incentives of firms at different tiers, leading to the formation of overly fragile supply chains.

4 - Preventing and Mitigating Supply Disruptions Under Inventory Competition
Sang Kim, Yale School of Management, 165 Whitney Ave, New Haven, CT, 06511, United States of America, sang.kim@yale.edu

Motivated by recent shortages of generic injectable drugs in the U.S., we analyze a model that captures random production shutdown and restoration and the competing firms' decisions on inventories to mitigate the impact of resulting supply shortages. We identify conditions under which product availability becomes higher or lower due to inventory competition.

■ TC07

Hilton- Continental 4

Identification, Assessment and Correction of Ill-Conditioning and Numerical Instability in Linear and Integer Programs

Cluster: Tutorials

Invited Session

Chair: Ed Klotz, IBM, Incline Village, NV, United States of America, klotz@us.ibm.com

1 - Identification, Assessment and Correction of Ill-Conditioning and Numerical Instability in Linear and Integer Programs
Ed Klotz, United States of America, klotz@us.ibm.com

The implementation of linear (LP) and mixed integer programming (MIP) algorithms on finite precision computers can create numerical challenges which are not addressed in the mathematical descriptions of these algorithms given in many introductory and more advanced textbooks and courses. Rounding errors associated with finite precision can be magnified due to ill-conditioning or numerical instability, resulting in unexpected, possibly inconsistent results. This tutorial helps the optimization practitioner identify sources of ill-conditioning and numerical instability, assess the cause and take appropriate remedial action. After discussing some finite precision computing fundamentals, it considers different measures of ill-conditioning, each one of which provides the simplest explanation of ill-conditioning on certain types of LP and MIP models. We then consider remedies for these numerical challenges: (i) optimizer parameter settings that treat the symptoms and (ii) diagnostic tactics that resolve the underlying MIP or LP issue.

■ TC08

Hilton- Continental 5

Joint Session Social Media/MAS: Diplomacy, Sentiment, & Social Network Analysis Using Social Media

Cluster: Social Media Analytics & Military Applications Society

Invited Session

Chair: Christopher Smith, Director, TRAC-MTRY, U.S. Army, 700 Dyer Road, Monterey, CA, 93943, United States of America, cmsmith1@nps.edu

1 - What's the Story with Digital Diplomacy and Credibility: Twitter, Narrative and Op. Pillar of Defense

Theo Mazumdar, Doctoral Candidate and Annenberg Fellow, USC, 500 N. Rossmore Ave., Apt. 315, Los Angeles, CA, 90004, United States of America, bmazumda@usc.edu

During Operation Pillar of Defense, the Israel Defense Forces (IDF) launched the most comprehensive digital diplomacy program ever undertaken by a warring nation. Focusing on the IDF's unprecedented use of Twitter, identifying and manipulating narrative elements, and through an experimental design and survey, this study is the first to empirically assess the effect of narrative on source credibility in a social media crisis diplomacy campaign.

2 - Modeling and Sensitivity Analysis to MADM Overlay to SNA

William Fox, Professor, Naval Postgraduate School, Department of Defense Analysis, Monterey, CA, 93943, United States of America, wpfox@nps.edu

We address several networks with various approaches such as DEA, AHP, TOPSIS, and SWA in order to identify the key nodes in the network. Of critical importance is being able to apply some sensitivity analysis to these methods. We suggest some sensitivity analysis method and illustrate them in context of SNA.

3 - Mapping Sentiment Polarity during a Real-Time Event at a Local and Global Level

Patrick Dudas, CIV/PhD Student, University of Pittsburgh, 135 N. Bellefield Ave., Pittsburgh, PA, 15213, United States of America, pmdudas@nps.edu

Provided is an exploratory and deterministic mapping of sentiment polarity of Twitter data at both the local-level to a dynamic, interactive visualization and presenting this representation at a higher, global level utilizing a map to showcase sentiment changes as time and location change. Coupling the two approaches may yield a more complete understanding of user-driven sentiment as real-time events or moments occur.

4 - Using Probabilistic Modeling and Data Facilitators to Filter Out the Noise in Social Media

Mark Gerner, Booz Allen Hamilton, Washington, DC, United States of America, Gerner_Mark@bah.com, Michael Abramovich, Alex Golub-Sass

Though prevalence and volume of social media data continues to grow exponentially, there has been little advancement in methods used by analysts to distinguish noise from the signal. We examine a process we've implemented at a Fortune 100 company to connect 4 years of social media conversation to internal investment and business-outcome related datasets. The resulting model helps marketing and communication departments focus their attention on signals in order to optimally allocate resources.

■ TC09

Hilton- Continental 6

Cognitive Decision Support Tool for Policy Makers

Cluster: Cognitive Analytics

Invited Session

Chair: Michal Rosen-Zvi, IBM, 27 Halamed He St, Jerusalem, Israel, ROSEN@il.ibm.com

1 - Using Decision Analysis in a Healthcare Institution

Adriana L. Chavez, MD Anderson, 1400 Holcombe Blvd, Unit 0466, Houston, TX, 77030, United States of America, alchavez@mdanderson.org

The use of decision analysis increases clarity in health care decision situations by helping to efficiently drive projects towards value creation and consensus building. DA is particularly useful in healthcare institutions because of the multiple stakeholders and high-stakes outcomes such as patient health and safety. Examples of DA applications in an internal consulting setting at MD Anderson Cancer Center will be presented.

2 - Decision Practice in Pharma

Keith Gardner, Principal Decision Scientist, AstraZeneca, 1200 Trinity Dr, Alexandria, VA, 22314, United States of America, keith.gardner@astrazeneca.com

We present a strategic view of risk structure and assessment for pharmaceutical development. This includes a model for combining probability of success, time to launch and net present value. We also discuss organizational challenges and behavior mitigation, graphical presentation of results and our effort to build and expand the practice. We present examples of MCDA, decision trees, probabilistic modeling, portfolio methods, processing of data and handling uncertainty, and some outcomes.

3 - A Simulation Based Decision Support System for Policy Makers

Michal Rosen-Zvi, IBM, 27 Halamed He St, Jerusalem, Israel, rosen@il.ibm.com

A simulation model of cervical cancer progression and for HIV is presented. This model can be used for making complex decisions such as vaccination plans (for cervical cancer) and resource allocations for prevention treatments.

■ TC10

Hilton- Continental 7

Information and Competition in Supply Chains and Service Systems

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Xin Geng, PhD Candidate, The University of British Columbia, 2329 W Mall, Vancouver, Canada, Xin.Geng@sauder.ubc.ca

1 - On the Value of Imperfect Advance Demand Information for Lost-Sales Inventory Systems

Engin Topan, Eindhoven University of Technology, Postbus 513, Eindhoven, 5600MB, Netherlands, e.topan@tue.nl, Rommert Dekker, Geert-Jan Van Houtum, Tarkan Tan

Motivated by real-life applications, we consider a lost-sales inventory system with imperfect advance demand information (ADI). We assume that ADI is imperfect in reliability and timing, there are yet demand occurrences without ADI and excess stock due to imperfect ADI can be cleared. We propose a model with a general representation of imperfect ADI to investigate the value of ADI. A partial characterization of the optimal policy and also an extensive numerical study are provided.

2 - Online Exchanges for Coordinating Industrial Surplus Chains

Suvrat Dhanorkar, PhD Candidate, University of Minnesota, 321 19th Avenue South, Minneapolis, MN, 55455, United States of America, dhano002@umn.edu, Kevin Linderman, Karen Donohue

Increasingly, Online Material & Waste Exchanges (OMWEs) facilitate the transaction of industrial surplus consisting of unused materials, by-products and waste. We examine opportunities for effectively matching buyers and sellers on these exchanges. Empirical analysis is conducted using archival data on more than 4500 surplus items and 100,000 buyer-seller interactions.

3 - Complete versus Partial Collusion in Competing Coalitions

Omkar Palsule Desai, Assistant Professor, Indian Institute of Management Indore, Rau Pithampur Road, Indore, India, omkardpd@iimidr.ac.in

In view of the merger paradox, a grand coalition of small producers seems to be a natural outcome. Multiple competing coalitions exhibiting distinct performance efficiencies depending on technologies and coalition forms adopted exist in industries such as milk, coffee. We adopt endogenously determined sharing rules to provide an alternate explanation to coalition formation. We show that the competing coalitions need not have (a)symmetric forms and they necessarily not form complete collusion.

4 - Fairness among Servers when Capacity Decisions are Endogenous

Xin Geng, PhD Candidate, The University of British Columbia, 2329 W Mall, Vancouver, Canada, Xin.Geng@sauder.ubc.ca, Tim Huh, Mahesh Nagarajan

We look at a service system with two servers and a single class arrivals. We examine the effect of routing policies on servers when they care about fairness, and when they can endogenously choose capacities. We study the two-server game where the servers' objective functions have a term explicitly modeling fairness. Theoretical results concerning the existence and uniqueness of the Nash equilibrium are proved for some policies. Further managerial insights are given based on simulation studies.

■ TC11

Hilton- Continental 8

Supply Chain Risk Management

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, Singapore, iseleelh@nus.edu.sg

1 - Mitigation Strategies for a Manufacturer Subject to Supply and Demand Risk

Nickolas Freeman, University of Houston, Melcher Hall Room 280, Houston, TX, 77204, United States of America, nfreeman@bauer.uh.edu, Sharif Melouk, John Mittenthal, Burcu Keskin

We consider disruption mitigation strategies for a capacitated manufacturer with supply and demand uncertainty. Sub-components dictate the quality of the manufactured products. Using an analytical model, we investigate and compare mitigation strategies including multi-sourcing, downward substitution, and in-house production.

2 - Assessing the Efficiency of Risk Mitigation Strategies in Supply Chains

Hakan Yildiz, Assistant Professor, Michiagn State University, 632 Bouge Street, East Lansing, Mi, 48824, United States of America, yildiz@bus.msu.edu, Srinivas Talluri, Thomas Kull, Jiho Yoon

We evaluate supply chain risk mitigation strategies in the presence of a variety of risk categories, risk sources, and supply chain configurations. We combine an empirically grounded simulation methodology with data envelopment analysis to analyze and rank alternative mitigation strategies. Our research presents several interesting and useful managerial insights for deciding what strategies are most capable of mitigating risks in a variety of contexts.

3 - Study of Supply Chain Risk under information Sharing

Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, Singapore, iseleelh@nus.edu.sg, Ek Peng Chew, Yi Tao

The increasing complexity of supply chains worldwide has caused them to be susceptible to supply chain disruptions. However, if different echelons in a supply chain are willing to share the information, the impact of the disruptions can be minimized. In this talk, we will demonstrate how systems dynamics model can be used to estimate the value of the information sharing.

■ TC12

Hilton- Continental 9

Sustainability Issues in Supply Chain Management

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Damian Beil, Associate Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI, 48109, United States of America, dbeil@umich.edu

Co-Chair: Sam Aflaki, Assistant Professor, HEC Paris, 1 Rue de la Liberation, Paris, France, aflaki@hec.fr

1 - Total-Cost Procurement Auctions with Sustainability Audits to Inform Bid Markups

Damian Beil, Associate Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI, 48109, United States of America, dbeil@umich.edu, Luk Van Wassenhove, Karca Aral

In this paper, we explore whether the buyer should conduct sustainability audits in order to make a more informed total-cost procurement decision. We find that although the audits are used for resolving uncertainty about suppliers' relative sustainability levels, greater uncertainty about supplier sustainability levels and a less sustainable supplier base do not necessarily make the audits more valuable for the buyer.

2 - Recovery Legislations or Taxation/Subsidy Based Policies? A Mixed Approach Might be More Effective

Shumail Mazahir, PhD Candidate, HEC, Jouy en Josas, 78350, France, shumail.mazahir@hec.edu, Sam Aflaki

We study the take back schemes such as recovery legislations and compare them with taxation/subsidy based schemes in a stackelberg game setting where the policy maker selects a policy and its policy parameters based on its welfare function and the firms maximizes their profits considering these policy parameters.We compare the environmental and economical performance with each of these schemes and present conditions where one policy performs better than the other.

3 - Optimal Feed-in-tariff Policies: The Role of Supply Chain Intermediaries

Shadi Goodarzi, HEC Paris, 1 rue de la Liberation, Jouy en Josas, 78350, France, shadi.goodarzi@hec.edu, Andrea Masini, Sam Aflaki

We assess the effectiveness of FIT policies in promoting renewable technologies taking into account the decisions of supply chain intermediaries. Modeling a three-tire supply chain that includes potential adopters, technology manufacturers and an electricity supplier, we show that the ability of policy makers in inducing adoption is greatly affected by the intermediaries market characteristics, an understanding of which sheds new light on the structure and magnitude of optimal FIT policies.

4 - Extended Producer Responsibility (EPR) for Pharmaceuticals

Beril Toktay, Professor, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, beril.toktay@scheller.gatech.edu, Isil Alev, Atalay Atasu, Ozlem Ergun

EPR, which holds producers responsible for environmentally safe treatment of their products, has emerged as the preferred policy for managing pharmaceutical overage. To analyze its effectiveness, we develop a game-theoretic model representing interactions in the pharmaceutical chain with a focus on factors causing overage. We uncover conditions for effective EPR implementation and critical factors determining stakeholder perspectives on EPR in the pharmaceuticals context.

■ TC14

Imperial B

Joint Session JFIG/ENRE: Models and Analysis of Invasion Processes

Sponsor: Junior Faculty Interest Group & Energy Natural Resources and the Environment

Sponsored Session

Chair: Esra Buyuktahtakin, Assistant Professor, Wichita State University, Wichita, KS, United States of America, esra.b@wichita.edu

Co-Chair: Robert Haight, USDA Forest Service Northern Research Station, 1992 Folwell Ave, St. Paul, MN, 55108, United States of America, rhaight@fs.fed.us

1 - Measuring Damages and Modeling Feedbacks between Economic and Ecological Systems

Travis Warziniack, Research Economist, USFS Rocky Mountain Research Station, 240 W. Prospect Rd, Fort Collins, CO, 80525, United States of America, twwarziniack@fs.fed.us

We describe integrated modeling efforts between social and natural scientists, sacrifices in complexity that may exist when working across disciplines, and whether those sacrifices are worth it. The session is built around a discussion about the spread of invasive species in the Laurentian Great Lakes and integrating a computable general equilibrium economic model with the Ecopath with Ecosim food web model. The speaker is an economist, and tips for working with such a species are given.

2 - The Cost of Simplicity: The Accuracy-Complexity Tradeoff for Disease Transmission Models

Danqi Luo, Bryn Mawr College, 101 North Merion Ave, BoxC-1121, Bryn Mawr, PA, 19010, United States of America, dluo@brynmawr.edu, Benjamin Armbruster

We study the differences of disease transmissions in the characteristics of an epidemic in a single population model versus a more heterogeneous model in terms of the number of subpopulations and stages of infection. The differences in attack rate and prevalence of steady states are computed in order to measure the cost of aggregation in SIR and SIS models. Under the symmetric mixing assumption, the aggregated model is a good alternative to the heterogeneous model.

3 - Investing in Classical Biological Control of Legacy Pests

Karen Jetter, Economic Researcher, University of California, Agricultural Issues Center, 1 Shields Ave, Davis, CA, 95616, United States of America, jetter@primal.ucdavis.edu, John Steggall, Dave Luscher, Mark Hoddle, Keith Warner, Charles Goodman

This study will present a risk analysis for biological control programs of legacy exotic arthropod pests that established in California prior to 1990. This project develops a selection criteria based on pest characteristics, current technology, and economics to pick legacy pests of tree and vine crops in Californian with a high probability of being effectively managed with biological controls. It then estimates the expected net benefits of investing in biological control for those pests.

4 - A Unified Model for the Analysis of the Distribution and Abundance of Invasive Species

Andrew Paul Gutierrez, Professor, University of California, Berkeley, Center for the Analysis of Sustainable, Agricultural Systems (CASAS Global), Kensington, CA, 94707, United States of America, casas_global@berkeley.edu, Luigi Ponti

The majority of invasive species are heterothermic and their distribution and abundance is largely determined by weather and by species they interact with. The biology is complex, but is simplified by analogous biological processes that determine their distribution and abundance under extant and climate change scenarios. Several systems are explored.

■ TC15

Hilton- Exec. Boardroom

Data Envelopment Analysis 2

Contributed Session

Chair: Ke Wang, Dr., Beijing Institute of Technology, 5 S. Zhongguancun St., Beijing, 100081, China, kewang2083@gmail.com

1 - Identifying the Role of Foreign Technology on Efficiency Change for Achieving MDGs using Panel DEA

Bo Kyeong Lee, Yonsei University, Shinchon, Seodaemungu, Seoul, Korea, Republic of, lee.bokyeong@yonsei.ac.kr, Soyoung Sohn

We study the role of foreign technology on efficiency change in developing countries in achieving Millennium Development Goals (MDGs). To measure efficiency change in panel data, we employ a Data Envelopment Analysis based Malmquist Productivity Index. The data includes indicators of MDGs as outputs and the endogenous factors as inputs for 43 developing countries between the early 1990s and the late 2000s. We regress pure efficiency change against the factors showing foreign technology inflows.

2 - A New Method for Congestion Measurement

Jun Wang, University of Science and Technology of China, No.96, JinZhai Road Baohe District, Hefei, 230026, China, wangjun1200@mail.ustc.edu.cn, Yan Wu

The paper represents congestions theories containing the undesirable output which are widespread existed in the production practice. So our proposed methodology not only promotes the development of congestion theory, but also takes both desirable and undesirable output combine in the DEA framework. Our methodology can contribute managers' better trade-off between economic development and environmental protection.

3 - Dynamic Network Data Envelopment Analysis-DEA on Evacuation Performance

Oscar Herrera-Restrepo, PhD Candidate, Virginia Tech, 4339 Taney Avenue Apt 401, Alexandria, VA, 22304, United States of America, oscar84@vt.edu, Joseph Trainor, Kostas Triantis, Pamela Murray-Tuite, Praveen Edara

This paper proposes a theoretical representation of a slacks-based dynamic network DEA approach for measuring evacuation performance when a ramp closure strategy is considered. It includes an integrated conceptual framework that incorporates stakeholder perspectives, evacuation-related systems and processes. The approach allows for the discovery of potential performance improvement actions that can inform the definition of future requirements of transportation evacuation strategy designs.

4 - Measuring Brazilian Hospital's Efficiency with Dynamic Data Envelopment Analysis

Marianna Cruz Campos, UFRN, Av Campos Sales, Tirol, Natal, 59020300, Brazil, mariannaccampos@gmail.com, Fernanda Rocha, Mariana Almeida

Data Envelopment Analysis was applied to evaluate the performance and efficiency of brazilian public hospitals. Using dynamic model to measured the productivity and returns to scale of 49 general hospitals between 2011 until 2013. The results showed that the best practices can improve the future scenarios of inefficient units.

5 - Energy Efficiency index via Data Envelopment Analysis (DEA): Methodology and application

Ke Wang, Dr., Beijing Institute of Technology, 5 S. Zhongguancun St., Beijing, 100081, China, kewang2083@gmail.com

Within a joint production framework of considering desirable & undesirable outputs, this study proposes several energy efficiency indices based on i) traditional DEA with undesirable outputs transformation technique; ii) directional distance function relying on weak disposability assumption; iii) range adjusted measure relying on natural & managerial disposability assumptions; and iv) multi-directional efficiency analysis from which both efficiency status and efficiency patterns can be detected.

■ TC16

Hilton- Franciscan A

Omni-channel Retail Analytics

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Pavithra Harsha, Research Staff Member, IBM Research, 1101 Kitchawan Road, Room 34-225, Yorktown Heights, NY, 10598, United States of America, pharsha@us.ibm.com

1 - Assortment Optimization in the Presence of Multiple Channels and Consumer Preference Uncertainty

Srikanth Jagabathula, New York University, 44 West Fourth St, New York, NY, 10012, United States of America, sjagabat@stern.nyu.edu, Daria Dzyabura

Most models of consumer purchase used in operations focus on purchases from a single channel (typically brick-and-mortar). However, with the proliferation of retail channels, there is a need to account for channel switching behavior in making operational decisions. We propose a choice model that accounts for channel switching through preference uncertainty. We validate this mdoel on real-world data and quantify the gain in revenues obtained through accounting for the channel switch behavior.

2 - A Novel Approach to Demand Modeling and Pricing for Omni-channel Retailers

Pavithra Harsha, Research Staff Member, IBM Research, 1101 Kitchawan Road, Room 34-225, Yorktown Heights, NY, 10598, United States of America, pharsha@us.ibm.com, Markus Ettl, Shiva Subramanian

Consumers are increasingly navigating across multiple channels to make purchases and retailers are finding that traditional approach to pricing channels in silos needs to be reconsidered. We present a comprehensive framework for omni-channel retailing to model and estimate the substitutions across channels. Further, we present an integrated price optimization problem across retail channels and locations with cross channel effects to maximize the retailer's total profitability with computations.

3 - Integrated Pricing and Inventory Optimization in an Omni-channel Environment

Joline Uichanco, Assistant Professor, University of Michigan, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, joline.uichanco@gmail.com, Markus Ettl, Pavithra Harsha, Shiva Subramanian

Lifecycle pricing is traditionally done for a single sales channel where inventory is exogenous. However, this ignores customers channel-switching due to differences in prices in different channels. We develop an optimization model for joint price and inventory management in an omni-channel retail environment. In our model, inventory is not exclusive to one channel (e.g. buy online pickup in store). Our model also considers demand uncertainty with both a stochastic model and a robust model.

4 - Optimizing Purchasing and Handling Costs in Supply Chain Procurement

Gonzalo Romero, U. of Toronto, 105 St George Street, Toronto, ON, M5S 3E6, Canada, gromeroy@mit.edu, Georgia Perakis, Retsef Levi

We introduce a new model that minimizes the purchasing and handling costs induced by case pack selection in procurement contracts. We prove structural results that lead to a practical method to both selecting the best case pack size per SKU, and serving orders at the distribution center. Specifically, we show that a threshold policy is optimal for serving orders. Furthermore, we implement this method on real data from a large utility company, finding significant supply chain cost reductions.

■ TC17

Hilton- Franciscan B

Dynamic Pricing in Service Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Ramandeep Randhawa, USC, Marshall School of Business, Los Angeles, CA, United States of America, ramandeep.randhawa@marshall.usc.edu

1 - Optimal Dynamic Pricing with Demand Model Uncertainty: A Brownian Model of Learning and Earning

Bora Keskin, The University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, bora.keskin@chicagobooth.edu

We consider a Brownian model of dynamic pricing with demand model uncertainty, in which a firm sells a product over a continuous time horizon. The firm is uncertain about the price-sensitivity of the demand for the product, and continuously updates its prior belief on the price-sensitivity by making observations on the market responses to prices. We derive and solve a partial differential equation to show how the value of learning should be projected onto prices in an optimal fashion.

2 - Value of Dynamic Pricing in a Congestible System

Jeunghyun Kim, USC, Marshall School of Business, Los Angeles, CA, United States of America, jeunghyun.kim.2015@marshall.usc.edu, Ramandeep Randhawa

Charging a higher premium for a highly demanded service is natural for firms seeking to increase revenue. In the context of a single server queue, we study and quantify the value of dynamic pricing. We find that surprisingly the conventional heavy traffic regime, which is optimal in large systems under a static pricing scheme, is no longer optimal. While the optimal pricing scheme is complex, we prove that a two-price policy is near optimal.

3 - Intertemporal Pricing without Priors

Ying Liu, New York University, 44 W 4th St, New York, NY, United States of America, yliu2@stern.nyu.edu, Ilan Lobel, Rene Caldentey

We consider a monopolist selling a product to a population of consumers who are heterogeneous in valuations and arrival times. We study the policies that attain minimum regret when selling to either myopic or strategic customers. We characterize the set of optimal policies and demonstrate their structural properties.

■ TC18

Hilton- Franciscan C

Managing Customer Behavior in Service and Retail Systems

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Eren Cil, University of Oregon, 1208 University of Oregon, Eugene, OR, United States of America, erencil@uoregon.edu

1 - Intertemporal Pricing and Strategic Rationing When Selling to Snobbish Consumers

Kenan Arifoglu, Assistant Professor, University College London, Gower Street, London, WC1E 6BT, United Kingdom, k.arifoglu@ucl.ac.uk, Sarang Deo, Seyed Iravani

We develop a stylized analytical model to understand why firms selling to snobbish (exclusivity-seeking) consumers display several differences in their pricing and rationing strategies. We show that the snobbish consumer behavior provides another explanation for these differences. Also we find that when selling to snobbish consumers, price markdowns are not always associated with excess inventory and the negative impact of strategic consumer behavior is lower.

2 - Sharing Aggregate Inventory Information with Customers: A Strategic Way of Cross-selling

Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Ruomeng Cui

Why do some firms share their inventory information with customers? We provide an answer to this question through an angle of product variety. We also show why firms share partial (or aggregate) inventory information with their customers rather than full information or no information by considering cross-selling of differentiated products.

3 - Strategies in Fairness-Sensitive Markets

Steven Shugan, Professor, University of Florida, 1405 W University Avenue, Room 219, Gainesville, FL, 32605, United States of America, steven.shugan@warrington.ufl.edu, Jihwan Moon

We study fairness sensitive markets where market norms determine fair and unfair fees. Rational consumers only engage in search when their firm deviates from the market norm (an information event). We find that adverse cost shocks cause firms to charge unfair fees regardless of whether consumers are fairness-sensitive. However, the transition to the new equilibrium depends on whether consumers are fairness-sensitive because high-quality firms can delay ostensibly unfair actions.

4 - From Used to New: Increasing Profit through Product Renewals

Michael Pangburn, University of Oregon, 1208 University of Oregon, Eugene, OR, 97405, United States of America, pangburn@uoregon.edu, Euthemia Stavrulaki

Product deterioration over time can benefit a manufacturer by driving repeat sales. Although planned obsolescence is an established strategy, some firms promote product longevity by offering a product renewal service. We show that such renewal service has the potential to increase revenues sufficiently to offset the additional expense, particularly for costly products. We also prove that the manufacturer can increase profits by committing in advance to the price of its refresh service.

■ TC19

Hilton- Franciscan D

Contemporary Topics in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Fredrik Odegaard, Ivey Business School, Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, fodegaard@ivey.uwo.ca

1 - Airline Switching Revenue with Price-Guarantees

Fouad Mirzaei, Ivey Business School, Western University, London, ON, Canada, fhassanmirzaei@ivey.uwo.ca

Many airlines permit ticket holders to change the time of their fight by paying a switching fee. Although the switching fee is a revenue item for the airline, a low or high fee could cause operational challenges, such as unsold capacity or lost sales. This raises a question that what fee should be set for switching. We model a single firm, which delivers two comparable services over two sequential periods and derive the optimal switching fee.

2 - Assortment Competition with the Decoy Effect

Xinchang Wang, Georgia Institute of Technology, School of Industrial and Systems Enginee, Atlanta, GA, 30332-0205, United States of America, xwang336@gatech.edu, Anton Kleywegt

We describe product assortment competition in a duopoly with decoys among candidate products. We characterize the Nash equilibria for different settings, and use models of learning to study the evolution of the competition and the stability of the equilibria. In some settings, all pure equilibria are stable, and all mixed equilibria are unstable. We also show settings in which the learning processes cycle without convergence to any equilibrium.

3 - On the Implications of Airfare Price Volatility on Transacted Prices, Sales and Revenue

Benny Mantin, Assistant Professor, University of Waterloo, 200 University Ave. W., Waterloo, Canada, bmantin@uwaterloo.ca, Eran Rubin

The airline industry has embraced the internet to frequently update prices of airline tickets. Many markets exhibit a considerable level of price volatility. Do these price movements induce consumers to pay more for the tickets and increase sales volumes at the same time? Controlling for market characteristics, we provide new insights on the link between price volatility, transacted airfares (level and dispersion), sales (fill rates), as well as revenues.

4 - Bundling with Dependent Valuations: The Price of Independence

Mihai Banciu, Bucknell University, 119 Taylor Hall, Lewisburg, PA, 17837, United States of America, mmb018@bucknell.edu, Fredrik Odegaard

We investigate the problem of pricing bundles of products when the valuations for the underlying components are dependent. We examine all possible bundling strategies, derive near-optimal prices for both the bundle and the components, and investigate how the total revenue when dependence is accounted for compares with the revenue obtained under the typical assumption of independence. We find that sacrificing dependency for tractability can lead to arbitrarily bad outcomes for the seller.

■ TC20

Hilton- Yosemite A

Facility Logistics III

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: S.Gökhan Özden, Mr., Auburn University, Shelby Center Room 3333, Auburn, AL, 36849, United States of America, sgo0002@auburn.edu

1 - Robust Design of Unit Load Storage Systems

Pratik Mital, PhD Candidate, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, pmital3@gatech.edu, Pratik Mital, Marc Goetschalckx, Edward Huang

We present a formulation for the design unit load storage system design problem under uncertainty which is a mixed-integer non-linear stochastic optimization problem. We also present a methodology that identifies all Pareto-optimal configurations with respect to the bi-objective of minimizing the expected value of the scenario costs and a risk term such as the standard deviation of the scenario costs, A case study and numerical experience will be also be shared.

2 - Optimal Assignment Models for AS/RS with Multiple In-the-Aisle Pick Positions

Faraz Ramtin, University of Central Florida, 4000 Central Florida Blvd, Orlando, FL, 32816-2993, United States of America, faraz.ramtin@ucf.edu, Jennifer Pazour

An AS/RS with multiple in-the-aisle pick positions (MIAPP-AS/RS) is a semi-automated case-level order fulfillment technology. We provide algorithms to find the optimal assignment of SKUs to pick positions that minimizes the expected travel time subject to different operating policies, demand profiles, and shape factors. Also, we derive closed-form models by assuming an infinite number of pick positions in the aisle to approximate the optimal assignment's expected travel time.

3 - Transport, Logistics and Supply Chain Network Design: Applications and Research Gaps

Reza Zanjirani Farahani, Kingston University London, KHBS 215, Kingston Business School, Kingston Hill, Kingston Upon Thames, United Kingdom, zanjiranireza@gmail.com

Network design comprises strategic decisions including the number, location, capacity and allocation of facilities in transport, logistics and supply chain systems. Network design has wide range of applications such as in business, urban, maritime, emergency and global logistics networks. Stimulated from real-life applications and practitioners' needs, this presentation tries to review traditional applications and research works in the literature and provides new insights for academics.

4 - Optimizing Non-Traditional Warehouse Designs for Order Picking Operations

S.Gökhan Özden, Mr., Auburn University, Shelby Center Room 3333, Auburn, AL, 36849, United States of America, sgo0002@auburn.edu, Alice E. Smith, Kevin R. Gue

The proposed research offers an approach that reduces the costs of most costly operation in a warehouse - order picking. We search through non-traditional designs by using evolutionary strategies. Since every fitness calculation includes allocating products and calculating the optimal pick tours of hundreds or thousands of pick lists, function evaluation is very time consuming. We discuss techniques that shorten overall computation time. This research is funded by NSF.

■ TC21

Hilton- Union Sq 1

TSL Prize Winners

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: M.Grazia Speranza, Professor, University of Brescia, C.da S.Chiara 50, Brescia, Italy, grazia.speranza@unibs.it

1 - TSL Prize Winners

M.Grazia Speranza, Professor, University of Brescia, C.da S.Chiara 50, Brescia, Italy, grazia.speranza@unibs.it

The TSL 2014 Prize Session finalists will present their award-winning work in this session. Prize committee chairs will say a few words about the winning selections.

■ TC22

Hilton- Union Sq 2

Coordinating Decentralized Transportation Systems

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Luyi Gui, Assistant Professor, Paul Merage School of Business, UC Irvine, Irvine, CA, United States of America

1 - Strategies to Consolidate Freight of Perishable Products

Christine Nguyen, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, 90089, United States of America, nguyen7@usc.edu, Xiaoqing Wang, Alejandro Toriello

We study a supply chain of perishable products, where suppliers have low demands and consolidate their product to achieve economical shipping rates. We develop an efficient heuristic approach that balances the inventory cost with the shipping cost. The heuristic considers the trade-off between holding inventory for future shipments and consolidating to ship today. A sensitivity analysis demonstrates the effect of inventory costs on the volumes shipped at the FTL, LTL or courier rate.

2 - The Cost of Equivalence in Rationing Air Transportation Capacities

Douglas Fearing, The University of Texas at Austin, 2110 Speedway, Stop B6500, Austin, TX, United States of America, doug.fearing@mccombs.utexas.edu

In the presence of severe weather disruptions, regulators are forced to ration aircraft arrivals into impacted airports and air sectors. The ration-by-schedule approach utilized in practice does not distinguish individual aircraft based on size, passenger counts, or operational considerations. Using optimization and simulation based on historical flight data, we investigate the extent to which this creates inefficiencies in the operation of the air transportation system.

3 - Trust and Reciprocity in Firms' Capacity Sharing

Xing Hu, University of Oregon, 484 Lillis, 1208 University of Oregon, Eugene, OR, 97403, United States of America, xingh@uoregon.edu, Rene Caldentey

We study a reciprocal incentive system that facilitates efficient capacity sharing between two service firms who have limited and substitutable capacity. We model two firms each controlling an M/M/1/1 queue, where customers not served by the host firm might be rerouted to the other firm. We incorporate a scoring system that records the numbers of favors exchanged between the firms.

4 - Managing Decentralized Resource Sharing in Carrier Alliances under Demand Uncertainty

Luyi Gui, University of California-Irvine, Irvine, CA, United States of America, luyig@uci.edu, Ozlem Ergun

We study the design of market-based resource sharing agreements to motivate and regulate capacity sharing in carrier alliances under demand uncertainty. We focus on designing a robust capacity exchange mechanism, aiming at achieving high routing efficiency over the entire service network of the alliance under multiple potential demand scenarios. We characterize how the structure of the service network affects the robustness of the mechanism, and propose capacity pricing solutions accordingly.

■ TC23

Hilton- Union Sq 3

Network Design Models and Methods

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Michael Hewitt, Loyola University Chicago, 820 N. Michigan Ave, Chicago, IL, 60611, United States of America, mhewitt3@luc.edu

1 - Filtering in B&C for Multicommodity Capacitated Network Design

Bernard Gendron, Univeristé de Montreal, Chemin de la Tour, Montreal, H3C 3J7, Canada, Bernard.Gendron@cirrelt.ca, Mervat Chouman, Teodor Gabriel Crainic

We study the impact of different filtering methods embedded into a specialized branch-and-cut algorithm for the multicommodity capacitated network design problem. Contrary to the preprocessing techniques used in state-of-the-art MIP solvers, these filtering methods exploit the structure of the problem, while being applicable to a very large class of network design problems. Computational results will be presented on a large set of randomly generated instances.

2 - Continuous Time Service Network Design Problem
Michael Hewitt, Loyola University Chicago, 820 N. Michigan Ave, Chicago, IL, 60611, United States of America, mhewitt3@luc.edu, Luke Marshall, Martin Savelsbergh, Natashia Boland

For a consolidation carrier to deliver goods in a cost-effective manner they must consolidate shipments, which in turn requires coordinating the paths for different shipments in both space and time. We propose an iterative refinement algorithm that will recognize that a truck may dispatch at any point in time without resorting to an a priori enumeration of all possible time points. We will illustrate its computational effectiveness on a wide array of instances.

3 - Integrating Resource Acquisition and Repositioning into Transportation Planning under Uncertainty
Maciek Nowak, Associate Professor, Loyola University Chicago, 1 E. Pearson, Chicago, IL, 60611, United States of America, mnowak4@luc.edu, Michael Hewitt, Walter Rei, Teodor Gabriel Crainic

Service network design formulations are often used in the planning processes of consolidation-based carriers. This research proposes a model that determines the number of resources to acquire, where to locate them, and the service network design executed by those resources to transport customer shipments. The model explicitly recognizes that there is uncertainty regarding the volume of shipments to transport, planning for the use of external resources to accommodate fluctuations in demand.

4 - A Multimodal Network Flow Problem with Perishable Products and Asset Management
Maryam SteadieSeifi, PhD Student, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, M.Steadie.Seifi@tue.nl, Nico Dellaert, Tom Van Woensel, Wim Nuijten

We present an optimization model and a solution algorithm for a horticultural transportation system with multiple transport modes, highly perishable products, demand and supply dynamics, and management of the reusable transport units. We integrate dynamic allocation and repositioning of the RTIs with a synchronized flow of products, in order to find the trade-off between quality requirements and operational considerations and costs. We also present detailed computational results and analysis.

■ TC24

Hilton- Union Sq 4

Professional Development Workshop

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Yingyan Lou, Assistant Professor, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, yingyan.lou@asu.edu

1 - Professional Development Workshop
Yingyan Lou, Assistant Professor, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, yingyan.lou@asu.edu, Stephen Boyles, Henry X. Liu

This professional development seminar is intended for young researchers. The panel will discuss topics such as identifying research problems, developing a long-term research plan, and the right mindset for approaching academic careers in today's environment.

■ TC25

Hilton- Union Sq 5

Transportation Planning I

Contributed Session

Chair: Jens Brunner, Universit‰t Augsburg, Universitatsstrafle 16, Augsburg, Germany, jens.brunner@wiwi.uni-augsburg.de

1 - A Hybrid Genetic Algorithm for Scheduling Food Bank Collections and Deliveries
Luther Brock, E T Care Health and Medical, 8007 N Point Blvd, Winston-Salem, NC, 27406, United States of America, lgbrockiii@hotmail.com, Lauren Davis

This research addresses vehicle routing challenges experienced by food banks. The essential features of this problem consists of constructing routes that encompass food collections, food deliveries, constraints on vehicle capacity, food spoilage, and operator workday, as well as collection and delivery frequency. A genetic algorithm-based metaheuristic is presented to solve the routing problem. Its ability to find good solutions for routing problems of varying sizes is demonstrated.

2 - Multi Traveling Salesmen Problem with Time Windows: A Real World Application
Haluk Yapicioglu, Anadolu University, Proje Birimi, Yunusemre Kampusu, Eskisehir, 26470, Turkey, hyapicio@anadolu.edu.tr

In this study, a new type of TSP problem that arises from a real world problem is introduced. Anadolu University administers exams six times a year throughout Turkey. In each city, university representatives must visit every exam location at least once. The exams are scheduled over four sessions. The mathematical programming formulation of the problem is presented with two different objective functions. Comparison of these two models is provided based on four problem instances.

3 - Type III Sensitivity Analysis of Right-hand-Side Parameters in Dual Transportation Problems
Kang-Ting Ma, National Tsing Hua University, No.101, Sec. 2, Guangfu Rd., HsinChu, 30013, Taiwan - ROC, d9734802@oz.nthu.edu.tw, Shu-Cherng Fang, Ue-Pyng Wen

Feasible solutions in transportation problems are inherent. To realize increments/decrements to/from which supplies/demands with shadow prices invariant is more important than perturbation ranges of keeping shipping pattern invariant. Type III sensitivity analysis keeps shadow prices at optimal shipping pattern invariant. In this paper, labeling algorithms are proposed to obtain the perturbation ranges of type III sensitivity analysis of the right-hand-side parameters of transportation problems.

4 - Optimizing Towing Processes at Airports
Jens Brunner, Universitat Augsburg, Universitatsstrafle 16, Augsburg, Germany, jens.brunner@wiwi.uni-augsburg.de, Jia Yan Du, Rainer Kolisch

We present a mathematical model that assigns tractors to aircraft. The objective function minimizes costs subject to operational restrictions such as technical compatibility of tractor types. The model considers a heterogeneous fleet, time windows, multiple depots, and multiple trips. To solve the model we present a column generation based heuristic. Computational results using real-world data highlight how schedulers can be supported in their daily work.

5 - A New Formulation for the Empty Railcar Distribution Problem
Ruhollah Heydari, Northeastern University, Mechanical & Industrial Engineering Dep., 360 Huntington Avenue, Boston, MA, 02115, United States of America, Emanuel Melachrinoudis

We formulate the empty railcar distribution problem as a multi-commodity capacitated network flow model with setup costs on blocks. The term "multi-commodity" refers to multiple car types considered in the model and the term "capacitated network flow" refers to the capacity constraints on the blocks and trains. Binary variables are used to formulate the "setup costs on the blocks" and gain economies of scale by making fewer larger blocks.

■ TC26

Hilton- Union Sq 6

Transportation, Maritime I

Contributed Session

Chair: Yingfeng Wang, City U of HK, Tat Chee Ave, Kowloon, Hong Kong - PRC, gilbertwyf@gmail.com

1 - Evading the Chasing from a Maneuverable Pirate Ship
Yu Wang, PhD Candidate, Hong Kong University of Science and Technology, Academic Building, Rm 5567, Clear Water Bay, Kowloon, Hong Kong - PRC, ywag19@gmail.com

Recently piracy attacks have become a serious safety problem for maritime logistics in some areas. While various strategies have been taken, such as rerouting, the problem cannot be resolved completely. We consider a decision making problem in which a vessel being chased by a pirate needs to decide its sailing angle and speed to evade. We formulate this as a nonlinear optimal control problem. We consider the evasion condition for direct heading and also turn policy for the vessel to evade.

2 - Evaluating Risk of International Transportation for Energy Resources
Shigeki Toriumi, Dr, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, 112-8551, Japan, toriumi@ise.chuo-u.ac.jp, Ryuta Takashima, Keisuke INADA

In Japan, energy and natural resources are imported by the maritime transport. It is, therefore, necessary to consider procurement of overseas energy resources and risk management of resource transportation. In this work, we define country risk and chokepoint risk using portfolio theory. Then, we propose a model for determining import countries and its volume. Finally, we analyze the relationship between the transport cost and risk by means of the LLI's vessel movement database.

3 - Risk Analysis of Shipbuilding-Shipping Industries: Findings from China, Japan and South Korea
Yingfeng Wang, City University of Hong Kong, Tat Chee Ave, Kowloon, Hong Kong - PRC, gilbertwyf@gmail.com, John Liu, Sheng Li

We conduct risk analysis of shipbuilding-shipping industries, with a particular focus on systemic risk measures. We use the model to address recent findings that idiosyncratic risk based models (such as the well-known mean-variance model) become ineffective or even inappropriate for asset assessment under predominance of systemic risk, in the context of national shipbuilding industries of China, Japan and South Korea, and their correlations with international shipping and trade markets.

■ TC27

Hilton- Union Sq 7

Advanced Analytics Tools for Smart Railroad Terminal Operations

Sponsor: Railway Applications
Sponsored Session

Chair: Behnam Behdani, Sr. Operations Research Specialist, BNSF Railway, 2400 Western Center Blvd., Fort Worth, TX, 76131, United States of America, Behnam.Behdani@BNSF.com

1 - Mixed Integer Programming Model for Optimizing Multi-level Operations Process in Rail Yards
Xuesong Zhou, Associate Professor, Arizona State University, School of Sustainable Engineering and th, Tempe, AZ, United States of America, xzhou74@asu.edu, Tie Shi

This talk presents a time-expanded multi-layer network flow model to describe the connection between different layers of rail yard operations. A mixed integer programming is developed to schedule the humping and pullback engine activities by jointly considering tightly interconnected components. A novel lot-sizing modeling framework and related valid inequality formulations are introduced to model the assembling jobs for outbound trains.

2 - New Frontiers in Yard and Terminal Analytics at CSX
Jeremiah Dirnberger, Manager-Network Modeling, CSX, 500 Water St, J315, Jacksonville, FL, 32202, United States of America, Jeremiah_Dirnberger@csx.com

Rail network management can be divided into three distinct primary functions: yards, terminals and line-of-road. Traditionally, the terms yard and terminal have been used interchangeably. However, in order to get a more complete picture of network capacity, these terms should be defined separately. This presentation will show how CSX has separated the analysis of these two functions and will also discuss the advances in the analytical tools that CSX uses to monitor and improve performance.

3 - Simulation Based Yard Case Studies
Krishna Jha, Vice President, Optym, LLC, 2153 SE Hawthorne Road, Gainesville, Fl, 32641, United States of America, krishna.jha@optym.com

Yards play a vital role in railroad operations. Generally, a railcar spends more time in yards than that on line-of-roads in its itinerary. With the growing traffic demand, railroads are looking for ways to improve yard throughput while providing quality service to customers. In this talk, we will present couple of case studies performed for large hump yards using a state-of-the-art simulation system to improve the throughput and the service level.

4 - Planning of Mechanical Locomotive Facilities for Repair, Maintenance, Service and Fueling
Siyang Xie, University of Illinois at Urbana-Champaign, 3150 Newmark Civil Engineering Lab, 205 N. Mathews Ave, Urbana, IL, 61801, United States of America, sxie13@illinois.edu, Yanfeng Ouyang, Zhaodong Wang, Xi Chen, Kamalesh Somani

We present a mixed-integer model that helps plan fixed and movable facilities for multiple types of locomotive mechanical work (e.g., repair, maintenance and service, and fueling). The decisions include (i) locations, capacities and capabilities of fixed facilities, (ii) fleet mix and size, routes, and home locations for movable facilities, and (iii) assignments of work to facilities. A series of solution algorithms are developed to solve this highly complex problem via empirical cases.

■ TC28

Hilton- Union Sq 8

Emerging Issues in Airport-Airline Gate Management and Operations

Sponsor: Aviation Applications
Sponsored Session

Chair: Jasenka Rakas, University of California, Berkeley, 107B McLaughlin Hall, NEXTOR II, Berkeley, CA, 94720, United States of America, jrakas@berkeley.edu

1 - The Role of Airports in Airline Competition: The U.S. Experience
Richard Golaszewski, Executive Vice President, GRA, Incorporated, 115 West Av, Suite 201, Jenkintown, Pe, 19046, United States of America, richg@gra-inc.com

Airline competition depends on the ability to access passengers in specific markets. Airport infrastructure can be key, especially when there are constraints on slots, gates, or other facilities. FAA and DOT policies require airports to submit competition plans in certain cases. This occurs when the airport reaches long-term agreements on airport gates, or other facilities. The FAA may intervene if an airport enters into exclusive contracts with an airline that could hamper new entrants.

2 - Dynamic Collaborative Gate Allocation
Mattan Mansoor, Associate, L.E.K. Consulting, 1453 Kyle Court, Sunnyvale, CA, 94087, United States of America, mattanmansoor@gmail.com, Joshua Sachse, Hoang Nguyen, Jasenka Rakas, Katharina McLaughlin, Alex Cuevas, Joanna Ji

Most airport gate allocations in the U.S. are currently optimized within each airline and not across the system (i.e., airport). Dynamic Collaborative Gate Allocation (DCGA) involves dynamic stochastic optimization modeling that helps airlines and airports collaboratively determine gate usage. These improved gate-sharing policies increase airport capacity without additional infrastructure and reduce flight delays, fuel usage and carbon emissions while improving the experience for passengers.

3 - Mobile Gate Design
Patrick Poon, UC Berkeley, 869 Charmain Dr., Campbell, CA, 95008, United States of America, PATRICK452@berkeley.edu, Ken Poon, Benny Chung, Graeme Scott, Steven Chen, Gohki Kobayashi, Ken Lim, Steven Van Leeuwen, Xiao Lin, Jasenka Rakas

This study addresses the shortage of gate capacity by proposing a Mobile Gate Design concept. The proposed concept increases gate maneuverability and gate physical mobility to dynamically meet different demands of aircraft-mixes by using next generation technology for maneuvering and managing parking spaces, jet bridges and gate locations. The proposed design should revolutionize traditional gate capacity management, while preserving passenger safety and jet bridge security.

4 - Solving Collaborative Gate Allocation Problem by the Bee Colony Optimization Algorithm
Jasenka Rakas, University of California, Berkeley, 107B McLaughlin Hall, NEXTOR II, Berkeley, CA, 94720, United States of America, jrakas@berkeley.edu, Milos Nikolic, Dusan Teodorovic

We develop a Swarm Intelligence-based model for the Collaborative Gate Allocation problem using the Bee Colony Optimization (BCO) metaheuristics as a problem solution. The BCO algorithm belongs to the class of population-based algorithms, mimicking the way bees look for nectar as the way to look for the best solution. We show that with the BCO algorithm, airlines and airports can significantly reduce delays and generate fast, high-quality solutions.

■ TC29

Hilton- Union Sq 9

Project Management 3

Contributed Session

Chair: Jingwen Zhang, Northwestern Polytechnical University, No.127,Youyi West Road, Xi'an, 710072, China, zhangjingwen@nwpu.edu.cn

1 - Probabilistic Measurement of Project Delay Cost
Feng Xu, Georgia Southwestern State University, 800 GSW State University Drive, Americus, GA, 31709, United States of America, feng.xu@gsw.edu

Many projects end with cost overruns due to delays in project delivery. This risk is usually managed using contingency and management reserves included in cost baseline and budget plan. Both reserves are commonly calculated as percentages of aggregated expected value of project activities' costs. This paper analyzes delay induced cost separately using established probability distribution functions, with the purpose to provide accurate measurements for project reserve analysis.

2 - Earned Value Analysis with Stochastic Activity Durations and Costs in Project Scheduling Problems
Jingwen Zhang, Northwestern Polytechnical University, No.127,Youyi West Road, Xi'an, 710072, China, zhangjingwen@nwpu.edu.cn

The duration and cost of an activity are modelled as random variables; accordingly the upper and the lower bounds for stochastic cumulative cost curves over time statistically represent the range for the budget cost of work scheduled, so the uncertain earned value analysis (EVA) is probed. The conclusions indicate that project managers can obtain a degree of flexibility when adopting uncertain EVA to monitor status during project execution, which differs greatly from deterministic situations.

3 - Optimization of Multi-mode Cash Flow Balanced Project Scheduling in Uncertainty Environment
Minjing Ning, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an, China, 344859543@qq.com, Zhengwen He

The balance between cash outflows and inflows is very significant for the smooth implementation of large and complex construction projects. However, for the disturbances of uncertainty factors, it is difficult to keep this balance throughout the execution of projects continuously. In the light of the fact above, this research involves the problem of how to schedule projects so that the balance of cash flows can be maintained under the uncertainty environment.

4 - An Operational Framework to Manage a Project
Narasimhan Ravichandran, Professor, Indian institute of management, Vastrapur, Ahmedabad, GU, 380015, India, nravi@iimahd.ernet.in

Based on a real life opportunity experienced by the author in managing a construction project an operational framework is developed to conduct detailed negotiation with the service provider for the early completion of the project with appropriate financial implications.The framework can be generalised to address similar issues in a variety of contexts.

5 - Enabling Contextual Factors Analysis for Project Risk Mmanagement
Anton Talantsev, PhD candidate, research assistant, Stockholm University, Borgarfjordsgatan 12, Kista, Stockholm, 164 40, Sweden, antontal@dsv.su.se, Aron Larsson

We approach the concept of contextual factors (CFs) and their impact on project performance with risk analysis. The approach suggests a scenario-based judgments elicitation process to define parameters of the CFs Magnitude and Impact functions, Monte-Carlo simulation to handle stochastic representation, non-additive impact aggregation function, and a Probability/Threat-Favor classification scheme to provide comprehensive and balanced risk-opportunity analysis of external project context.

■ TC30

Hilton- Union Sq 10

Models and Algorithms for Sequencing and Scheduling in Applied Transportation Problems

Cluster: Scheduling and Project Management

Invited Session

Chair: Brian Lemay, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, blemay@umich.edu

1 - Crash Test Scheduling for Vehicle Safety Assessment
Yuhui Shi, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, yuhuishi@umich.edu, Amy Cohn, Marina Epelman, Daniel Reich

We develop, implement, and analyze models and algorithms for scheduling the sequencing and timing of vehicle crash tests for the development and safety-testing of new vehicle lines.

2 - A Time-Constrained Vehicle Routing Problem with a Heterogeneous Fleet: Algorithms and Analysis
Young-Chae Hong, University of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, hongyc@umich.edu

We consider a new variant of the Time-Constrained Heterogeneous Vehicle Routing Problem (TCHVRP). The travel time of any given arc vary by vehicle type within a heterogeneous fleet. Each vehicle type has its own limit on total travel time allowed. We formulate TCHVRP as a path-based model, which we solve using column generation. We introduce several different methods to solve the pricing problem and conclude with empirical analyses to assess the impact of data on our algorithm performance.

3 - Optimal Download Scheduling for Multi-Satellite, Multi-Ground Station Missions
Brian Lemay, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, blemay@umich.edu

We address the problem of scheduling data downloads from a constellation of satellites to a network of ground stations. Our optimization model incorporates the energy and data dynamics of the system to ensure feasible download schedules. We introduce alternative scheduling methods for comparison purposes and test each method on a variety of scenarios. We identify the types of scenarios that benefit most from optimization and study the effects of system enhancements such as improved solar panels.

4 - Optimally Scheduling Satellite Communications under Uncertainty
Jeremy Castaing, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, jctg@umich.edu

We consider the problem of scheduling and managing the download of data from a collecting satellite to receiving ground stations. We design models to compute optimal download schedules over the planning horizon. We introduce uncertainty in the model by assuming that each ground station is only available with a certain probability and we develop algorithms to create more robust download schedules while handling the complexity of the stochastic optimization models.

■ TC31

Hilton- Union Sq 11

Staffing and Resource Allocation in Public and Private Service Systems

Sponsor: Service Science

Sponsored Session

Chair: Arthur Swersey, Professor of Operations Research, Yale School of Management, Box 208200, New Haven, Ct, 06520, United States of America, arthur.swersey@yale.edu

1 - Using Customer Counts to Improve Retail Labor Scheduling
Michele Samorani, University of Alberta, Edmonton, AB, Canada samorani@ualberta.ca, Armann Ingolfsson, Ivor Cribben, Osman Alp

In this project, we use data on customer traffic, transactions, and staffing to optimally schedule staff at retail stores. We use time series models to forecast customer hourly traffic, we use predicted traffic and staffing levels to forecast conversion (transactions/traffic), and we use the resulting models to develop profit-maximizing staff schedules. A Canadian retail chain has agreed to test our schedules.

2 - Optimal Staffing Policies in Robotic Surgery
Senay Solak, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, solak@isenberg.umass.edu, Armagan Bayram, Oz Harmanli

Based on our data-based finding that experience of each team member is a key determinant of operating room (OR) time in robotic surgery, we develop policies for hospitals to determine surgical team configurations that would maximize OR efficiency. The policies are derived through stochastic optimization, and can be implemented through spreadsheet based methods. The value of the proposed policies is assessed through comparisons with historical surgical team configurations at a major hospital.

3 - The Value of Patient Information in Allocating Emergency Medical Service Resources
Laura McLay, Associate Professor, University of Wisconsin-Madison, 1513 university ave, Madison, WI, 53706, United States of America, lmclay@wisc.edu, Soovin Yoon

This talk explores how the value of patient information affects the usage of ambulances in terms of locating, dispatching, and staffing ambulances. We focus on the revelation of patient information over the course of each call as well as performance goals across different districts. We explore these issues through a discrete optimization model and analyze the results using data from a real-world setting.

4 - Improving Fire Department Productivity: Merging Fire and Emergency Medical Units
Arthur Swersey, Professor of Operations Research, Yale School of Management, Box 208200, New Haven, Ct, 06520, United States of America, arthur.swersey@yale.edu

Under this innovative plan dual-trained teams of fire medics respond to medical emergencies or fire incidents. We describe how the plan was used in New Haven, Ct. before falling victim to political pressures. We present cost savings, and derive response time performance measures using a spatial queuing model. We then discuss how a variant of the plan is now being used in St. Paul, Minn.

■ TC32

Hilton- Union Sq 12

Service Science - Telemarketing and Call Centers

Contributed Session

Chair: Tian Sun, Kijiji China, Guangyuan Xi Rd 55 rm1808, Shanghai, China, suntian@baixing.com

1 - Predictive Modeling to Identify Prospective Customers for Effective Telemarketing

Tian Sun, Kijiji China, Guangyuan Xi Rd 55 rm1808, Shanghai, China, suntian@baixing.com, Zhe Liang

Telemarketing often fails to identify potential customers, causing low conversion rate and poor customer experience. We present effective predictive models to generate candidate phone list based on the customer historical data obtained from a telemarketing company. Models are tested on the real-life operations, indicating significantly improved conversion rate.

2 - Call Center Staffing Optimization with Uncertainty in Arrival, Service and Abandonment Rates

Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy 411, San Marcos, TX, 78666, United States of America, tahirekin@gmail.com, Tevfik Aktekin

We consider the short term dynamic staffing problem for a call center operating with uncertainty in arrival, service and abandonment rates. Bayesian inference is utilized to deal with uncertainty. Dependency of abandonment on previous staffing decisions is also considered. To solve the resulting stochastic program, we present the use of a simulation based algorithm which is based on constructing an augmented probability model in decision and random variable spaces.

3 - A Review of Informatics-oriented Product-Service Systems: Concept, Characteristics, and Challenges

Jun-Yeon Heo, Postech, Eng Bldg. 4-316, 77 Cheongam-ro, Nam-gu, Pohang, Korea, Republic of, bluejy@postech.ac.kr, Ki-Hun Kim, Chang-Ho Lee, Kwang-Jae Kim

A product-service system (PSS) is an integrated bundle of products and services which aims at creating customer value. Recently, with the advancement of ICT and analytics technologies, informatics is utilized in PSSs. Such type of PSS is called informatics-oriented PSS and has different properties compared with conventional PSSs. In this talk, we provide a review of informatics-oriented PSS. Based on the review, we clarify the concept of the PSS and discuss its characteristics, and challenges.

4 - Experienced Based Routing in Call Center

Thomas Robbins, Associate Professor, East Carolina University, 3212 Bate Building, Greenville, NC, 28590, United States of America, robbinst@ecu.edu

We examine assumptions commonly made in modeling call centers, in particular that agents are homogeneous, statistically equivalent servers. Using empirical data we explore an environment where agents increase their productivity over time but eventually leave the organization. We consider the implication of this heterogeneity and explore a routing policy that attempts to exploit it; routing to agents based on their availability and their experience relative to other available agents.

5 - Optimizing Agent's Roles in a Large Call Center

Moeed Haghnevis, Senior Resource Planning Analyst, Progressive Casualty Insurance, 4550 S 44th Place, Phoenix, AZ, 85040, United States of America, moeed_haghnevis@progressive.com, Michael Durbin

The sets of skills assigned to agents in a call center define their role (profile) within a workgroup. The goal of this project is to minimize the number of roles needed to staff and schedule workgroups while staffing needs are met for each skill given call type and workload requirements. Moreover, this project improves overall utilization of agents by standardizing the sets of skills assigned to agents in each workgroup and eliminating specialization that does not add value.

■ TC33

Hilton- Union Sq 13

Operations/Finance Interface 2

Contributed Session

Chair: Zhan Pang, Lancaster University, Management School, Lancaster, LA1 4YX, United Kingdom, z.pang@lancaster.ac.uk

1 - Dynamic Financial Hedging and Inventory Control under Demand and Price Uncertainty

Zhan Pang, Lancaster University, Management School, Lancaster, LA1 4YX, United Kingdom, z.pang@lancaster.ac.uk, Qing Ding, Panos Kouvelis

Many firms are experiencing the challenge of increasing commodity price volatilities in procurement while facing uncertainty in demand. Financial derivative and inventory are typical instruments to hedge against the price and demand risks. How should a firm coordinate the hedging and inventory control strategies under both demand and price uncertainties? What is the relationship between financial hedge and inventory in a dynamic environment?

2 - Pooling Operations and Receivables

Kasper van der Vliet, Eindhoven University of Technology, Den Dolech 2, 5612 AZ, Eindhoven, Netherlands, k.v.d.vliet@tue.nl, Matthew Reindorp, Jan C. Fransoo

Risk pooling has many applications in operations research and finance, but these are often studied independently. We explore the possibility of interaction between pooling applications: two firms can pool operations, which allows for a reduction in the marginal cost of production; pool receivables, which allows for a reduction in capital cost by factoring; or both. We determine the value of each pooling application and identify conditions that entail a benefit to coordinating them.

3 - Mitigating Supplier Distress: Purchase Order Finance, Advance Payment Discount and Backup Production

Lima Zhao, Assistant Professor, WHUñOtto Beisheim School of Manage, Burgplatz 2, Vallendar, NA, 56179, Germany, lima.zhao@whu.edu, Arnd Huchzermeier

This paper examines a capital constrained supply chain consisting of one retailer and two suppliers. The retailer has three strategies to manage supplier financial distress and mismatch risk: Purchase order finance(POF), advance payment discount(APD), and backup production. Pre-shipment finance (POF/APD) and backup supply can be complements or partial substitutes for the retailer, depending on demand variability.

4 - Risk Control of Financial Logistics Based on VaR (Value at Risk) and Case Study

Shuyan Lin, The University of Hong Kong, Dept. of IMSE, The University of Hong Kong, Hong Kong, Hong Kong - PRC, shuyan.lin@yahoo.com

This paper studies the risk control of financial logistics during the cooperation of logistics firms, small and medium-sized enterprises (SME), and banks. A simple game-theoretical example shows that the win-win cooperation can be reached in some cases. A case study illustrates that there has been a new trend of using transparent and trackable information as pledge. Since credit system remains imperfect, we further assess the liquidation ability of such novel pledge using VaR methodology.

■ TC34

Hilton- Union Sq 14

Transportation and Security under Uncertainty

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Gino Lim, Department Chair, Hari and Anjali Agrawal Faculty Fellow, Associate Professor, University of Houston, E206 Engineering Building 2, Houston, TX, 77204, United States of America, ginolim@uh.edu

1 - Robust Liquefied Natural Gas Shipping Problem under Shamal Disruptions

Jaeyoung Cho, PhD Student, University of Houston, 333 Dominion Drive, #1021, Katy, TX, 77450, United States of America, uncmac.rokag@gmail.com, Hamid Parsaei, Taofeek Biobaku, Selim Bora, Gino Lim

The purpose of this study is to propose a robust LNG supply chain management model against potential disruptions of Shamal wind. It is formulated in multi-period vehicle routing problem with time windows to maximize overall revenue and also generates optimal vessel routes visiting multiple depots with multiple vessels considering dust storm impact. We also consider cargo tank filling limits and its effects called 'sloshing' as this can cause structural damage.

2 - Supply Chain Node Resilience and Importance

Selim Bora, Texas A&M University at Qatar, PO Xob 23874, Doha, Qatar, selim.bora@qatar.tamu.edu, Taofeek Biobaku, Jaeyoung Cho, Hamid Parsaei, Gino Lim

Our goal is to design supply chain networks (SCN) that are resilient under stress by incorporating the concept of node importance. We propose node criticality index (NCI), to give a quantitative measure of the resiliency and importance of components of the SCN. The model is based on the idea of resiliency triangle. Our results show that NCI gives valuable information to decision makers for designing resilient supply chains and assessing the resiliency of existing systems.

3 - Optimal Deployment of Underwater Sonar System

Taofeek Biobaku, PhD Student, University of Houston, University of Houston, Houston, TX, United States of America, tobiobaku@uh.edu, Gino Lim, Jaeyoung Cho, Selim Bora, Hamid Parsaei

In this paper, we study optimal sonar deployment planning to detect underwater threats. We propose a new multi-optimization model to detect potential threats by placing under-water sonars within a port, estuary or waterway of interest. Results from our numerical experiments indicate that our model and deployment strategy provides adequate coverage even under strict budget limits in a multi-period deployment scheme.

■ TC35

Hilton- Union Sq 15

Models for Health Care Delivery

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Ravi Anupindi, David B. Hermelin Professor of Business Administration, Ross School of Business, 701 Tappan Avenue, Ann Arbor, MI, 48109, United States of America, anupindi@umich.edu

1 - Understanding the Efficiency of In-country Global Health Programs

Gemma Berenguer, Purdue University, 403 W. State St., West Lafayette, IN, 47906, United States of America, gemmabf@purdue.edu, Ananth Iyer, Prashant Yadav

Using population reproductive health programs as an example, the goal of this work is to study the major efficiency drivers of global health programs. In particular, we study the effects of environmental conditions and donor fragmentation on the efficiency of global health programs at the country level. To analyze these relationships, we employ a benchmarking tool (three-stage DEA-SFA model) that evaluates the efficiency of a set of sub-saharan african country programs.

2 - Giving it Away to Increase Profits? Price Discrimination and the Effect of Free Goods

Jacob Chestnut, PhD Candidate, University of Michigan, 701 Tappan St. R0400, Ann Arbor, MI, 48109, United States of America, jacob.chestnut@gmail.com, Hyun-Soo Ahn, Ravi Anupindi

We consider a provider serving customers who are heterogeneous in their willingness-to-pay and desired quality. A standard approach is to model as an adverse selection problem, which results in a non-linear pricing schedule. Motivated by empirical evidence that consumer's utility becomes discontinuous when the goods are offered for free, we examine situations where giving away for free can indeed increase the provider's profit.

3 - Public Procurement of Multiple Health Products: The Effect of Alternative Distribution Channels

Iva Rashkova, Management Science and Operations, London Business School, Sussex Place, Regent's Park, London, NW1 4SA, United Kingdom, irashkova@london.edu, Jérémie Gallien

Motivated by Global Fund grant recipients, we study the periodic inventory procurement of multiple health products subject to a common uncertain fund disbursement schedule. The objective is to minimize expected health costs when demand and delivery lags are random, and inventory may be available at alternative channels such as private pharmacies. We derive near-optimal heuristics for the dynamic allocation of funds, characterize their theoretical performance, and discuss managerial insights.

4 - Forecasting the National Deceased Donor Organ Availability for Liver Transplantation

David Hutton, University of Michigan, 1415 Washington Heights, SPH II: M3525, Ann Arbor, Mi, 48109, United States of America, dwhutton@umich.edu, Mariel Lavieri, Wesley Marrero, Neehar Parikh, Kunal Sanghani, Yongcai Xu

We performed secondary analysis of the UNOS OPTN database of adult liver transplant recipients and adult donors from 1999-2012 to project donor organ utilization from 2014-2023. It is estimated that population growth will outpace the growth of available donor organs, thus likely exacerbating the existing liver graft shortage. Strategies to increase organ availability are warranted in order to alleviate this shortage and prevent waitlist dropout.

■ TC36

Hilton- Union Sq 16

Information Systems 1

Contributed Session

Chair: Maryam Eslamichalandar, Conservatoire National des Arts et Métiers (CNAM), Cédric, 2 Rue Conté, Paris, France, mechalandar@gmail.com

1 - Subsidizing Subscriber Internet Access by Content Providers – An Economic Analysis

Soo Hyun Cho, University of Florida, 2901 SW 13th St. Apt 251, Gainsville, FL. United States of America, soohyun.cho@warrington.ufl.edu, Subhajyoti Bandyopadhyay

Internet service providers (ISPs) are experimenting with a business model that allows content providers (CPs) to subsidize Internet access for consumers as an incentive for accessing CPs' content. We develop a game-theoretical model to analyze the effects of this business model. We find that the ISP would adopt a pricing mechanism that induces the more competitive CP to subsidize subscribers' Internet access. The results have several implications on the ongoing net neutrality debate.

2 - Obtaining Value from the Customization of Packaged Business Software: A Model and Simulation

Bryon Balint, Assistant Professor, Belmont University, 1900 Belmont Boulevard, Nashville, TN, 37212, United States of America, bryon.balint@belmont.edu

Software vendors and anecdotal evidence recommend that businesses should customize packaged software as little as possible. However, businesses continue to exceed budgets on implementing and maintaining customized software, often significantly. In this paper I model the primary factors in the customization decision. Simulation techniques are used to illustrate the conditions under which customization is likely to provide value, as well as conditions under which customization should be avoided.

3 - Listen to Your Customers! Product Feature Extraction from Online Customer Reviews

Aindrila Chakraborty, PhD Student, School of Business,University of Connecticut, 2100 Hillside Road Unit 1041, Storrs, CT, 06269, United States of America, aindrila.chakraborty@business.uconn.edu

It has always been a challenging task to determine which product/service attributes or features are the most important to the markets that influences consumers' purchasing decisions. Customer reviews provide a wealth of information regarding consumers' thoughts, beliefs and experiences with a product. The paper proposes a text mining method to extract product features from reviews which is helpful for product designers also in designing new products or modifying existing products.

4 - A Branch-and-Price Approach for Deployment of Multi-tier Cloud Services

Björn Nygreen, Professor, Norwegian University of Science and Technology, Dept. of Industrial Econ & Tech mngnt, Trondheim, 7491, Norway, bjorn.nygreen@iot.ntnu.no, Anders Nordby Gullhav

We present a branch-and-price approach for solving a deployment problem faced by a provider of multi-tier services. The problem consists of finding a cost-efficient mapping between a set of replicated service components and the infrastructure while providing a satisfactory quality of service. The main decisions are the selection of replication levels of the components and where to place the resulting replicas. Our results show that branch-and-price performs better than a direct MIP formulation.

■ TC37

Hilton- Union Sq 17

Intelligent Heuristics and Systems

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Sam Thangiah, Professor, Slippery Rock University, Artificial Intelligence and Robotics Lab, 250 ATS, Slippery Rock, PA, 16057, United States of America, sam.thangiah@sru.edu

1 - Approximating School Buses Required for a School District using Population Data

Larry Wilson, Slippery Rock University, 250 ATS, Slippery Rock, PA, 16057, United States of America, lpw1002@sru.edu, Sam Thagiah, Cody Young, James Mullen, Sean Brown, Theresa Wajda

We describe a study done for a school district on using population and road networks data available from the U.S. Census Bureau to determine the approximate number of school buses required to transport regular students in a school district in the state of Pennsylvania.

2 - Analysis on Consensus of Opinion Dynamics using Clustered Social Networks

Kuru Ratnavelu, Professor, Institute of Mathematical Sciences, University of Malaya, Pantai Valley, Kuala Lumpur, 50603, Malaysia, kururatna2012@gmail.com, Jeeva Sathya Theesar Shanmugam

The structure of human communication is formulated as social network where edge of the network defined by human interactions. In general non-consensus in opinion formation leads to chaos and various models were exhibited for opinion dynamics. The present theoretical opinion dynamics model is corroborated on the topology of clustered network data. The results are compared with few other opinion dynamics models. This study is expected to help in understanding the collective human decision making.

3 - A Brain-Computer Interface to Control Mobile Robots

Sam Thangiah, Professor, Slippery Rock University, Artificial Intelligence and Robotics Lab, 250 ATS, Slippery Rock, PA, 16057, United States of America, sam.thangiah@sru.edu, Jordan Schiller, Stephen Bierly, Marc Sensenich, Emily Day, Aaron Weckerly

The Brain-Computer Interface (BCI) research project uses an Electroencephalogram (EEG) to receive neural signals from a user's brain, analyze the data and filter thought patterns and commands. Once a pattern is recognized and classified as a particular command, the command is sent to a mobile robot. The goal of the BCI research project is to create a symbiosis between a user's thoughts and the actions of a mobile robot.

■ TC38

Hilton- Union Sq 18

Health Care Modeling Optimization – Planning and Optimization

Contributed Session

Chair: Kazim Topuz, Graduate Asistant, Wichita State University, 3540 N Inwood St, Wichita, KS, 67226, United States of America, mktopuz@gmail.com

1 - Realistic Patient Scheduling Methods

Michael Samudra, KU Leuven, Naamsestraat 69, Leuven, 3000, Belgium, Michael.Samudra@kuleuven.be, Erik Demeulemeester, Brech Cardoen

In one of Belgium's largest hospitals, UZ Leuven, approximately every third patient receives surgery later than medically advised. In order to improve the current situation, the lateness of patients has to be understood. Surgeons do their scheduling themselves and do not use algorithms to support their decision. As a consequence, we analyzed scheduling mechanisms that are easy to apply manually. Additionally, we also identify those combinations that best match the hospital data.

2 - Load Balancing in Prioritized Surgery Scheduling Environment

Kazim Topuz, Graduate Asistant, Wichita State University, 3540 N Inwood St, Wichita, KS, 67226, United States of America, mktopuz@gmail.com, M Bayram Yildirim

Minimizing the waiting time is challenging due to the variability in surgery duration's with resource and time constraints. Patients are assigned to a day of operation, based on the availability of provider, room and patient desire as well as priority/target value. In this study, (1) a load balancing model formulated for weekly scheduling and (2) several heuristics proposed for in day scheduling. (3) Results of the computational experiments evaluated and best heuristic solutions presented.

3 - Care on Demand in Nursing Homes: A Queueing Theoretic Approach

Rene Bekker, VU University Amsterdam, De Boelelaan 1081a, Amsterdam, Netherlands, r.bekker@vu.nl, Karin van Eeden, Dennis Moeke

Nursing homes face ever-tightening budgets, requiring improvements in the allocation of care workers for the daily care of residents. Insight in the care delivery process is however lacking, partly due to absence of data. In this talk, we present the characteristics of care requests based on real-life `call button' data. Based on this we propose a queueing model that can be used by nursing home managers to determine the number of care workers required to meet specific service levels.

4 - Hierarchical Associative Evidential Chain-based Fusion Reasoning for Medical Diagnosis

Haiyan Yu, PhD Candidate, Tianjin Univ., Mailbox 9069, College Of Management and, 92 Weijin Road, Nankai District, Tianjin, 300072, China, yhy188@gmail.com

A fusion reasoning model is proposed for heterogeneous information in diagnostic decisions. Case sequences from multi-source information are associated with rule antecedents using evidential chains. The balance of the enhancement of reasoning accuracy and the reduction of misdiagnosis loss is traded off. The interpretable evidential chains contribute to information sharing and enhance the applicability and robustness of diagnostic decision.

■ TC39

Hilton- Union Sq 19

Hospital Capacity and Resource Management

Sponsor: Health Applications

Sponsored Session

Chair: Cecilia Zenteno, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E62-389, Cambrdige, Ma, 02139, United States of America, ceciliaz@mit.edu

1 - Stochastic Operating Room Planning with Recovery Flow

Maya Bam, University of Michigan, 1205 Beal Avenue, 2828 IOE Building, Ann Arbor, MI, 48109-2117, United States of America, mbam@umich.edu, Brian Denton, Mark Van Oyen

Surgery scheduling is impacted by operating room availability, surgeons, and downstream resources, like the post-anesthesia care unit. We present a new approach, based on our collaboration with a mid-sized hospital, that combines mixed integer programming with discrete event simulation to create schedules that optimize the tradeoff between operating room overtime and operating room blocking.

2 - Staffing Service Systems with Load Dependent Service Rate

Galit Yom-Tov, Technion-Israel Institute of Technology, Technion City, Haifa, Israel, gality@tx.technion.ac.il, Jing Dong, Pnina Feldman

Most OM literature assumes that service times are independent of the load of the system. However, in many Healthcare systems the two are correlated. For example, patients' condition may worsen if treatment is delayed, resulting in longer stays. We examine how load-related slowdown affects the operational performance. We develop and analyze fluid and diffusion approximations of an Erlang-A model with load-dependent service times. We propose methods to stabilize and improve system performance.

3 - Efficient Resource Allocation and Cost Accounting in Healthcare Networks

Fernanda Bravo, MIT, 100 Main St, E62-459, Cambridge, MA, 02139, United States of America, fbravo@mit.edu, Marcus Braun, Retsef Levi, Ali Aouad

This paper presents a novel optimization driven approach to address the issue of effective consolidation in healthcare delivery networks. Specifically, we provide a framework that allows us to understand the true cost of service and to support strategic resource allocation and system design decisions in a multi-site network. In addition, we report on the application of our approach to a real healthcare delivery network and describe the projected impact and managerial insights derived from it.

4 - Surgical Supply Inventory Management in Large Academic Medical Centers

Cecilia Zenteno, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E62-389, Cambridge, Ma, 02139, United States of America, ceciliaz@mit.edu, Matt Schlanser, Retsef Levi, Peter Dunn, Bethany Daily

Massachusetts General Hospital performs over 36,000 operations per year. Surgical supplies come either individually packaged and sterilized (soft goods), or procured in pre-assembled custom packs. We study the composition of the surgical packs and how to combine them with soft goods to satisfy the demand driven by the surgeons' requirements, while optimizing their base stock levels. We prescribe a modular pack structure to reduce inventory levels and associated costs via demand pooling.

■ TC40

Hilton- Union Sq 20

Healthcare Operations Research

Sponsor: Health Applications

Sponsored Session

Chair: Soroush Saghafian, Arizona State University, Tempe, AZ, United States of America, Soroush.Saghafian@asu.edu

1 - Incorporating Time-Varying, Modifiable Risk Factors in Chronic Disease Models

Margaret Brandeau, Professor, Stanford University, MS&E Department, Stanford, CA, 94305, United States of America, brandeau@stanford.edu, Jeremy Goldhaber-Fiebert

Risk factors (e.g., smoking) increase chronic disease incidence and severity. We develop a methodology for embedding time-varying, modifiable risk factors in chronic disease models, and for calibrating the models using available, cross-sectional data. We illustrate feasibility with the policy-relevant example of smoking, and smoking cessation programs, in India. We show that incorporating exposure-change rates can improve estimates of chronic disease outcomes and outcomes of interventions.

2 - Forecasting and Dynamic Adjustment of Staffing Levels in Hospital Operating Rooms

Su Xie, Stanford Graduate School of Business, 655 knight way, Stanford, CA, 94305, United States of America, xiesu@stanford.edu, Stefanos Zenios

This paper considers the problem of setting nurse staffing levels for a hospital operating room. The goal is to reduce total nurse staffing costs, which include an hourly staffing salary for scheduled nurse time plus an overtime rate when surgeries take longer than scheduled (and therefore nurses need to stay beyond their scheduled time).

3 - Admission and Discharge Decisions in ICU

Huiyin Ouyang, UNC at Chapel Hill, 2000 Baity Hill Dr, Apt 215, Chapel Hill, NC, 27599, United States of America, ouyang5@live.unc.edu, Nilay Argon

In this paper, we consider a model for an ICU with patients whose health status change during their care at the hospital. We formulate an MDP model to gain some insights into which patients have larger benefit from ICU to help make admission and discharge decisions. We find a condition under which ICU is more preferable than the general ward, and we prove that under this condition the optimal discharge policy when the ICU is full is of threshold type.

4 - Capacity Planning for Long-Term Care Networks with Homogenous Patient Population

Yan Li, Purdue University, West Lafayette, IN, 47907, United States of America, li528@purdue.edu, Nan Kong, Mark Lawley

Long-term care (LTC), mainly in the forms of nursing homes and home- and community-based services, has placed huge economic burden on the US health care system. Given a finite homogenous patient population and a finite monetary budget, we study the capacity planning for each set of services. We propose a migration network model for patient flows and a newsvendor model for network-wide profit maximization. We present both analytical solutions and numerical results to draw managerial insights.

■ TC41

Hilton- Union Sq 21

Health Care, Strategy, and Policy 1

Contributed Session

Chair: Dawei (David) Zhang, Assistant Professor, University of Scranton, 800 Linden St, Scranton, PA, 18510, United States of America, dawei.zhang@scranton.edu

1 - The Role of Familiarity on Productivity: The Case of Cardiac Surgey Operations

Emmanouil Avgerinos, PhD Student, University College London, 10 Gough House, Windsor street, London, N18QA, United Kingdom, emmanouil.avgerinos.10@ucl.ac.uk, Bilal Gokpinar

Fluid teams are commonly used by a variety of organizations to perform similar and repetitive yet highly critical and knowledge-intensive tasks. In this paper, we develop and test a model of knowledge transfer based on team composition in fluid team operations. Using a unique dataset of 6,206 cardiac surgeries from the cardiac unit of a private hospital in Europe over seven years, we investigate knowledge transfer mechanisms through which team familiarity may influence productivity.

2 - IT and Hospital Performance

Dawei (David) Zhang, Assistant Professor, University of Scranton, 800 Linden St, Scranton, PA, 18510, United States of America, dawei.zhang@scranton.edu, Victoria Mitchell, Barrie Nault

Hospitals in the US are progressively becoming overwhelmed by the mounting number of tasks as the U.S. population continues to make strides in longevity. Consequently, hospitals have been making investments in information technology (IT), hoping to improve healthcare decisions. Surprisingly, there is a gap in the IS literature on the impact of IT on hospital performance. Our study aims to shed light on the role of health IT in affecting hospital performance.

3 - Explaining Outstanding Hospital Performance on Multiple Fronts

Carol Theokary, Assistant Professor of Business, Mills College, 5000 MacArthur Boulevard, Oakland, CA, 94613, United States of America, ctheokary@mills.edu, Kate Karniouchina

Motivated by the hospital value-based purchasing program that is designed to promote better clinical outcomes for hospital patients, as well as improve their experience of care during hospital inpatient stays, we use a large dataset featuring more than 2,000 hospitals to empirically examine how the latest addition of a cost efficiency component to the scoring system affects overall hospital performance.

4 - Saving Patient Ryan - Can Health IT Make Patient Care Safer? Evidence from Pennsylvania Hospitals

M Zia Hydari, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15146, United States of America, zia@cmu.edu, William Marella, Rahul Telang

Patient safety is widely expected to benefit from health IT but the evidence of its impact on safety is inconclusive. We estimate the impact of advanced Electronic Medical Records (EMRs) on patient safety using a panel of Pennsylvania hospitals over 2005ó2012. Using a differences-in-differences identification strategy, we find that EMRs lead to a 27% decline in patient safety events. Thus, we provide evidence to stakeholders that hospitals' adoption of advanced EMRs improves patient safety.

■ TC42

Hilton- Union Sq 22

Joint Session HAS/Analytics: Analytics for Chronic Care Decision-Making

Sponsor: Health Applications, Health Applications, & Analytics Section

Sponsored Session

Chair: Shinyi Wu, Associate Professor, University of Southern California, 1150 S. Olive Avenue, Suite 1400, Los Angeles, CA, 90015, United States of America, shinyiwu@usc.edu

1 - Considering Multiple Perspectives in Simulation Modeling for Better Implementation of Interventions

Irene Vidyanti, Los Angeles Department of Public Health, 3530 Wilshire Boulevard, Los Angeles, CA, 90010, United States of America, irenevidyanti@gmail.com, Shinyi Wu

This research makes the case for considering multiple perspectives by analyzing cost-benefit of several Diabetic Retinopathy screening strategies from the societal, payer, and medical system perspectives using a simulation model. Optimal screening strategy differs based on perspective taken. As different parties have different interests but cooperation from all is required for successful implementation, having this information is useful to determine incentives to facilitate implementation.

2 - Developing Depression Symptoms Prediction Models to Improve Depression Care Outcomes

Haomiao Jin, University of Southern California, 3650 McClintock Avenue, Rm 340, Los Angeles, CA, 90089, United States of America, haomiaoj@usc.edu, Shinyi Wu, Irene Vidyanti, Paul Di Capua, Brian Wu

This study targets to develop depression symptoms prediction models from a rich dataset yielded from a recent, large-scale clinical trial. Bench model was developed using the historical scores of a depression symptom scale called PHQ-9 to predict the PHQ-9 thereafter. Additional predictors were then added to improve the accuracy of prediction. The prediction models developed in this study are useful predictive analytics tools that can assist in improving depression care outcomes.

3 - Cost-effectiveness of Colorectal Cancer Screening Interventions Incorporating Patient Choice

Maria Mayorga, Associate Professor, North Carolina State University, 111 Lampe Dr., Raleigh, NC, 27695, United States of America, memayorg@ncsu.edu, David Cornejo, Kristen Hassmiller Lich

We present an individual-based simulation model that accounts for heterogeneity in patient screening behavior; cancer progression is affected by individuals' characteristics and their screening and mode decisions. A set of discrete choice models determine patients' compliance and modality choices. We consider several distinct public health interventions that affect people's choice behavior. Cost effectiveness is evaluated with respect to several outcomes, such as life-years up-to-date.

4 - Using Microsimulation to Analyze Long-term Care Transition

Hambisa Keno, Purdue University, West Lafayette, IN, 47907, United States of America, hkeno@purdue.edu

A state-transition microsimulation model is presented for long-term care (LTC) transition processes and service utilization. The four states (care settings) in the model are home, nursing home, home care, and hospital. For each patient, the model captures the semi-Markov LTC transition process in two steps: which care setting to transition and the dwelling duration before the transition. Our model was validated based on a prospective cohort study. The model will be used to assess various intervention scenarios on service utilization.

■ TC43

Hilton- Union Sq 23

Computational Optimization and Applications

Sponsor: Computing Society

Sponsored Session

Chair: Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01602, United States of America, atrapp@wpi.edu

1 - Solving Semidefinite Programs over Symmetric, Diagonally Dominant Matrices

David Phillips, U.S. Naval Academy, Mathematics Department, Annapolis, MD, 21401, United States of America, dphillip@usna.edu, R. Michael Lewis, Rui Zhang

We consider semidefinite programs (SDPs) over symmetric, weakly diagonally dominant matrices. This class of SDPs has applications to network design and large scale instances are intractable for general SDP solvers. We present a potential function method that is provably and practically efficient. A key distinction of our algorithm is that we penalize the linear matrix inequality. We know of no other work that adopts this strategy.

2 - Speeding Up Modified Support Vector Machines with Decomposition

Talayeh Razzaghi, Postdoctoral Research Fellow, School of Computing, Clemson University, Clemson, SC, 29634, United States of America, trazzag@clemson.edu, Petros Xanthopoulos, Qipeng Zheng

Modified Support Vector Machines (SVMs) with ramp loss and hard margin loss functions are usually employed when outliers are present in the data. The success of solution methods is limited due to expensive computation, particularly for large datasets. To overcome this deficiency, we present a decomposition technique aiming to speed up the training process.

3 - Bayesian Global Optimization of Expensive Functions with Low-dimensional Noise

Peter Frazier, Assistant Professor, Cornell University, 232 Rhodes Hall, Ithaca, NY, 14853, United States of America, pf98@cornell.edu, Jing Xie, Sethuraman Sankaran, Abhay Ramachandra, Saleh Elmohamed, Alison Marsden

In many applications of simulation optimization, most of the variability in the output measure of interest is determined by a small number of random exogenous inputs. Motivated by an application to the design of cardiovascular bypass grafts using a computationally-expensive physics-based stochastic simulator, we provide a new Bayesian global optimization method that exploits this low-dimensional structure to improve performance.

4 - Hierarchies of Bounds for Multistage Stochastic Mixed-integer Programs

Gabriel L. Zenarosa, PhD Student, University of Pittsburgh, 3700 O'Hara Street, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, glz5@pitt.edu, Oleg Prokopyev, Andrew Schaefer

Many practical dynamic decisions under uncertainty can be formulated as multistage stochastic mixed-integer programs (SMIPs). Unfortunately, multistage SMIP instances are large, making them nearly impossible to solve. SMIP instances must be decomposed into manageable problems. We propose a framework for scenario tree decomposition—a novel approach for multistage SMIPs—where lower and upper bounds are obtained by solving SMIPs over subsets of the scenario tree.

■ TC44

Hilton- Union Sq 24

Online Social Networks and Content Generation

Sponsor: Information Systems

Sponsored Session

Chair: De Liu, University of Kentucky, 550 S Limestone St,, Lexington, KY, 40506, United States of America, de.liu@uky.edu

1 - How do Consumers use Social Shopping Sites? The Impact of Social Endorsements

Pei Xu, PhD Student, University of Kentucky, 3800 Nicholasville Rd Apt 31626, Lexington, KY, 40503, United States of America, xupei124@gmail.com, De Liu

Social shopping is a new form of e-commerce that uses social media to connect consumers and facilitate collaborative shopping. This research aims to understand how product endorsements via the social channel influence the amount of private consideration and public endorsement a product can receive. Based on the theory of social contagion, herding effect and identity-signaling theory, we argue that the working mechanisms of social endorsements differ in consumers' private and public behaviors.

2 - Examining user Content Similarity and Network Growth within Content-based Online Social Networks

Mitchell Church, Assistant Professor, Slippery Rock University, Slippery Rock, PA, 16057, United States of America, mitchell.church@sru.edu, Xia Zhao, Lakshmi Iyer

Using a unique dataset from Pinterest, our study examines how rich-media diffusion and network growth are affected by the actions and rich-media content similarity of users within content-based social networks. Our findings show that content similarity between network users impacts how Pinterest users receive, share and consume rich-media content. Additionally, we show that user actions and content similarity influence the growth and structure of content-based networks.

3 - The Role of Social Networks in Online Reviewing

Zhihong Ke, University of Kentucky, 550 S Limestone St,, Lexington, KY, 40506, United States of America, zhihong.ke@uky.edu, De Liu

Extant research on user content generation has primarily focused on what motivates users to contribute content, and less on the effects of informational and social environment surrounding these users. The aim of this study is to examine how a user's contribution to an online review platform is affected by reviews of his/her friends from both informational and social perspectives.

■ TC45

Hilton- Union Sq 25

Behavioral Aspects in Forecasting and Inventory Decisions

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Michael Becker-Peth, Assistant professor, University of Cologne, Albertus-Magnus-Platz, Cologne, Germany, michael.becker-peth@uni-koeln.de

1 - The Effect of Group Identity on Supply Chain Forecasting and Ordering

Felix Papier, Associate professor, ESSEC Business School, Av. Bernard Hirsch, Cergy, 95021, France, papier@essec.edu, Torsten Gully, Ulrich Thonemann

We analyze a supply chain in which a demand planner provides demand forecasts to a production planner, who cannot observe the effort that the demand planner invests. We use a game theoretic model and laboratory experiments to show that social preferences affect the alignment between both planners: Some demand planners invest effort and production planners anticipate this effort. We show that group identity can be used to increase social preferences and to align the supply chains.

2 - Improving the Effectiveness of Forecasting Processes: A Case Study in the Food Industry

Stefanie Protzner, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, sprotzner@rsm.nl, Steef van de Velde, Laurens Rook

Lack of trust and transparency between sales, marketing and supply chain is a serious problem in forecasting processes of many organizations harming the credibility of the forecast and the overall process. In this study, we explore the effects of a re-design of a forecasting process. Results show that changes in ownership structure and process flow and performance based inclusion can reduce dysfunctional biases, improve forecast accuracy and the effectiveness of the forecasting process.

3 - Task Decomposition and Newsvendor Decision Making

Yun Shin Lee, Assistant Professor, Korea Advanced Institute for Science and Technology, 85 Hoegiro Dongdaemoon-gu, Seoul, Korea, Republic of, yunshin@business.kaist.ac.kr, Enno Siemsen

We separate newsvendor order decisions into point forecasts, uncertainty judgments, and service level decisions in a behavioral laboratory experiment. Point forecasts are influenced by the underlying overage and underage cost parameters, and suffer from demand chasing. Uncertainty judgments are subject to overconfidence, and service level decisions suffer from a cognitive dissonance bias where service levels are rarely set below 50 percent.

4 - Empirical Newsvendor Decisions under a Service Level Contract
Michael Becker-Peth, Assistant Professor, University of Cologne, Albertus-Magnus-Platz, Cologne, Germany, michael.becker-peth@uni-koeln.de, Stefan Minner, Ulrich Thonemann, Anna-Lena Sachs

Analyzing the newsvendors in laboratory experiments gives new insights into the behavioral aspects of decision makers. However, a valid question is whether the results of those experiments can be transferred to real world decisions. We test this by analyzing the decisions of real decision makers. Our findings indicate that real decision makers show similar decision biases as students in laboratory environments and we find a new decision bias, as our decision maker optimizing multiple products.

■ TC46

Hilton- Lombard

MIP Theory and Multi-level Applications

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: J. Cole Smith, Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, jcsmith@clemson.edu

1 - The Level-d Partial Convexification Cut for 0-1 Mixed Integer Program
Youngho Lee, Korea University, Sung Buk Ku, Seoul, Korea, Republic of, yhlee@korea.ac.kr, Junsang Yuh, Jeongyi Moon

The level-d partial convexification closure is obtained by augmenting all the partial convexification cuts generated from level-d RLT polyhedron. We present an algorithm for approximately optimizing over the level-d partial convexification closure. This is accomplished by iteratively solving the separation problem that projects the extended space of the RLT formulation into the original space. We present computational results on well-known benchmark instances from MIPLIB 3.0.

2 - Shortest-path Interdiction with Dynamic Attacks
Jorge A. Sefair, University of Florida, 303 Weil Hall, Gainesville, FL, 32608, United States of America, j.sefair@ufl.edu, J. Cole Smith

We study a shortest-path interdiction problem in which two agents (user and an interdictor) interact in a network. The user travels the network intending to reach a destination node at the minimum cost, while the interdictor attacks some arcs to increase the traversing cost. To maximize the user's shortest path, the interdictor can attack while the interdictor travels the network, i.e., the interdictor can initially attack a subset of arcs and, after observing the user's reaction, attack again.

3 - On a General Framework for Three-stage Interdiction Problems with Fortification
Leonardo Lozano Sanchez, PhD Student, University of Florida, 303 Weil Hall, Gainesville, FL, 32698, United States of America, llozano@ufl.edu, J. Cole Smith

Interdiction problems with fortification involve two players who compete in a sequential game where a defender fortifies his system in anticipation to an optimal attack. We present a solution framework that is build upon the intuition of sampling the third-stage problem to obtain upper bounds while adding cuts to the first-stage problem. We conducted computational experiments on the shortest path problem achieving compelling results over large instances with up to 53,658 nodes and 192,084 arcs.

4 - Effectively Handling Indicator Constraints in IBM-Cplex
Andrea Lodi, Professor, University of Bologna, DEIS, Viale Risorgimento 2, Bologna, 40136, Italy, andrea.lodi@unibo.it, Pierre Bonami

Mixed Integer Linear Programming (MILP) models are commonly used to model indicator constraints, which either hold or are relaxed depending on the value of a binary variable. However, classical bigM formulations are notoriously weak and MILP solvers have serious difficulties to deal with them. Motivated by a class of Classification problems with Ramp Loss functions on which Mixed Integer Nonlinear Programming models with nonconvex constraints are solved better than the equivalent MILP formulations, we describe an entirely new and effective implementation of the way IBM-Cplex handles indicator constraints. The implementation is based on the iterative strengthening of the constraints at the nodes through local cutting planes. (Joint work with Pierre Bonami.)

■ TC47

Hilton- Mason A

Stochastic/robust Optimization Application in Energy Systems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Muhong Zhang, Arizona State University, 5910 W Park Ave., Chandler, United States of America, muhong.zhang@asu.edu

1 - Integration of Progressive Hedging and Dual Decomposition for Stochastic Integer Programs
Ge Guo, PhD Student, Iowa State University, 610 Squaw Creek Drive, Unit 13, Ames, IA, 50010, United States of America, geguo@iastate.edu, Sarah M. Ryan

We present a method for integrating the Progressive Hedging Algorithm (PHA) and the Dual Decomposition (DD) method for stochastic mixed-integer programs using PySP and DDSIP. A method to transform non-anticipativity weights from PHA to Lagrange multipliers in DD is found. Fast progress in early iterations of PHA speeds up convergence of DD to an exact solution. We report computational results on stochastic server location and unit commitment instances.

2 - Reserve Response Sets for Unit Commitment under Wind Uncertainty
Joshua Lyon, PhD Candidate, Arizona State University, P.O. Box 875706, Tempe, United States of America, jdlyon@asu.edu, Muhong Zhang, Kory Hedman

Uncertainty from renewable resources is a growing concern for power system schedulers. Deterministic models remain in favor due to their computational tractability, but they may overlook solutions that respond well to forecast deviations. One problem is that deterministic policies rarely consider the cost of dispatching reserves. In this research, we propose a decomposition algorithm that determines reserve requirements based on cost criteria as well as reserve deliverability.

3 - Strong Formulation for Unit Commitment Problems
Kai Pan, PhD Student, University of Florida, Weil Hall 411, Gainesville, FL, 32611, United States of America, kpan@ufl.edu, Jean-Paul Watson, Yongpei Guan, Qianfan Wang

We propose a strong formulation for unit commitment problem. The computational experiments verify its effectiveness in solving the unit commitment problem efficiently.

4 - Mathematical Determination of Reserve Requirements in Unit Commitment Problem
Chao Li, PhD Student, Arizona State University, 2343 W Main Street, Apt 2097, Mesa, AZ, 85201, United States of America, Chao.Li.cidse@asu.edu, Muhong Zhang

System reliability is critical in power system operation. Stochastic programming and robust optimization have been proposed to model uncertainties. However, both are limited in applications due to computational challenges. Reserve requirements are adopted by system operators. In this work, reserve requirement policies are determined systematically based on polyhedron structures. A case study will be presented to compare the performance of the proposed methods versus rule-of-thumb rules.

■ TC48

Hilton- Mason B

Optimization, Combinatorial 2

Contributed Session

Chair: Kresimir Mihic, Oracle Labs, 501 Island Parkway #3102, Belmont, CA, 94002, United States of America, kresimir.mihic@oracle.com

1 - Generalized Decomposition for Non-linear Problems
Kresimir Mihic, Oracle Labs, 501 Island Parkway #3102, Belmont, CA, 94002, United States of America, kresimir.mihic@oracle.com, Alan Wood

We present Randomized Decomposition (RD), a method for solving non-linear, non-convex mathematical programs. RD is similar to Bender's Decomposition but does not require any knowledge of the problem structure. Instead, the problem is partitioned into random subsets of decision variables, each of the sub-problems represented by the random subsets are optimized, and the process is repeated. Sub-optimal solutions are permitted at certain points in the solution process to help escape local optima.

2 - The Paired Assignment Problem
Vardges Melkonian, Ohio University, 1 Ohio University, Athens, OH, 45701, United States of America, melkonia@ohio.edu

We consider a variation of the maximum bipartite matching problem where each completed task must have at least two agents assigned to it. We prove that the basic solutions of LP-relaxation are half-integral. It is shown that a fractional basic solution can be further processed to obtain an optimal solution.

3 - Formulating a Realistic Mixed Model Assembly Line Balancing Problem
Anas Alghazi, PhD Candidate, Clemson University, Freeman Hall, Clemson, SC, 29634, United States of America, aalghaz@clemson.edu, Mary Elizabeth Kurz

We investigate the formulation of the mixed model line balancing problem that captures realistic characteristics such as zoning constraints and parallel stations. Since the problem is NP-Hard, making use of the structure of the problem is important in order to be able to solve reasonably sized problems to optimality. Different exact solution procedures and formulation techniques are studied to achieve this goal.

4 - Computational Complexity of the Deterministic Annealing Algorithm
Pratik Mayur Parekh, Graduate Student, University of Illinois, Urbana-Champaign, Coordinated Science Laboratory, 1308 West Main St., Urbana, IL, 61801, United States of America, pparekh2@illinois.edu, Carolyn Beck

The deterministic annealing approach to clustering is derived on the basis of the principle of maximum entropy and produces natural hierarchical clustering solutions through a sequence of phase transitions. In this article, the computational complexity for the classic DA algorithm is analyzed through analytical derivation and simulation study. We have also applied smoothing analysis to study the variation in complexity for small perturbations of input data.

■ TC49

Hilton- Powell A

Network Optimization and Routing Problems

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Qie He, Department of Industrial and Systems Engineering, University of Minnesota, 111 Church St, SE, Minneapolis, MN, 55455, United States of America, qhe@umn.edu

1 - Algorithms in Traveling Salesman Problem with Continuous Arc Cost Distribution
Zhouchun Huang, University of Central Florida, 4000 Central Florida Blvd., University of Central Florida, Orlando, FL, 32816, United States of America, zhouchun.huang@knights.ucf.edu, Qipeng Zheng

The formulation of Traveling Salesman Problem that incorporates risk managements with conditional value-at-risk is proposed. As a commonly occurring continuous probability distribution, Gaussian distribution is applied to describe the uncertain arc costs. several algorithms including a new cutting plane method are developed to solve the problem in both small-sized or large-sized networks.

2 - Branch-and-Cut-(and-Price) for the Chance-Constrained Vehicle Routing Problem
Thai Dinh, Graduate Student/Research Assistant, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, tndinh@wisc.edu, Ricardo Fukasawa, James Luedtke

We study algorithms for the chance-constrained vehicle routing problem, in which a limit is imposed on the probability that truck capacity is exceeded. We present a branch-and-cut algorithm that requires minimal assumptions on the random demands, and also a branch-and-cut-and-price algorithm for the case when demands are independent normal. Computational results will be presented.

3 - Inventory Routing Problem for a Single Perishable Product with Stochastic Demands
Mahmood Rezaei, Researcher, University of Liege, Rue Louvrex 14, Liege, 4000, Belgium, m.rezaei@ulg.ac.be, Yves Crama, Tom Van Woensel, Martin Savelsbergh

We consider an inventory routing problem where perishable products are dispatched from a central depot to a set of geographically dispersed stores. Demands to each store are stochastic. The objective is to maximize the total profit of the network (the total revenue minus the total transportation costs) during an infinite planning horizon. We develop 4 different approaches to model and solve the problem. The solution methods are compared by simulation and managerial insights are drawn.

4 - Minimum Concave Cost Flows in Capacitated Grid Networks
Qie He, Department of Industrial and Systems Engineering, University of Minnesota, 111 Church St, SE, Minneapolis, MN, 55455, United States of America, qhe@umn.edu, Shabbir Ahmed, Shi Li, George Nemhauser

We study the minimum concave cost flow problem over a two-dimensional grid network (CFG), where one dimension represents time and the other represents echelons. We give a characterization of the computational complexity of CFG based on the grid size, the distribution of sources and sinks over the grid, and arc capacity values. Our algorithms and hardness results generalize complexity results for many variants of the lot-sizing problem, and answer several open questions on serial supply chains.

■ TC50

Hilton- Powell B

Optimization Methodologies 2

Contributed Session

Chair: Yaping Wang, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ypwang@neo.tamu.edu

1 - Lung Cancer: New information from Old Data
Katia Camacho-Caceres, Graduate Student, 10 Ramirez Silva, Mayaguez, 00680, Puerto Rico, katia.camacho@upr.edu

This work re-examines lung cancer microarray data with a multiple criteria optimization-based strategy. This strategy does not require any adjustment of parameters by the user and is capable to converge consistently to important genes potential biomarkers even in the presence of multiple and incommensurate units across microarrays. Groups with distinct smoking habits and gender are contrasted to elicit a set of highly differentially expressed genes, several of which are associated to lung cancer

2 - A Rigid Point Set Registration Approach for Aligning Two Metrology Data with Different Resolution
Yaping Wang, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ypwang@neo.tamu.edu, Erick Moreno-Centeno, Yu Ding

Given two misaligned metrology datasets with different cardinality and resolution from the same manufacturing part surface, a crucial step to get better prediction of the underlying true surface is to find correspondences between the two datasets. We combine down sampling, solving downsized problem to optimality, partial solution propagation, and iterative local search to obtain solutions with much higher quality than other commonly used approaches within reasonable amount of time limit.

3 - Deploying OPL Optimization Models on Client-server Architectures
Vincent Beraudier, OPL Program Manager - CPLEX Optimization Studio, IBM, Porte Neuve, Bat A, 4 Av Alphonse MorelL, Grasse, 06130, France, vincent.beraudier@fr.ibm.com

CPLEX Optimization Studio enables you to take advantage of all your computing resources locally or remotely. Using the OPL modeling language and its dedicated UIs, we will demonstrate how to take advantage of all your computing resources in minutes to create, debug and deploy optimization models. We will take you through all the steps of implementing optimization projects, including formulating the optimization model, integrating it with user data, and deploying the project on a server.

4 - Semidefinite and Copositive Relaxation of Polynomial Optimization by Using Symmetric Tensors
Xiaolong Kuang, Student, Lehigh University, 425 Montclair Avenue, Bethlehem, PA, 18015, United States of America, kuangxiaolong0731@gmail.com, Luis Zuluaga

We study relaxation of general polynomial optimization problem over the cones of positive semidefinite and completely positive tensors, which are natural extensions of the cones of positive semidefinite and copositive matrices. Then we characterize the relationship between Lagrangian bounds, semidefinite bounds and copositive bounds of polynomial optimization.

■ TC51

Hilton- Sutter A

Optimization Society Prizes

Sponsor: Optimization

Sponsored Session

Chair: Sanjay Mehrotra, Professor, Northwestern University, Evanston, IL, United States of America, mehrotra@iems.northwestern.edu

1 - Optimization Society Student Paper Prize
Santanu Dey, Georgia Tech, 765 Ferst Drive, NW, Atlanta, United States of America, santanu.dey@isye.gatech.edu

The INFORMS Optimization Society Student Paper Prize was established in 2006 and is awarded annually at the INFORMS Fall National Meeting to one or more student(s) for an outstanding paper in optimization that is submitted to and received or published in a refereed professional journal during the three calendar years preceding the year of the award. The prize serves as an esteemed recognition of promising students who are looking for an academic or industrial career.

2 - The INFORMS Optimization Society Prize for Young Researchers
Andrzej Ruszczynski, Distinguished Professor, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08550, United States of America, rusz@business.rutgers.edu

The INFORMS Optimization Society Prize for Young Researchers was established in 1998 and is awarded annually to one or more young researcher(s) for an outstanding paper in optimization that was accepted, or published in a refereed professional journal within the last four years. All authors must have been awarded their terminal degree within the last eight years. The prize serves as an esteemed recognition of promising colleagues who are at the beginning of their career.

3 - The Farkas Prize of the INFORMS Optimization Society
Yinyu Ye, Professor, Stanford University, Huang 308, Stanford, CA, 94025, United States of America, yyye@stanford.edu

The Farkas Prize of the INFORMS Optimization Society was established in 2006 and is awarded annually at the INFORMS Fall National Meeting to a mid-career researcher for outstanding contributions to the field of optimization, over the course of their career. Such contributions could include papers (published or submitted and accepted), books, monographs, and software. The awardee will be within 25 years of their terminal degree as of January 1 of the year of the award. The prize serves as an esteemed recognition of colleagues in the middle of their career.

4 - The Khachiyan Prize for Lifetime Accomplishments in Optimization
Tamas Terlaky, Professor, Lehigh University, 200 W. Packer Ave, Bethlehem, PA, United States of America, terlaky@lehigh.edu

The Khachiyan Prize of the INFORMS Optimization Society was established in 2010 and is awarded annually at the INFORMS Fall National Meeting to an individual or a team for life-time achievements in the area of optimization. The award recognizes a sustained career of scholarship from nominees who are still active at the year of the nomination. The prize serves as an esteemed recognition of innovativeness and impact in the area of optimization, including theory and applications.

■ TC52

Hilton- Sutter B

Optimization, Convex

Contributed Session

Chair: Cun Mu, PhD Student, IEOR, Columbia University, 500 West 120th Street, Rm. 315, Columbia University, New York, NY, 10027, United States of America, cm3052@columbia.edu

1 - Subgradient Optimization for Parametric Nonlinear Programming
Jonathon Leverenz, Clemson University, Clemson University, Clemson, SC, 29634, United States of America, jlevere@clemson.edu, Margaret Wiecek

Parametric Programming is used to address uncertainty in optimization problems. Solutions are functions of the parameter and are typically obtained using approximations of the primal problem. Subgradient optimization has not previously been applied in this setting but can improve the quality of these solutions when used to solve the dual problem. An algorithm is presented along with a basic convergence result and illustrative examples.

2 - A Semi-definite Programming Approach for Optimal Selection in Tree Breeding
Makoto Yamashita, Tokyo Institute of Technology, 2-12-1-W8-29, Oookayama, Meguro-ku, Tokyo, Se, 152-8552, Japan, Makoto.Yamashita@is.titech.ac.jp, Tim Mullin

In tree breeding, we wish to optimize parent-genotype contributions in grafted seed orchards, achieving the greatest genetic value in the orchard seed while maintaining essential genetic diversity. We represent this optimization problem as a semi-definite program, and we combine the SDPA solver into open-source optimal selection software, OPSEL. This approach has considerable flexibility, and we found from numerical results that the semi-definite program provides a valuable solution.

3 - Linear Inverse Problems for Multi-structured Signals – With Application in Low-rank Tensor Recover
Cun Mu, PhD Student, IEOR, Columbia University, 500 West 120th Street, Rm. 315, Columbia University, New York, NY, 10027, United States of America, cm3052@columbia.edu, Bo Huang, John Wright, Donald Goldfarb

Recovering a multi-structured signal from incomplete information is a recurring problem in signal processing and machine learning. In this talk, we first give a negative result on the common approach of minimizing the sum of individual sparsity inducing norms (e.g. \ell_1, nuclear norm). Then we demonstrate that, for the low-rank tensor recovery problem, it is possible to design a better model by exploiting those structures jointly.

4 - Largest Inscribed Rectangles In Geometric Convex Sets
Mehdi Behroozi, PhD Student, University of Minnesota, 111 Church St. SE, Minneapolis, MN, 55455, United States of America, behro040@umn.edu, John Carlsson, Shuzhong Zhnag

We consider the problem of finding maximum area inscribed box inside a compact and solid convex set, representable in finite number of inequalities. For the traditional 2-dimensional n-gon problem, we present optimization based exact and approximation algorithms, which find the largest inscribed axis-aligned rectangle for any given direction of axes in $\mathcal{O}(n)$ time and compute $(1-\epsilon)$-approximation to the largest inscribed rectangle in $\mathcal{O}(\frac{n}{\epsilon})$ time.

5 - An Efficient Algorithm for the Nested Resource Allocation Problem
Thibaut Vidal, LIDS — Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 32-D566, Cambridge, MA, 02139, United States of America, vidalt@mit.edu, Nelson Maculan, Patrick Jaillet

We propose an exact polynomial algorithm for a nested resource allocation problem with convex costs and constraints on partial sums of resource consumptions, in the presence of either continuous or integer variables. This resource allocation problem appears prominently in a variety of applications related to production and resource planning, scheduling, ship speed optimization and vehicle routing.

■ TC53

Hilton- Taylor A

Finance, Portfolio Analysis 1

Contributed Session

Chair: Jinming Xie, The Chinese University of Hong Kong, Dept. of Syst. Eng. & Eng. Manag., Shatin, Hong Kong - PRC, jmxie@se.cuhk.edu.hk

1 - Are Markets Efficient? An Exercise in Predicting Exchange Rates
Arnav Sheth, Assistant Professor, Saint Mary's College of California, 380 Moraga Rd, Moraga, CA, 94556, United States of America, aas3@stmarys-ca.edu, Adam Duncan

Institutional traders trade foreign equities through the foreign exchange market at a benchmark rate called the WM/Reuters Fixing Rate, or the WM Fix. This indicates that a strong relationship between the WM Fix and equity indices exists. We test the predictability of the WM Fix, and exchange rates in general, using stepwise regression techniques and we find that such a relationship does indeed exist. This puts into question the hypothesis of informational efficiency in financial markets.

2 - Empirical Pricing Kernels: A Revisit
Jinming Xie, The Chinese University of Hong Kong, Dept. of Syst. Eng. & Eng. Manag., Shatin, Hong Kong - PRC, jmxie@se.cuhk.edu.hk, Duan Li

In this research, we revisit the empirical pricing kernels estimated by the option prices and the underlying asset prices. We estimate a time series of empirical pricing kernels non-parametrically and find that they consistently have oscillating shapes. Similar phenomenon are found in both the US and Hong Kong market. Besides, these oscillating shapes provide support to the Friedman and Savage utility function theory based on real market data.

3 - Financial Risk in Multifractal Asset Returns
Woojin Chang, Associate Professor, Seoul National University, 1 Gwanak-ro Gwanak-gu, Seoul, Korea, Republic of, changw@snu.ac.kr, Ho Jin Lee

Multifractal Processes provide long memory in volatility, fat-tail distribution behavior, and the moment scaling. We applied the Multifractal Model of Asset Returns, which was introduced by Calvet, Fisher, and Mendelbrot in 1997, to financial risk models such as Value at Risk and Expected shortfall. Both simulations and empirical studies are conducted to confirm the validity of our application.

4 - Set-valued Shortfall Risk Measures for Multi-asset Markets with Frictions
Cagin Ararat, PhD Candidate, Princeton University, 1 Charlton Street, Sherrerd Hall, Princeton, NJ, 08540, United States of America, cararat@princeton.edu, Birgit Rudloff, Andreas H. Hamel

In a multi-asset market with frictions, existence of individual utility functions for assets is assumed and the corresponding utility-based set-valued shortfall risk measures are studied. Their values are defined as the solutions of certain convex set optimization problems. Using a recent set-Lagrange duality, dual problems are obtained and they give rise to multi-objective versions of optimized certainty equivalents. Examples include the entropic risk measure and average value at risk.

5 - Enhancing Rebalancing Gains through Randomization and the use of Portfolio Tactics
Maximilian Goer, PhD Candidate, Princeton University, 12 Lawrence Dr, Apt 501, Princeton, NJ, 08540, United States of America, mgoer@princeton.edu, Woo Chang Kim, John Mulvey

It is well established that rebalancing gains or 'volatility pumping' can enhance the risk-reward characteristics of a portfolio. Due to increasing correlations between the major asset classes, these gains are hard to capture in practice. We show that rebalancing gains can be achieved by using portfolio tactics and selective randomization to decide which tactics are invested at any given time. Special attention will be given to the commodities space.

■ TC54

Hilton- Taylor B

Quantitative Financial Risk Management

Sponsor: Financial Services Section

Sponsored Session

Chair: Samim Ghamami, Economist, Federal Reserve Board, 20th Street and Constitution Ave NW, Washington, DC, 20551, United States of America, samim.ghamami@frb.gov

Co-Chair: Bo Zhang, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, United States of America, bozhang@gatech.edu

1 - Large Dimensional Factor Models Based on High-frequency Observations
Markus Pelger, University of California, Berkeley, Department of Economics, 508-1 Evans Hall, Berkeley, CA, 94720, United States of America, markus.pelger@berkeley.edu

This paper develops an inferential theory for factor models of large dimensions based on high-frequency observations. I estimate the number of factors and derive consistent and asymptotically normal estimators of the loadings and factors for very general stochastic processes in continuous time. The estimation approach can separate factors for systematic large sudden movements, so-called jumps factors, from continuous factors. I apply the approach to the U.S. equity market.

2 - Optimal Importance Sampling of Default Losses
Alexander Shkolnik, UC Berkeley, Berkeley, CA, United States of America, ads2@stanford.edu, Kay Giesecke

We develop an importance sampling estimator of large-loss probabilities in reduced-form models of name-by-name default timing. Such default timing models are widely used to measure portfolio credit risk and to analyze securities exposed to correlated default risk. In contrast with classical methods, our approach does not require knowledge of the loss transform and is implementable for virtually any model. We discuss the technical conditions guaranteeing asymptotic optimality of the estimator.

3 - Systemic Risk with Central Counterparty Clearing
Hamed Amini, EPFL, Extranef 249, Lausanne, 1015, Switzerland, hamed.amini@epfl.ch

We study a financial network in a stochastic framework. We measure systemic risk in terms of a coherent valuation principle. The framework allows us to examine the effects on systemic risk and price contagion of multilateral clearing via a central clearing counterparty (CCP). This is based on joint work with Damir Filipovic and Andreea Minca.

4 - Static Models of Central Counterparty Risk
Samim Ghamami, Economist, Federal Reserve Board, 20th Street and Constitution Ave NW, Washington, DC, 20551, United States of America, samim.ghamami@frb.gov

International standard setting bodies have outlined a set of principles for central counterparty (CCP) risk management; they have also devised CCP risk capital requirements on banks for their CCP exposures. There is still no consensus on how CCP risk should be measured coherently in practice. Based on novel applications of well-known mathematical models in finance, we introduce a coherent CCP risk measurement framework that gives a risk sensitive definition of the CCP risk capital.

■ TC55

Hilton- Van Ness

Stochastic MINLP With Endogenous Uncertainty

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Ban Kawas, IBM Research, 1101 Kitchawan Rd, Yorktown Heights, NY, 10598, United States of America, bkawas@us.ibm.com

1 - Transit Network Design Problem with Uncertain Demands
Chungmok Lee, Research Staff Member, IBM Research Ireland, Damastown Industrial Estate, Mulhuddart, Dublin, 15, Ireland, chungmok@ie.ibm.com, Rahul Nair

We consider a transit network design problem (TNDP) with uncertain demands. Typically the transit networks are very large and the formulation of the problem often requires nonlinear constraints making solving of the problem difficult. We present a decomposition approach enabling us to exploit the special structure of problem, which naturally localizes the uncertain demands only to user-behavior modeling sub problems. We then apply robust optimization to warrant solutions over uncertain demands.

2 - Distribution Shaping and Scenario Bundling for Stochastic Programs with Endogenous Uncertainty
Ban Kawas, IBM Research, 1101 Kitchawan Rd, Yorktown Heights, NY, 10598, United States of America, bkawas@us.ibm.com, Marco Laumanns, Steve D. Prestwich

Stochastic programs are usually formulated with probability distributions that are exogenously given. Handling endogenous uncertainty still remains a largely unresolved challenge. We develop a new approach to handle decision-dependent probabilities based on the idea of distribution shaping. We demonstrate on a pre-disaster planning problem and solve a recently considered instance of the Istanbul highway network to optimality within seconds, for which only approximate solutions had been known.

■ TC56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Syncopation Software - Decisions Large and Small, Made Faster and Better with DPL
Chris Dalton, CEO, Syncopation Software

This demonstration will explore the full range of DPL products. With DPL 8's convenient Excel add-in interface, performing a quick analysis on a spreadsheet takes just a few clicks, all right in Excel's ribbon. Moving beyond the basics, DPL's influence diagrams, decision trees and fault trees make quick work of a broad range of problems, from business valuation to tough security analyses. Need to make that decision 100 times? DPL's Portfolio version has you covered, including a new turnkey system for portfolio data management.

2 - FICO - Optimization on the FICO® Analytic Cloud
Oliver Bastert, FICO, Maximilianstr. 35a, Munich, Germany, OliverBastert@fico.com

This demo will show you how to turn an optimization model into a full optimization application, using FICO® Xpress Optimization Suite. We will also demonstrate how to deploy this application on the FICO® Analytic Cloud, with just a few clicks. Through the FICO Decision Management Platform, FICO's new cloud-based tools platform, you can build, implement and scale complex solutions combining predictive analytics, rules and optimization.

■ TC57

Hilton- Golden Gate 1

Curriculum Development

Sponsor: INFORM-ED

Sponsored Session

Chair: Peter Bell, Ivey Business School, 1255 Western Road, London, ON, N6G 0N1, Canada, pbell@ivey.uwo.ca

1 - Embed Decision Making in Middle School Mathematics
Kenneth Chelst, Wayne State University, 4815 Fourth St. MEB, Detroit, MI, 48201, United States of America, kchelst@wayne.edu, Asli Salhi-Koca, Thomas Edwards

Almost all middle school mathematics is simply descriptive and does not ask the student to use the information to make a quantitative based decision. Ratios, rates and percentages are critical skills developed in middle school mathematics. A standard example is: the ratio of boys to girls in a class is 3:2. If the class has 30 students how many are girls? We will demonstrate how to transform this and other standard textbook examples into practical decision making contexts.

2 - SAS Analytics Certificate Programs for Universities
Mike Speed, Analytical Consultant, SAS Institute, 9312 Lake Forest Ct S, College Station, TX, 77845, United States of America, mike.speed@sas.com, Jerry Oglesby, Curt Hinrichs

Over three dozen universities have partnered with SAS to offer certificate programs that provide their graduates with recognition for sought-after skills in the job market. Certificate programs vary by institution with some being more specialized in specific areas such as data mining while others being more general such as analytics. The talk will provide an overview of the programs, benefits and requirements for interested faculty and universities.

3 - MIT BLOSSOMS: A Gentle Introduction to OR for High School Classes
Richard Larson, Professor, MIT, E40-233, Cambridge, MA, 02139, United States of America, rclarson@mit.edu, Elizabeth Murray

The MIT BLOSSOMS program presents a freely available repository of interactive video lessons for high school STEM classes, STEM = Science, Technology, Engineering and Math. In its 7th year, we review BLOSSOMS, its "Teaching Duet" pedagogical model, its use in teacher Professional Development, its eight country partners, and its gentle introduction to OR concepts depicted in many BLOSSOMS lessons. Examples: applied probability, LP, social networks and graph theory.

■ TC58

Hilton- Golden Gate 2

Production and Scheduling 3

Contributed Session

Chair: Jian Chen, The University of Hong Kong, LG108, Composite Building, HKU, Hong Kong, Hong Kong - PRC, justinchenjian@gmail.com

1 - Stochastic Lot Sizing Problem with Controllable Processing Times
Esra Koca, Bilkent University, Department of Industrial Engineering, Bilkent, Ankara, 06800, Turkey, ekoca@bilkent.edu.tr, M. Selim Akturk, Hande Yaman Paternotte

We consider the stochastic lot sizing problem with controllable processing times. We assume that the compression cost function is a convex function as it may reflect increasing marginal costs of larger reductions and may be more appropriate when the resource life, energy consumption or carbon emission are also taken into consideration. We formulate the problem as a second order cone program (SOCP), use the recent advances in SOCP to strengthen it and then solve by a commercial solver.

2 - Rich Project Scheduling Based on Decomposition
Mehmet Gulsen, Asst. Professor, Baskent University, Baglica Kampus, Etimesgut, Ankara, 06810, Turkey, mgulsen@baskent.edu.tr, Huseyin Guden, Arda Turkgenci

We consider the rich project scheduling problem with multi-projects, multi-modes, resource constraints, divisible and indivisible tasks, and cost-time trade off which is motivated by an actual instance. Since the proposed model needs too much time and memory for solving large instances a heuristic method, based on the decomposition, is proposed for such instances. Critical path method and another model are used to reduce the size of the model. The method was tested in the actual instance.

3 - Robust Design and Operation of Red Blood Cell Production in a Parallelized Hollow Fibre Bioreactor
Ruth Misener, Royal Academy of Engineering Research Fellow, Imperial College London, South Kensington Campus, London, United Kingdom, r.misener@imperial.ac.uk, Nicki Panoskaltsis, Maria Fuentes Gari, Eirini Velliou, Stratos Pistikopoulos, Athanasios Mantalaris

Recent work developed a novel, biomimetic, cost-effective three-dimensional hollow fiber bioreactor for growing healthy red blood cells ex vivo. Experiments to empirically improve the bioreactor are cost- and labor-intensive, so we propose robust superstructure optimization for bioreactor design. We discuss the potential of our superstructure design strategy not only on this individual bioreactor but also more generally on bioprocess optimisation.

4 - Synchronization of Production Scheduling and Shipment in an Assembly Flowshop
Jian Chen, The University of Hong Kong, LG108, Composite Building, HKU, Hong Kong, Hong Kong - PRC, justinchenjian@gmail.com, George Q. Huang, Hao Luo, Jun Qiang Wang

We study a synchronized scheduling problem of production simultaneity and shipment punctuality in a two-stage assembly flowshop. Simultaneity seeks that all products belonging to a same customer order are simultaneously completed. Punctuality attempts to meet orders' individual due dates. Two performance measures is presented. We develop a scheduling model by balancing the two criteria. Genetic algorithm is used for solving the model. Numerical studies reach several significant findings.

■ TC59

Hilton- Golden Gate 3

Special Session: Best of Women in OR/MS

Sponsor: Women in OR/MS

Sponsored Session

Chair: Güzin Bayraksan, Associate Professor, Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, bayraksan.1@osu.edu

1 - How Near-Miss Events Amplify or Attenuate Risky Decision Making
Robin Dillon-Merrill, Georgetown University, 517 Hariri, McDonough School of Business, Washington, DC, 20057, United States of America, rld9@georgetown.edu

Exposure to near-misses alters responses to future risky events, and the results of exposure are not always the same. We differentiate two types of near-miss events: vulnerable, in which the events are viewed as disasters that almost happened, and resilient, in which the events are understood as disasters that did not occur. We show that vulnerable near-misses reduce future risk-taking behavior whereas resilient near-misses do not. We also offer recommendations for communicating risk.

2 - Optimization with Multivariate Conditional Value-at-Risk Constraints
Nilay Noyan, Associate Professor, Sabanci University, Sabanci University, Istanbul, 34956, Turkey, nnoyan@sabanciuniv.edu, Gabor Rudolf

For many decision making problems under uncertainty, it is crucial to specify decision makers' risk preferences based on multiple stochastic performance measures. We introduce a multivariate risk-averse preference rule based on CVaR and develop optimization models with multivariate CVaR constraints. For finite probability spaces we develop a cut generation algorithm, where each cut is obtained by solving a MIP. We show that our results can be extended to a wider class of coherent risk measures.

3 - Learning Consumer Tastes through Dynamic Assortments
Canan Ulu, Georgetown University, McDonough School of Business, Georgetown University, Washington, DC, 20057, United States of America, cu50@georgetown.edu, Dorothee Honhon, Aydin Alptekinoglu

We model this problem as a discrete time dynamic program where each period the firm chooses an assortment based on the prior distribution over consumer tastes. The consumers then choose a product that maximizes their own utility and the firm observes sales. We order assortments based on their information content and show that the optimal assortment cannot have lower information content than the myopically optimal assortment.

■ TC60

Hilton- Golden Gate 4

Inventory Management II

Contributed Session

Chair: Burcu Keskin, Associate Professor, University of Alabama, 300 Alston Hall, Tuscaloosa, Al, 35487, United States of America, bkeskin@cba.ua.edu

1 - Managing Disruption Risks: Aligning Inventory, Dual Sourcing and Agility Capacity Decisions

Florian Lücker, École Polytechnique Fédérale de Lausanne, EPFL - TOM Odyssea 4.16, Station 5, Lausanne, Switzerland, florian.luecker@epfl.ch, Ralf W. Seifert

In this talk we investigate the relationship between the three operational risk mitigation measures safety inventory, dual sourcing, and agility capacity by modeling a manufacturing firm. We quantify the decrease in inventory levels in the presence of dual sourcing and agility capacity. Furthermore, we show how to determine optimal inventory and dual sourcing decisions holistically. Within our modeling framework we introduce an operational metric that quantifies supply chain resilience.

2 - Sparsity-constrained Inventory Positioning in Online Retailing

Annie Chen, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, anniecia@mit.edu, Stephen Graves

Many online retailers operate with a large network of fulfillment centers. To reduce their operational overhead, the retailer will limit the number of fulfillment centers that hold each item. We formulate an optimization problem to position the inventory in their network, and propose a computationally efficient algorithm for solving it.

3 - Base-stock Policies for Lost Sales Models: Aggregation and Asymptotics

Joachim Arts, Eindhoven University of Technology, Postbus 513, Eindhoven, 5600MB, Netherlands, j.j.arts@tue.nl, Retsef Levi, Bert Zwart, Geert-Jan Van Houtum

We consider the optimization of base-stock policies for periodic review lost sales inventory models. We take an unconventional view of the state space that allows for aggregation. We derive asymptotic results for approximations within this aggregations. The rate of convergence of these asymptotics is independent of the lead time. Numerical results show that these approximations lead to optimality gaps of 0.01% on average.

4 - An Integrated Supplier Selection and Inventory Problem with Lateral Transshipments

Burcu Keskin, Associate Professor, University of Alabama, 300 Alston Hall, Tuscaloosa, Al, 35487, United States of America, bkeskin@cba.ua.edu, Mohammad Firouz, Sharif Melouk

We study the supplier selection problem of a firm operating multiple warehouses that face stationary stochastic demands, allowing multi-sourcing from suppliers and lateral transshipments among warehouses to mitigate the risks that arise from supplier quality, capacity, and disruptions. We use simulation-optimization approach to solve the problem and show the inherent trade-off between multi-sourcing and single sourcing under different disruption scenarios.

■ TC61

Hilton- Golden Gate 5

Military Applications Research at RAND

Sponsor: Military Applications Society

Sponsored Session

Chair: Adam Resnick, RAND Military Applications, xx, xx, United States of America, adam_resnick@rand.org

1 - Evaluating Basing Options for Optimizing Accessibility for Global Response Force

Jeremy Eckhause, Operations Researcher, RAND Corporation, 1200 S. Hayes St., Arlington, VA, 22202, United States of America, eckhause@rand.org, Christopher Pernin, Michael Schwille, Katharina Best

For a global response force to achieve its mandate, rapid access to almost any point on the globe is essential. Since the long-term presence of the US is difficult to predict, using of a set of intermediate bases may be required for establishing fast and sustainable access to large numbers of contingency locations. We present an approach for identifying a robust set of intermediate bases for ensuring global access and a methodology for identifying new bases as infrastructure requirements change.

2 - How Deployments Affect the Capacity and Utilization of Army Military Treatment Facilities

Adam Resnick, RAND Military Applications, United States of America, adam_resnick@rand.org

The Army wished to understand whether the Army's Force Generation cycle, designed to make the generation of deployable units more predictable, created ebbs and flows in the ability of military treatment facilities to provide care and respond to changing family needs as soldiers and care providers deploy and return home. This study examines how the cycle affects capability and soldier health care utilization at Army military treatment facilities and how it affects family health care utilization.

■ TC64

Parc- Cyril Magnin I

Market Microstructure and High Frequency Asymptotics

Sponsor: Applied Probability Society

Sponsored Session

Chair: Josh Reed, New York University, 44 W 4th St, New York, NY, 10012, United States of America, jreed@stern.nyu.edu

1 - Hydrodynamic Limit of Order Book Dynamics

Xuefeng Gao, Assistant Professor, The Chinese University of Hong Kong, William M. W. Mong Engineering Building, Shatin, Hong Kong - PRC, xfgao@se.cuhk.edu.hk, Jim Dai, Ton Dieker, Shijie Deng

We study the temporal evolution of limit order book shape on the macroscopic time scale, motivated by a desire to better understand the interplay among order flows, order book shape and price impact. Our main result states that in the scaling regime where time goes to infinity and price tick size goes to zero, a pair of measure-valued processes representing the sell-side shape and buy-side shape of an order book converges weakly to a pair of deterministic measure-valued processes.

2 - A Model for Queue Position Valuation

Kai Yuan, Columbia University, 3022 Broadway, 4J, Uris Hall, New York, NY, 10027, United States of America, KYuan17@gsb.columbia.edu, Ciamac Moallemi

We develop a model for valuing limit orders based on their relative queue position by identifying two important components of positional value: a static component that relates to the tradeoff at an instant of trade execution between earning a spread and incurring adverse selection costs; a dynamic component, which captures the optionality associated with the future value that accrues by locking in given queue position. Moreover, the model can be empirically calibrated.

3 - High Frequency Trading in Limit Order Markets: Stochastic Modeling and Asymptotic Analysis

Rama Cont, Imperial College, London, SW7 2AZ, United Kingdom, r.cont@imperial.ac.uk

We propose a stochastic model for a limit order market which captures the coexistence of high and low frequency and examine the consequences of HFT on price dynamics, volatility and liquidity. A detailed study of empirical HF data points to a multi-scale heavy traffic regime in which the limit order book may be described as a measure-valued Markov process, solution of a stochastic free boundary problem whose properties give some insight into how HFT affects price and order book dynamics.

4 - Scaling Limit of a Limit Order Book Model via the Regenerative Characterization of Lévy Trees

Peter Lakner, NYU Stern School of Business, New York, NY, United States of America, plakner@stern.nyu.edu, Josh Reed

We consider a one-sided limit order book model in a high frequency regime. Our main result shows that in the case where the mean displacement from the current best bid at which a new order is placed is positive, the measure-valued process describing the whole limit order book converges to a simple functional of reflected Brownian motion. A cornerstone of our approach is the regenerative characterization of Lévy trees proved by Weill.

■ TC65

Parc- Cyril Magnin II

Industry Job Search Panel

Cluster: INFORMS Career Center

Invited Session

Chair: Anne Robinson, Director of Supply Chain Strategy and Analytics, Verizon Wireless, Anne.Robinson@VerizonWireless.com

1 - Industry Job Search Panel

Moderator: Anne Robinson,Director of Supply Chain Strategy and Analytics, Verizon Wireless, Anne.Robinson@VerizonWireless.com, Panelists: Daniel H. Fylstra, Theresa Kushner, Thomas Olavson

MIT claims that 67% of companies see having analytics capabilities as a driver for their competitive advantage. However, according to TDWI, 46% of companies listed inadequate staffing or skills as the top barrier for realizing value from their data and analytics investments. What does it take to successfully position yourself for a career in big data and analytics in an organization? How do you identify the right employers who "get it" and will position you on a successful (and lucrative) job path? What are the other skills and leadership qualities required to be successful? Listen to a panel of industry experts answer these questions and more.

■ TC66

Parc- Cyril Magnin III

Panel Discussion on "Publishing in Quality and Reliability: The Editor's Perspective"

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Tirthankar Dasgupta, Associate Professor, Harvard University, 1 Oxford Street, 7th Floor, Harvard Statistics Department, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu

1 - Voice of the Editor (JQT)

Moderator: Bradley Jones, SAS/JMP, Bradley.Jones@jmp.com

The editor of the Journal of Quality Technology will share his perspectives and experiences with the audience and answer questions pertaining to publication.

2 - Voice of the Editor (Quality and Reliability Engineering International)

Douglas Montgomery, Arizona State University, United States of America, doug.montgomery@asu.edu

The editor of Quality and Reliability Engineering International will share his perspectives and experiences with the audience and answer questions pertaining to publication.

3 - Voice of the Editor (Technometrics)

Peihua Qiu, Professor, University of Florida, 2004 Mowry Road, Gainesville, FL, 32610, United States of America, pqiu@ufl.edu

The editor of Technometrics will share his perspectives and experiences with the audience and answer questions pertaining to publication

4 - Voice of the editor (IIE Transactions)

Jianjun Shi, Professor, Georgia Institute of Technology, 765 Ferst Dr NW, Atlanta, United States of America, jianjun.shi@isye.gatech.edu

The editor of IIE Transactions (Quality and Reliability Engineering) will share his perspectives and experiences with the audience and answer questions pertaining to publication.

■ TC67

Parc- Balboa

Application of Game-Theoretical Methods in Supply Chain, Reliability and Inventory

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Maryam Hamidi, Session Chair, University of Arizona, 1127 E. James E. Rogers Way, Room 111, P.O. Box 210020, Tucson, AZ, 85721, United States of America, mhamidi@email.arizona.edu

1 - Mining Leasing Contracts through Games Theory: Chilean Mine Case Study

Diego Carrasco, Pontificia Universidad Católica de Chile, vicuña mackena 4860, Santiago, RM, 7820436, Chile, dncarras@uc.cl, Maryam Hamidi, Haitao Liao, Rodrigo Pascual

The objective of this article is to present a methodology to assess mining leasing contracts decisions. The modeling of the problem considers a fleet composed of multicomponent equipment, each having different increasing failure rates. This failure rate is affected by the usage intensity given by the lessee to the equipment, and the quality of maintenance given by the lessor. The problem formulation is through games theory. It is tested on a haul trucks fleet operating in a mine in Chile.

2 - Revenue Sharing Contracts When Retailers can be Dishonest

Eda Kemahlioglu-Ziya, Assistant Professor, Poole College of Management at the University of North Carolina, Raleigh, NC United States of America, ekemahl@ncsu.edu, Seb Heese

To investigate the impact of dishonest information transfer, we consider a single-supplier single-retailer supply chain that operates under a contract with a revenue sharing clause, providing the retailer incentive to underreport sales revenues. We study the impact of cheating on the different supply chain constituents. We show that when the retailer can exert sales effort, a supplier might benefit from the retailer's dishonesty.

3 - Impact of Collaborative Incentive on Supply Chain Member Performance

Liyan Wang, Tongji University, Shanghai, China, ker820416@163.com, Minghai Ye

The objective of this paper is to uncover the nature of supply chain collaboration and explore its impact on supply chain member performance based on collaborative incentive. A three level model including a manufacture, a retailer and a salesperson is established based on game theory. The key propositions of the paper are listed as follows: both the manufacturer and the salesperson are beneficiaries of the collaborative incentive, while the retailer benefits or not is uncertain.

4 - Application of Game Theory on Inventory Level Decision Making

Masoud Vaziri, University of Rhode Island, University of Rhode Island, Kingston, RI, 02881, United States of America, masoudvaziri@my.uri.edu, manbir sodhi

Spare parts can be very profitable for corporations. This paper studies spare parts inventory games as N-person non-zero-sum single-shot games involving the OEM and the market in a non-cooperative setup. The OEM decides on its pricing strategy as well as the order-up-to stock level and resulting in a mixed strategy solution.

■ TC68

Parc- Davidson

New Directions in Applied Probability

Sponsor: Applied Probability Society

Sponsored Session

Chair: David A. Goldberg, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, dgoldberg9@isye.gatech.edu

1 - State Space Collapse for Critical Multistage Epidemics

Florian Simatos, Researcher, Inria, 23 avenue d'Italie, Paris, 75013, France, florian.simatos@inria.fr

We study a multistage epidemic model generalizing the SIR model, where individuals go through K stages of the epidemic before being removed. Infected individuals infect susceptible ones, who directly go to the same stage of the epidemic; or they go to the next stage of the epidemic. For this model, we identify the critical regime in which we establish diffusion approximations. Surprisingly, the limiting diffusion exhibits an unusual form of state space collapse which we analyze in detail.

2 - Scheduling using Interactive Oracles

Jinwoo Shin, Assistant Professor, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, jinwoos@kaist.ac.kr, TongHoon Suk

Since Tassiulas and Ephremides proposed the maximum weight scheduling algorithm in 1992, extensive research efforts have been made for resolving its high complexity issue. In this paper, we resolve the issue by developing a generic framework for designing throughput-optimal and low-complexity scheduling algorithms in constrained queueing networks via establishing a rigorous connection between iterative optimization methods and low-complexity scheduling algorithms.

3 - High-dimensional Estimation with Geometric Constraints
Elena Yudovina, University of Michigan Dept of Statistics, 439 West Hall, 1085 S University Ave, Ann Arbor, MI, 48109, United States of America, yudovina@umich.edu, Yaniv Plan, Roman Vershynin

Consider measuring an (unobserved) vector x in R^n through inner product with some (observed, possibly random) measurement vectors a_1, ..., a_m. The measurements may be nonlinear, e.g. because of clipping; they can even be one-bit, giving only the sign of the inner product. We give a simple procedure for recovering x, which is completely agnostic with respect to the nature of the nonlinearity, and gives essentially the best possible error bounds in several natural models.

4 - A Sensitivity Approach to Model Uncertainty
Henry Lam, Boston University, 111 Cummington Mall, Boston, MA, United States of America, khlam@bu.edu

Virtually any type of performance analysis of stochastic systems builds on model assumptions that, to various extents, deviate from the truth. I will demonstrate an optimization-based methodology to assess the impact of this model error, using Kullback-Leibler divergence as a model discrepancy measurement. Our contribution is a new infinitesimal approximation that reduces the typically difficult optimization problems into tractable simulation problems for suitably defined sensitivity quantities.

■ TC69

Parc- Fillmore

Joint Session ENRE/JFIG: Analysis of Biomass/Biofuel Production: Economic and Environmental Impacts

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment & Junior Faculty Interest Group

Sponsored Session

Chair: Halil Cobuloglu, PhD Candidate, Wichita State University, 1845 Fairmount St, Wichita, KS, United States of America, halil.cobuloglu@gmail.com

1 - Supply Chain Design and Management for Biocrude Production via Waste from Pulp & Paper Plants
Mohammad Marufuzzaman, Mississippi State University, Industrial & Systems Engineering, PO Box 9542, Starkville, MS, 39762, United States of America, maruf237@gmail.com, Sushil Poudel, Sandra D. Eksioglu

The objective of this research is to develop an optimization model to design and manage a biocrude supply chain network using waste generated from pulp & paper facilities. We propose a two-phase Analytic Center Cutting Plane algorithm to solve this challenging NP-hard problem. We tested the performance of the algorithm on a case study which we develop using data from the southeast region of U.S. Furthermore, we employ ArcGIS to visualize and validate the results from the optimization model.

2 - Sequential Location-Allocation Optimization of Fast Pyrolysis Facilities
Yihua Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, yihuali@iastate.edu, Guiping Hu, Wright Mark

A mixed integer linear programming (MILP) model is formulated to perform sequential expansion planning of biofuel production system with fast pyrolysis, hydroprocessing and refining technology. A case study in Iowa shows a sequential spatial construction under different levels of processing goal and the potential of drop-in fuels production in Iowa.

3 - Food vs Biofuel: An Optimization Approach to Analyze Land-use Competition and Environmental Impacts
Halil Cobuloglu, PhD Candidate, Wichita State University, 1845 Fairmount St, Wichita, KS, United States of America, halil.cobuloglu@gmail.com, Esra Buyuktahtakin

In this study, we develop a multi-objective mixed-integer optimization model to investigate trade-offs and competition between biomass and food production. The model maximizes total benefits and provides optimal decisions at the farm level while considering economic and environmental impacts such as soil erosion, GHG emission, nitrogen pollution, biodiversity, and food sustainability. Results are demonstrated with an application in Kansas by considering switchgrass and corn production.

4 - Bioenergy Supply Chain Network Design Model to Enhance Biomass Quality Characteristics
Krystel Castillo, Assistant Professor, The University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, krystel.castillo@utsa.edu, Erin Webb

This paper has two main contributions. First, a biomass supply chain network design model including quality uncertainties as well as operational costs is presented in order to capture the impact of the prevention or pretreatment activities to improve the moisture and ash content and reduce the energy consumption in the drying process and ash disposal at the conversion facility. Second, a metaheuristic method is proposed to solve this problem.

■ TC70

Parc- Hearst

Sustainability I

Contributed Session

Chair: Raja Jayaraman, Assistant Professor, Khalifa University, Department of Industrial & Systems Engin, Abu Dhabi, United Arab Emirates, raja.jayaraman@kustar.ac.ae

1 - A Case Study for Analyzing Air Pollution Impact Factors
Vahid Hosseini, Assistant Professor, Sharif University of Technology, Department of Mechanical Engineering, Tehran, Iran, vhosseini@sharif.edu, Hossein Shahbazi, Masoud Hamedi

Tehran is the capital city of Iran and one of the largest cities in western Asia, ranked 19th in the world with a population of 8.5 million. Air pollution is a major problem in Tehran, and has been influenced by several factors during recent years including rapid population growth, increasing personal car ownership, low technology level of produced vehicles and use of old vehicles with high fuel consumption. This study aims to investigate the impact of such parameters on Tehran air quality.

2 - Application of Green Supply Chain Management Strategies in Various Industries
Suna Cinar, PhD Student, Wichita State Unniversity, Wichita State University, Industrial Eng, 1845 Fairmount, Wichita, KS, 67260-0035, United States of America, sxcinar@wichita.edu, M Bayram Yildirim

Due to increasing environmental awareness, companies around the world want to become environmental friendly by reducing the amount of waste produced, amount of energy used, and by meeting the current environmental regulations. Green supply chain management is one of effective practices that can help industries including manufacturer, supplier to collaborate and create a green supply chain in their organization.

3 - Using Priming to Design Features that Influence Sustainable Purchases
Erin MacDonald, Assistant Professor, Iowa State University, 2020 Black Engineering Building, Ames, IA, 50011, United States of America, erinmacd@stanford.edu, Jinjuan She

This research strives to communicate a product's sustainability to the consumer through product features that trigger the consumer to value and seek further sustainability information during purchase. A novel design technique uses psychological priming to help designers create such features. We found that priming successfully enhances designers' skills. As tested with realistic prototypes, the features created affect consumers' thoughts of sustainability during product evaluation and purchase.

4 - Wal-Mart's Dilemma: Sales Growth vs. Inventory Growth
Seungjae Shin, Mississippi State Unveristy, Meridian, 2212 5th Street, Meridian, MS, 39301, United States of America, sjshin1204@gmail.com

Wal-Mart's business target is making a higher sales growth rate than inventory growth rate. Comparing with financial ratios of its competitors, Wal-Mart has significantly better ratios for day-in-inventory and cash-conversion-cycle. Regression analysis reveals that day-in-inventory, cash-conversion-cycle, and per employee cost-efficiency have similar effect on both sales growth rate and inventory growth rate. Supply chain ratio has more effect on inventory growth rate than sales growth rate.

5 - Sustainability and Firm Performance: The Mediating Role of Innovation
Paulo Gomes, Visiting Assistant Professor, Babson College, Babson Park, Wellesley, MA, United States of America, pgomes@babson.edu, Graça Silva

Do you need to innovate in order to profit from being green? This study investigates the mediating role of innovation on the relationship between sustainability practices and firm performance based on statistical analysis of data from manufacturing firms in Europe. We distinguish between three types of practices inbound, outbound and production. Results show that product innovation mediates the relationship between sustainability practices and sustainable performance.

■ TC71

Parc - Lombard

Pricing and Computation in Package Auctions

Cluster: Auctions

Invited Session

Chair: Ben Lubin, Assistant Professor, Boston University, 595 Commonwealth Ave, Room 621A, Boston, MA, 02215, United States of America, blubin@bu.edu

1 - Computational Techniques for Incentive Auctions

David Bergman, School of Business, University of Connecticut, One University Place, Stamford, CT, United States of America, david.bergman@business.uconn.edu, Andre Cire, Robert Day

The Federal Communications Commission is creating rules for and planning to run a voluntary incentive auction for broadcast TV spectra. In this talk we discuss how to model the problem of assigning stations to channels in the final repacking stage of the auction, and discuss various computational techniques that can be applied to solve for a valid repacking, including recently introduced binary decision diagram-based optimization.

2 - Informative Pricing in Package Auctions

Sebastien Lahaie, Researcher, Microsoft Research, 641 Avenue of the Americas, New York, NY, 10011, United States of America, slahaie@microsoft.com

The notion of informative prices is important in package auctions and motivates design choices such as linear prices, but the concept remains informal in the literature. Prices are informative if they give good estimates of the final cost of bundles, and drive the auction to convergence in a small number of rounds. We formalize the concept and derive implications using ideas from online and statistical learning.

3 - A Bayes-Nash Equilibrium Analysis of Payment Rules for Core-Selecting Combinatorial Auctions

Ben Lubin, Assistant Professor, Boston University, 595 Commonwealth Ave, Room 621A, Boston, MA, 02215, United States of America, blubin@bu.edu, Benedikt Bunz, Sven Seuken

In this paper, we use computational methods to study approximate Bayes-Nash equilibria of payment rules for core-selecting combinatorial auctions. Within these equilibria, we study the incentives, fairness, and efficiency of a wide range of existing and novel payment rules.

■ TC72

Parc- Stockton

Energy III

Contributed Session

Chair: Wei Yuan, PhD candidate, IMSE,USF, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, weiyuan@mail.usf.edu

1 - Reinforcement Learning for Energy Consumption Prediction of Converter Steelmaking Process

Yanyan Zhang, Northeastern University, 3-11 Wenhua Road, Heping District, Shenyang, China, zhangyanyan@ise.neu.edu.cn, Lixin Tang

The energy consumption prediction aims at estimating the amount of energy resources to be used. The problem is challenging owing to the coupling of energy consumption, regeneration, conversion, and the time-varying characteristic of production environment. This paper develops SVM based Q-learning method to deal with the energy prediction problem. Experimental results show that RL method is stable and with no less than 95% prediction accuracy.

2 - Cost-effective Power Grid Defending with Transmission Line Switching

Wei Yuan, PhD candidate, IMSE,USF, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, weiyuan@mail.usf.edu, Bo Zeng

Optimal power grid protection through defender-attacker-defender (DAD) model is a state-of-art approach for power system defending problem. In this research, we introduce transmission line switching as a cost-effective post-contingency mitigation operation into the DAD model. Exact algorithm is designed and numerical studies validate the effectiveness of transmission switching.

3 - Dynamic Allocation of Mobile Plants to Monetize Associated or Stranded Natural Gas under Uncertainty

Siah Hong Tan, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, tansh@mit.edu, Paul Barton

Associated or stranded gas presents a challenge to monetize due to its low volume and lack of supporting infrastructure. Mobile plants which produce GTL fuel or LNG on a small scale have been identified as attractive but yet unproven routes to gas monetization, We examine a multi-stage optimization framework which allocates mobile plants in a field under uncertainty of prices, supply and demand and perform a case study of monetizing associated gas in the Bakken shale play.

4 - Some Polyhedral Results for DCOPF Problem with Switching

Burak Kocuk, Georgia Institute of Technology, 765 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, burak.kocuk@gatech.edu, Santanu Dey, Andy Sun

Transmission line switching in power networks has become increasingly important in practice. However, underlying theory of this problem is not well-studied. In this work, we first prove some hardness results. Then, we propose a new formulation based on cycles, which is used to find valid inequalities and polyhedral results. Furthermore, we consider the problem with cardinality constraint. Finally, numerical results are provided.

5 - A Two-stage Price-based Unit Commitment Model for GENCOs with Wind Penetration

Yidong Peng, North Dakota State University, Industrial & Manufacturing Engineering, 1410 14th Avenue North Room 202 CIE, Fargo, ND, 58102, United States of America, yidong.peng@ndsu.edu, Jing Shi

In this study, we propose a two-stage stochastic programming model to solve Price-Based Unit Commitment problem (PBUC) for GENCOs with wind penetration. The proposed model considers both day-ahead and real-time electricity markets. The first stage deals with GENCOs' bidding strategies in day-ahead market, as well as the day-ahead PBUC, while the second stage considers GENCOs' real time actions in corresponding to the electricity price in the real-time market and volatility of wind power output.

■ TC73

Parc- Mission I

Storage and Demand Side Resources in Power Systems

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Yongpei Guan, University of Florida, Weil 413, Gainesville, FL, 32611, United States of America, guan@ise.ufl.edu

1 - Optimal Control of Plug-In Hybrid Electric Vehicles with Market Impact and Risk Attitude

Lai Wei, PhD Candidate, University of Florida, 387 Maguire Village, Apt 2, Gainesville, FL, 32603, United States of America, laiwei@ufl.edu, Yongpei Guan

We develop optimal electricity storage control policies for plug-in hybrid electric vehicles for the benefit of an energy market participant. We explore the cases for aggregators to participate only in a real-time market and in both the real-time and day-ahead markets. For each developed model, we analyze the properties of the value function and explore the corresponding optimal policy structure. Finally, through numerical study, we discuss the insights.

2 - Determining the Marginal Cost for Pumped-storage Plants for use in the Real-time Market

Goran Vojvodic, PhD Student, George Washington University, Department of Decision Sciences, School of Business, Washington, DC, 20052, United States of America, goranv@gwu.edu, David Morton, Ahmad Jarrah

In the energy sector, there is a huge interest in grid-level storage and efficiency in terms of resource usage. We deal with both topics and argue that a precise estimation of the marginal cost for pumped-storage units is needed. We introduce the concept of forward-looking thresholds and provide a stochastic optimization-based approach in order to estimate the thresholds. We demonstrate the stability and quality of our methodology and its superiority compared to an expected value based approach.

3 - Large Scale Optimization in Energy Systems
Mona Asudegi, University of Maryland, 9348 Cherryhill Road, Apt 811, College Park, MD, 20740, United States of America, asudegi@umd.edu, Ali Haghani

Developing an advanced system which can accommodate green energy and technologies such as solar, wind energy, and many more in the electric power grid and also applying an appropriate demand management system are fundamental keys toward resolving some of the energy concerns in the world. This study is focused on developing a demand response model and also an efficient heuristic algorithm for solving the model for the electric grid system.

4 - Value of Pumped Storage Hydropower in Ancillary Service Markets
Zhi Zhou, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, zzhou@anl.gov, Thomas Veselka, Vladimir Koritarov, Matthew Mahalik, Todd Levin

Energy storage facilities are becoming increasingly important in integrating variable generation into the power grid. Besides energy price arbitrage, a pumped storage plant can provide various ancillary services. We model the optimal operation strategy of a pumped storage system in a two-settlement electricity market and the associated ancillary service market. The value of pumped storage is analyzed for different levels of variable renewable generation in the system.

■ TC74

Parc- Mission II

Stochastic Programming in Energy

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Canan Uckun, Argonne National Laboratory, 9700 S. Cass Avenue, Lemont, IL, 60439, United States of America, cuckun@anl.gov

1 - Capacity Adequacy and Revenue Sufficiency in Electricity Markets with Wind Power
Todd Levin, Computational Engineer, Argonne National Laboratory, 9700 S. Cass Ave., Bldg. 221, Argonne, IL, United States of America, tlevin@anl.gov, Audun Botterud

We present a computationally efficient stochastic MIP that determines optimal generator expansion decisions, as well as periodic unit commitment and dispatch. The model is applied to analyze the impact of increasing wind power capacity on the optimal generation mix and the profitability of thermal generators. We find that increasing wind penetration reduces energy prices while the prices for operating reserves increase. Additionally, no thermal units are profitable without scarcity pricing.

2 - Optimizing a Battery Storage for the Regulation Service using Approximate Dynamic Programming
Bolong Cheng, Princeton University, Olden Street Engineering Quadrangle, Electrical Engineering, Princeton, NJ, 08544, United States of America, bcheng@princeton.edu, Warren Powell

There is growing interest in the use of battery storage to provide ancillary services to the electricity grid. We focus on the frequency regulation market of the PJM grid, where the storage unit needs to react to a control signal every two seconds. In addition, we also want to minimize the energy consumption during the optimization horizon and control the degradation from frequent charge/discharge cycles. We develop an approximate dynamic programming algorithm that optimizes the use of battery.

3 - Stochastic Optimization for Unit Commitment – A Review
Qipeng Zheng, Assistant Professor, University of Central Florida, Industrial Engineering & Management Sys, Orlando, FL, 32817, United States of America, Qipeng.Zheng@ucf.edu, Jianhui Wang, Andrew Liu

With the high penetration of renewables, increasing deregulation of the electricity industry and growing demands on system reliability, recent research has been focusing on transition from traditional deterministic approaches to stochastic optimization for unit commitment. Related literature has grown rapidly in the past several years, this talk is to review the works that have contributed to the modeling and computational aspects of stochastic optimization based UC, and discuss future research.

4 - An Improved Stochastic Unit Commitment Formulation to Accommodate Wind Power
Canan Uckun, Argonne National Laboratory, 9700 S. Cass Avenue, Lemont, IL, 60439, United States of America, cuckun@anl.gov, Audun Botterud, John Birge

The expansion of renewable resources, especially weather-based resources such as wind, creates more uncertainty and variability in the operation of the power grid. In this work, we propose an improved stochastic programming formulation to address these challenges. The proposed formulation improves the standard two-stage stochastic unit commitment problem by producing dynamic unit commitment decisions over time rather than fixing them in the first stage.

■ TC75

Parc- Mission III

Reliability I

Contributed Session

Chair: Arda Vanli, Assistant Professor, Industrial and Manufacturing Engineering Department. Florida State University, 2525 Pottsdamer St., Tallahassee, FL, 32310, United States of America, avanli@fsu.edu

1 - Condition Monitoring of Composites with Guided-wave Sensors
Arda Vanli, Assistant Professor, Industrial and Manufacturing Engineering Department. Florida State University, 2525 Pottsdamer St., Tallahassee, FL, 32310, United States of America, avanli@fsu.edu, Spandan Mishra

This study proposes a new statistical approach for damage identification and degradation monitoring of composites with guided-wave sensors. The features of Lamb-wave sensor signal that are sensitive to through-thickness cracks and delaminations are first identified using principle component analysis. An updating strategy is developed for Bayesian posterior distribution of the features with new condition data to make continuous assessment of the condition of the structure.

2 - Optimal Allocation of Resources in Reliability Growth Testing
MohammadHossein Heydari, University of Arkansas, Department of Industrial Engineering, 4129 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, mhheydar@uark.edu, Kelly Sullivan, Edward Pohl

Reliability growth testing seeks to identify and remove failure modes in order to improve the reliability of a product entering the market. We seek to deploy limited testing resources across a series-parallel system (i.e., at the system, subsystem, and component levels) in effort to maximize the reliability of a product upon entering the market, considering cost-benefit tradeoffs in testing at each level. We present a simulated annealing heuristic and analyze results for a set of experiments.

3 - A Synthesis of Feedback and Feedforward Control for Stationary and Nonstationary Disturbance Models
Lihui Shi, data scientist, eBay, 523 122nd PL Apt 3, Bellevue, WA, 98005, United States of America, shilihui@uw.edu, Kailash Kapur

Process adjustment strategy is an important part of the process improvement methods. For continuous improvement and proactive strategies, we propose the periodic shift disturbance models, and investigate the feedforward control application from a new disturbance decomposition framework. We combine feedforward control with feedback control for maintaining the stability of the process and delivering products at target values.

4 - Design Decision Process and Sensitivity Analysis for Multi-state Systems with Multi-state Components
Carlos Solorio, CETYS University, Calzada CETYS S/N, Mexicali, Mexico, carlos.solorio@cetys.mx

The level of complexity in the process of designing real life systems has grown tremendously. Highly reliable systems are needed, considering this high level of complexity. The analysis should consider the way components affect the whole system reliability. The performance measures developed are used for comparing two or more systems at a point in time and over a time horizon, and they also consider the disutility function, which help in selecting the best system.

5 - Random Field Modeling with Insufficient Snapshots for Probability Analysis and Design
Zhimin Xi, Assistant Professor, University of Michigan - Dearborn, 4901 Evergreen Rd, Dearborn, MI, 48128, United States of America

This paper proposes a new random field modeling method using a Bayesian Copula. The proposed method is composed of three key ideas: (i) determining the marginal distributions of random field variables, (ii) determining optimal Copulas to model the bivariate distributions of the random field variables, and (iii) modeling a joint probability density function of the random field variables. Two case studies were employed for the purpose of demonstrating.

■ TC76

Parc- Embarcadero

Practical & Tactical Pricing Decision Support Approaches

Sponsor: The Practice Track

Sponsored Session

Chair: Jim Mullin, VP, Planning Analytics, Veritec Solutions, 824 Miramar Terrace, Belmont, CA, 94002, United States of America, Jim@veritecsolutions.com

1 - Practical Tactical Pricing Decision Systems - Industry Examples
Jim Mullin, VP, Planning Analytics, Veritec Solutions, 824 Miramar Terrace, Belmont, CA, 94002, United States of America, Jim@veritecsolutions.com

This talk will provide an overview of practical decision support systems used for helping companies make more efficient and profitable pricing decisions. Examples of applications in several industries will be discussed.

2 - Using OR Analytics in Social Media Advertising
Brad Smallwood, VP, Advertising, Facebook, bsmallwood@fb.com

This talk will cover practical quantitative methods employed by social media companies to support tactical decision-making in advertising pricing and targeting. Specific emphasis will be given to real world examples over the last few years as the industry has grown rapidly and analytic techniques have evolved.

3 - Effective Pricing Decisions and Process for the Self-Storage Industry
Kevin Bowman, Director, Pricing & Revenue Management, kevin.bowman@storage-mart.com

This talk provides some background on the history and evolution of the self-storage industry, with a focus on how prices are set. In the last 3-4 years, substantial progress has been made in the use of data analytics to support a more formal pricing process. The result is that the industry leaders have moved towards a proactive, data-driven approach that is enabling them to separate their performance from slower-movers.

■ TC77

Parc- Market Street

Joint Session Analytics/HAS: Clinical Analytics, Informatics and Clinical Decision Making

Sponsor: Analytics & Healthcare Applications

Sponsored Session

Chair: John Zaleski, Chief Informatics Officer, Nuvon, Inc., 4801 S. Broad Street, Suite 120, Philadelphia, PA, 19112, United States of America, jzaleski@nuvon.com

1 - Early Warning Notifications Developed Using Medical Device Data
John Zaleski, Chief Informatics Officer, Nuvon, Inc., 4801 S. Broad Street, Suite 120, Philadelphia, PA, 19112, United States of America, jzaleski@nuvon.com

While much of the automatically collected medical device data in inpatient wards is obtained for the purpose of charting and documentation, collecting such data can offer greater clinical benefit. This presentation will survey some of the protocol- and guideline-based patient care management directives and detail how commonly-collected and automated medical device data can facilitate rapid decision making.

2 - Critical Medical Decisions
Adam Seiver, Senior Director and Chief, Medical Affairs, Philips Healthcare, Therapeutic Care, 27869 Saddle Court, Los Altos Hills, CA, 94022, United States of America, adam.seiver@philips.com

Despite massive investment, the electronic medical record disappoints when helping critical care clinicians make and execute high-quality decisions. This talk will: 1. Present three scenarios that highlight features of critical care decision-making. 2. Propose a decision-analytic (DA) framework for analyzing critical care decisions 3. Storyboard a DA-based computer system under development intended to help the critical care team make and execute high-quality critical care decisions.

3 - Modular Multi-parameter Clinical Decision Support on an EMR-independent Platform
Jim Fackler, Associate Professor, Johns Hopkins Univ. Sch. of Medicine, 318 Overhill Road, Baltimore, MD, 21210, United States of America, jim@jhmi.edu

Bridging data and decisions in an intensive care unit can be, quite literally, life and death. 300 data streams of varied data density and fidelity come from one patient. Although time-series analyses of single parameters adds value (e.g. heart rate variability), decisions will best be supported with multi-parameter "chunking" of data for analytics. This talk will discuss the role of 1) a modular clinical decision support system and 2) an EMR-independent architecture for its implementation.

■ TC78

Parc- Mason

Decision Analysis 4

Contributed Session

Chair: Jing Chen, Associate Professor, Dalhousie University, 6100 University Avenue, Halifax, NS, B3H 4R2, Canada, jchen@dal.ca

1 - Customer Returns, Pricing, and Personalization in an Online-Retail Dual Channel
Jing Chen, Associate Professor, Dalhousie University, 6100 University Avenue, Halifax, NS, B3H 4R2, Canada, jchen@dal.ca, Bintong Chen

The retailing industry today increasingly distributes product through both retail and online channels. Advances in data collection and analytics technology make it possible to implement personalized pricing in an online channel. An online channel, however, usually incurs significantly higher rates of customer returns. We examine how customer returns and personalized pricing affect a retailer's decision on whether to add an online channel in addition to a retail channel.

2 - Analysis of Supplier Performance using MAUT and Simulation
Hardik Bora, Iowa State University, Ames, IA, United States of America, hdbora@iastate.edu, Anuj Mittal, Pratik Pingle, Caroline Krejci

The analysis of supplier performance and identification of suppliers for improvement is essential to ensure product quality and to allocate organizational resources rationally. We describe a methodology that combines multi-attribute utility theory and Monte Carlo simulation to analyze various supplier performance metrics and rank suppliers accordingly, using case study data.

3 - The Effect of Educational Programs on Individual Protective Behaviors Toward Seasonal Influenza
Elnaz Karimi, Concordia University, 3440 Durocher, Apt.1405, Montreal, H2X2E2, Canada, karimi.lnz@gmail.com, Ketra Schmitt, Ali Akgunduz

A Health Belief Model (HBM)-based questionnaire was administered to two groups of undergraduate students to determine the predictors of seasonal influenza interventions. While the control group received only the questionnaires, the treatment group was subjected to an educational program about flu. The behavioral predictors in both groups were assessed based on a multivariate regression analysis.

4 - Bargainers Negotiating Attributes with Strict Tradeoffs
Michael Menasco, Emeritus, at University, San Bernardino, 9132 Hoopa Drive, Kelseyville, CA, 95451, United States of America, menasco_sr@mchsi.com, Abhik Roy

We construct necessary conditions for two bargainers negotiating over n attributes in a lexicographic order of attributes. We show negotiated outcomes are equivalent in both preference (utility) and attribute spaces. We begin with the basic case, whereby, there is constant rate of substitution between two attributes x and y (Keeney and Raiffa, 1976)and apply these results to three attributes (x, y, z).

5 - A Hierarchical Model for Making General Search Decisions
Matthew Oster, Pacific Northwest National Laboratory, 902 Battelle Blvd, Richland, WA, United States of America, matthewoster@gmail.com, Dale Henderson, Samrat Chatterjee

Searching for a lost plane at sea or a buried nuclear warhead requires careful planning and resources. Decisions related to choice of strategies, tactics, and resources are often made at different administrative levels. We propose a hierarchical structuring of this decision space in which many search policies may be shaped.

■ TC79

Parc- Powell I

Joint Session DAS/SPPSN: Decision Analysis in Policy Applications

Sponsor: Decision Analysis & Public Programs, Service and Needs
Sponsored Session

Chair: Karen Jenni, Insight Decisions, 2200 Quitman St, Denver, CO, 80212, United States of America, kjenni@insightdecisions.com

1 - Decision Analysis without Decision Makers
Karen Jenni, Insight Decisions, 2200 Quitman St, Denver, CO, 80212, United States of America, kjenni@insightdecisions.com

For a recent systematic multi-attribute based evaluation of alternative nuclear fuel cycles, current decision-makers specified only the factors that should be considered. Instead of further guidance on value functions, we were directed to consider multiple policy perspectives. We will describe several innovative techniques used to assure that an appropriately broad set of value perspectives could be considered, and the benefits of those approaches to the study sponsors.

2 - Turning Water into Wine: Decision Analysis Applied to Water Issues in the Heart of Napa Valley
Timothy Nieman, President, Decision Applications, 1390 Grove Court, Saint Helena, Ca, 94574, United States of America, tnieman@decisionapplications.com

Application of rigorous decision analysis framing and modeling methods can be very useful to small municipal government decision making, yet these applications face unique challenges. We discuss an application to water management issues in Napa Valley using Monte Carlo based climate modeling as a foundation for policy decisions, illustrating both the challenges and rewards of institutionalizing better decision methodologies at this level of government.

3 - Choosing Cleanup Strategy for Canada's Faro Mine – Challenges for Environmental Decision Analysis
Lee Merkhofer, Lee Merkhofer Consulting, 22706 Medina Court, Cupertino, CA, 95014, United States of America, lmerkhofer@prioritysystem.com

A description of a collaborative decision analysis, wherein members of Canada's Federal government, Yukon government, Indian tribes, and local citizens worked together to see if they could reach agreement on what to do about the abandoned Faro mine, a "toxic nightmare" that was once the largest lead and zinc mine in the world. Challenges and limitations of DA for resolving controversial environmental policy problems are well illustrated.

4 - Decision Analytical Applications in Ecosystem Recovery Planning
Bill Labiosa, Regional Science Coordinator, U.S. Geological Survey, Northwest Region, 909 1st Ave, 8th Floor, Seattle, WA, 98104, United States of America, blabiosa@usgs.gov

Within the context of the ecosystem recovery planning processes of the lead State agency in Puget Sound, WA, I will focus on two examples of the use of decision analytical framing and tools: 1) multi-attribute models to prioritize ecosystem recovery strategies involving multiple agencies and diverse stakeholders and 2) probability models to assess and represent uncertainty within a large model-based expert assessment used to rank "ecosystem threats" at watershed and coastal ecosystem scales.

■ TC80

Parc- Powell II

Recent Advances in Utility Theory

Sponsor: Decision Analysis
Sponsored Session

Chair: Ali Abbas, Professor, University of Southern California, Industrial and Systems Engineering, Price School of Public Policy, Los Angeles, CA, United States of America, aliabbas@illinois.edu

1 - Multiattribute Utility Functions Satisfying Mutual Preferential Independence
Ali Abbas, Professor, University of Southern California, Industrial and Systems Engineering, Price School of Public Policy, Los Angeles, CA, United States of America, aliabbas@illinois.edu, Zhengwe Sun

We discuss the general form of multiattribute utility functions that satisfy the ordinal condition of mutual preferential independence, and present methods for their assessments.

2 - Expected Utility, Parameter Uncertainty and Narrow Framing
Manel Baucells, USC Center for Social and Economic Research, 12025 Waterfront Drive, Playa Vista, Ca, 90094, United States of America, mbaucells@gmail.com, Rakesh Sarin

Can decisions made in isolation be optimal for the grand problem? For monetary decisions, we offer a simple proof that only logarithmic utility permits narrow framing in the presence of learning. Under parameter uncertainty, we show that narrow framing, learning, and ambiguity aversion cannot coexist. With no learning, aversion to parameter uncertainty reduces the optimal amount invested, and we provide a heuristic support for partial Kelly strategies based on such aversion.

3 - Multiattribute Ordinal Utility Functions
David Bell, Harvard Business School, Boston MA, United States of America, dbell@hbs.edu, Ali Abbas

We discuss desirable conditions that allow practical assessment of multiattribute ordinal utility functions.

4 - Revisiting Even Swaps
Debarun Bhattacharjya, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10598, United States of America, debarunb@us.ibm.com, Jeffrey Kephart

Even swaps (Hammond et al. 1998, 1999) is an interactive method that solves deterministic multi-attribute decision problems by iteratively removing columns and rows from the consequence table representation of the problem. We revisit the even swaps method, presenting (i) new properties such as the conditions under which an even swap is feasible; (ii) heuristics including a Bayesian method that learns preferences while guiding the user; and (iii) results from extensive experiments.

■ TC81

Parc- Divisadero

Social Media and Network Analysis in Data Mining

Sponsor: Data Mining
Sponsored Session

Chair: Onur Seref, Assistant Professor, Virginia Tech, Pamplin 1007, Blacksburg, VA, 24061, United States of America, seref@vt.edu

1 - Successful Delivery in Vehicle Routing
Fahrettin Cakir, University of Iowa, Department of Management Sciences, Iowa City, 52242, United States of America, fahrettin-cakir@uiowa.edu

Recent trend in businesses is to explore big data to discover facts they did not know before. Researchers resort to data-mining to increase business knowledge. However, there has been relatively little attention paid to the vehicle routing problem. Specifically, we focus on the problem of making successful delivery to locations. We study the correlation between the probability of successful delivery between locations and show why this information is valuable for logistics companies.

2 - Influence-Guided Community Detection in Social Networks
Wenjun Wang, PhD Student, The University of Iowa, S283 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, wenjun-wang@uiowa.edu, Nick Street

Using a new influence cascade model, we proposed an effective algorithm (IGSK) for community detection in binary networks. In this paper, we extend it to weighted networks to incorporate the weights on edges. Moreover, we present a novel influence-guided label propagation algorithm (IG-LPA) to uncover the hierarchical community structure in social networks. Tests on real-world networks and synthetic benchmarks demonstrates its excellent performance in terms of both accuracy and efficiency.

3 - Corporate Competitive Actions on Social Media: An Empirical Analysis
Alan G. Wang, Virginia Tech, Blacksburg, United States of America, alanwang@vt.edu, Yuhong Li, Weiguo Fan

An increasing number of firms have adopted social media for various business purposes. We focus on two dominant social media platforms, Facebook and Twitter, and empirically examine corporate competitive actions (CA) in social media. We aim to reveal the types of competitive actions undertaken by corporates on social media, the differences in competitive actions between social media and traditional media, and the effect of social media competitive actions on corporate performances.

4 - A Computational Rhetoric Framework for Mining Online Stock Commentaries
Onur Seref, Assistant Professor, Virginia Tech, Pamplin 1007, Blacksburg, VA, 24061, United States of America, seref@vt.edu, Michelle Seref, Alan Abrahams

We develop a computational rhetoric methodology that combines data mining, machine learning, and natural language processing to analyze rhetorical moves in online stock pitch arguments of players from an online investment game. We derive predictive models to determine a player's stock prediction accuracy and their influence in their online community. We compare our framework to conventional text mining methods to highlight the contribution of our computational rhetoric approach.

■ TC82

Parc- Haight

MCDM & Service Science: Theory and Applications

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Adiel T. de Almeida Filho, Assistant Professor, Universidade Federal de Pernambuco, Caixa Postal 7471, Recife, PE, 50630-971, Brazil, adieltaf@googlemail.com

1 - Tackling Uncertainty in Complex MCDA and MAUT Problems
Lisa Scholten, Eawag, Swiss Federal Institute of Aquatic Science and Technology, Ueberlandstrasse 133, P.O. Box 611, Duebendorf, ZH, 8600, Switzerland, lisa.scholten@eawag.ch, Nele Schuwirth, Peter Reichert, Judit Lienert

We present a new approach for tackling uncertainties in preference elicitation and predictive modeling of complex MCDA/MAUT problems and apply it to water infrastructure planning in Switzerland. A two-step procedure for preference elicitation is combined with uncertainty and global sensitivity analyses (UA, GSA). We will show the usefulness of UA and GSA to explore the importance and contribution of often ignored uncertainties and to focus on those crucial for discriminating alternatives.

2 - Integrating Stakeholders in an MCDA-process for Sustainable Water Infrastructure Planning
Judit Lienert, Dr., Eawag, Swiss Federal Institute of Aquatic Science and Technology, Ueberlandstrasse 133, P.O. Box 611, Duebendorf, ZH, 8600, Switzerland, judit.lienert@eawag.ch, Jun Zheng, Lisa Scholten

We focus our talk on stakeholder participation in an exemplary MCDA for sustainable water infrastructure planning. We combined a stakeholder with a social network analysis to identify main actors and their objectives. These were confirmed in a group workshop, in which we also generated alternatives for water infrastructures, and socio-economic future scenarios. Preference elicitation for the MCDA was done online and in interviews. We present main results of the case study and of lessons learnt.

3 - Examining Customer Service Features on Retail Websites
Kaveepan Lertwachara, Professor, California Polytechnic State University, 1 Grand Avenue, San Luis Obispo, CA, 93407-0304, United States of America, klertwac@calpoly.edu, Anteneh Ayanso

This research examines customer service functionalities implemented on top online retail sites in the U.S. Our study aims to determine the relationship between retailers' customer service performances, website traffic, and online sales. Our analysis is based on the Customer Service Life Cycle (CSLC) theory which includes four customer service stages: Requirements, Acquisition, Ownership, and Retirement.

4 - Service Design & Optimization in a Multi-channel Customer Support Environment
Ehud Rattner, University College Dublin, School of Business, Belfield, Dublin 4, Ireland, ehud.rattner@ucdconnect.ie, Vincent Hargaden, Paula Carroll

We develop a framework for service design and delivery in a multi-channel customer support environment. Using a linear programming approach, we optimize agent allocation, where the objective function is a weighted abandon rate. Hard constraints include agent availability and business metrics, time for agent training is a soft constraint.

■ TC83

Parc- Sutro

Optimization Models and Algorithms for Data Mining with Uncertainties

Sponsor: Data Mining

Sponsored Session

Chair: Neng Fan, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, nfan@email.arizona.edu

1 - Support Vector Machine Classification with Robust Chance Constraints
Ximing Wang, University of Florida, Gainesville, FL, 32611, United States of America, x.wang@ufl.edu, Panos Pardalos

In this talk, we explored approximation schemes for robust chance constraints in support vector machine classification assuming the moment information of the uncertain data are given. With an exact approximation and solving algorithm, the problem can be solved efficiently.

2 - Data-driven Support Vector Machines with Uncertainties
Neng Fan, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, nfan@email.arizona.edu, Elham Sadeghi

In this talk, we discuss data-drive support vector machines with uncertainties by robust optimization, chance-constrained optimization models and algorithms.

3 - Smartly Sharing your Information against User Account Linkage across Multiple Online Social Networks
Yilin Shen, benoit.shen@gmail.com, Hongxia Jin

Users are posting their personal status without being aware of how their information is shared across multiple OSNs. We first identify a practical and easy-to-conduct attack model to accurately link user accounts across OSNs, in which only very few public user information is needed. In order to defend against this attack, we develop the first countermeasure which keeps as much as user's information visible and meanwhile prevents users' accounts from being linked on various OSNs via k-anonymity.

Tuesday 4:30pm - 6:00pm

■ TD01

Hilton- Golden Gate 6

Search Theory

Sponsor: Military Applications Society

Sponsored Session

Chair: Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Graph Search with Delayed, Out-of-Sequence, and Incomplete Observations
David Casbeer, Air Force Research Laboratory, 2210 8th St, R300, WPAFB, OH, United States of America, david.casbeer@us.af.mil

A UAV is searching for a ground vehicle on a road network that is out-fitted with unattended ground sensors (UGSs). The UGSs are communication constrained and can only relay observations when the UAV visits them. The UAV lacks the ability to detect and identify the evader and must visit the UGSs to learn the evader's location. This scenario leads the UAV's control actions to depend on delayed, out-of-order, and incomplete observations. UAV control policies for guaranteed capture are discussed.

2 - When to Believe an Informant: A Model for Human Intelligence
Michael Atkinson, Naval Postgraduate School, 1411 Cunningham Road, Monterey, CA, United States of America, mpatkins@nps.edu, Moshe Kress

A searcher desires to find a target hiding in one of n cells. The searcher receives a stream of intelligence tips about the location of the target from an imperfect informant. At any time the searcher can engage the cell he thinks contains the target. There is urgency for the searcher to engage the cell quickly before the target executes an attack. If the target executes his attack, the searcher incurs some cost. If the searcher engages the wrong cell, additional collateral damage occurs.

3 - Dynamic Search Time Allocation Problem in a Complete Graph
Yan Xia, University at Buffalo, 342 Bell Hall, Buffalo, NY, 14260-2050, United States of America, yanxia@buffalo.edu, Rajan Batta, Rakesh Nagi

Decentralized method of routing a fleet of vehicles rarely considers workload sharing under stochastic environment. In this paper, we investigate the benefit of workload sharing for a decentralized, stochastic routing and time-allocation problem motivated by reconnaissance applications of unmanned aerial vehicles (UAVs). We develop two tractable routing methods with sharing for any given routing method with no sharing. One of the methods is guaranteed to be better the no-sharing method.

4 - CADSIM: A Tool for Analyzing Multiparty Strategic Interactions
Paul Scerri, Carnegie Mellon University, Robotics Institute, Pittsburgh PA, United States of America, pscerri@cs.cmu.edu, Joe Mola, Elan Freedy, Amos Freedy

Military analysts must often try to understand complex strategic interactions involving multiple parties with a mixture of cooperative and adversarial relationships. We present CADSIM, a tool that uses MDPs to explore a strategy space. The tool builds on an algorithm called TREMOR that manages a very large state space by focusing on interactions between actors, but otherwise computing policies independently. Graphical tool support empowers analysts to work with complex models.

■ TD02

Hilton- Golden Gate 7

Technology Entrepreneurship in China

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Yanbo Wang, Assistant Professor, Boston University, 595 Commonwealth Avenue, Boston, MA, United States of America, wyanbo@bu.edu

Co-Chair: Chuck Eesley, Assistant Professor, Stanford Univ., Huang Engineering Center Room 355, 475 Via Ortega, Stanford, 94305, United States of America, cee@stanford.edu

1 - Firm Performance & State Innovation Funding: Evidence from China's Innofund Program
Yanbo Wang, Assistant Professor, Boston University, 595 Commonwealth Avenue, Boston, MA, United States of America, wyanbo@bu.edu

Leading industrial economies have historically employed innovation subsidies with the aim of overcoming the market failures associated with financing tech-oriented small firms. Although our understanding of these policies' impact is mixed, industrializing economics have begun to embrace similar policies. Using a regression discontinuity design, this project investigates how a major innovation subsidy program in China impact firm performance, including survival, patenting, and refinancing.

2 - Innovation Paradox of Returnees: Evidence from China's High Technology Industries
Haiyang Li, Rice University, Houston, TX, United States of America haiyang@rice.edu, Jiangyong Lu, Seong-Jin Choi, Xiaohui Liu

We investigate why technology ventures led by returnees who in general enjoy technology advantage underperform the ventures led by their local counterparts. With a sample of technology ventures in China's high technology industries, we found that while returnee ventures have a higher level of innovation input, their innovation efficiency is lower than their local counterparts. Our results also show that innovation efficiency mediates the negative effect of returnees on venture performance.

3 - Political Hazards and Firms' Geographic Focus
Nan Jia, Assistant Professor, Marshall School of Business, University of Southern California, BRI 306, 3670 Trousdale Pkwy, Los Angeles, CA, 90089, United States of America, Nan.Jia@marshall.usc.edu, Kyle Mayer

We examine the relationship between the geographic focus of a firm's sales and the firm's vulnerability to expropriation hazards in the form of unauthorized levies. Although expanding outside the home location can initially increase a firm's exposure to government expropriation, we find that this effect reverses when a firm's sales outside its home location reach the point at which the firm pose a credible threat to exit the market in which it is being targeted.

4 - Does Institutional Change in Universities Influence High-Tech Entrepreneurship? Evidence from China
Chuck Eesley, Assistant Professor, Stanford Univ., Huang Engineering Center Room 355, 475 Via Ortega, Stanford, CA, 94305, United States of America, cee@stanford.edu, Delin Yang, Jamber Li

We examine how policies that attempt to change educational institutions to be more innovative affect the beliefs and behaviors of alumni entrepreneurs as well as the performance of firms they start. We address this question by studying how China's Project 985, an educational reform that attempted to foster innovation within a subset of Chinese universities, impacted entrepreneurs' beliefs regarding innovation.

■ TD03

Hilton- Golden Gate 7

Economics of Online Services

Sponsor: eBusiness

Sponsored Session

Chair: Mingdi Xin, Assistant Professor, University of California at Irvine, United States of America, mingdi.xin@uci.edu

1 - Optimal Timing of Sequential Distribution: Day-and-Date Strategy in the Movie Industry
Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Terrence August

We present a model of consumer choice that examines trade-offs between substitutable products (theatrical and video forms), the possibility of purchasing both alternatives, and a congestion externality affecting consumption at theaters. We characterize the market conditions under which a studio should pursue direct-to-video, day-and-date, and delayed video release strategies.

2 - Cardinality Bundling with Constrained Prices
Jianqing Wu, Purdue University, 403 W. State Street, West Lafayette, In, 47906, United States of America, wu35@purdue.edu, Mohit Tawarmalani, Karthik Kannan

Cardinality bundling (CB) is a kind of bundling strategies where firms set prices that depend only on the size of the bundle. The existing analytical framework of CB lacks sub-additivity constraints on bundle pricing, which limits its application in reality. In this study, we solve the CB problem with additional constraints on bundle prices: marginal decreasing prices; unit decreasing prices; and the general sub-additive prices. In addition, we provide gap analysis between different CB models.

3 - Spreading Goodwill through Social Media: Gratitude, Network Distance, and Charitable Giving
Dobin Yim, Fordham University, 113 West 60th Street, New York, NY, 10023, United States of America, dyim@fordham.edu

We explore how expression of gratitude affects charitable giving behavior, conditional on the distance the message travels over social networks. We extract message patterns from an online charitable giving campaign on Twitter and show that gratitude is positively associated with donation behavior. However, this positive effect dissipates over network distance. We discuss the implications of our findings and future direction of the study.

■ TD04

Hilton- Continental 1

Pharmaceutical and Healthcare Supply Chains

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Hui Zhao, Penn State University, Smeal College of Business, University Park, United States of America, huz10@psu.edu

1 - Recruitment Stocking Processes
Anh Ninh, RUTCOR, Rutgers Center for Operations Research, 100 Rockafeller Rd, Piscataway, NJ, 08954, United States of America, ninhtuananh@gmail.com, Yao Zhao, Benjamin Melamed

We define a general class of inventory control problems - recruitment stocking problems (RSP), where one needs to recruit a target number of subjects through multiple locations. RSP can be found in clinical trials, marketing research as well as recruitment of employees and military forces. We provide a mathematical characterisation of RSP and its performance metrics both exactly and approximately.

2 - Gatekeeper or Roadblock: Tradeoffing Evidence Generation and Access to New Drug

Hui Zhao, Penn State University, Smeal College of Business, University Park, United States of America, huz10@psu.edu, Leon Xu

The rocketing R&D cost and the flat number of new drugs approved over decades imply an unprecedented crisis in drug innovation productivity and post questions to the current drug innovation regulation. We consider alternatives to tradeoff access and evidence generation. Based on detailed modeling, we propose remedies for the accelerated approval pathway instituted in 1992 to speed up the development of new drugs but failed its original purpose.

3 - Coordination of the Influenza Vaccine Supply Chain in the Presence of Costly Demand Effort

Xinghao Yan, Ivey Business School - Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, xyan@ivey.uwo.ca, Greg Zaric

We study influenza vaccination supply chain consisting of a government, a vaccine manufacturer, and population. We show that the optimal order quantity is never less than the critical vaccination demand, defined as the demand without vaccine shortages. The optimal critical vaccination demand may not lead to herd immunity. We provide sufficient and necessary conditions for the existence of coordinating contracts in different contract families, defined according to which decisions are verifiable.

4 - Designing Health Care Supply Chain for Cardiovascular Diseases: A Predictive Analytic Application

Kingshuk Sinha, Professor, Mosaic Company Professor of Corporate Responsibility, Carlson School of Management, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Bhupinder Juneja, Ujjal Mukherjee

We report the results of an empirical study where socio-economic considerations are accounted for in designing a health care supply chain for cardiovascular diseases. A "big" data set on cardiovascular diseases is analyzed using predictive analytic techniques to develop a risk model for the population level disease condition.

■ TD05

Hilton- Continental 2

Retail Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Dorothee Honhon, Assistant Professor, University of Texas at Dallas, Naveen Jindal School of Management, Dallas, TX, 75080, United States of America, Dorothee.Honhon@utdallas.edu

Co-Chair: Amy Xiajun Pan, Assistant Professor, University of Florida, Department of ISOM, Warrington College of Business Administr, Gainesville, FL, 32611, United States of America, amy.pan@ufl.edu

1 - Econometric Analysis of Customer Conversion in eRetail

Nikolay Osadchiy, Assistant Professor, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30309, United States of America, nikolay.osadchiy@emory.edu, Vishal Gaur

We model the process of customer acquisition and conversion in retail. Using the data from an online specialty retailer, we estimate parameters of the customer conversion process and discuss implications for advertising and promotion planning.

2 - Optimal Pricing and Ordering Policy for Perishable Products

Amy Xiajun Pan, Assistant Professor, University of Florida, Department of ISOM, Warrington College of Business Administr, Gainesville, FL, 32611, United States of America, amy.pan@ufl.edu, Zumbul Atan, Dorothee Honhon

We consider the problem of a retailer managing fresh and perishable/old products. Depending on the shelf display, consumers have different purchase behavior. We provide the optimal discounting policy for the old products and ordering policy for the fresh products, and propose effective heuristics.

3 - Dynamic Assortments in Online Retailing

Bharadwaj Kadiyala, PhD Student, University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, 75080, United States of America, bxk121930@utdallas.edu, Dorothee Honhon, Canan Ulu

Online retailing offers a unique opportunity to gather information about customer preferences. The extent to which this information is censored depends largely on the framework in which websites operate i.e., where and how much information about products is displayed to customer during their browsing process. Using a Bayesian framework, we study assortment decisions with information obtained from online sales and customer clicks, with the aim of maximizing profits.

4 - Selling to Nanostores

Jiwen Ge, PhD Candidate, Eindhoven University of Technology, De Lismortel 38, Eindhoven, 5612AR, Netherlands, J.Ge@tue.nl, Dorothee Honhon, Jan C. Fransoo, Lei Zhao

Nanostores are small retail stores which are prevalent in mega-cities. Consumer Packaged Goods manufacturers frequently send salespersons to visit nanostores and generate sales. We build MDP models to optimize a manufacturer's sales effort strategy while considering the suboptimal behavior of the nanostores. Optimal polices and parametric results are derived.

■ TD06

Hilton- Continental 3

Disruption Risk Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Nitin Bakshi, Assistant Professor, London Business School, NW1 4SA, London, United Kingdom, nbakshi@london.edu

1 - Inducing Suppliers to Improve Reliability with Contracts and Delegation

Woonam Hwang, PhD Candidate, London Business School, Regent's park, London, NW14SA, United Kingdom, whwang@london.edu, Nitin Bakshi, Victor DeMiguel

Suppliers can mitigate supply risk by improving their processes or overproducing, but their mitigating actions are often not directly contractible. We investigate how buyers can use contracts and delegation to induce the suppliers to improve reliability. We find that, although suboptimal, simple contracts can often generate high efficiency. Also, delegating the production quantity decision to the supplier can mitigate the problem of incentive alignment, resulting in higher efficiency.

2 - Increasing Supply Chain Robustness through Process Flexibility and Strategic Inventory

Yehua Wei, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yehua.wei@duke.edu, He Wang, David Simchi-Levi

In this talk, we consider a combination of process flexibility and strategic inventory as an effective disruption mitigation strategy. For a manufacturer with multiple plants, we analyze K-chain flexibility designs in which each plant is capable of producing exactly K products. We find that while 2-chain can be very effective in disruption mitigation, 3-chain is significantly more robust than 2-chain when there is demand uncertainty.

3 - Responsible Sourcing in Supply Chains

Robert Swinney, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27516, United States of America, robert.swinney@duke.edu, Hau Lee, Ruixue Guo

We analyze the sourcing decision of a buyer choosing between two supplier types: responsible suppliers are costly while risky suppliers are less expensive but may experience responsibility violations. Some consumers are socially conscious, willing to pay for a responsibly sourced product and willing to punish (by exiting) if there is a responsibility violation. We find the buyer's optimal sourcing strategy and determine how market and supply chain characteristics drive incentives to source responsibly.

■ TD07

Hilton- Continental 4

INFORMS Analytics Maturity Model

Cluster: INFORMS Communities

Invited Session

Chair: Barry List, Director of Commuications, INFORMS, 5521 Research Park Dr., Catonsville, MD, 21228, United States of America, barry.list@informs.org

1 - Launching INFORMS Analytics Maturity Model 2.0

Norm Reitter, Director, Analytics, CANA Advisors, 7371 Atlas Walk Way, Gainesville, VA, 21055, United States of America

The IAMM has been developed over two years to provide organizations with a probing way to do self-assessment and plan for the future. The IAMM committee chair explains how it has gone from beta version to launch date at the INFORMS Annual Meeting.

2 - How Business, Government and Consultants Can Use the New INFORMS Maturity Model
Aaron Burciaga, Senior Manager, North America Inventory Analytics Lead, Accenture, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, adburciaga@gmail.com

The IAMM is a diagnostic and planning tool that can be used not only by business, but also by government agencies and consultants working with a variety of organizations. Aaron Burciaga, a key participant in the model's development, demonstrates how it can be used to full advantage.

3 - What Every Academic Needs to Know About the Maturity Model
Barry List, Director of Commuications, INFORMS, 5521 Research Park Dr., Catonsville, MD, 21228, United States of America, barry.list@informs.org

Academics can gain advantage from the IAMM by acting as advisors to industry. INFORMS Communications Director Barry List reviews the academic/industry connection.

■ TD10

Hilton- Continental 7

Supply Chain Design

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Nico Vandaele, Professor Dr., KU Leuven, Naamsestraat 69, Leuven, 3000, Belgium, Nico.Vandaele@kuleuven.be

1 - A Stakeholder Perspective as a Basis for Sustainable Supply Chain Design
Catherine Decouttere, Senior researcher, KU Leuven, Naamsestraat 69 Box 3555, Leuven, 3000, Belgium, catherine.decouttere@kuleuven.be, Nico Vandaele, Stef Lemmens

A 5-step framework is presented which embeds sustainability in supply chain modelling: stakeholder analysis, key performance setup, model and scenario building, scenario ranking and final choice. We focus on the first and second step: the stakeholder analysis reveals the number, type and interrelationships between the stakeholders; here from a concise set of key performance indicators is derived. We include technical, economical and value based KPI's based on real-life industrial evidence.

2 - Integrated Supply Chain Network Design for Vaccines: A Literature Review
Stef Lemmens, PhD-researcher, KU Leuven, Naamsestraat 69 Box 3555, Leuven, 3000, Belgium, stef.lemmens@kuleuven.be, Nico Vandaele, Catherine Decouttere

Companies all over the world are confronted with designing the supply chain of their businesses. The aim of this literature review is twofold. We provide an updated overview on integrated supply chain network design and we study the concepts for a peculiar pharmaceutical product: vaccines. This presentation provides an overview of different supply chain network characteristics, supply chain performance measures and show how uncertainty is incorporated in the design of a supply chain network.

3 - Horizontal Collaboration and Fairness
Philippe Chevalier, Professor, UCLouvain, Voie du Roman Pays 34, L1.03.01, Louvain-la-Neuve, 1348, Belgium, philippe.chevalier@uclouvain.be, Alejandro Lamas

We model participants to the supply chain as a capacitated lot sizing problem and study how fairness can be implemented to foster fair and efficient horizontal collaboration in a supply chain.

4 - Designing Supply Chain Interfaces under Asymmetric Information
Per Agrell, Université Catholique de Louvain, 34 Voie du Roman Pays, L1.03.01, Louvain-la-Neuve, 1348, Belgium, per.agrell@uclouvain.be, Peter Bogetoft

Delegation of upstream supplier coordination to contract manufacturers is found in practice, but disputed. We study the organizational and contractual choice of a coordinator to either control or delegate the investment decision of some shared resource to a CM or to an upstream supplier in a three-stage supply chain. The analysis derives closed-form results for the economic performance for different delegation schemes under asymmetric information on investment cost.

■ TD11

Hilton- Continental 8

MSOM Fellows Session

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Gal Raz, Associate Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, razg@darden.virginia.edu

1 - Multidimensional Approximation Algorithms for Capacity-expansion Problems
Robin Roundy, Brigham Young University, Provo, UT, 84602, United States of America, robin@mathematics.byu.edu, Van-Anh Truong

We develop high-dimensional approximation algorithms to compute provably near-optimal capacity-expansion policies. Our approach is computationally efficient and produces a policy with expected cost of no more than twice that of an optimal policy. We overcome the curse of dimensionality using cost-separation schemes. This is the first approximation technique for multimachine, multiproduct systems with stochastic, nonstationary, correlated demands.

2 - Operations Management and the Discounting-Risk Neutrality Conundrum
Matthew J. Sobel, Case Western Reserve University, Weatherhead School of Management, Cleveland, OH, 44106, United States of America, Matthew.sobel@case.edu

The following result from preference theory does not square with empirical reality: if a decision-maker's preferences are consistent with time discounting, then they are consistent with risk neutrality. In my experience, operations managers are sensitive to both timing and risk. This talk sketches the conundrum, outlines a possible solution, and describes some consequences for research in operations management.

3 - The Service and Information Economy: Research Opportunities
Uday Karmarkar, UCLA, 110 Westwood Plaza, Gold Hall, Suite B-512, Los Angeles, CA, 90066, United States of America, uday.karmarkar@anderson.ucla.edu

The US economy is already dominated by services and information. These trends are also present in all large economies in the world. I discuss opportunities for research in Operations and Technology Management related to these substantial economic shifts.

■ TD12

Hilton- Continental 9

Emerging Issues in Sustainable Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Isil Alev, Doctoral Student, Georgia Tech School of Industrial and Systems Engineering, isilalev@gatech.edu

1 - The Implications of Extended Warranties on a Closed-Loop Supply Chain
Wayne Fu, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, United States of America, Wayne.Fu@scheller.gatech.edu, Atalay Atasu

Extended warranties can improve the product value perceived by customers. But they also expand the obligation of manufacturers. In this study, we establish a stylized model that accounts for the effects of warranties, endogenizes the allocation decisions, and demonstrates the impact of extended warranties on product-line choices, and overall profitability. We also highlight the relationship between extended warranties offering and product-line choices.

2 - Strategic Allocation of Medical Surplus
Wee Meng Yeo, YeoWee.Meng@scheller.gatech.edu

To bridge the gap between medical surplus and needs, the Medical Surplus Recovery Organization (MSRO) allows recipients to pick items under full information visibility. Each recipient can either order or wait. We characterize the equilibrium strategies that are Pareto-optimal threshold. We investigate an alternative strategy where MSRO dictates the choice of its recipient and shipment. We develop novel insights and frameworks guiding the operational strategies for a medical-surplus supply chain.

3 - Effect of Government Subsidies on the Adoption of Energy Efficient Products
Haoying Sun, Assistant Professor, Texas A & M University, 301K Wehner, 4217 TAMU, College Station, TX, 77845, hsun@mays.tamu.edu, Steve Gilbert

We use the durable goods framework to study how the timing of the government subsidy program on energy efficient products affects the manufacturer's production and investment decisions and how this in turn affects the energy consumption.

4 - Impact of E-Waste Regulations on the Sale and Lease Strategies
Ni Fang, HEC Paris, 1, Rue de la Libération, Jouy en Josas, 78350, France, ni.fang@hec.edu, Andrea Masini

While e-waste regulation is becoming increasingly popular to minimize the environmental impact, its actual effects remain unclear. In this paper, we study impact of e-waste legislations on the regulated manufacturer's distribution channel strategies amid manufacturer's free choice of dealing with off-lease units in monopoly environment.

■ TD14

Imperial B

Joint Session WORMS/JFIG/MIF: Speed Networking

Sponsor: Women in OR/MS, Junior Faculty Interest Group, & Minority Issues Forum

Sponsored Session

Chair: Susan Martonosi, Associate Professor, Harvey Mudd College, Claremont, CA, United States of America, martonosi@g.hmc.edu

Co-Chair: Julie Ivy, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, United States of America, jsivy@ncsu.edu

Co-Chair: Esra Buyuktahtakin, Assistant Professor, Wichita State University, Wichita, KS, United States of America, esra.b@wichita.edu

1 - Speed Networking
Esra Buyuktahtakin, Assistant Professor, Wichita State University, Wichita, KS, United States of America, esra.b@wichita.edu

Are you looking for a new research collaborator? Eager to branch out into a new area of research? Looking to establish professional connections outside of your institution? WORMS, MIF and JFIG invite you to this Speed Networking session. Participants will be grouped according to broad research interests and will meet successively in pairs to share research backgrounds and contact information. Bring your business cards!

■ TD15

Hilton- Exec. Boardroom

Revenue/Yield Management I

Contributed Session

Chair: Pawan Chowdhary, IBM Research Center, 650 Harry Rd, San Jose, CA, 95120, United States of America, chowdhar@us.ibm.com

1 - Differentiated B2B Pricing Strategy for Service Configurations
Pawan Chowdhary, IBM Research Center, 650 Harry Rd, San Jose, CA, 95120, United States of America, chowdhar@us.ibm.com, Zhengliang Xue, Markus Ettl

We study a method to price personalized service configurations. A seller has to deal with request-for-quotes of fully customized packages. A top-down and bottom-up approach is applied to estimate buyer's purchase probability for any configuration based on historical data. In a B2B setting, client relationship is considered in pricing decision, which is incorporated into a utility model assessing market value of configuration and impact of relationship. The business impact is justified by data.

2 - Immediate vs. Past-Purchase Based Retail Price Discounts
Michael Pangburn, University of Oregon, 1208 University of Oregon, Eugene, OR, 97405, United States of America, pangburn@uoregon.edu, Monire Jalili

Retailers commonly offer an immediate discount percentage off regular price. In contrast, some retailers apply a credit toward a future purchase, based on the customer's prior purchase. We contrast the efficacy of these two discounting strategies to better understand conditions under which prior-purchase based discounts may outperform immediate discounts.

3 - Optimal Keyword Bidding in Search Based Advertising
Baris Selcuk, Assoc.Professor, Bahçesehir University, Ciragan cad., Ciragan cad., Istanbul, 34353, Turkey, bariselcuk@gmail.com, Ozgur Ozluk

In search-based advertising, advertisers bid on keywords to have an impact on their ad's placement. An advertiser must bid correctly for each keyword in order to maximize the expected revenue while keeping the daily costs in mind. We construct an optimization model that maximizes total expected advertising revenue while keeping the total costs below a given advertising budget where the stochastic relationship between the bid prices and the click-through-rates is considered.

■ TD16

Hilton- Franciscan A

New Applications of Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Georgia Perakis, William F. Pounds Professor, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, 02142, United States of America, georgiap@mit.edu

1 - Optimization Models and Insights for Promotion Planning
Maxime Cohen, PhD Candidate, MIT, maxcohen@mit.edu, Georgia Perakis, Kiran Panchamgam

We study the Promotion Optimization Problem, i.e., deciding which items to promote, at what time and at what price. Our formulation includes several business rules that arise in practice. We build demand models from data in order to capture the stockpiling behavior as well as cross items effects. This gives rise to a hard problem. We then propose efficient LP based methods, show theoretical performance guarantees and validate our results using real data.

2 - Scheduling with Testing
Yaron Shaposhnik, MIT, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, United States of America, shap@mit.edu, Retsef Levi, Thomas Magnanti

We study a new class of scheduling problems that captures a common tradeoff between using resources for processing jobs, and investing resources to 'test' jobs and learn more about their uncertain attributes. This can inform future decisions, but also delay service. We derive intuitive structural properties of the optimal policies, and use a new cost-accounting scheme to devise a surprisingly low dimensional dynamic programming formulation, which ultimately leads to an FPTAS.

3 - Data-driven Bundle Pricing with Dynamic Product Valuation and Substitution Effects
Wei Sun, Researcher, IBM T J Watson Research Center, 1101 Kitchawan Road, 05-034D, Yorktown Heights, NY, 10598, United States of America, sunw@us.ibm.com, Anshul Sheopuri, Dashun Wang

We study bundle pricing for technology products and services (e.g., handset with plans, console with games), where dynamic product valuations (willingness to pay) and substitution effect within a product group are prominent. We propose a data-driven method that fits a copula model over the joint valuations with sales data. A case study on a telecom company demonstrates the importance of incorporating dynamic valuation, product substitution and correlations in the joint distribution.

4 - Data-driven Newsvendor with a Mixture Distribution
Chongli Daniel Chen, Operations Research Center, MIT, 77 Mass Ave, Bldg E40-130, Cambridge, MA, 02139, United States of America, dcchen@mit.edu, Retsef Levi, Georgia Perakis

We consider a newsvendor facing demand that is a mixture of known finite distributions, but with unknown weights. Given a small sample of the true distribution, we formulate the problem as a robust optimization problem using a mixture distance to define the uncertainty set. This results in a tractable linear program, and we prove convergence properties. Preliminary simulations show good performance for small sample sizes. This approach is general and can be adapted for different cost functions.

■ TD17

Hilton- Franciscan B

Empirical Studies in Healthcare Operations Management

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Nan Liu, Assistant Professor, Columbia University, 600 W. 168th St., 6th floor, New York, NY, 10032, United States of America, nl2320@columbia.edu

Co-Chair: Pengyi Shi, Assistant Professor of Operations Management, Purdue University, Krannert School of Management, West Lafayette, IN, United States of America, shi178@purdue.edu

1 - A Comprehensive Probabilistic Framework for Prediction of Patients' Readmission to Medical Centers

Adel Alaeddini, University of Texas at San Antonio, One UTSA Circle, San Antonio, United States of America, Adel.Alaeddini@utsa.edu, Jon Stauffer, Kurt Bretthauer, Jonathan Helm

The problem of readmission to medical centers after getting discharged often causes serious problems to both patients and medical centers. In this study we develop a comprehensive probabilistic framework based on integration of survival models, and local regression analysis to provide an accurate real-time estimate of readmission, personalized for each patient. We also design a comprehensive optimization model to find the optimal parameters of the proposed framework.

2 - Consequences of Delays in Patient Transfers Out of the Mass General Hospital ICU

David Scheinker, dscheink@gmail.com, Sara Dolcetti, Benjamin Christensen, Retsef Levi, Ulrich Schmidt, Tara Tehan, Bethany Daily, Peter Dunn

More expert guidelines exist to prevent transfer delay to an Intensive Care Unit than transfer delay from an ICU. We test the assumption that a patient delayed in the ICU is no worse off than she would be in a general care unit. In particular, we examine the impact of transfer delays from the ICU on total patient length of stay. We find that ICU transfer delays extend total patient hospital length of stay. This finding allows us to more accurately quantify the financial impact of such delays.

3 - The Effect of Health Plan Type on the Utilization of Advanced Diagnostic Imaging

Xin Zheng, Boston University, 595 Commonwealth Ave, Boston, United States of America, xinzheng@bu.edu, Rona Doncaster, Amy McLaughlin, Justin Ren, Anita Tucker, Jonathan Beebe

Using 2010 Thomson-Reuters MarketScan commercial claims and encounters database, we found that HMO beneficiaries overall uses about 339 millions less and HDHP beneficiaries uses around 392 millions less imaging studies than PPO beneficiaries given all the control variables in these plans the same. These differences could be the potential source for unwanted health care usage. Understanding this can help us reduce health care waste from the costly imaging studies.

4 - An Analysis of Patient Preferences and Choice Behavior in Outpatient Appointment Scheduling

Nan Liu, Assistant Professor, Columbia University, 600 W. 168th St., 6th floor, New York, NY, 10032, United States of America, nl2320@columbia.edu, Stacey Finkelstein, Beena Jani, David Rosenthal, Margaret Kruk

Patient choice of an outpatient appointment depends on her preferences over a variety of attributes associated with the appointment and how she makes trade-off among them. By conducting discrete choice experiments on different populations, we investigate a comprehensive set of "operational" attributes that can affect patient choice. We also explore heterogeneity in patient preferences and explain this heterogeneity by identifying individual characteristics that can modify patient preferences.

■ TD18

Hilton- Franciscan C

Customer Choices, Upgrades and Prices

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Metin Cakanyildirim, University of Texas at Dallas, Campbell Road, Richardson, United States of America, metin@utdallas.edu

1 - Dynamic Pricing and Replenishment with Customer Upgrades

Oben Ceryan, Assistant Professor, Department of Decision Sciences, LeBow College of Business, Drexel University, 3220 Market St., Philadelphia, PA, 19104, United States of America, oc43@drexel.edu, Ozge Sahin, Izak Duenyas

We study the impact of product upgrades on a firm's pricing and replenishment policies by considering a multiple period, two-stage model where the firm first sets prices and replenishment levels, and after observing the demand, it decides whether to upgrade any customers to a higher quality product. We characterize the structure of the optimal upgrade, pricing, and replenishment policies and find that offering upgrades assists in preserving the vertical price differentiation of the products.

2 - Revenue Management under Customer Choice Behavior with Cancellations and Overbooking

Dirk Sierag, CWI, Science Park 123, Amsterdam, Netherlands, D.D.Sierag@cwi.nl, Jean-Pierre van der Rest, Bert Zwart, Rob van der Mei, Ger Koole

In many application areas such as airlines and hotels a large number of bookings are cancelled. We propose a revenue management model that takes cancellations into account in addition to customer choice behaviour. Numerical results show that the model without cancellations can lead to a revenue loss of up to 20%. The combination of the model, tractable and well-performing solution methods, and an accurate parameter estimation method ensures that the model can efficiently be applied in practice.

3 - National and Store Brand Advertising and Pricing Strategies

Stanko Dimitrov, University of Waterloo, 200 University Avenue West, Waterloo, Canada, sdimitro@uwaterloo.ca, Jen-Yi Chen

In this presentation we discuss different pricing and advertising decisions competing national and store brands can take. We consider three cases, when both advertising and pricing decisions are made at the same time, and when one decision is fixed and the other must be made. We find that the allowing both pricing and advertising decisions to be made in unison leads to boundary solutions. We conclude with interpretations of our results and future research directions.

4 - WTP-Choice Model

Metin Cakanyildirim, University of Texas at Dallas, Campbell Road, Richardson, United States of America, metin@utdallas.edu, Varun Gupta

We propose a WTP (Willingness To Pay)-choice model and use it to compare equilibrium prices, demands and profits of several contexts: without considering inventory and with stockouts - lost sales and backorders. One of the interesting results with independent WTPs is the loose coupling of retailers; equilibrium prices are not coupled but profits are. Dependent WTPs can cause price cycles. Empirical comparisons with (mixed) Logit are also presented.

■ TD19

Hilton- Franciscan D

Pricing and New Product Development in Supply Chains

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Chia-Wei Kuo, National Taiwan University, 1, Sec. 4 Roosevelt Road, Taipei, 106, Taiwan - ROC, cwkuo@ntu.edu.tw

1 - Simultaneous vs. Sequential Crowdsourcing Contests

Lu Wang, Rotman School of Management, 105 St. George Street, Toronto, Canada, Lu.Wang12@Rotman.Utoronto.Ca, Ming Hu

In a crowdsourcing contest, innovation is outsourced by an innovating firm to an open crowd whose members compete in generating best solutions. We consider two mechanisms when innovation demands expertise in multiple attributes. One is to run a simultaneous contest, where a single solution is simultaneously submitted by each contestant. The other is to run multiple sequential sub-contests, with each dedicated to one attribute. Which mechanism should the firm choose?

2 - Dynamic Pricing with Gain-Seeking Reference Price Effects
Zhenyu Hu, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, hu48@illinois.edu, Peng Hu, Xin Chen

We study a dynamic pricing problem of a monopolist facing an aggregate demand with gain-seeking reference price effects. We show that even the myopic pricing strategy leads to complex dynamics over time. We then consider a special case, in which consumers only remember the price in the last period and the demand is mainly driven by promotions. Our results suggest that a skimming cyclic pricing strategy is optimal. Conditions are derived to guarantee the optimality of high-low pricing strategies.

3 - Contract Design for Cloud Computing Service with Service Level Consideration
Kwei-Long Huang, Assistant Professor, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei, 106, Taiwan - ROC, craighuang@ntu.edu.tw, Carol Hsu, Chia-Wei Kuo, Chao-Lung Yang

Design of contracts for cloud computing service with resource guarantee is considered. A service provider determines pricing and resource allocation by offering two types of contracts with different service levels. Each contract specifies price and associated penalty if the provider cannot fulfill the requested resource. Optimal pricing and resource allocation decisions as well as the equilibrium contracts of the service provider are analyzed based on the dynamics of the model characteristics.

■ TD20

Hilton- Yosemite A

Facility Logistics IV

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: Suzanne Marcotte, Associated professor, ESG-UQAM, Dept Management and technology, P.O. Box 8888, Downtown Station, Montreal, Qc, H3C3P8, Canada, Suzanne.Marcotte@cirrelt.ca

1 - A GPU Accelerated Sub-gradient Lagrangian Search for the Quadratic Assignment Problem
Rakesh Nagi, Professor and Department Head, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, nagi@illinois.edu, Ketan Date

The Quadratic Assignment Problem (QAP) is the fundamental problem in facilities layout. It is strongly NP-hard. In this work, we study a linearization model for the QAP and parallelize the sub-gradient Lagrangian search algorithm using graphics processing unit (GPU). We show this method can be used to obtain quick and strong lower bounds on the large instances of the QAP.

2 - Models for Unit Load Storage System Design
Pratik Mital, PhD Candidate, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, pmital3@gatech.edu

Unit load storage systems are by far the most common storage system architectures. Different objectives and hardware implementations have yielded a large variety of models. Characteristics of the various models and a hierarchy of the models will be presented.

3 - Designing a Rotated Aisle Layout for Improved Facility Performance
Dean Marinchek, Ohio University, 270 Stocker Center, Athens, OH, 45701, United States of America, dm089112@ohio.edu, Dale Masel

Traditionally, aisles in a manufacturing facility are designed to run parallel to the walls of the facility, which means that travel can't follow the shortest distance between two points. To allow more direct travel between departments, this work uses a layout in which main aisles running across the facility divide it into bays. The departments are arranged with the main aisles parallel to the walls of the facility and then the main aisles are rotated to reduce the overall travel distance.

4 - Evaluation of Dynamic Deployment of Production, Storage and Handling Resources in a Modular Facility
Suzanne Marcotte, Associated Professor, ESG-UQAM, Dept Management and technology, P.O. Box 8888, Downtown Station, Montreal, Qc, H3C3P8, Canada, Suzanne.Marcotte@cirrelt.ca, Ben Montreuil

We previously proposed a design methodology for a dynamic deployment of production, storage and handling resources in a modular facility design. Indeed, facilities can be modeled as a grid on which generic modules can be located. Resources such as production, storage and handling resources are to be assigned to these modules to minimize the total cost trough time. We provide empirical results and insights in this paper through a case study of a computer refurbishing and recycling facility.

■ TD21

Hilton- Union Sq 1

Innovative Solutions for Congestion Mitigation III

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Siriphong (Toi) Lawphongpanich, University of Florida, Industrial and Systems Engineering, Gainesville, FL, 32611, United States of America, Lawphong@ise.ufl.edu

Co-Chair: Yafeng Yin, University of Florida, Gainesville, FL, United States of America, yafeng@ce.ufl.edu

1 - Maintenances & Repair Planning Model Based on Day-to-Day Dynamic Traffic Assignment
Terry Friesz, Penn State, 305 Leonhard Building, University Park, PA, 16802, United States of America, tfriesz@psu.edu, Terry Friesz, Ke Han, Yuqi Sun

We propose a maintenance & repair planning model based on day-to-day dynamic traffic assignment. This model captures both transient congestion caused by M&R activities in progress and post-project effects as a result of improved road quality and capacity. An optimal M&R planning strategy, which accounts for both maintenance and congestion costs, is solved with heuristics.

2 - Speed Harmonization for A Bottleneck Based on Vehicle-to-Infrastructure Communications
Hao Yang, Postdoctoral Associate, Virginia Tech Transportation Institute, 3500 Transportation Research Plaza, Blacksburg, VA, 24061, United States of America, yhharolduci@gmail.com, Hesham Rakha

Capacity drop at bottlenecks is one major cause of congestion and road instability. This study proposes a speed harmonization strategy with vehicle-to-infrastructure (V2I) communications to solve this problem. The strategy provides variable speed limits, which force probe vehicles travel with smaller speed and constrain inflow rates to bottlenecks, based on a feedback control system. Experiments show that the strategy significantly mitigates congestion when capacity drop happens at a bottleneck.

■ TD22

Hilton- Union Sq 2

Emergency Response Capability Modeling

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Halit Uster, Southern Methodist University, Lyle School of Eng., Dallas, TX, 75275, United States of America, uster@smu.edu

1 - Assessing the Responsiveness of a Healthcare Network to Sudden Surge Demand
Mercedeh TariVerdi, mercedeh.t@gmail.com, Elise Miller-Hooks, Yanshuo Sun, Eirini Kastrouni

An urban disaster event can lead to sudden surge demand for urgent healthcare. To a community, efficient response by the healthcare system is as vital as the performance of each individual facility. A queueing system conceptualization of a network of hospitals in NYC is taken in assessing system performance.

2 - A Heuristic Method for Relevant Performance Measures in a Dynamic Ambulance Management Model
Thije van Barneveld, Centrum Wiskunde en Informatica, Science Park 123, Amsterdam, 1098 XG, Netherlands, t.c.van.barneveld@cwi.nl, Sandjai Bhulai, Rob van der Mei

In serious life-threatening emergency situations, the ability of ambulance service providers to arrive at the emergency location within a few minutes to provide medical aid makes the difference between survival or death. In this talk, we focus on Dynamic Ambulance Management: how to redeploy the available ambulances if an ambulance becomes busy? We present a DAM-model and we propose a heuristic for making ambulance redeployments in this presentation.

3 - Equity Modeling and Resource Management for Hospital Evacuations
Esra Agca, Kadir Has University, Istanbul, Turkey, esra.agca@khas.edu.tr, Douglas Bish

We present a hospital evacuation transportation model for multiple evacuating hospitals, which may be managed by different hospital groups, sharing available evacuation resources in the same region. The proposed model is an IP with a system-level utilitarian objective of minimizing the average evacuation risk. We discuss equity issues that arise with resource sharing employing an equity modeling framework based on the social welfare function of risk-based utilities for each hospital and each patient.

4 - Emergency Response Network Design Integrating Supply and Demand Sides under Data Uncertainty
Jyotirmoy Dalal, Ph D candidate, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, jyotirmoy.dalal@gmail.com, Halit Uster

We consider an emergency response network design problem focusing on both cost-effective relief distribution (supply side) and fast evacuation (demand side). We explore the effects of uncertainties of demand, supply, various cost components, and available infrastructure. We present computational results and analysis based on data from a network serving coastal Texas.

■ TD23

Hilton- Union Sq 3

Joint Inventory and Location Models

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Jianing (Jenny) Zhi, The University of Alabama, 300 Alston Hall, Box 870226, Tuscaloosa, AL, 35404, United States of America, jzhi@crimson.ua.edu

1 - An Inventory Modulated Capacitated Facility Location Model with Correlated Demands
Kayse Maass, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, leekayse@umich.edu, Mark Daskin, Siqian Shen

While current capacitated fixed charge location problems use inflexible capacities, in reality, facility managers have many operational tools to extend capacity or to allow the facility to accept demands in excess of the capacity constraint for short periods of time. Our model begins to capture these operational extensions and has the potential to reveal operating policies that take advantage of spatial and temporal correlations in demand that would not be evident in current models.

2 - Dynamic Inventory Rebalancing of Vehicle Sharing Systems under Nonstationary Demand
Cathy Xia, Associate Professor, Ohio State University, Columbus, OH, United States of America, xia.52@osu.edu

We present a decentralized approach to dynamically manage the inventory of vehicles at different locations in a sharing system. Our approach is robust and adaptive to arbitrary nonstationary demand patterns and provides long-term guarantees on achieving a given service availability target.

3 - Production Planning with Price-Dependent Supply Capacity
Z. Melis Teksan, University of Florida, ISE Dept. 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611, United States of America, zmteksan@gmail.com, Joseph Geunes

We consider a producer who procures input for production, where the available supply of the input depends on the price offered to suppliers. The producer seeks a production and supply-pricing plan that minimizes the cost incurred while meeting a set of demands over a finite number of discrete time periods. The most general version of the problem is NP-Hard. We provide polynomial-time algorithms for practical special cases, and a new and efficient algorithm for convex-cost lot sizing problems.

4 - An Integrated Location and Inventory Problem with Multiple Newsvendors
Jianing (Jenny) Zhi, The University of Alabama, 300 Alston Hall, Box 870226, Tuscaloosa, AL, 35404, United States of America, jzhi@crimson.ua.edu, Burcu Keskin

In a newsvendor setting, we compare a direct shipment option from a supplier to multiple retailers with a consolidated shipment from a supplier to a DC and then to retailers. While the direct shipment considers only inventory decisions, the consolidated shipment problem is an integrated location-inventory problem where the location of the DC is on a continuous plane. For various transportation costs, we identify the conditions that impact the expected profits.

■ TD24

Hilton- Union Sq 4

Optimal Sensor Locations in Traffic Networks

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Kuilin Zhang, Assistant Professor, Michigan Technological University, 1400 Townsend Drive, 870 Dow Environmental Sciences, Houghton, MI, 49931, United States of America, klzhang@mtu.edu

Co-Chair: Dengfeng Yang, Sr. R&D Engineer, Infor US Inc., 8777 N. Stemmons Freeway, Dallas, TX, United States of America, dengfeng.yang@infor.com

1 - The Influence of Sampling Procedures in Freight Tour Synthesis
Carlos Gonzalez-Calderon, Postdoctoral Research Associate, Rensselaer Polytechnic Institute, 110 8th St, JEC 4037, Troy, NY, 12180, United States of America, gonzac8@rpi.edu, Xuegang (Jeff) Ban, Jose Holguin-Veras

This paper introduces an entropy-maximization model to estimate the flows of delivery tours on the basis of traffic counts, and develops heuristic approaches to identify the location of the traffic counts that should support the estimation process. Three heuristics are defined and implemented. The performing of the formulation and the heuristics are tested in the Sioux Falls network.

2 - Reliable Mobile Sensor Network Design through Optimizing Packets Transmissions in VANETs
Dengfeng Yang, Sr. R&D Engineer, Infor US Inc., 8777 N. Stemmons Freeway, Dallas, TX, United States of America, dengfeng.yang@infor.com, Kuilin Zhang

A vehicular ad hoc sensor network (VANET) uses cars as mobile nodes to create a mobile sensor network. Packets transmission paths in the VANET are likely disrupted due to weak radio strength of vehicle moving dynamics and environment changes. We formulate a mixed-integer linear programming model to determine optimal packets scheduling and routing in the VANET to enhance a reliable mobile sensor network connectivity. Customized branch-price-cut and heuristic algorithms are proposed.

3 - Enhancing Observability of Dynamic Traffic Systems: A Stochastic Linear Programming Approach
Kuilin Zhang, Assistant Professor, Michigan Technological University, 1400 Townsend Drive, 870 Dow Environmental Sciences, Houghton, MI, 49931, United States of America, klzhang@mtu.edu, Xuesong Zhou

Measuring observability for static traffic state variables such as OD, path and link flow, has received increasing attention recently. We present a holistic approach to model the observability for practically important performance measures, such as corridor-level travel time dynamics and reliability, under various sensor network design plans. A novel two-stage stochastic linear programming framework is developed to quantify and optimize the value of information from heterogeneous sensors.

■ TD25

Hilton- Union Sq 5

Transportation Planning II

Contributed Session

Chair: Haihong Xiao, HEC Paris, 1, Rue de la Libération, PhD Office, Jouy en Josas, 78351, France, haihong.xiao@hec.edu

1 - Long-haul Freight Selection for Last-mile Cost Reduction
Arturo Pérez Rivera, PhD Student, University of Twente, P.O. Box 217, Enschede, 7500 AE, Netherlands, a.e.perezrivera@utwente.nl, Martijn Mes

We consider the planning problem a company faces when it must transport multiple freights from a single origin to different, and far away, destinations on a regular basis (e.g., daily trips). In each trip, freights are consolidated for the long-haul and transported to their destinations in the last-mile. Last-mile costs depend on the combination of freights transported in each trip. We study how these costs can be reduced, over time, by using look-ahead consolidation polices for the long-haul.

2 - GreenYourRoute Platform for Environmentally Friendly Vehicle Routing
Erotokritos Skordilis, University of Thessaly, Ogl 39, Volos, Greece, erskordi@gmail.com, George Saharidis, George Kolomvos, George Liberopoulos

The objective of the proposed research is to develop a Decision Support System (DSS) for a web based platform which will help individuals and companies move commodities in the most environmental friendly way, minimizing environmental externalities (e.g. CO2 emissions) and transportation costs. The developed platform which is the final outcome of an FP7 European research project, referred to as GreenRoute project.

3 - Truck-Trailer Routing Problem with Intermediate Inventory Facilities for Industrial Gas Distribution
Haihong Xiao, HEC Paris, 1, Rue de la Libération, PhD Office, Jouy en Josas, 78351, France, haihong.xiao@hec.edu, Laoucine Kerbache, Soumia Ichoua, Nicoleta Neagu

The truck and trailer routing problem with intermediate inventory facilities(TTRPIIF) is a variant of the well known vehicle routing problem (VRP). Different from the VRP, in the TTRPIIF, customers are serviced by a fleet of trucks and trailers, Due to some characters, each type of industrial gas can only be carried on by a particular type of trucks, the truck can execute one or two “trips” on one route.

4 - Highway Improvement Project Selection by Multi-Objectives
Peter Kelle, Professor, Louisiana State University, ISDS Department, BEC 2213, Baton Rouge, LA, 70803, United States of America, qmkell@lsu.edu, Helmut Schneider

In highway improvement project selection several objectives must be considered; some of them are based on perceptions, some others are costly and difficult to measure. We use available crash data as proxy measures and for hazard perception in a multi-criteria selection under budget constraint. In the application case we analyze four years of accident data at 23 thousand of potential locations.

■ TD26

Hilton- Union Sq 6

Transportation, Maritime II

Contributed Session

Chair: Cagatay Iris, PhD st., Technical University of Denmark, Bygningstorvet 116B, Building 115, room, DTU, Copenhagen, 2800, Denmark, cagai@transport.dtu.dk

1 - Port-Hinterland Container Dwell Time Analysis: The Shippers Effect
Panagiotis Ypsilantis, PhD Student, Rotterdam School of Management, PO Box 1738, Rotterdam, Netherlands, pypsilantis@rsm.nl, Rob Zuidwijk

Container dwell times are considered a crucial performance indicator of container terminals affecting both their capacity as much as their attractiveness to shippers that usually face long lead times. We analyze data derived from an intermodal carrier, in the Netherlands, and assess the main determinants of container dwell times. Our results demonstrate that next to other factors, the shippers and their strategies have a very significant effect on the development of dwell times.

2 - Stowage Planning Models in Cargo Composition Analysis
Dario Pacino, Technical University of Denmark, Bygningstovet 115, Kgs. Lyngby, 2800, Denmark, darpa@transport.dtu.dk, Alberto Delgado Ortegon, Rune Möller Jensen

The last decade has seen a growing interest on automated stowage planning solutions from both the industry and academia. Recently, stowage planning models have proven to scale to industrial level application. Operational stowage planning is, however, not the sole application. In this presentation, we show how stowage planning models can also be used at the tactical level. In particular, we show how revenue and vessel utilization can be analyzed by our models in terms of cargo composition.

3 - Container Relocation Problem under Truck Appointment System in Container Terminals
Dusan Ku, PhD Stu., University of Auckland, Level 4 (ISOM), 12 Grafton Road, Auckland, 1010, New Zealand, d.ku@auckland.ac.nz, Tiru Arthanari, Tava Olsen

We study the container relocation problem with truck appointment system (TAS). Though mainly purposed to reduce the number of trucks during peak hours and improve their turn-time, the TAS can also lend itself to minimising yard reshuffling for pickups. To this end, a stochastic dynamic programming model is formulated and a B&B method with the abstraction heuristics computes the expected number of reshufflings. A heuristic is proposed and its performance is compared with that of the B&B method.

■ TD27

Hilton- Union Sq 7

Optimization for Rail Planning

Sponsor: Railway Applications

Sponsored Session

Chair: Mingzhou Jin, The University of Tennessee, 525D John D. Tickle Buidling, Knoxville, TN, 37996, United States of America, jin@utk.edu

1 - Classification Track Assignment in Railway Hump Yards
Mingzhou Jin, The University of Tennessee, 525D John D. Tickle Buidling, Knoxville, TN, 37996, United States of America, jin@utk.edu, Haodong Li

The classification track assignment in a hump yard determines tracks for all blocks following predetermined hump and assemble times. This paper proposes an integer program to minimize dirty tracks and pullback operations subject to classification tracks capacity constraints and track number constraints for outbound trains. A Lagrangean relaxation-based algorithm is proposed. The application of the model and the efficiency of the solution approach are demonstrated by a real-world hump yard.

2 - Integrated Modeling of Strategic Train Operation Planning on a Shared-Use Corridor
Bo Zou, University of Illinois at Chicago, 2073 Engineering Research Facility, 842 West Taylor Street, Chicago, IL, 60607, United States of America, bzou@uic.edu, Ahmadreza Talebian

We develop a hypergraph based approach to model strategic operation planning on shared use rail corridors. Given the passenger train scheduling priority, passenger and freight side costs are sequentially minimized. We propose a solution approach which takes advantage of the problem structure and leads to efficient solution time. The impact of speed heterogeneity and delay tolerance on corridor performance is examined. We also demonstrate the model applicability to a real case study in the US.

3 - Strategies to Control a Shortest Path Based Railroad Blocking Network
Erick Wikum, Principal Scientist, Tata Consultancy Services, Seven Hills Park, 1000 Summit Drive, Milford, OH, 45150, United States of America, erick.wikum@tcs.com

With "algorithmic blocking," routes for rail movements are generated by solving shortest path problems. We describe algorithmic blocking, motivate the need for corresponding control mechanisms, and explain the main control mechanisms behind algorithmic blocking. Then, we present strategies to ensure the routes returned by algorithmic blocking are those desired by railroad experts. In the process, we present a new approach to the calibration of the block costs used to compute shortest paths.

4 - Optimization-based Train Dispatching Systems in Operation in Europe
Leonardo Lamorgese, Researcher, SINTEF ICT Optimization, Trondheimsveien 17, Oslo, Os, 0560, Norway, leonardo.lamorgese@sintef.no, Carlo Mannino

Train dispatching is the process of directing train movements on a railway. When delays or disturbances occur, dispatchers take decisions to minimize deviations. We show that this optimization problem can be tackled effectively by integer programming using suitable exact and approximate decomposition techniques, so improving train punctuality. Dispatching systems based on our algorithms for main line and large stations are in operation in Italy, Norway and Latvia.

■ TD28

Hilton- Union Sq 8

Control of Airport Operations for Congestion Mitigation

Sponsor: Aviation Applications

Sponsored Session

Chair: Alexandre Jacquillat, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-246, Cambridge, MA, 02139, United States of America, alexjacq@mit.edu

1 - Speed Control
Michael Levin, The University of Texas at Austin, ECJ 6.2, Austin, TX, 78712, United States of America, michaellevin@utexas.edu, Travis Waller, David Rey

Sector and airport capacity oversaturation is often resolved through human-assigned radar vectors, which may strongly affect en-route delay and fuel consumption, and are seldom fair with regards to airlines operations costs. Therefore, speed control based models provide an attractive framework to coordinate and separate aircraft. We use these controls in a combined sector and airport model that integrates equity. Results are analyzed by a simulation of air traffic between several major airports.

2 - Managing Capacity Uncertainty in Ground Delay Programs through En Route Speed Control
James Jones, University of Maryland, College Park, MD, 20742, United States of America, jonesjc1@umd.edu, David Lovell, Michael Ball

Capacity uncertainty at airports during inclement weather creates challenges in scheduling flights during Ground Delay Programs. We present a stochastic programming model to manage this uncertainty using both speed control and ground delays. The model demonstrates strong potential to reduce the amount of airborne holding and ground delay particularly in the event of an early weather pattern clearance.

3 - Modeling the Airport Runway Configuration Selection Process
Jacob Avery, Massachusetts Institute of Technology, Cambridge, MA, United States of America, avery2@mit.edu, Hamsa Balakrishnan

An airport's runway configuration refers to the combination of runways being used to serve arrivals and departures. Air traffic controllers choose runway configuration by considering factors such as wind speed and direction, visibility, demand, coordination with surrounding airports, and noise mitigation. We present a maximum likelihood discrete-choice model of the decision process for runway selection. We demonstrate our approach using data from Newark, LaGuardia, and San Francisco airports.

4 - Airline-Driven Ground Delay Programs: Motivation, Models and Benefit Assessment
Chiwei Yan, PhD Student, Operations Research Center, MIT, 77 Massachusetts Avenue, E40-130, Cambridge, MA, 02139, United States of America, chiwei@mit.edu, Michael Ball, Prem Swaroop, Cynthia Barnhart, Vikrant Vaze

We develop an airline-driven ground delay program (GDP) planning framework to inform the design of GDP parameters. Contrary to existing optimal planning methods, ours takes into account private preferences and business objectives of airlines. We develop a novel voting mechanism to facilitate the framework, which is also applicable to other multi-player context where decision space is continuous. Benefit assessment based on both simulated and realistic environment suggests promising results.

■ TD29

Hilton- Union Sq 9

Operations Management/Manufacturing

Contributed Session

Chair: Deanna Kennedy, Assistant Professor, University of Washington Bothell, 18115 Campus Way NE, Bothell, WA, 98011, United States of America, kennedy.deanna@gmail.com

1 - The Effects of Disruptions to Lean Operations: How Responding Means Waste Creation
Deanna Kennedy, Assistant Professor, University of Washington Bothell, 18115 Campus Way NE, Bothell, WA, 98011, United States of America, kennedy.deanna@gmail.com, Anthony Stillman, Ashley Thayer, Jiansheng Xu, M. Travis Maynard, Amy Sommer

Lean organizations strive to remove all excess waste from processes. However, they may be forced to create waste when disruptions happen. We examine disruptions by lean manufacturers and service providers in healthcare and compare their responses. Insights about how learning and complexity contribute to the responses are discussed.

2 - Process Parameters under Multiple Objectives
Amit Mitra, Professor, Auburn University, Harbert College of Business, 419 Lowder Hall, Auburn, AL, 36849-5266, United States of America, mitraam@auburn.edu

Product manufacturing often requires multiple operations with subsequent operations being influenced by those preceding it. It is of interest to determine process parameter values, such as mean and standard deviation associated with corresponding operations. Such determination may be under multiple objectives, some of which may be conflicting to each other.

3 - Mapping Product Characteristics onto Optimal EOL Strategies
Daniel Steeneck, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, steeneck@vt.edu, Subhash C Sarin

Recently, much attention has been devoted to research in reverse supply chain (RSC) management. This has been motivated both by academic interest and by the significant impact that the RSC activities, including remanufacturing, have on a nation's economy and the environment. In this presentation, we will discuss how a product's characteristics influence a manufacturer's decision regarding the appropriate value-recovery strategy and product design to employ.

4 - Design of a Production and Distribution System with Production Disruptions
Louis Luangkesorn, Research Assistant Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara St., Pittsburgh, PA, 15261, United States of America, lol11@pitt.edu, Jue Gong, Bopaya Bidanda

Production capacity decisions can be in a setting where severe production disruptions can occur. One area is prison industries, where prison inmates are employed to provided needed goods such as food for other state institutions. This system would be subject to unplanned disruptions for administrative, safety, and security reasons. We use Bayesian data analysis to justify assumptions for the production and distribution with disruptions model, then provide analytical results.

■ TD30

Hilton- Union Sq 10

Operations Management/Marketing Interface I

Contributed Session

Chair: Régis Chenavaz, Assistant Professor, Kedge Business School, Domaine de Luminy, Marseille, France, r.chenavaz@gmail.com

1 - Control Theory Application in a Traditional Budget Spending Problem for a Small to Medium Size Firm
Gurkan Akalin, Assistant Professor, Eastern Illinois University, 4008 Lumpkin Hall, Charleston, IL, 61920, United States of America, gurkanakalin@hotmail.com

In this paper, a mathematical model is developed based on the control theory in order to find an optimum budget spending for advertising and quality improvements in small to medium size firms when there is additional word of mouth pressure. Further managerial insights are presented.

2 - Dynamic Lot Sizing and Product Diffusion Model for New Products
Xiang Wu, Huazhong University of Science and Technology, School of Management, 1037 Luoyu Road, Wuhan, China, hsiangstevenwu@gmail.com, Haoxuan Xu, Jinlong Zhang, Yeming Gong

This paper considers dynamic lot sizing and pricing policies for new products, where the retailer faces a time-varying demand. We incorporate product diffusion into dynamic lot sizing model with price effects, and explain how to combine ordering and pricing policies to maximize the revenue.

3 - Group Buying: Retail Stores' Performance and Implications
Qijun Qiu, The University of Hong Kong, RM 723, 7/F, K.K.Leung Building, The University of Hong Kong,Pokfulam RD., Hong Kong, Hong Kong - PRC, angieq@hku.hk, Benjamin Yen

We study a new promotion strategy, Group Buying (GB), in which consumers enjoy a price discount by forming a group. We build monopoly and competition models to examine if and how store offers GB in a sustainable manner. We find that store's decision depends on the market pattern and its regular pricing policy, while it still can manage to secure a reasonable profit. Further, store competition affects the equilibrium in a quite dramatic way. All these explain the prevalence of GB worldwide.

4 - Consideration of Options Demand Forecasting in the Design of Option Bundles
Radu Constantin Popa, Technische Universitat Munchen, Arcisstr. 21, Munich, 80333, Germany, radu.c.popa@tum.de, Martin Grunow, Thomas Stablein

Option bundling is the sale of several options as a package, which can improve forecasts. However, no existing bundle design method focuses on the accuracy of options demand forecasting. Instead, revenue maximization is used as standard objective. Since the resulting bundles do not level options demand enough to lead to better forecasts, we developed a clustering method integrating the improvement of forecasting with revenue maximization. We tested the method on data from the automotive sector.

■ TD31

Hilton- Union Sq 11

Retail Service Operations

Sponsor: Service Science

Sponsored Session

Chair: Olga Perdikaki, Texas A&M University, MS 4217 TAMU, College Station, United States of America, operdikaki@mays.tamu.edu

1 - Analyzing Big-box Retailer in an Emerging Market
Aditya Jain, Assistant Professor, Indian School of Business, Gachibowli, Hyderabad, India, Aditya_Jain@isb.edu, Mehmet Gumus, Saibal Ray

We consider the impact of the entry of a big-box retailer in a market dominated by small retailers. The small retailers are characterized by local coverage of the market, whereas the big-box retailer provides services valued by customers. Since both types of retailers obtain supplies from a common manufacturer, big-box retailer's entry affects the supply conditions. Our work thus highlights roles of direct competition as well as indirect supply side effect on small retailers and customers.

2 - The Effectiveness of Targeted Return Management in Retailing
Mehmet Sekip Altug, Assistant Professor, George Washington University, School of Business, Washington, DC, 20052, United States of America, maltug@gwu.edu

As retailers offer more lenient return policies, customer abuse and fraudulent returns are also on the rise. In order to combat that situation, instead of changing the return policies for everyone, retailers started to implement a tool that identifies those "bad" customers. In a newsvendor framework, I study a monopolist retailer's first-period inventory, price and return policy decisions where the retailer selectively changes its second-period return policy and discuss its impact on profit.

3 - Getting a Second Opinion: Category Advisors
Alper Nakkas, Associate Professor, Nova School of Business and Economics, Campus de Campolide, Lisbon, 1099-032, Portugal, nakkas@skku.edu

Category captainship, which is a common category management implementation in the retailing industry, can have a tremendous impact on the retailer's bottom line performance. In order to better align the incentives of the category captains, retailers often seek advice from other non-captain manufacturers as well, manufacturers who often referred to as category advisors. Our research investigates the consequences of using a category advisor on the category captainship implementations.

4 - An Integrated Approach for Retail Budget Allocations across Store Labor and Marketing Activities
Olga Perdikaki, Texas A&M University, MS 4217 TAMU, College Station, United States of America, operdikaki@mays.tamu.edu, Subodha Kumar, Chelliah Sriskandarajah

We establish the relationship between weekly sales of a retail store with respect to weekly store traffic, weekly store labor hours, and intra-day traffic variability within a week. We develop an optimization model that allocates store budget across store labor, advertising, and arrival variability reduction efforts to maximize store sales. We present a framework that incorporates the output of the budget allocation model to support salesforce scheduling and discuss managerial implications.

■ TD32

Hilton- Union Sq 12

Service Science II

Contributed Session

Chair: Xiaowei Zhang, HKUST, Hong Kong, China, xiaowiez@ust.hk

1 - Contracting Service Outsourcing with Objective and Subjective Performance Metrics
Zhi Ouyang, School of Management, Xiían Jiaotong University, No. 28 at Xianning West Road of Xiían, Xi'an, China, ouyangzhi1987@stu.xjtu.edu.cn, Qin Su

As to the poor service quality in outsourcing practice, we introduce subjective performance metrics into traditional outsourcing contacting. Based on the contract theory, we analyze the optimal performance for service outsourcing and investigate the reward and punishment mechanism for performance changes. We suggest the situation where the subjective requirements are needed and show optimal objective incentive factor needs to be modified with subjective requirement for higher outsourcing results

2 - Staffing Call Centers After Learning
Xiaowei Zhang, HKUST, Hong Kong, China, xiaowiez@ust.hk, Bangxian Wu

Queueing-theoretic methods have been widely used for designing appropriate call center staffing rules. However, the assumptions of many queueing models are often violated due to the heterogeneity and sophistication of real systems. It is conceivable that the queueing-theoretic staffing rules may not be accurate. In this talk, we will present a framework that attempts to learn the modeling error from data so that necessary adjustment can be made to make the staffing rules more reliable.

3 - Typology-based Analysis of New Service Development
Thomas Meiren, Fraunhofer IAO, Nobelstr. 12, Stuttgart, Germany, thomas.meiren@iao.fraunhofer.de, Ilyas Khan

Based on empirical data from 200 service companies a typology of services was derived and used for the analysis of their service development activities. Depending on the type of service the study shows clear differences concerning strategy, customer integration, development process and methods. The presentation discusses the main findings and provides recommendations for practitioners.

4 - The Three Laws of Service
Robin Qiu, Penn State, 30 E. Swedesford Road, Malvern, PA, 19355, United States of America, robinqiu@psu.edu

By rethinking service encounters, we introduce the new three laws of service. Based on the three laws of service for service encounters, we can view the systems behavior of a service organization as the dynamics of cocreation-oriented service networks. Examples will be used to elucidate the corresponding concepts and principles.

■ TD33

Hilton- Union Sq 13

Health Care Modeling Optimization III

Contributed Session

Chair: Daniel Gartner, Carnegie Mellon University, The H. John Heinz III College, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu

1 - An Implementation of Operating Room Scheduling System in Aichi Medical University Hospital
Mari Ito, Graduate School of Mathematical Sciences and Information Engineering, Nanzan University, d13mm002@nanzan-u.ac.jp, mari.1211.ito@gmail.com, Seto, 489-0863, Japan, d13mm002@nanzan-u.ac.jp, Atsuo Suzuki, Yoshihiro Fujiwara

We develop a support system for generating schedules of operations in Aichi Medical University Hospital. At the result, the schedule obtained has the high efficiency of utilization of operating rooms. We estimate the processing time of operations, than assign the operations to the available time slot operating rooms by integer programming method.

2 - Elective Surgery Scheduling to Improve Patient Safety
Joonyup Eun, PhD Student of Industrial Engineering, Purdue University, 315 N. Grant Steet, West Lafayette, IN, 47907, United States of America, eunj@purdue.edu, Sang-Phil Kim, PhD, Yuehwern Yih, PhD

Surgery scheduling without considering patient health condition exposes patients to be at risk of sentinel events or decreases patient safety. This research describes an operating room planning problem in which patients with different health conditions are scheduled for elective surgery. The problem deals with diseases which not only exacerbate patient health condition with the lapse of waiting time, but also have different severity when they are diagnosed.

3 - Delay Modeling and Analysis Approach for Surgical Scheduling
Maryam Khatami, PhD Student, Wayne State University, 4815 Fourth Street, Detroit, MI, United States of America, maryam.khatami@wayne.edu, Alper Murat

We model the delay propagation in surgical operations to improve elective case scheduling practices. Given the extent of resource sharing, effectiveness of a schedule greatly depends on how delays with different sources and duration could be eliminated via resource de-coupling and absorbed with slack time allocation. Using data from a Detroit hospital with 30 ORs, we construct delay propagation networks and present analysis results from employing delay elimination and reduction strategies.

4 - On Coordinating Anesthesiology and Internal Medicine in a Patient-Centered Surgical Home
Douglas Morrice, Professor, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, Douglas.Morrice@mccombs.utexas.edu, Luci Leykum, Susan Noorily, Dongyang Ester Wang, Kumar Muthuraman, Jonathan Bard

In this paper, we consider different levels of coordination of Anesthesia and Internal Medicine services through patient scheduling in a Patient-Centered Surgical Home. Our work is motivated by a study conducted at the University of Texas Health Sciences Center, San Antonio and its affiliated teaching hospital.

5 - Flexible Hospital-wide Scheduling of Elective Patients
Daniel Gartner, Carnegie Mellon University, The H. John Heinz III College, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu, Rainer Kolisch, Rema Padman

We evaluate three model extensions of Gartner and Kolisch (2014) in which elective patients are scheduled hospital-wide to maximize contribution margin given clinical pathways and scarce resources: First, we decide whether or not a patient is admitted. Second, we decide on the assignment of a patient to one out of several wards (e.g. for multi-morbid patients). Third, we allow for overtime of human resources. In an experimental study, we evaluate these extensions based on real-world data.

■ TD34

Hilton- Union Sq 14

Transport Risk Management

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Vedat Verter, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, vedat.verter@mcgill.ca

1 - A Time-Dependent Road Ban Design Problem In Hazmat Transportation Network

Tolou Esfandeh, PhD Student, University at Buffalo (SUNY), Industrial and Systems Engineering, Buffalo, NY, 14260, United States of America, tolouesf@buffalo.edu, Rajan Batta, Changhyun Kwon

In this talk, we develop and analyze a time dependent road-ban policy to mitigate the risk of hazardous material (hazmat) transportation. By closing roads at particular times, we aim to route hazmat trucks in paths that are dissimilar as far as possible in order to reduce the likelihood of accidents involving hazmat and simultaneously reducing road congestion.

2 - Regulating Intermodal Transportation of Hazardous Materials

Manish Verma, Associate Professor, McMaster University, 1280 Main Street W, Hamilton, ON, L8S 4M4, Canada, mverma@mcmaster.ca, Ginger Ke, Ghazal Assadipour

This research suggests two distinct bi-level programming driven optimization frameworks to assist the government in regulating the usage of intermodal terminals for hazardous material transportation. In the first policy, the government closes certain intermodal terminals; while in the second one, the government deters the carrier from using certain terminals by imposing tolls. Distinct hybrid particle-swarm optimization based solution methodology is also proposed to solve the resulting models.

3 - A Bi-objective Model for the Used Oil Location-routing Problem

Jiahong Zhao, School of Transportation & Logistics, Southwest Jiaotong University, 111 Erhuanlu Beiyiduan,Chengdu,Sichuan, Chengdu, 610031, China, zhao.jiahong@mail.mcgill.ca, Vedat Verter

We present a bi-objective model for the used oil location-routing problem to minimize the total cost and environmental risk. Focusing on hazardous materials contained in used oils that are airborne on release,we propose an environmental risk measure by incorporating the Gaussian plume model in the box model. To solve the problem,we used a modified weighted goal programming approach. The application of the proposed approach in Chongqing of Southwest China provided interesting managerial insights.

4 - Regulating Hazmat Transportation by Game Theory

Stefano Giordani, University of Rome, "Tor Vergata", Via del Politecnico 1, Rome, Italy, stefano.giordani@uniroma2.it, Massimiliano Caramia, Lucio Bianco, Veronica Piccialli

We study a toll setting policy to regulate hazmat transportation, where the regulator aims at minimizing the network total risk and achieving risk equity by minimizing the maximum link total risk. The idea is discouraging hazmat carriers from using links with high risk concentration, assuming that the toll paid by a carrier on a link depends on the link total risk, i.e., by all the carriers' route choices. The model is a bilevel problem where the inner problem is a Nash game among the carriers.

■ TD35

Hilton- Union Sq 15

Joint Session DAS/SPPSN: Decision Analysis Insights for Homeland Security

Sponsor: Decision Analysis & Public Programs, Service and Needs

Sponsored Session

Chair: Robin Dillon-Merrill, Georgetown University, 517 Hariri, McDonough School of Business, Washington, DC, 20057, United States of America, rld9@georgetown.edu

1 - Perceived Risk, Fear and Avoidance Behavior: The Economic Value of Risk Communication

William Burns, Professor, Decision Research, 1201 Oak St Suite 200, Eugene, OR, 97401, United States of America, william_burns@sbcglobal.net

Respondents nationwide participated in a risk communication experiment in which they were exposed to risk communication messaging and then several days later a simulated terrorist attack on an airline. Those receiving a risk message that informed them that DHS could respond effectively to possible attacks reported less fear and intention to cancel planned air travel. Economic modeling of these mitigating results, show significant reductions in loss to the airline industry and U.S. economy.

2 - Your Money or Your Privacy: Eliciting Trade-offs for Cyber Security

Heather Rosoff, Research Assistant Professor, University of Southern California, 3710 McClintock Avenue, RTH 314, Los Angeles, CA, 90089, United States of America, rosoff@usc.edu, Kenneth Nguyen, Richard John

In the cyber world, individuals must decide how to protect their privacy from threats ranging from individual hackers to larger organizations (marketers, government). In doing so, they are forced to assess what values they are willing to trade-off to protect their privacy. In this presentation, we evaluate individuals' smartphone purchase preferences based on trade-off assessments between privacy, cost, processing speed, available apps for download, ease of interface, and server quality.

3 - An Experimental Study of Response to a Near Miss Loss of Coolant Accident (LOCA)

Richard John, Associate Professor, University of Southern California, RTH 310, University Park, Los Angeles, CA, 90089, United States of America, richardj@usc.edu, Jinshu Cui, Heather Rosoff

Public response to a near miss LOCA was using a video scenario simulation of an unfolding crisis at a local nuclear power plant. Over 900 respondents were randomly assigned to one of 18 conditions, using a 3 (cause of LOCA) by 3 (attribution for near miss) by 2 (resolution) between-groups factorial design. Affect, risk perceptions, and behavioral intentions at 3 separate time points were included in an SEM constructed to account for all 3 manipulated variables and demographic variables.

4 - Near-Misses and the Challenges for Cyber Security Decision Making

Robin Dillon-Merrill, Georgetown University, 517 Hariri, McDonough School of Business, Washington, DC, 20057, United States of America, rld9@georgetown.edu

Much about cybersecurity technologies and practices is known but not put into practice. We believe one understudied factor is the impact of prior near-miss events. A near-miss may occur but if there are no salient cues of a possible bad outcome, people appear to mistake such good fortune as an indicator of system resiliency. In several studies, we study people's reaction to near-miss events in the cyber-context. We discuss the implications of our studies for risk communication.

■ TD36

Hilton- Union Sq 16

Information Systems 2

Contributed Session

Chair: Zhuoxin Allen Li, PhD Student, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78703, United States of America, zhuoxin.li@phd.mccombs.utexas.edu

1 - IT and Productivity Paradox: A Firm-level Empirical Research with Dynamic DEA Methods

Jiawen Liu, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, China, jiawen_liu@hust.edu.cn, Yeming Gong

While some researches argue that IT can improve the enterprise productivity, others maintain the impact of IT is negative. Using 67 samples from enterprises in Asia, Europe and US, we develop a dynamic two-stage DEA model, allowing intertemporal effects in efficiency measuring, to study IT productivity paradox.

2 - Dynamic Backing Behaviors in Online Crowdfunding with Network Externalities

Zhuoxin Allen Li, PhD Student, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78703, United States of America, zhuoxin.li@phd.mccombs.utexas.edu

Online crowdfunding enables entrepreneurs to fund their project by soliciting small investments from a large number of potential investors over the Internet. In addition to the static project information provided by the entrepreneur, investors also assess a project's prospect based on other investors' backing decisions. We develop a dynamic structural model that captures investors' backing behaviors and estimate the model using data collected from a major crowdfunding platform.

3 - Budget Allocation over Cybersecurity Investment Categories through a Portfolio Approach

Yueran Zhuo, PhD Candidate, University of Massachusetts Amherst, 121 Presidents Drive, 226, Amherst, MA, 01003, United States of America, yzhuo@som.umass.edu, Senay Solak

Cybersecurity is an indispensable component of business success. The deterioration of cyber environment has increased the need for efficient planning of cybersecurity investments. We develop a generic framework to optimize budget allocation over cybersecurity investment categories to achieve the maximum protection against cyber-attacks under multiple industry background settings. Numerical and analytical analyses are conducted to conclude managerial insights separately for different industries.

4 - TamagoCar – Using a Simulation App to Explore Demand Response to Energy Tariffs

Ksenia Koroleva, Rotterdam School of Management, Burgmeester Oudlaan 50, Rotterdam, Netherlands, koroleva@rsm.nl, Micha Kahlen, Wolf Ketter

We propose to study the behavior of electric vehicle (EV) users with a specifically designed application, TamagoCar, which combines real world driving behavior with a simulated EV environment. The uncertainty about the future price, range anxiety and uncertainty about future travel are hypothesized to reduce price sensitivity of demand for electricity. Participants adjust their behavior in response to real-time price changes and smooth out the demand peaks, thus favorably impacting the grid.

5 - Disease Co-Contingencies and Impact on Test Alert Closure Times in E-Patient Portals

Yazan Alnsour, PhD Student, Business School, University of Colorado Denver, 1475 Lawrence St., Denver, Co, 80202, United States of America, yazan.alnsour@ucdenver.edu, Jiban Khuntia, Todd Trautman

Comorbidity and contiguous disease lead to multiple alerts in e-portals. This study explores how concerns with comorbidity leads to a better result in closing alerts. Using e-Portal datasets for diabetes patients, our analysis provides evidence that comorbidity conditions lead to early closure of alerts, and complement each click and view of the alerts; in comparison to contiguous disease. We compare and contrast these results with patients with renal insufficiency as focal diseases.

■ TD37

Hilton- Union Sq 17

Big Data 1

Contributed Session

Chair: Samik Raychaudhuri, 24/7 Customer Pvt. Ltd., EGL Business Park, Off Intermediate Ring Road, Bangalore, 560071, India, samikr@gmail.com

1 - Machine Learning to Recognize Customer Intent in Big Data

Samik Raychaudhuri, 24/7 Customer Pvt. Ltd., EGL Business Park, Off Intermediate Ring Road, Bangalore, 560071, India, samikr@gmail.com, Ravi Vijayaraghavan

In this presentation, we will discuss some of the ML models that we use in various channels to ferret out customer intent from the voluminous "big data" - which are collected through our interaction with the customers at various touchpoints.

2 - Leveraging Big Data to Enhance user Engagement

Wesley Gifford, IBM T.J. Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, wmgifford@us.ibm.com, Yi-Min Chee, Ashish Jagmohan, Anshul Sheopuri

Many businesses devote considerable effort to maintaining user engagement. In this work we study the problem of identifying users who would be most suited for engagement actions, the best content to recommend to them based on a variety of novel mechanisms, and the appropriate time to engage such users. Models are developed which capture relevant user dynamics and performance results are given based on experiments using real-world data.

3 - Group Sparse Optimization via Nonconvex Regularization

Yaohua Hu, Zhejiang University, 38 Zheda Road, Hangzhou, ZJ, 310027, China, hyh19840428@163.com

In this paper, we investigate the theoretical properties and design an efficient numerical algorithm for the group sparse optimization. We introduce the group restricted eigenvalue condition, and apply it to establish the oracle result and recovery bound for the $\ell_{p,q}$ regularization problem. We also apply the proximal gradient method to solve the $\ell_{p,q}$ regularization problem and present some numerical results on both simulated data and real data in gene transcriptional regulation.

4 - Streaming Analytics for High Velocity Big Data IoT Platforms

Michiel Van Herwegen, Ghent University, Tweekerkenstraat 2, Gent, 9000, Belgium, michiel.vanherwegen@ugent.be, Dirk Van den Poel

Using an actual IoT application deployed on a lambda architecture cloud platform, this study covers the challenges of streaming analytics when the high velocity aspect must be met in an IoT context that also has to scale to millions of simultaneous devices. In order to achieve highly scalable algorithms that can cope with incomplete information, we reworked batch ensemble algorithms for streaming data to cope with common IoT data issues while retaining the core properties of the algorithm.

5 - The Fundamentals of Responsive Processes: Exploiting Context in an Entropy-Based Analytic Framework

Andy Bruntsch, PhD Cand., The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, abruntsch@ust.hk

In an era of pervasive customer focus a processes' capability to dynamically respond to escalating process requirements in the most efficient, yet feasible and still compliant way is no longer optional. A novel analytical approach is presented based on an analogy. It establishes entropy for quantifying dynamic change in the context of a process and for modeling its translation into dynamic process behavior. Application to an extensive dataset of a patenting process shows the practical relevance.

■ TD38

Hilton- Union Sq 18

Health Care Modeling Optimization IV

Contributed Session

Chair: Guohua Wan, Professor, Shanghai Jiao Tong University, 535 Fahuazhen Road, Shanghai, 200052, China, ghwan@sjtu.edu.cn

1 - An Optimization Framework to Improve Patient Safety in Radiation Therapy Care Delivery Process

Pegah Pooya, North Carolina State University, 111 Lampe Dr, Campus Box 7906, Raleigh, NC, United States of America, ppooya@ncsu.edu, Prithima Mosaly, Julie Ivy, Lukasz Mazur, Katharin Deschesne

We develop an optimization framework to improve the process reliability and patient safety of radiation therapy care delivery process for cancer patients. The use Safety Barriers (SB) in radiation oncology is a widely recognized method for detecting potential errors before they reach the patient. In this study, a Dynamic Programming model is developed to optimize the location and elements of Safety Barriers (SB).

2 - Multi-level HIV Prevention Funds Allocation Process – Asymmatric Information

Monali Malvankar, University of Western Ontario, Schulich School of Medicine & Dentistry, London, ON, Canada, mmalvan@uwo.ca, Greg Zaric, Xinghao Yan

HIV prevention funds often traverse several levels of decision-making. We model the process of allocation of prevention funds in which an upper-level decision maker allocates funds to multiple lower-level decision makers as a dynamic programing model. The upper-level decision maker attempts to improve outcomes through use of a priori information.

3 - A Mixed Integer Programming Approach to Surgery Scheduling with Simultaneous Decision Making

Halil Ibrahim Guenduez, Assistant Professor, RWTH Aachen University, Kackerstr. 7, Aachen, 52072, Germany, guenduez@or.rwth-aachen.de, Martin Baumung

Our work covers a real case of surgeon and elective surgery scheduling for a small clinic department in University Hospital Aachen, Germany, and aims at improving the scheduling in order to reduce costs related to the operating room time while considering different resources simultaneously. For this purpose, we developed a mixed integer linear programming model, which aims at minimizing the costs for the operating room time required to perform all of the surgeries.

4 - Scheduling Surgical Operations in a Large Chinese Hospital

Guohua Wan, Professor, Shanghai Jiao Tong University, 535 Fahuazhen Road, Shanghai, 200052, China, ghwan@sjtu.edu.cn, Liwei Zhong, Guochun Tang

We study the surgical operations scheduling problem in a large Chinese hospital. We first model the problem as a deterministic multimachine scheduling problem to determine the assignment of the jobs to operating rooms and the sequence of the jobs in each operating room. Then, given the job sequence and assuming random processing times, we determine the job starting times by an appointment scheduling model. These models and algorithms are built in a real scheduling system running in the hospital.

5 - Scheduling of Operating Room Activities with a Balanced Distiribution of Surgical Services

Bülent Cekiç, Dr., Hacettepe University, Hacettepe University Beytepe Campus, Department of Business Administration, Ankara, 06800, Turkey, bulentc@hacettepe.edu.tr

This study aims to find an optimal solution to the balanced distribution of surgical services to operating rooms. For that matter, a mixed integer programming model is developed. The objective function of the model aims to minimize setup costs and provides a weekly balanced distribution of operating rooms to surgical services. The results shows that the alternative scenarios exhibit more balanced operation distributions and a flexible operating room usage with less time and setup costs.

■ TD39

Hilton- Union Sq 19

Kidney Exchange Models

Sponsor: Health Applications

Sponsored Session

Chair: Yichuan Ding, Assistant Professor, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, Daniel.Ding@sauder.ubc.ca

1 - Optimizing over Pure Stationary Equilibria in Consensus Stopping Games

Amin Dehghanian, University of Pittsburgh, 1061 Benedum Hall, 3700 O'Hara St,, Pittsburgh, PA, 15261, United States of America, amd120@pitt.edu, Murat Kurt, Andrew Schaefer

We consider consensus stopping games, a class of stochastic games that requires the consent of all players to terminate the game. We show that each consensus stopping game may have many pure stationary equilibria, which in turn raises the question of equilibrium selection. We develop an efficient algorithm to find a best pure stationary equilibrium of a consensus stopping game. We discuss an application of this class of games in the context of kidney exchanges.

2 - Current Challenges in Kidney Exchange

Itai Ashlagi, MIT, 100 Main St., Cambridge, MA, United States of America, iashlagi@mit.edu

Different practices will be explored followed by models that explain some of the achievements of some kidney exchange clearinghouses. I will further empirical findings that shed light on the kidney exchange marketplace.

3 - Experiences from a Large Kidney Exchange, and New Results on Dynamic, Failure-aware, Fair Matching

Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, sandholm@cs.cmu.edu, John Dickerson

Modern kidney exchanges conduct complex matching with 2-cycles, 3-cycles, and altruistic-donor-triggered chains that extend potentially infinitely. I will share learnings from running the optimization side of the UNOS kidney exchange since its inception in 2010. It now includes 59% of the US transplant centers. I will present new experiments on advanced kidney exchange matching that combines dynamic matching via potentials, matching that is cognizant of pre-surgery edge failures, and fairness.

4 - Rationing Non-Directed Donors in Kidney Exchange

Chris Ryan, The University of Chicago Booth School of Business, Chicago, IL, United States of America, christopher.ryan@chicagobooth.edu, Yichuan Ding, Dongdong Ge, Simai He

Historically, non-directed donors (NDDs) have been allocated to the decreased-donor waitlist. Recently, use of NDDs in exchanges has increased the number of transplants but reduced prospects for patients without donors. We take a non-asymptotic approach to quantify the marginal benefit of NDDs to the exchange pool. When the pool size is not moderately large and the proportion of low sensitized patients is above a threshold, the marginal benefit of NDDs diminishes quickly.

■ TD40

Hilton- Union Sq 20

Dynamic Programming in Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Steven Shechter, Associate Professor, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T-1Z2, Canada, steven.shechter@sauder.ubc.ca

1 - Managing Healthcare Systems: Speedup versus Admission Control

Galit Yom-Tov, Technion-Israel Institute of Technology, Haifa, Israel gality@techunix.technion.ac.il, Carri Chan

Waiting, admission control and speedup of service rates have been used to manage congestion in Service Systems. We examine a multi-server queueing system which allows for admission control and speedup. We characterize properties of the optimal control, and do performance evaluation of a queueing system with a two-threshold policy. We use the approximation analysis to characterize the region of the optimal solution, and develop a greedy heuristic to derive a near-to-optimal solution.

2 - Issuing Policies for Hospital Blood Inventory

Alireza Sabouri, University of British Columbia, Vancouver, BC, V6T 1Z2, Canada, alireza.sabouri@sauder.ubc.ca, Tim Huh, Steven Shechter

We propose a model for allocating red blood cells for transfusion to patients, which is motivated by recent evidence suggesting that transfusing older blood is associated with increased mortality rate. We study the properties of blood issuance policies that balance the trade-off between "quality" measured in average age of blood transfused and "efficiency" measured in the amount of shortage. Based on our analysis, we design efficient issuance policies and evaluate their performance.

3 - Dynamic New Patient Consult Scheduling for Medical Oncology

Antoine Sauré, Post-Doctoral Fellow, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, antoine.saure@sauder.ubc.ca

Motivated by an increasing demand for cancer care and long waits for new patient consults, we undertook a study of medical oncology scheduling practices at a regional cancer center. As a result, we formulated and approximately solved a discounted infinite-horizon MDP model that seeks to identify good policies for allocating oncologist consultation time to incoming new patients, while reducing waits in a cost-effective manner. The benefits from the proposed method are evaluated using simulation.

■ TD41

Hilton- Union Sq 21

Health Care, Strategy and Policy 2

Contributed Session

Chair: George Miller, Altarum Institute, 3520 Green Court, Suite 300, Ann Arbor, MI, 48105, United States of America, george.miller@altarum.org

1 - Measuring the Efficiency of Home Health Agencies

Mehmet Kilinc, University of Arkansas, Bell Engineering, Fayetteville, AR, 72701, United States of America, mkilinc@uark.edu, Ashlea Milburn

The objectives of this study are to analyze the efficiency of home health agencies by Data Envelopment Analysis (DEA) and to investigate differences in efficiency across a study area. Some of the research questions that this study aims to address are: How much variation is there in efficiency in home healthcare industry? What are the driving factors determining efficiency of agencies? What are the best practices? What are the possible policy interventions to improve inefficient agencies?

2 - Assessing the Benefits and Costs of Prevention from Multiple Stakeholder Perspectives

George Miller, Altarum Institute, 3520 Green Court, Suite 300, Ann Arbor, MI, 48105, United States of America, george.miller@altarum.org, Charles Roehrig

We describe a new analysis tool for characterizing the value of an investment in nonclinical primary prevention from the multiple perspectives of organizations that can influence the investment. Applications to smoking and obesity interventions illustrate how stakeholder-specific value is affected by (1) the time horizon and costs of interest, (2) the costs associated with increased longevity caused by an intervention, and (3) the impact of improved treatment on the benefits of prevention.

3 - Capacity Planning for Cancer Prevention
Aaron Ratcliffe, University of North Carolina Greensboro, 438 Bryan Building, PO Box 26170, Greensboro, NC, 27402-6170, United States of America, aaron.ratcliffe@uncg.edu, Ann Marucheck, Wendell Gilland

We analyze a queuing network to study the relationship between screening guidelines and capacity planning for colorectal cancer. The screen provider chooses its capacity to balance the cost of cancer detection delay with the cost of additional capacity. Patients spend a random time at home before scheduling a repeat screen. We consider the impact of other provider interventions such as price changes and education efforts about screening guidelines.

4 - Risk Assessment of Occupational Injuries Using Accident Severity Grade
Nasibeh Azadeh-Fard, PhD Student, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24060, United States of America, nasibeh@vt.edu, Anna Schuh, Jaime Camelio

To identify workplace hazards, safety surveillance techniques have been used, including official accident severity metric. However, the definition of severity used by these tools does not consider important employee and workplace factors with potential significant impacts on accident severity. A new severity scoring and risk assessment system is introduced which considers multiple influential factors that improves risk assessment and the estimation of accident severity.

5 - Cigarette Packet Pictorial Warning: Is There Any Impact on New, Old, and Non-Smokers
Siddhartha Rastogi, Assistant Professor, IIM Indore, Rau-Pithampur Road, IIM Indore, Indore, 453331, India, srastogi@iimidr.ac.in, Rajhans Mishra

India made pictorial warning on cigarette packets mandatory following most industrial nations. However, it is not ascertained in case of India if this warning has had any desirable impact. We seek to assess this impact on three different groups of adults, namely - smokers, initiators, and non-smokers. We use survey method with purposive sampling and triangulate our results with those of international studies. The study hopes to contribute with marketing and policy insights.

■ TD42

Hilton- Union Sq 22

Joint Session HAS/Analytics: Big Data Analytics in Healthcare

Sponsor: Health Applications & Analytics Section

Sponsored Session

Chair: Hao Zhang, University of Maryland School of Medicine, 22 S Greene St, Baltimore, MD, 21201, United States of America, hzhan001@umaryland.edu

1 - Applying Advanced Analytics to Generate Value from Big Data in Health
Juergen Klenk, Principal Scientist, Exponent, Inc., 1800 Diagonal Road, Suite 500, Alexandria, VA, 22314, United States of America, jklenk@exponent.com

Fueled by legislative catalysts (e.g., HITECH, ACA) and remarkable discoveries that demonstrate the actual value of data driven decision making in organizations (e.g., Erik Brynjolfsson, MIT), the Healthcare Industry is now rushing to generate value from Big Data. We will review key components of a Big Data Analytics strategy, demonstrate how it can be successfully implemented to benefit your organization, and discuss specific examples related to Personalized Medicine and Wellness.

2 - Parallel Predictive Modeling Platform for Healthcare Analytic Research using EHR
Jimeng Sun, Associate Professor, School of Computational Science and Engineering, Georgia Tech, 266 Ferst Drive, Atlanta, GE, 30363, United States of America, jsun@cc.gatech.edu

Healthcare analytics research increasingly involves the construction of predictive models for disease targets across varying patient cohorts using electronic health records (EHRs). We implemented this platform using Map-Reduce to enable independent tasks to run in parallel in a cluster computing environment.

3 - Electronic Health Records for Decision Support - Meaningful Use of Complex Medical Data
Eva Lee, Professor & Director, Georgia Institute of Technology, Ctr for OR in Medicine & Healthcare, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

This work is joint with Grady Memorial Hospital and the Children's Healthcare of Atlanta. We focus on identifying reasons behind the recurrence of patient admissions, and designing classification models to predict potential readmissions. Large scale data analysis and results will be presented. This is critical given the Affordable Care Act is beginning to implement readmission penalties. The algorithmic approach could detect readmission triggers without human monitoring.

4 - Understanding Temporal Patterns in Drug Therapy
Margrét Bjarnadóttir, University of Maryland, 4324 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu

Non-adherence to drug therapy can lead to worsening of conditions and health decline. Summary statistics are often used to describe adherence, but they do not adequately capture patients' different adherence patterns, which vary widely. In this study we propose a methodology to understand drug adherence in large scale populations through clustering and Eventflow, a novel interactive visualization tool, summarizing prescription patterns of large patient cohorts.

■ TD43

Hilton- Union Sq 23

Data-driven Service Systems

Sponsor: Computing Society

Sponsored Session

Chair: Omid Nohadani, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, nohadani@northwestern.edu

Co-Chair: Jocelyn Dunn, Visiting Pre-Doctoral Fellow, Northwestern University, Industrial Eng. and Management Sciences, Evanston, IL, 60208, United States of America, jocelyn.dunn@northwestern.edu

1 - Data-driven Approaches for Planning Equipment Maintenance
Ying Tat Leung, IBM Research - Almaden, 650 Harry Road, San Jose, CA, 95120, United States of America, ytl@us.ibm.com, Hyung-il Ahn, Axel Hochstein

With increasing availability of data, quantitative approaches for planning equipment maintenance have evolved beyond the classic statistical approach in the last two decades. We present an example of how straightforward historical data reporting, the traditional time-based maintenance model, a more equipment-specific condition-based one, and a most assertive predictive maintenance approach are used simultaneously to provide different types of information to aid the maintenance planner.

2 - Robust Data-Driven Categorization for Service System Usage
Omid Nohadani, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, nohadani@northwestern.edu, Jocelyn Dunn, Gerhard Klimeck

When defining categories of service system usage, typically, dissension among multiple criteria is observable. These criteria measure different aspects of data and have unknown importance in categorization. With uncertain weights on these multiple criteria, a robust data-driven approach is developed and applied to nanoHUB usage data to deduce, validate, and optimize categories of usage. The proposed method is generic and free of assumptions enabling targeted improvement of diverse systems.

3 - CityScan: Urban Predictive Analytics
Mallory Nobles, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, mallory.nobles@gmail.com, Seth Flaxman, Daniel Neill

We present CityScan, a novel approach to urban predictive analytics. CityScan applies state-of-the-art detection methods to identify emerging clusters of various leading indicators, and uses these clusters to predict when and where an event of interest is likely to occur. It has been deployed in Chicago to predict emerging events relevant to city operations, including hot-spots of violent crime and rodent infestations, and achieves high accuracy at fine-grained spatial and temporal resolutions.

■ TD44

Hilton- Union Sq 24

Social Media Consumer Analytics

Sponsor: Information Systems

Sponsored Session

Chair: Ramesh Shankar, Associate Professor, University of Connecticut, 2100 Hillside Road, Unit 1041, Storrs, CT, 06269, United States of America, Ramesh.Sankaranarayanan@business.uconn.edu

1 - Firm's Social Media Efforts, Consumer Behavior, and Firm Performance: Evidence from Facebook

Sunghun Chung, Postdoctoral Fellow, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A1G5, Canada, sunghun.chung@mcgill.ca, Animesh Animesh, Kunsoo Han, Alain Pinsonneault

This study theorizes and empirically examines how firm's social media efforts influence consumer behavior and firm performance. Using detailed data collected from Facebook pages, we find that richness and responsiveness of a firm's social media efforts are significantly associated with the firm's market performance, captured by abnormal return and Tobin's q. Interestingly, the intensity of firm's social media effort is not significantly associated with firm performance.

2 - WOM, Cast and Fans: Movie Demand Prediction using Derived Networks

Yang Wang, University of Utah, David Eccles School of Business, 1655 East Campus Center Drive, Salt Lake City, UT, 84112, United States of America, yang.wang@business.utah.edu, Olivia Sheng, William Moore, Vandana Ramachandran

WOM and movie sales can be correlated according to past studies. Can future movie demand prediction using WOM be enhanced by linkage between movies established via common casts, crews or fans? Using data from the most popular Chinese movie review platform, douban.com, we improve demand forecasts for foreign movies shortly after their premiere outside China via Hierarchical Bayesian Modeling and the aforementioned linkage amongst movies.

3 - Factors Driving Customer Engagement in Location-Based Social Media

Ram Gopal, Professor, Department Head, University of Connecticut, 2100 Hillside Road Unit 1041, Storrs, CT, 06269, United States of America, ram.gopal@business.uconn.edu, Ramesh Shankar, Lei Wang, Joseph Pancras

Retailers are increasingly utilizing location-based services via mobile devices to enhance customer engagement. We develop a two stage model of location-based customer engagement in Foursquare to seek how business characteristics, geographic proximity and demographic similarity together affect customer engagement. We find a persistent spatial interdependence, a spatial phenomenon that we term 'social congregation' effect, and a temporal agglomeration effect in the restaurant industry.

4 - Linguistic Features and Peer-to-Peer Loan Quality: A Machine-learning Approach

Mingfeng Lin, University of Arizona, 1130 E. Helen St, Tucson, AZ, 85721, United States of America, mingfeng@email.arizona.edu, Qiang Gao

We study the information value of linguistic features in predicting loan qualities in online peer-to-peer lending, using transactions data from a leading platform. Using both explanatory and predictive models, we find that linguistic features, or how borrowers write their loan request descriptions, can differentiate good and bad loans. Interestingly, investors are not always able to interpret such information, suggesting that our machine learning approach can help improve market efficiency.

■ TD45

Hilton- Union Sq 25

Quality and Inventory Issues in Behavioral Operations

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Elena Katok, Ashbel Smith Professor, University of Texas at Dallas, 800 W. Campbell Drive, Dallas, TX, 75080, United States of America, ekatok@utdallas.edu

1 - The Effect of Social Influence on Consumers' Switching Behavior under Quality Competition

Dayoung Kim, Cornell University, 301K Sage Hall, Ithaca, NY, 14850, United States of America, dk668@cornell.edu, Andrew Davis, Vishal Gaur

We conduct a laboratory experiment to investigate the effect of social influence on consumers' choices between firms competing on service quality. First, we examine how consumers choose between two firms differing in service quality, absent social influence, and how this behavior impacts market share and uncertainty in demand. We then explore how the presence of social influence affects these same performance metrics, and provide managerial implications for both high and low quality firms.

2 - Cry Wolf or Equivocate? Credible Forecast Guidance in a Cost-loss Game

Elena Katok, Ashbel Smith Professor, University of Texas at Dallas, 800 W. Campbell Drive, Dallas, TX, 75080, United States of America, ekatok@utdallas.edu, Gary Bolton

What is the most credible way to convey forecast uncertainty to the users of expert models? We test two ways - give end users uncertainty information, or give them specific recommendations. We find that the effectiveness of both methods is hampered by a cry wolf effect, but substantially more so for recommendations. People are particular sensitive to the cry-wolf effect when the optimal decision is to take a counter-intuitive action.

3 - How Supplier Scorecards Affect Quality: A Behavioral Study

Elena Katok, Ashbel Smith Professor, University of Texas at Dallas, 800 W. Campbell Drive, Dallas, TX, 75080, United States of America, ekatok@utdallas.edu, Zhixi Wan

Supplier scorecards are used to evaluate existing suppliers and motivate them to deliver high quality, by linking current performance with future contracts. We present an analytical model of supplier behavior with scorecards, and investigate it in the laboratory.

4 - The Bright and Dark Sides of Perception Biases in Inventory Decisions

Yaozhong Wu, National University of Singapore, Singapore, 119245, Singapore, yaozhong.wu@nus.edu.sg

We study the impact of perception biases in competing inventory decisions. We analyze how a manager's perception bias affects each other's inventory decisions and performances in strategic interactions, and more importantly who benefits from these biases in the short and long runs. We show that a perception bias can serve as a competitive advantage in the sense that a biased manager can achieve a higher profit than an unbiased competitor.

■ TD46

Hilton- Lombard

Dynamic Combinatorial Optimization under Uncertainty

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Alejandro Toriello, Assistant Professor, Georgia Tech ISyE, 765 Ferst Dr NW, Atlanta, GA, 30332, United States of America, atoriello3@isye.gatech.edu

1 - Randomized Minmax Regret for Combinatorial Optimization under Uncertainty

Andrew Mastin, MIT, EECS & LIDS, Cambridge, United States of America, mastin@mit.edu, Sang Chin, Patrick Jaillet

We consider a randomized model for minmax regret combinatorial optimization under uncertainty, where an optimizing player selects a probability distribution over solutions and an adversary selects costs with knowledge of the player's distribution. While the deterministic minmax regret versions of most polynomial solvable problems are NP-hard, we show that under this randomized model, the minmax regret version of any polynomial solvable combinatorial problem becomes polynomial solvable.

2 - New Efficient Algorithms for the Time Cost Tradeoff Problem in Project Management

Dorit Hochbaum, Professor, University of California, Berkeley, IEOR Department, Etcheverry Hall, Berkeley, CA, 94720, United States of America, hochbaum@ieor.berkeley.edu

The time-cost trade-off problem (TCT) is to determine the extent of expediting, or crashing, of activities in a project so as to benefit most from early completion incentives. We describe two polynomial time algorithms that provide a new interpretation of old algorithms: one solving the primal and the other solving the dual.

3 - Semi-Infinite Relaxations for the Dynamic Knapsack Problem with Stochastic Item Sizes

Alejandro Toriello, Assistant Professor, Georgia Tech ISyE, 765 Ferst Dr NW, Atlanta, GA, 30332, United States of America, atoriello3@isye.gatech.edu

We consider a knapsack problem in which item sizes are stochastic and realized after an attempted insertion, and the decision maker chooses an item to insert dynamically based on remaining capacity. We derive relaxations of polynomial and pseudo-polynomial size based on different approximations of the value function, relate them to previous work and compare them.

4 - A MIP Model and Solution Approach for Supply Chain Planning with Time-Aggregated Quantity Discounts

Aly Megahed, Research Staff Member, IBM Research - Almaden, 650 Harry Road - Office D3-428, San Jose, CA, 95120, United States of America, aly.megahed@us.ibm.com, Pratik Mital

We present a supply chain planning problem with time-aggregated quantity discounts. Such discounts are given on aggregated order quantities (e.g. total annual orders that were placed on a monthly basis). A MIP-based local search algorithm is developed as a solution approach. Numerical results that show the efficiency of that algorithm are shared.

■ TD47

Hilton- Mason A

Information, Networks and Big Data

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Eugene Perevalov, Lehigh University, IS&E Department, Bethlehem, PA, 18015, United States of America, eup2@lehigh.edu

1 - Predicting Long-Term Product Ratings in Business-to-Consumer Online Systems

Alexander Nikolaev, University at Buffalo (SUNY), 312 Bell Hall, Buffalo, NY, 14260, United States of America, anikolae@buffalo.edu, Sushant Khopkar

Online users often rely on observed product ratings. However, when an average product rating is based on a small number of ratings, they may not feel confident about the product, even if the average is high. This paper presents a new Bayesian Network (BN) method for predicting the long-term average product rating. Compared to Running Average and Linear Regression predictors, the BN method works particularly well around the time of product introduction when prediction accuracy is most valuable.

2 - Education Supply Chains and Network Science – A Preliminary Investigation

Soundar Kumara, Allen E. Pearce/Allen M. Pearce Professor, The Pennsylvania State University, 222 Leonhard Building, Industrial Engineering, University Park, PA, 16802, United States of America, skumara@psu.edu, Gerhard Klimeck, Yi-Shan Sung, Cheng-Bang Chen, Jim Slopsema, Lynn Zentner, Mike Zentner

On-line education can be equated with supply chains, where different educational modules and tools can be considered as products; students, researchers and others can be considered as customers. In this talk we deal with longitudinal data from nanohub on-line learning and research resource usage (from Purdue University) to investigate product mix, and capacity requirements by using statistical and Graph analytics.

3 - On the Theory of Information Extraction

Xing Wang, Student, Lehigh University, 205 Summit Street, Bethlehem, PA, 18015, United States of America, xiw313@lehigh.edu, Eugene Perevalov

The classical Information Theory provides tools for optimizing information transmission by virtue of properly describing information quantity. On the other hand, in order to optimize information acquisition from sources, a general quantitative description of information accuracy and, respectively, of the structure of the sources' knowledge is needed. We describe the basics of a general theory of information accuracy that naturally extends the classical information theory in this direction.

■ TD48

Hilton- Mason B

Optimization, Robust 1

Contributed Session

Chair: Mohammad Javad Feizollahi, Phd Candidate, Georgia Institute of Technology, 765 Ferst Drive NW, Suite 439 (main building), Atlanta, GA, 30332-0205, United States of America, feizollahi@gatech.edu

1 - A Method for Robust Parameter Design with a Categorical Response

Gonca Karabulut, Production Engineer, Unilever, Camalti Sitesi A2 Blok No:13 Atasehir, Istanbul, Turkey, goncabacanli@gmail.com, Gülser Köksal

A relatively simple and effective method called Logistic Regression Model Optimization (LRMO) is studied for analysis of categorical response data for product design. Its performance is compared with those of four other design optimization methods for an ordered categorical response: Accumulation Analysis (AA), Weighted Signal-to-noise Ratio (WSNR), Scoring Scheme (SS), Weighted Probability Scoring Scheme (WPSS).

2 - Uncertainty Quantification for Robust Optimization and Extended Relational Algebra of Polytopes

Abhilasha Aswal, International Institute of Information Technology, Bangalore, 26/C Electronics City, Bangalore, KA, 560100, India, abhilasha.aswal@iiitb.ac.in, Anushka Chandrababu, GNS Prasanna

Our robust polyhedral representation of uncertainty allows a simple quantification of amount of information driving the optimization. We can establish info equivalences and create new constraint sets, equal in info to an old constraint set. An extended relational algebra of polytopes enables a qualitative visualization of the relations among alternative constraint sets. We show that our approach is computationally simpler than stochastic alternatives and more expressive than robust alternatives.

3 - The Robust Deviation Quadratic Assignment Problem

Mohammad Javad Feizollahi, Phd Candidate, Georgia Institute of Technology, 765 Ferst Drive NW, Suite 439 (main building), Atlanta, GA, 30332-0205, United States of America, feizollahi@gatech.edu, Igor Averbakh

We consider a generalization of the classical quadratic assignment problem, where material flows are uncertain, and only upper and lower bounds are known for each flow. The objective is to find a minmax regret solution. We present an exact Benders decomposition algorithm, a tabu search based heuristic, and a hybrid approach that allows us to combine the speed of heuristics with the rigor and precision of the exact method. We discuss the results of extensive computational experiments.

4 - A Robust Optimization Inventory Model with Uncertain Demand and Lead Time

Mohammad Rahdar, Iowa State University, Iowa State University, Ames, IA, 50011, United States of America, rahdar@iastate.edu, Guiping Hu, Lizhi Wang

A robust optimization model is proposed to explicitly address the uncertain demand and lead time in an inventory model. The model has a tri-level structure. The top level makes ordering decision in the current period, the middle level identifies the worst scenario for all the future periods, and the bottom level is a deterministic inventory model for the remaining periods of the planning horizon. We propose an exact algorithm for the tri-level programming model and report the numerical results.

5 - Robust Vehicle Routing Problem with Time Windows

Da Lu, PhD Student, University of Waterloo, 200 University Ave West, Waterloo, ON, N2L 3G1, Canada, d4lu@uwaterloo.ca, Fatma Gzara

This paper proposes a robust model for the vehicle routing problem with time windows where customer demands are uncertain. The uncertainty is defined as a set of cardinality constrained supports. We propose a branch-and-price-and-cut algorithm to solve the problem. The subproblem is a robust counterpart of shortest path problem with resource constraints(SPPRC) that is solved by solving a series of SPPRC. A new separation strategy tailored for the robust case is developed to find violated cuts.

■ TD49

Hilton- Powell A

Combinatorial Optimization and Social Network Analysis

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Cynthia Wood, Rice University, 6100 Main St. - MS 134, Houston, TX, 77005, United States of America, ciw2@rice.edu

1 - Upper Bound on the Clique Number of a Graph
Chitra Balasubramaniam, Texas A&M University, 3131 TAMU, College Station, 77843, United States of America, bcvaidyanath@neo.tamu.edu, Sergiy Butenko

The Maximum Clique Problem has many practical applications that include social network analysis, fault tolerance, and protein interaction networks among others, but it is intractable. We develop a good upper bound for this problem using clique relaxations and compare the results with the bounds from literature.

2 - A Branch-decomposition Algorithm for the p-Median Problem
Caleb Fast, Rice University, 6100 Main St. - MS 134, Houston, TX, 77005, United States of America, ccf5@rice.edu, Illya Hicks

This talk presents results from using a dynamic programming algorithm on branch decompositions of linear relaxations to approximate optimal solutions of p-Median problems. This problem is NP-hard, making an approximation algorithm attractive. This talk compares the branch decomposition algorithm with a standard integer program solver and heuristics for the problem.

3 - Community Detection in Dynamic Social Networks
Aaron Schecter, Northwestern University, 1424 Main St, Evanston, IL, 60202, United States of America, aschec@gmail.com, Noshir Contractor

Research on the identification of communities has focused on their detection in static networks. With the increased availability of time-stamped digital trace data it is now possible to model the dynamics of communities where ties appear, disappear, or change in intensity. We utilize a hierarchical clustering algorithm and a fuzzy clustering algorithm to identify dynamic communities based on cohesion and structural equivalence respectively. We use simulations to validate our methods.

4 - Finding the Maximum Weighted Co-2-Plex in a {Claw, Bull}-Free Graph
Cynthia Wood, Rice University, 6100 Main St. - MS 134, Houston, TX, 77005, United States of America, ciw2@rice.edu

The maximum weighted co-2-plex problem determines a subset of vertices of maximum total weight of a given graph, in which each vertex has degree at most one. This talk presents two polynomial time algorithms for solving MWC2P problem in {claw, bull}-free graphs.

■ TD50

Hilton- Powell B

Optimization, Metaheuristics 1

Contributed Session

Chair: Rym M'Hallah, Associate Professor, Kuwait University, PO Box 5969, Safat, Kuwait, 13060, Kuwait, rymmha@yahoo.com

1 - An Iterated Local Search Variable Neighborhood Descent for the m-Machine Flowshop
Rym M'Hallah, Associate Professor, Kuwait University, PO Box 5969, Safat, Kuwait, 13060, Kuwait, rymmha@yahoo.com

This paper considers the minimal earliness tardiness -machine permutation flow shop scheduling problem with distinct due dates and no inserted idle time when a job is waiting. It presents a mixed integer program, and approximately solves it using V, a fast iterated local search variable neighborhood descent. The results prove the good performance of V, which matches 20.02 % existing upper bounds and tightens 70.54% ones with a 0.07% average deviation.

2 - Transmission Expansion Planning using Multivariate Interpolation
Ebrahim Mortaz, Auburn University, Auburn, AL 36849, Auburn, United States of America, emortaz@auburn.edu, Jorge Valenzuela

The total cost of the Transmission Expansion Planning (TEP) problem consists of investment and operation costs. In this research, we propose a multivariate interpolation method to compute the operation cost for the TEP problem in which the demand changes from hour to hour and the fuel price from day to day. A binary particle swarm optimization is also proposed to solve the problem. We compare our method with traditional methods based on the total cost of the obtained expansion plans.

3 - Mitigating Irreducible Complexity in Evolutionary Algorithms via Initial Population Seeding
Matthew Hoffman, Sandia National Laboratories, P.O. Box 5800, MS 1188, Albuquerque, NM, 87185-1188, United States of America, mjhoffm@sandia.gov, Jack Gauthier, Geoffry Pankretz

Logical constraints confound evolutionary operations in combinatorial optimization problems, leading to "Irreducible Complexity" - the existence of viable (possibly optimal) solutions that cannot be discovered by traditional evolutionary means. We discuss one avenue for mitigating this issue: seeding the initial population with solutions that satisfy the logical constraints least likely to be satisfied by chance. We will demonstrate efficacy of such seeding by comparing results vs. status quo.

4 - A Comparative Study of Algorithms to the Social Team Formation Problem
Victor Cavalcante, Researcher, IBM Research, Rodovia Jornalista Fco. Aguirre Proença, Km 09 - Chacaras Assay, Hortol,ndia, SP, 13186-525, Brazil, victorfc@br.ibm.com, Steven Tsukamoto, Ana Paula Appel, Thiago Rosario, Vagner Santana

Team members' ability to work together is paramount in collaborative tasks. Thus, assembling effective teams to perform collaborative tasks requires considering not only skills, capabilities or availabilities, but also contemplating social links among potential team members. This Social Team Formation Problem is the subject of the current work, where an implementation of a GRASP meta-heuristic is depicted and experimental results are reported and compared with other optimization approaches.

5 - Many Heuristics are Better than One: A Data-driven Approach to Solving MAX-CUT
John Silberholz, PhD Candidate, MIT, 77 Massachusetts Ave, E40-149, Cambridge, MA, 02139, United States of America, josilber@mit.edu, Swati Gupta, Iain Dunning

Can graph properties predict the performance of heuristics on NP-hard problems? Can multiple heuristics be combined into a method that outperforms any single one of them? What is the value added of a new heuristic? We address these questions by constructing a large test bed of instances and implementing 40 published heuristics for MAX-CUT. We show that a hybrid method outperforms any single heuristic and discuss how large-scale test beds and code repositories can improve heuristic evaluation.

■ TD51

Hilton- Sutter A

Data Mining in Medical and Engineering Domain

Sponsor: Data Mining

Sponsored Session

Chair: Cao (Danica) Xiao, PhD Student, University of Washington, Seattle, 3900 Northeast Stevens Way, Mechanical Engineering Building, Room G6, Seattle, WA, 98195, United States of America, danicaxiao@gmail.com

1 - Mining the Structure of Aggregate Energy Demand for Large Consumer Populations
Adrian Albert, Senior Scientist, C3 Energy, 1300 Seaport Blvd, Redwood City, CA, 94062, United States of America, adrian.albert@c3energy.com, Ram Rajagopal

We study the structure in consumption variability of large groups of residential consumers. Variability in aggregate demand is of particular importance for utilities, since they have to make advance decisions on bids into day-ahead and spot markets. We develop a method to form portfolios of individual consumers for which the aggregate is predictable in some sense. For this we design an algorithm to estimate the covariance structure between users that uses past history and exogenous covariates.

2 - Support Vector Data Description-Based Clustering Validity Index
Young-Seon Jeong, Chonnam National University, Dept. of Industrial Engineering, Gwangju, Korea, Republic of, young.jeong@jnu.ac.kr, Soo-Hyun Lee, Jae-Yun Kim, Myong-Kee Jeong

This talk presents a novel clustering validity index (CVI) based on a support vector data description (SVDD) based compactness. Unlike the existing CVIs, which are sensitive to arbitrary shapes of a clustering, the proposed CVI can accurately evaluate a clustering compactness in kernel space. The preliminary results show that the proposed CVI can achieve the accurate compactness for arbitrary shapes of a clustering such as a lengthy stick shape.

3 - A Markov Model to Predict the Future Diabetes Burden in the U.S.
Ji Lin, Centers for Disease Control and Prevention, 4770 Buford Highway, Building 107, MS F-73, Atlanta, GA, 30341, United States of America, xhi6@cdc.gov, Theodore Thompson, Yiling Cheng, Xiaohui Zhuo, Ping Zhang, Edward Gregg, Deborah Rolka

Forecasting of future diabetes prevalence is helpful for formulating health policy and allocating resources. A Markov model is developed to predict prevalence of diabetes for demographic cohorts. Future prevalence depends on current prevalence, incidence, mortality, and migration. Transition probabilities are estimated by statistical modeling on U.S. Census projections and National Health Interview Survey. The system is represented in difference equations and solved by Monte Carlo Simulation.

4 - Decomposed K Nearest Neighbors
Cao (Danica) Xiao, PhD Student, University of Washington, Seattle, 3900 Northeast Stevens Way, Mechanical Engineering Building, room G6, Seattle, WA, 98195, United States of America, danicaxiao@gmail.com, W. Art Chaovalitwongse

DKNN is a variant of KNN that considers the distance to the class prototypes of nearest neighbors as the classification rule, as opposed to the majority votes. Our DKNN also has a training process to learn the distance metric that minimizes classification errors and maximize the margin of decision boundary. Furthermore, DKNN introduces a regularization term (Frobenius or L1) to increase robustness and improve prediction accuracy.

■ TD52

Hilton- Sutter B

Optimization, Constraint Programming

Contributed Session

Chair: Qingwei Jin, Associate Professor, Zhejiang University, Department of Management Science and Eng, Hangzhou, Zh, 310058, China, qingweijin@gmail.com

1 - Graphic Method for n-variable Linear Programming with Two Constraints
Youkang Fang, Professor, Beihai College of Beihang University, 88 Yintan Street, Beihai, 536002, China, fykfyk2004@163.com

In this paper, we show that any linear programming with n variables and two constraints can be solved by using two dimensional graphic method at most twice, and the the degeneracy problem in the simplex method is no more a problem in our method.

2 - Evolutionary Multi Point Search In CPLEX Studio's Constraint Programming Solver Engine
Renaud Dumeur, Principal Architect, Constraint Programming Product Development, IBM, 9 Rue de Verdun, Gentilly, 94250, France, renaud.dumeur@fr.ibm.com, Paul Shaw

In this talk, we present the Multi Point search used in CP Optimizer, the Constraint Programming solver of IBM ILOG CPLEX Studio. After a short introduction to both Constraint Programming and Evolutionary Computation, we will present how the later is hybridized with the former to implement MultiPoint search, as well as information about its usage, parameterization and performance on a large sets of integer and scheduling problem instances.

3 - Semidefinite Relaxation Based Branch and Bound Algorithm for Nonconvex QCQP
Qingwei Jin, Associate Professor, Zhejiang University, Department of Management Science and Eng, Hangzhou, Zh, 310058, China, qingweijin@gmail.com, Cheng Lu

To globally solve convex quadratically constrained quadratic programming problems with nonconvex objective functions, we design a semidefinite relaxation based branch and bound algorithm. We add valid nonconvex constraints, use their convex relaxation and design a branch and bound algorithm to tighten the relaxations, which enforces the nonconvex constraints being satisfied gradually. Numerical experimental results show that the proposed algorithm is very effective.

4 - Optimal Solutions to a Root Minimization Problem over a Polynomial Family with Affine Constraints
Mert Gurbuzbalaban, Postdoctoral Researcher, Massachusetts Institute of Technology, MIT/Lab for Information and Decision Sys, 32 Vassar St., Building 32-D614, Cambridge, MA, 02139, United States of America, mert@cims.nyu.edu, Michael Overton, Julie Eaton, Sara Grundel

We consider the problem of minimizing the root radius and abscissa over the space of monic polynomials of degree n subject to k affine constraints on their coefficients, motivated by some challenging optimal design problems in control. This is a difficult optimization problem due to the nonsmoothness and nonconvexity of the objective function. We prove that there exists an optimizer with at least n-k+1 active roots and present numerical experiments.

5 - A New Globally Convergent Incremental Newton Method
Mert Gurbuzbalaban, Postdoctoral Researcher, Massachusetts Institute of Technology, MIT/Lab for Information and Decision Sys, 32 Vassar St., Building 32-D614, Cambridge, MA, 02139, United States of America, mert@cims.nyu.edu, Asuman Ozdaglar

We develop and analyze a new globally convergent incremental Newton method for minimizing the sum of strongly convex functions, motivated by machine learning problems over large data sets and distributed optimization over networks. We discuss its convergence rate and prove its linear convergence under some assumptions.

■ TD53

Hilton- Taylor A

Finance, Portfolio Analysis 2

Contributed Session

Chair: Mehmet Benturk, Student, Lincoln University, 401 15th St, Oakland, CA, 94612, United States of America, mbenturk@yahoo.com

1 - The Effect of Taste Change on Optimal Portfolio Selection when Assets Exhibit Varied Liquidity
Mehmet Benturk, Student, Lincoln University, 401 15th St, Oakland, CA, 94612, United States of America, mbenturk@yahoo.com, Aharon Hibshoosh

We analyze optimal portfolio selection where some assets are illiquid and are leveraged with different interest rates and different collateral value limits. We assume a taste change when the market changes from bear to bull. We decompose the effect of taste change on asset selection into a substitution effect and income effect. In a portfolio with risky investments and with leverage we derive and characterize the efficient frontier under alternative assumptions on leverage determination.

2 - Portfolio Optimization using Gini-based Risk Measures
Ran Ji, PhD, George Washington University, 2201 G St, NW, Funger Hall 415, Washington, DC, 20052, United States of America, jiran@gwmail.gwu.edu, Srinivas Y. Prasad, Miguel Lejeune

We formulate portfolio optimization models that employ the Gini Mean Difference (GMD) risk measure. We introduce the Mean-Gini Ratio metric that jointly accounts for the expected return and GMD criteria, and show that it is SSD consistent and LP solvable. Computational and cross-validation results as well as comparisons with other risk measures will be presented. Practical insights about the influence of the risk aversion coefficient will be illustrated.

3 - A Black Litterman Model for CVaR Optimization
Cagatay Karan, PhD Student, North Carolina State University, 2152 Burlington Labs, 2500 Stinson Drive, Raleigh, NC, 27695, United States of America, ckaran@ncsu.edu, Tao Pang

The Black Litterman Model (BLM) has contributed to modern portfolio theory a new perspective where the investor views and market equilibrium expected excess returns are combined in a Bayesian manner to get the optimal portfolio weights. Bertsimas, Gupta and Paschalidis(2012) have showed that one can get BLM type results by using inverse optimization. We will show our algorithms and numerical results for the BLM type optimization problems under CVaR risk measure.

4 - Computing near-optimal Value-at-Risk portfolios using Integer Programming techniques
Onur Babat, Lehigh University, 217 West Packer Avenue Apt:106, Bethlehem, PA, 18015, United States of America, onur.babat@lehigh.edu, Luis Zuluaga, Juan C. Vera

We consider the Value-at-Risk (VaR) portfolio optimization problem, which is an extension of Markowitz model in which VaR is used instead of variance as the risk measure. The VaR model can be formulated as an integer programming (IP) problem, and the formulation can be solved for small to mid-size instances in a reasonable amount of time. We exploit the IP formulation to develop an efficient algorithm to solve larger scale instances of the VaR model. Relevant numerical experiments will be given.

5 - A Model Selection Method for Option Pricing
Berk Orbay, Bogazici University, Suna sok. 34 Etiler, Istanbul, Turkey, berk.orbay@boun.edu.tr, Refik Güllü, Wolfgang Hörmann

Empirical evidence on comparison of option pricing models shows that there is no consensus on a single dominating model for all contract parameters and over different time periods. We propose a clustering method to find the relevant regions of contract parameters for model selection. Then, we use a decision rule to select the most suitable model over these regions. Finally, we provide out-of-sample testing results using different assets and option pricing methods over different time periods.

■ TD54

Hilton- Taylor B

Optimal Stopping with Applications to Finance and Economics

Sponsor: Financial Services Section

Sponsored Session

Chair: Dharma Kwon, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 South Sixth Street, Champaign, United States of America, dhkwon@illinois.edu

1 - A Dynamic Analysis of Short Time Work Arrangements
Kuno Huisman, Tilburg University, Post Office Box 90153, Tilburg, Netherlands, K.J.M.Huisman@uvt.nl

This paper analyses the temporary unemployment regulations that were introduced during the recent recession. We view these measures as a collection of real options that governments provide to ?rms and value these options. The e?ect of such measures on the liquidation decision of the ?rm is studied and in addition the e?ect of government limitations on the duration of the program. Temporary unemployment measures delay a ?rm's liquidation. However, the programme is not necessarily good for welfare

2 - Detection with Post-Change Drift Uncertainty
Heng Yang, Graduate Center, CUNY, 365 fifth avenue, New York, NY, 10016, United States of America, hyang@gc.cuny.edu, Olympia Hadjiliadis, Mike Ludkovski

We consider the problem of quickest detection of an abrupt change when there is uncertainty about the post-change distribution. The objective is to find a decision rule to minimize a measure of worst detection delay of the min-max type subject to a frequency of false alarm constraint. In this effort, we discuss two different rules: the first rule is a delayed version of CUSUM algorithm, and the second rule is an online composite CUSUM-based stopping time.

3 - Optimal Mean Reversion Trading with Transaction Cost and Stop-Loss Exit
Tim Leung, Columbia University, 500 West 120th Street MC4704, New York, United States of America, tl2497@columbia.edu, Xin Li

Motivated by the industry practice of pairs trading, we study the optimal timing strategies for trading a mean-reverting price spread. An optimal double stopping problem is formulated to analyze the timing to start and subsequently liquidate the position subject to transaction costs. We apply a probabilistic methodology and derive the optimal price intervals for entry and exit. We also incorporate a stop-loss constraint and investigate its impact on the optimal timing strategies.

4 - Sequential Replacement under Uncertainty in the Population Distribution
Dharma Kwon, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 South Sixth Street, Champaign, United States of America, dhkwon@illinois.edu, Steven Lippman

We study the impact of uncertainty in the problem of sequential replacement of projects with unknown quality and unknown population distribution of quality. The decision-maker can operate one project at a time, observe the performance, update his belief on the quality and the population distribution, and replace it with another project from the population. Our novel result: the real option value is decreasing in the uncertainty in the population distribution.

■ TD55

Hilton- Van Ness

Integer Nonlinear Programming and Applications – 2

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Monique Guignard, Professor, University of Pennsylvania, OPIM Dept., the Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104-6340, United States of America, guignard_monique@yahoo.fr

1 - Using MINLP in Real Time Crossdock Optimization
Heng Zhang, University of Pennsylvania, 200 S 33rd St., Philadelphia, PA, 19104, United States of America, hengzhang24@gmail.com, Monique Guignard, Peter Hahn

The Crossdock Door Assignment Problem (CDAP) determines door assignments once for the entire planning period, thus possibly sacrificing operational efficiency. We propose a dynamic approach that repeatedly solves the CDAP when information needs updating in response to events during the planning period. We use for that our fast Convex Hull MatHeuristic CHH, designed for general MINLPs with linear constraints. Simulation demonstrates the superiority of the dynamic approach over the static one.

2 - Combined Multiproduct Maritime Inventory Routing & Blend Scheduling: Approaches to Large-Scale MINLP
Nicolas Sawaya, ExxonMobil, 800 Bell Street, Houston, United States of America, nicolas.sawaya@exxonmobil.com, Ahmet Keha, Jin-Hwa Song, Kevin Furman, Myun-Seok Cheon

We introduce a very large-scale problem for simultaneous optimization of ship routing, inventory management and tank blending of multiple bulk products. Nonlinearities arise due to the blending of products in on-shore tanks in order to meet demand specifications as well as achieve value uplift. We examine multiple modeling and solution approaches to solve this MINLP problem.

3 - Using SDP-based Convexification for Quadratic MIP Problems
Monique Guignard, Professor, University of Pennsylvania, OPIM Dept., the Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104-6340, United States of America, guignard_monique@yahoo.fr, Lucas Letocart, Michael Bussieck

We review SDP-based methods for convexifying the quadratic objective function of MINLP problems with linear constraints. We describe how they can be used in conjunction with commercial MINLP optimization software, and discuss implementation issues. We report on numerical experiments with quadratic knapsack problems, generalized assignment problems and crossdock door assignment problems.

■ TD56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - SAS - Building and Solving Optimization Models with SAS
Ed Hughes, SAS, United States of America, Ed.Hughes@sas.com

SAS provides a comprehensive set of data and analytic capabilities, including statistical analysis, data and text mining, econometrics and forecasting, and operations research methodsóoptimization, simulation, and scheduling. OPTMODEL from SAS provides a powerful and intuitive algebraic optimization modeling language and unified support for building and solving LP, MILP, QP, NLP, CLP, and network-oriented models. We'll demonstrate OPTMODEL for basic and advanced problems, highlighting its newer capabilities and its support for both standard and customized solution approaches.

2 - American Optimal Decisions - Portfolio Safeguard (PSG): Advanced Nonlinear Mixed-Integer Optimization Package
Stan Uryasev, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, uryasev@ufl.edu

Portfolio Safeguard is an advanced nonlinear mixed-integer optimization package used in risk management, statistics, financial engineering, military, medical and other applications. Design and solve complex optimization problems with built-in functions (maximum, StDev, variance, probability, VaR, CVaR, Drawdown, cardinality, fixed-charge, spline, recourse etc.) See real-life case studies at www.aorda.com/aod/psg.action.

■ TD57

Hilton- Golden Gate 1

Panel Discussion: Publishing in INFORMS Transactions on Education

Sponsor: INFORM-ED

Sponsored Session

Moderator: Armann Ingolfsson, University of Alberta, School of Business, Edmonton, AB, T6G2R6, Canada, aingolfs@ualberta.ca

1 - Panel Discussion: Publishing in INFORMS Transactions on Education

The panelists include ITE editors and authors who have published recently in ITE. The authors will discuss their experiences with submitting articles to ITE, successful and not. The editors will provide suggestions to authors who wish to submit their work to ITE—in particular, articles about case studies and about educational games.

2 - Experiences in Publishing in ITE
Theresa Roeder, Associate Professor, San Francisco State University, College of Business, 1600 Holloway Ave, San Francisco, CA, 94132, United States of America, tmroeder@sfsu.edu, Timothy C. Y. Chan, Keith Willoughby, Susan Martonosi

This presentation discusses the author's experiences in submitting a variety of articles to ITE, both successfully and not. We discuss the different subject matters as well as the submission and review process.

■ TD58

Hilton- Golden Gate 2

Scheduling I

Contributed Session

Chair: Yu "Washington" Zhang, UNC Chapel Hill, 101 Misty Woods Circle Apt R, Chapel Hill, NC, 27514, United States of America, yuzhang@email.unc.edu

1 - ATM Replenishment Scheduling

Yu "Washington" Zhang, UNC Chapel Hill, 101 Misty Woods Circle Apt R, Chapel Hill, NC, 27514, United States of America, yuzhang@email.unc.edu

We consider an ATM replenishment problem where the bank operates multiple ATMs in the same area. If a customer finds an ATM without any cash available, certain cost will be incurred. The replenishment cost is non-linear in the sense that the bank will pay more money for replenishing multiple ATMs by sending out one truck for each ATM than filling them up altogether. We present structures of the optimal strategy and study a heuristic policy which is easy to implement.

2 - A Collaborative Scheduling Method for Quay Crane Dual Cycling in Container Terminals

Yujiao Sun, Dalian University of Technology, No.2 Linggong Road, Ganjingzi District, Dalian, China, sunyujiao@mail.dlut.edu.cn, Xiangpei Hu

Dual cycling is a rising Quay Crane scheduling method that has proved to be of high economical and environmental advantages. However, yard reshuffles and the integration of loading and unloading operations make it a complex problem. We propose a collaborative scheduling strategy, which coordinates the operational sequence of containers on Yard Cranes, Yard Trucks, and Quay Cranes. Based on this strategy, we formulate a mixed integer programming model and solve it by a hybrid genetic algorithm.

3 - Enhancing HPC Scheduling through Predictive Analytics

Sarah Powers, Oak Ridge National Labs, One Bethel Valley Rd., Oak Ridge, TN, United States of America, powersss@ornl.gov

Foreknowledge of job arrivals to a High Performance Computing (HPC) system provides valuable information to the job scheduler. Optimizing the utility earned by the system is key for both users and administrators. This talk will discuss the use of predictive modeling, data mining and simulation to enable better scheduling criteria in a heterogeneous computing environment.

4 - Stochastic Scheduling of Patients to Maximize Number of On-time Appointments

Esmaeil Bahalkeh, Ohio University, 1602 apt,15 S.Shafer st,, university commons, Athens, OH, 45701, United States of America, eb867213@ohio.edu, Gursel A. Suer

In this study, we have proposed a stochastic math model to schedule the patients. The model determines the patients' appointment times considering a certain level of risk. The objective is to generate a sequence where the number of patients who can be seen by their appointment time is maximized. Other patients are given higher priority in the next period.

5 - Scheduling Learning Dependent Jobs in Assembly Lines Considering Ergonomic Factors

Flavio S. Fogliatto, Federal University of Rio Grande do Sul, IE Department, Porto Alegre RS, Brazil, ffogliatto@gmail.com, Michel Anzanello, Marcia Echeveste, Ana Rita Facchini

We propose a method to select clustering variables aimed at grouping customized product models into families. Two groups of clustering variables are considered: those generated by expert assessment on product features, and those representing workers' learning rate, obtained through learning curve modeling. The method integrates the "leave one variable out at a time" elimination procedure with a k-means clustering technique.

■ TD59

Hilton- Golden Gate 3

Panel Discussion with Department Chairs: How to Recruit, Retain, and Support Women and Minority Students

Sponsor: Women in OR/MS

Sponsored Session

Chair: Lauren Davis, Associate Professor, North Carolina A&T State University, 1601 East Market Street, Greensboro, NC, 27411, United States of America, lbdavis@ncat.edu

Chair: Banafsheh Behzad, Assistant Professor, California State University, Long Beach, Department of Information Systems, College of Business Administration, Long Beach, CA, 90840, United States of America, behzad1@illinois.edu

Co-Chair: David Morrison, University of Illinois, Urbana-Champaign, 1624 T St Apt 4, Sacramento, CA, 95811, United States of America, drmorr0@gmail.com

1 - Panel with Department Chairs: How to Recruit, Retain, and Support Women and Minority Students

Moderator: Banafsheh Behzad, Assistant Professor, California State University, Long Beach, Department of Information Systems, College of Business Administration, Long Beach, CA, 90840, United States of America, behzad1@illinois.edu, Panelists: Rakesh Nagi, Mark Daskin, Janis Terpenny, J. Cole Smith

Women and students of color continue to be underrepresented in engineering fields. To address these concerns, this panel session holds a discussion on effective strategies for recruiting, retaining, and supporting women and minority students. Several engineering department chairs will present ideas which support attracting women and underrepresented minority students to engineering fields.

■ TD60

Hilton- Golden Gate 4

Inventory Management III

Contributed Session

Chair: Min Wang, Drexel University, 3141 Chestnut Street, Philadelphia, United States of America, mw638@drexel.edu

1 - Critical Level Rationing in Inventory Systems With Continuous Demand

Pablo Escalona, Universidad Técnica Federico Santa MarÌa, Avenida España 1680, ValparaÌso, Chile, pablo.escalona@usm.cl, Fernando Ordonez

This paper analyzes the use of a critical level policy for an inventory system that provides differentiated service-levels for two demand classes (high and low priority). We considering an inventory system with continuous review (Q,r) policy and demand classes that are modeled through continuous distributions. We look for closed form optimal solution under mild assumptions. We separate our analysis in two cases, when demand follows a distribution with positive support and a normal distribution.

2 - Last Time Buy and Re-use of Parts

Sina Behfard, University of Twente, Ravelijn building, Hallenweg 17, Enschede, 7522 NH, Netherlands, s.behfard@utwente.nl, Matthieu van der Heijden, Ahmad Al Hanbali, Henk Zijm

Spare part availability is essential for capital goods with a long service period. Sourcing decisions are hard once production of spares ceases while the remaining service period is long. We develop a decision support model to optimize the mix of supply sources (a last order before production stops, repair of failed parts, and recovery of useable parts from phased-out systems). We show that repairs and asset recovery are attractive, even when expensive, because of the postponement effect.

3 - Stabilizing Costs in a Continuous Review Inventory System: A Bi-Objective Approach

Gonca Yildirim, Assistant Professor, Cankaya University, Industrial Engineering Department, Ankara, Turkey, goncayildirim@cankaya.edu.tr, Dincer Konur

Focusing on cost minimization in a continuous review inventory system can result in cost variability between replenishment cycles due to stochastic nature of the demand. This cost fluctuation may be undesirable for planning purposes in practice. This study adopts a bi-objective approach that minimizes total costs and its range. A numerical study is conducted to demonstrate how costs can be stabilized using our approach.

4 - Optimizing Inventory's Contribution to Profitability in a Regulated Utility

Linda Li, Student, the University of Alabama, 1105 17th Street Tuscaloosa, Apt 5102A, Tuscaloosa, 35401, United States of America, lczy1985@163.com, Chuck Schmidt, David Miller

Through DEA model, we first investigates a group of electric utilities when the resource is inventory which implies these firms procure a significant extra amount in inventory (materials and supplies). Then we construct an analytical model of the inventory policy controlling the extra buying of material that will be inventoried and added to the firm's rate base.

5 - Decision Rules for Emergency Replenishments in an Inventory System

Sven Axsater, Professor, Lund University, Box 118, Lund, Sweden, sven.axsater@iml.lth.se

This paper provides a new decision rule for emergency replenishments in an inventory system. The decision rule is a generalization of a previous decision rule suggested and evaluated in Axs‰ter (2003, 2007). An improvement step is added to this rule. The decisions are based on complete information about the system state. It is possible to handle batch ordering, compound Poisson demand and emergency replenishments that take time. Emergency replenishments will always lead to lower expected costs.

■ TD61

Hilton- Golden Gate 5

Joint Session MAS/DAS: Military Decision Analysis Applications

Sponsor: Military Applications Society & Decision Analysis

Sponsored Session

Chair: Greg Parnell, Professor, Dept of Industrial Engineering, University of Arkansas, Fayetteville, AR, 72701, United States of America, gparnell@uark.edu

1 - Automated Commercial Imagery Adjudication

Freeman Marvin, Executive Principal, Innovative Decisions, Inc., 8230 Old Courthouse Road, Suite 460, Vienna, VA, 22182, United States of America, ffmarvin@innovativedecisions.com

The National System for Geospatial Intelligence (NSG) expects to increase reliance upon commercial sensors in coming years, to decrease costs and increase capacity. Due to technological advances, modern commercial imagers are now able to address a wide range of intelligence questions. Unfortunately, the process by which analysts can task commercial imagery is inefficient. This paper examines economic and decision analytic methods to improve the value of commercial imagery to national security.

2 - Combining Technology and Soft Skills in the Bayesia Expert Knowledge Elicitation Environment (BEKEE)

Joe Tatman, Innovative Decisions, Inc., 8230 Old Courthouse Road, Suite 460, Vienna, VA, 22182, United States of America, jatatman@innovativedecisions.com, Amanda Hepler, Gary Smith, Sean Tatman, Bill Patchak, Suzanne Mahoney, Dennis Buede

US Army CECOM Equipment Diagnostic Analysis Tool (CEDAT) project requires building of Bayesian networks using subject matter experts anywhere in the world. The technology of BayesiaLab BEKEE was combined with IDI experience in the soft skills of expert elicitation to develop a process for CEDAT enabling online experts to contribute effectively to all phases of Bayesian network model building. The process is being transferred to the CEDAT model builders and initial applications are underway.

3 - Program Objectives Memorandum (POM): Alternative Decision Analytic (DA) Approaches

Terry Bresnick, Innovative Decisions Inc., 3132 NW 63rd St, Boca Raton, FL, United States of America, bresnick@ix.netcom.com

DoD and the IC all prepare POMs, but there is little consistency in approach. We review 3 approaches spanning the spectrum of applications. USMC uses a balance beam approach to produce an order-of-buy. An IC agency built the POM around a MODA framework aimed at information needs. Several DoD/IC organizations use incremental benefit/cost analysis to produce a Pareto-optimal efficient frontier. Pros and cons of each will be discussed along with "social" aspects of implementation.

4 - Development of the Bayesian Enterprise Analysis Model

Mark Gallagher, Technical Director, HQ USAF A9, 1570 Air Force Pentagon, Washington, DC, 20330, United States of America, Mark.Gallagher@pentagon.af.mil, Justin Sorice, David Blum

The Bayesian Enterprise Analysis Model (BEAM) is a military enterprise analysis tool to evaluate force structure and strategies across the US Department of Defense in multiple scenarios. BEAM will evaluate alternative force structures including future systems against an adaptive adversary that varies allocations in response to observations. The presentation will highlight current development achievements, lessons learned and future research goals.

■ TD62

Hilton- Plaza A

Social Media Sentiment

Cluster: Social Media Analytics

Invited Session

Chair: Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, 01730, United States of America, lservi@mitre.org

1 - Network Contagion in Social Media

Chaitanya Kaligotla, PhD Student, INSEAD, Boulevard de Constance,, Fontainebleau, 77300, France, Chaitanya.kaligotla@insead.edu

This research studies the diffusion of inaccurate information versus that of competing accurate information, within the same network over time. This talk investigates how the dynamics of influence spreads over networks is effected by network structure. The project involves a mix of theoretical analysis and empirical analysis from mined Social Network data.

2 - What Social Media Sentiment Can (And Cannot) Tell Us About Public Opinion

Clay Fink, John Hopkins, Applied Physics Lab, 11100 Johns Hopkins Rd, Laurel, MD, 20723, United States of America, finkcr1@jhuapl.edu

We contrast sentiment expressed on Twitter in Nigeria toward president Goodluck Jonathan. We find that Twitter sentiment is more negative but correlates with surveys by region and over time. These results hold after reweighting survey results by factors associated with Twitter use.

3 - Heuristics for Secretary Pool Problems

Donald Gaver, Distinguished Professor of Operations Research, Naval Postgraduate Schoo, Monterey, CA, 93943, United States of America, DGaver@nps.edu, Patricia A. Jacobs

Classical single-secretary optimum selection (examine field for 1/e opportunities; pick 1st > max therein in remaining time) is generalized to cover the s >= 1 selection problem. Various alternative formulations are proposed and explored. Selection of superior organization teams from a candidate universe is a Social Media objective.

4 - Non-linear Dynamics of Human Emotions Expressed by Twitter Data and its Implication

Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, 01730, United States of America, lservi@mitre.org, Waldemar Karwowski, Nabin Sapkota, Tareq Ahram, Dylan Schmorrow

Exploration of the extent that human emotions, expressed in Twitter data, have chaotic and non-linear dynamics has profound implications in forecasting a population's mood. This study examined such dynamics found in 7320 data points, collected from hourly data representing over 380,000 Twitter messages.

■ TD63

Hilton- Plaza B

Behavioral OR and Applications of Cognitive Analytics

Cluster: Cognitive Analytics

Invited Session

Chair: Horst Samulowitz, IBM Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, samulowitz@us.ibm.com

1 - Text Analytics and Sentiment Analysis: Past, Present and Future

Richard Socher, Stanford, Serra Mall, Stanford, United States of America, richard@socher.org

Sentiment analysis is both linguistically interesting and crucial to business intelligence. In this talk, I will first describe overly simple methods for sentiment analysis that have been used in the past. Next, I will describe current methods of sentiment analysis and demo an easy to use tool for text and sentiment classification: etcml.com. In the third part, I will introduce more sophisticated models based on recursive deep learning which may supersede currently used algorithms.

2 - Analytics Integrated into Cognitive Algorithms Environment
Ali Koc, IBM TJ Watson Research Center, 1101 Kitchawan Rd,, Yorktown Heights, United States of America, akoc@us.ibm.com, Chandra Reddy, Meinolf Sellmann, Horst Samulowitz

We study analytic techniques and algorithms that integrate into cognitive computing and algorithms environment. The techniques have to be efficient and flexible enough to facilitate interactivity with the user and visualization. We present the work on a pre-disaster planning problem that strengthens a rural area transportation network, and on a fire evacuation planning problem. The specific applications solve extreme linear resource constraints with non-linear/stochastic objective functions.

3 - On the Importance of Behavioural OR
Raimo Hamalainen, Professor, Aalto University, Espoo, Espoo, 00076, Finland, raimo.hamalainen@aalto.fi

The new research area of Behavioural Operational Research(BOR) studies the behavioural aspects in OR based problem solving and decision support as well as the use of OR methods in the analysis of human behaviour. BOR aims to improve the practice of OR and to advance the use of OR models of social systems. Behavioural research exists in some areas of OR (e.g.decision analysis, behavioural operations ,system dynamics, game theory) but more studies are needed across the full spectrum of OR.

■ TD64

Parc- Cyril Magnin I

Rare Events, Sensitivity, and Exact Simulation

Sponsor: Applied Probability Society

Sponsored Session

Chair: Jose Blanchet, Associate Professor, Columbia University, Rm. 323, School of Engineering, 500 West 120th Street, New York, NY, 10027, United States of America, jose.blanchet@columbia.edu

1 - Sensitivity Analysis for Markov Chains
Chang-han Rhee, Georgia Tech, North Ave NW, Atlanta, GA, 30332, United States of America, rhee@gatech.edu, Peter Glynn

We introduce a general theory that provides sufficient conditions for differentiability of various types of performance measures including ones associated with random horizon expectations and stationary expectations, which are known to be notoriously difficult to deal with. The new theory is easy to apply on the basis of the model building blocks and requires weaker conditions than the ones provided by the existing literature. It also provides expressions useful for computation via simulation.

2 - Interplay of Insurance and Financial Risks
Qihe Tang, The University of Iowa, Iowa City, IA, United States of America, qihe-tang@uiowa.edu

Consider an insurance company exposed to a stochastic economic environment that contains two kinds of risks. The first kind is the insurance risk caused by traditional insurance claims, and the second kind is the financial risk resulting from investments. In this talk I will study the interplay of the two risks on the ruin probability for heavy-tailed cases.

3 - Rare-event Analysis for the Extreme Eigenvalues of the Beta-Laguerre Ensemble
Gongjun Xu, University of Minnesota, xuxxx360@umn.edu

We consider the tail behavior of the extreme eigenvalues coming from the Beta-Laguerre ensemble, which is a generalization of the Wishart matrix and plays an important role in multivariate analysis. We provide asymptotic approximations and bounds for the tail probabilities of the extreme eigenvalues. Moreover, we construct efficient Monte Carlo simulation algorithms to compute the tail probabilities. This is a joint work with Kevin Leder and Tiefeng Jiang.

4 - Exact Simulation of Multidimensional Reflected Brownian Motion
Karthyek Rajhaa Annaswamy Murthy, PhD Student, Tata Institute of Fundamental Research, Homi Bhabha Road,, Navy Nagar, Colaba, Mumbai, 400005, India, kamurthy@mailhost.tifr.res.in, Jose Blanchet

Using the recently developed tolerance enforced simulation techniques, we present the first exact simulation method for multidimensional reflected Brownian motion (RBM). The problem of obtaining samples from reflected diffusions is challenging because of the presence of correlated local-time-like terms in their definition. We obtain samples of RBM by first obtaining a piecewise linear approximation to the RBM, and then by applying a novel acceptance/rejection procedure to eliminate the error.

■ TD65

Parc- Cyril Magnin II

Stochastic Control Applications

Sponsor: Applied Probability Society

Sponsored Session

Chair: Bora Keskin, The University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, bora.keskin@chicagobooth.edu

1 - Moment Conditions for Multi-Server Queues with Integral Load
Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu, Michele Dufalla, Rein Vesilo

We provide a partial answer to the open question concerning the performance of multi-server queues with integral load. We do so by finding tighter necessary conditions for finite expected delay moments for these queues under power-law (i.e. Pareto) service times, using domain of attraction theory. This reduces, but does not close, the gap between necessary and sufficient conditions for these queues.

2 - Investment Timing with Incomplete Information and Multiple Means of Learning
Nur Sunar, University of North Carolina at Chapel Hill, Nur_Sunar@kenan-flagler.unc.edu, Michael Harrison

We consider a firm that can use one of several costly learning modes to dynamically reduce uncertainty about the unknown value of a project in a continuous-time setting. In addition to dynamic decisions about its learning mode, the firm must decide when to stop learning and either invest or abandon the project. We solve both the discounted and undiscounted versions of this problem, and extend our analysis to consider a firm that can choose multiple learning modes simultaneously.

3 - Queuing System Topologies with Limited Flexibility
Kuang Xu, MIT, 77 Massachusetts Ave., Cambridge, United States of America, kuangxu@mit.edu, John Tsitsiklis

We study a multi-server model where n flexible servers are connected to rn queues through a fixed connectivity graph, with average degree d. We show that as n tends to infinity, both a diminishing delay and a large capacity region are jointly achievable, even under limited flexibility (d << n): a family of random graphs are shown to stabilize all bounded admissible arrival rates, while simultaneously ensuring a diminishing queueing delay under a new class of matching-based scheduling algorithms.

4 - Server-Side Scheduling for Video Service: Earliest Progressive Deadline First
Kristen Gardner, Carnegie Mellon University, Computer Science Department, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, ksgardne@cs.cmu.edu, Sem Borst, Mor Harchol-Balter

Video servers must deliver content to clients on time. Each byte has a deadline by which it must be received by the client. We introduce a new server-side scheduling policy, Earliest Progressive Deadline First (EPDF), and prove that EPDF maximizes the fraction of bytes delivered on time. Like most server-side scheduling policies, EPDF is difficult to analyze exactly; we provide several bounds and approximations. Empirical results show that other policies, like GPS, perform similarly to EPDF.

■ TD66

Parc- Cyril Magnin III

Data Fusion for Prognostics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, United States of America, kliu8@wisc.edu

1 - Scalable Predictive Analytics for Multi-sensor Condition Monitoring Applications
Xiaolei Fang, Georgia Institute of Technology, 1207 Noble Creek Dr NW, Atlanta, GA, 30327, United States of America, xfang33@mail.gatech.edu, Kamran Paynabar, Nagi Gabraeel

We develop a multi-sensor prognostic model that utilizes multistream signals to predict residual lifetimes of partially degraded systems. We first fuse the multistream degradation signals via Multivariate Functional Principal Components Analysis (MFPCA). Next, the fused features are used for prognostics via adaptive functional regression. To address some of the Big Data challenges, a randomized low-rank matrix approximation technique is incorporated to speed up the MFPCA matrix decomposition.

2 - Reliability Analysis of a Surveillance System with Multifunctional Sensors

Yiwen Xu, United States of America, yiwen.xu6@gmail.com, Haitao Liao

In this paper, we study the reliability of a surveillance system with multifunctional sensors. Such multifunctional components provide another degree of flexibility for functional redundancy within the system. The analytic formulation of system reliability is provided and a redundancy allocation problem is formulated and solved through a heuristic-enhanced genetic algorithm.

3 - Iterative System Optimization Based on Condition Monitoring Data and Bayesian Updating

David Coit, Rutgers university, 96 Frelinghuysen Rd., Piscataway, NJ, 08854, United States of America, coit@rutgers.edu, Nida Chatwattansiri

This paper proposes a method to update model parameters of condition monitoring system with generalized series-parallel structure using Weibull distributions. We analyze actual system usages in future scenarios that take various uncertainties into consideration. In particular, our method uses Bayesian approach to update model parameters of the system reliability. The technique is illustrated by numerical examples of independent Weibull component lifetimes with scale parameters.

4 - Integration of Data Fusion Methodology and Degradation Modeling Process to Improve Prognostics

Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, United States of America, kliu8@wisc.edu, Shuai Huang

This talk develops a systematic data-level fusion methodology that combines the degradation-based signals from multiple sensors to construct a health index for better characterizing the condition of a unit. The novelty of this methodology lies in integrating the fusion procedure and the degradation modeling in a unified manner. The methodology was tested and validated by using the degradation-based signals of aircraft gas turbine engine that was generated by C-MAPSS.

■ TD67

Parc- Balboa

Data Driven Scientific Discovery

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Chiwoo Park, Florida State University, 2525 Pottsdamer St., Tallahassee, Fl, 32310, United States of America, cpark5@fsu.edu

1 - Ensemble Data Assimilation: Combining Geophysical Models with Observational Data

Jeffrey Anderson, Senior Scientist, National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO, 80307-3000, United States of America, jla@ucar.edu

Data assimilation (DA), originally developed for weather prediction, combines computer forecasts and observations to produce initial conditions for subsequent forecasts. Ensemble DA uses sample statistics from sets of forecasts to estimate the impact of observations on model state variables. This talk presents an introduction to state-of-the-art ensemble DA algorithms that use millions of observations per day, models with 100 million variables, and O(100) ensemble members.

2 - Scalability of Scientific Image Analysis

Daniela Ushizima, Research Scientist, Lawrence Berkeley National Lab., 1 Cyclotron, Berkeley, CA, 94720, United States of America, dushizima@lbl.gov

Research laboratories store images as part of experimental records. Limitations in scientific image analysis hamper ability to understand the acquired data. This talk will overview current research on fundamental and domain-specific pattern recognition methods that exploits mathematical and statistical image analysis techniques to bring knowledge about known structures as constraints, apply priors to find scientifically relevant constructs and allow fast software for use in everyday analysis.

3 - Robust Nanoparticles Detection by Fusing the Complementary Image Information

Yanjun Qian, Research Assistant, Texas A&M University, 1501 Holleman Dr, Apartment 82#, College Station, TX, 77840, United States of America, qianyanjun09@gmail.com, Xiaodong Li, Yu Ding, Jianhua Huang

This paper studies the problem of detecting nanoparticles in noisy transmission electron microscopic (TEM) images. In order to achieve robustness while handling low contrast and high noise, we propose an approach to fuse two kinds of complementary image information: the region information and the edge information. We apply our method to a set of TEM images taken under different resolutions and noise levels. It can process a TEM in a few minutes, and the processed outcomes appear rather robust.

4 - Data-Driven Study of Nanoparticle Growth

Chiwoo Park, Florida State University, 2525 Pottsdamer St., Tallahassee, Fl, 32310, United States of America, cpark5@fsu.edu, Nigel Browning, Taylor Woehl, James Evans

We present a data-driven approach for studying nanoparticle growth in a solution. Individual nanoparticles in a solution typically grow through a series of single atom attachments, but more importantly, when they reach to a critical size they can aggregate with other particles to form bigger particles. We exploit the realtime microscopic images of the growth process and our image sequence data analysis method for previously unexplained findings on aggregation-based particle growth.

■ TD68

Parc- Davidson

Emerging Topics in Simulation Analysis & Optimization

Sponsor: Simulation

Sponsored Session

Chair: Jie Xu, Assistant Professor, George Mason University, 4400 University Dr., MS 4A6, Fairfax, VA, 22030, United States of America, jxu13@gmu.edu

1 - Efficient Multi-fidelity Simulation Optimization

Jie Xu, Assistant Professor, George Mason University, 4400 University Dr., MS 4A6, Fairfax, VA, 22030, United States of America, jxu13@gmu.edu, Loo Hay Lee, Edward Huang, Nurcin Celik, Si Zhang, Chun-Hung Chen

There are often simulation models of different levels of fidelity for evaluating alternative solutions of a complex system, offering a trade-off between accuracy and speed. We propose a Multi-fidelity Optimization with Ordinal Transformation and Optimal Sampling framework to exploit the benefits of high- and low-fidelity simulation models to perform optimization efficiently. Through preliminary analysis and numerical experiments, we demonstrate the promising performance of the proposed method.

2 - Simulation Swarm Optimization

Lee Schruben, Berkeley University, Berkeley, CA, United States of America, lees@berkeley.edu, Raunak Bhinge, Eike Ebel

A swarm of simulation models can explore multi-dimensional feasible regions. The simulations can change their configurations (locations) as they run, guiding each other toward optimal solutions. The basic notion is akin to Particle Swarm Optimization where the particles are stochastic discrete-event simulation models running in parallel. The models can replicate themselves as they approach stochastic constraints or promising positions to balance exploration, exploitation, and estimation.

3 - Agent-Based Simulation of Financial Markets: Multifractal Analysis of Positive-Intelligence Models

James Thompson, Research Analyst, NC State University, Fitts Dept Indust & Sys Engr, Raleigh, NC, 27695-7906, United States of America, j7sthompson@gmail.com, James Wilson

To analyze the impact of intelligent traders on agent-based simulations of financial markets, we enhance the classic zero-intelligence model of financial markets with positive-intelligence agents using the MASON modeling framework. Exploiting multifractal detrended fluctuation analysis, we analyze the series of stock prices generated by the positive-intelligence simulation. We study the changes in this output process when altering the mix of agents with competing market philosophies.

4 - Simulation-based Continuous Optimization with Stochastic Constraints

Liujia Hu, Georgia Institute of Technology, 765 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, lhu9@gatech.edu, Sigrun Andradottir

We consider simulation optimization problems with stochastic constraints. We propose an Adaptive Search with Discarding and Penalization (ASDP) method for solving this problem. ASDP utilizes the penalty function approach to convert the original problem into a series of simulation optimization problems without stochastic constraints. We present conditions under which the ASDP algorithm converges almost surely, and conduct numerical studies aimed at assessing its efficiency.

■ TD69

Parc- Fillmore

Carbon-Considerate Operations Management

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Tarkan Tan, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, T.Tan@tue.nl

1 - Managerial Implications of Considering CO2 Emissions on Vehicle Routing Problems

Josue Velazquez-Martinez, Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Santa Fe, Mexico City, Mexico, josue.velazquez@itesm.mx, Jose Cohen, Jan C. Fransoo

We present a new model for the VRP that minimizes CO2 emissions. Our model is formulated based on the NTM methodology. Extensive numerical experiments show that substantial CO2 savings can be achieved when truck utilization increases or truck capacity is large. We present conditions in which minimizing distance is equivalent to minimizing CO2 emissions.

2 - Carbon Leakage: The Impact of Asymmetric Emission Regulations on Technology and Capacity Investments

Beril Toktay, Professor, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, beril.toktay@scheller.gatech.edu, Ximin (Natalie) Huang, Tarkan Tan, Kristel Hoen

We study the decisions for an energy-intensive good producer to choose between (1) investing in cleaner technology in an area where emissions are regulated and/or (2) expanding capacity in the unregulated area, under the uncertainty of future emission price. We also compare the impacts of different mitigation options of the policy maker numerically: grandfathering is preferable by companies while border tax is more effective in inducing lower total emission when the emission price is moderate.

3 - The Impact of Coordination on the Retail Chain Emissions

Yann Bouchery, Ecole de Management de Normandie, 30, Rue de Richelieu, Le Havre, 76087, France, y.bouchery@tue.nl, Zied Jemai, Tarkan Tan, Asma Ghaffari

This paper analyzes the impact of coordination on the retail chain emissions besides a cost analysis. We show that the supply chain carbon emissions can be greater under pure cost driven coordination. We also show how this effect could be mitigated. We argue that the objective of coordination needs to be clearly defined to ensure cost and carbon emissions reduction. Accordingly, we use multiobjective optimization to identify the solutions achievable when coordinating the supply chain.

4 - Where to Exert Abatement Effort for Sustainable Operations Considering Supply Chain Interactions?

Tarkan Tan, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, T.Tan@tue.nl, Astrid Koomen

We consider the problem of how firms can take the dynamics of supply chain interactions into account when "greenifying" their operations. We introduce a framework which firms can use in defining the right optimization problem and boundaries when they want to exert abatement effort. Our framework, which is applied at a chemical company, can help firms in determining which impact certain decisions have on other firms' emissions in the supply chain and the resulting total footprint of the product.

■ TD71

Parc - Lombard

The Economics of Auction Markets

Cluster: Auctions

Invited Session

Chair: Brian Baisa, bhbaisa@gmail.com

1 - Reference-Dependent Bidding in Dynamic Auctions

Marion Ott, Lehrstuhl für Volkswirtschaftslehre, Templergraben, Germany, marion.ott@vwl1.rwth-aachen.de, Karl-Martin Ehrhart

Loss-averse bidders (a la K˝szegi and Rabin, 2006) with independent private values face different sensations as the price clock proceeds in English (EA) or Dutch auctions (DA). We solve for personal equilibrium profiles (PEP), which contain each bidder's best response given the others' strategies and the reference point induced by the strategies. If PEP exist in both auctions, the revenue in the DA exceeds that from the EA, mainly due to the aversion to losing the item in the DA.

2 - Revealed Preference in Bidding: Empirical Evidence from Recent Spectrum Auctions

Oleg Baranov, Colorado Technical University, CO, United States of America, Oleg.Baranov@Colorado.edu, Lawrence Ausubel

Activity rules are among the key innovations underlying modern dynamic multi-item auctions. In recent work, Ausubel and Baranov (2013, 2014) have advocated that the traditional activity rules may be both too weak and too strong, and instead have advocated activity rules based upon the Generalized Axiom of Revealed Preference (GARP). Detailed bidding data from two recent spectrum auctions provide unique opportunity to examine whether GARP-based activity rules are too restrictive to be viable.

3 - The Role of a Market Maker in Networked Cournot Competition

Subhonmesh Bose, California Institute of Technology, 1200 E. California Blvd, Pasadena, United States of America, boses@caltech.edu, Adam Wierman, Desmond Cai

We study the role of a market operator in a transmission constrained electricity market. We model the market as a one-shot networked Cournot competition. This mimics the operation of a spot market in a deregulated market structure. We focus on possible mechanisms employed by the market operator to balance demand and supply. We the characterize existence of Generalized Nash Equilibrium and show that market outcomes at equilibrium can be very different under different market operator mechanisms.

4 - Bid Behavior in the Uniform Price and Vickrey Auctions on a General Preference Domain

Brian Baisa, bhbaisa@gmail.com

I compare the Vickrey auction and the uniform-price auction in a setting where bidders have private values and multiunit demands. I remove the standard quasilinearity restriction and assume only that bidders have weakly positive wealth effects. I show that truth-telling is not a dominant strategy in the Vickrey auction and both auctions are generally inefficient. When the auction is large, both give approximately equal allocations and revenues, and both are approximately ex-post efficient.

■ TD72

Parc- Stockton

Energy IV

Contributed Session

Chair: Nikolaos Gatsis, Assistant Professor, The University of Texas at San Antonio, One UTSA Circle, BSE 1.500, San Antonio, TX, 78249, United States of America, nikolaos.gatsis@utsa.edu

1 - Nodal Pricing Applied to Feed-in RES in a Hybrid Pricing Context

Hong Cai, PhD Student, Norwegian School of Economics, Room 108, Helleveien 124, Bergen, -, 5043, Norway, hong.cai@nhh.no, Mette Björndal, Evangelos Panos, Endre Björndal

Using a large scale network, we mainly study in a joint market, whether nodal pricing (location marginal pricing) helps one pricing area (zone) to reduce the volatility within the grid caused by the increased share of feed-in wind generated power in other pricing areas where zonal pricing is applied.

2 - Peer Effects vs. Competitive Effects under Alternative Regulatory Regimes

Eun-Hee Kim, Assistant Professor, George Washington University, Funger Hall 615D, 2201 G Street, NW, Washington, DC, 20052, United States of America, eunheek@gwu.edu

This paper studies drivers of operating efficiency in the power sector under alternative regulatory regimes by making use of a unique dataset from the U.S. electric power industry. The dataset matches confidential tested data and publicly available observed data on power plant efficiency and is used to construct a disaggregated measure of efficiency based on self-benchmarking.

3 - Capacity Mechanisms and Generation Investments in Electricity Markets

Yuto Takano, Tokyo University of Science, 2641 Yamazaki Noda-shi, Chiba, Japan, 7414617@ed.tus.ac.jp, Ryuta Takashima

Recently a capacity mechanism has been introduced in various countries in order to recover an investment cost. It is necessary to discuss the design of the capacity mechanism due to the penetration of the renewable energy. In this paper we analyze an effect of the capacity market on investments under uncertainties by means of stochastic programming. Especially, we compare the outcome with that for energy-only market in order to extract the effect of the capacity market.

4 - Optimization of Energy Management in Large Scale Smart Grid Systems
Sunil Vuppala, IIITB, Electronics City, Bangalore, India, sunil.vuppala@iiitb.ac.in, GNS Prasanna

We present optimization techniques for near real time control in smart grids handling objectives of consumers and utility with price uncertainty in a rolling horizon approach. Our MILP handles fine grain constraints till the level of individually controllable appliances. Our results are compared with an ALL-OR-NONE heuristic that is scalable up to 100,000's of consumers. The results indicate 5-15% of energy bill reduction by using optimization methods, compared to heuristics, on area wide grids.

5 - Stochastic Programming Models for Power Flow Optimization in Electricity Distribution Networks
Nikolaos Gatsis, Assistant Professor, The University of Texas at San Antonio, One UTSA Circle, BSE 1.500, San Antonio, TX, 78249, United States of America, nikolaos.gatsis@utsa.edu, Mohammadhafez Bazrafshan

Stochastic programming models for real and reactive power management in distribution networks are introduced. Decisions include real power consumption from programmable loads, and reactive power consumption or generation from photovoltaic generation units, which is adaptive to the uncertain (random) generated solar power. The aim is to minimize expected thermal losses or maximize the user sum-utility, under risk-constrained voltage regulation. Decentralized solution algorithms are presented.

■ TD73

Parc- Mission I

Energy Planning and Uncertainty

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Soheil Shayegh, Georgia Institute of Technology, North Ave NW, Atlanta, GA, 30332, United States of America, soheilsh@gatech.edu

1 - Impact of Forecast Errors on Expansion Planning of Power Systems with a Renewables Target
Salvador Pineda, University of Copenhagen, Universitetsparken 5, Copenhagen, Denmark, spinedamorente@gmail.com, Juan Miguel Morales, Trine Krogh Boomsma

We present a model to determine the expansion plan that minimizes investment and operating costs, while ensuring a given share of renewable generation. This model includes both a day-ahead and a balancing market to capture the impact of both production forecasts and the associated prediction errors. Within this framework, we compare two paradigmatic market designs that differ in whether the day-ahead generation schedule and the subsequent balancing re-dispatch are co-optimized or not.

2 - Optimal Bidding Policies in the Electricity Market using Approximate Dynamic Programming
Daniel Jiang, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08540, United States of America, drjiang@princeton.edu, Warren Powell

There is growing interest in the use of grid-level storage to smooth variations in supply that are likely to arise with increased use of wind and solar energy. Battery arbitrage is becoming an important way of paying for these expensive investments. The problem of optimal bidding in the presence of storage is complicated by the fact that bids need to be placed either day or hour-ahead. We propose the use of approximate dynamic programming (ADP) techniques to find profitable bidding policies.

3 - Quantitatively Exploring the Future of RPS in the Korean Electricity Sector via an Energy Model
Dong Gu Choi, Senior Researcher, Korea Institute of Energy Research, 152 Gajeong-ro Yuseong-gu, Daejeon, 305-343, Korea, Republic of, doonggus@gmail.com, Sang Yong Park, Jong Chul Hong

We investigate the Korean renewable portfolio standard (RPS) mechanism and develop a multi-regional bottom-up model (via TIMES model) to implement how the mechanism will work. Based on scenario-based analysis with model, we predict the possible future results of the mechanism under a national basic plan on electricity demand and supply. We indicate the disharmony between the plan and mechanism. In addition, we address some insights and suggestions on its continued application.

4 - Fuel Hedging Strategy for Electric Power Utilities
Jo Min, Associate Professor, Iowa State University, 3004 Black Engineering, Ames, 50011, United States of America, jomin@iastate.edu, Chung-Hsiao Wang

Electric power utility companies have used contracts to hedge against fuel price volatility for their coal generation units. With the recent popularity of natural gas combined cycle generation units, the fuel hedging strategy now needs to consider natural gas as well. As coal-based and natural gas-based generation units are competing for economic dispatch, for a utility owning both types of generation units, we show how fuel hedging strategy can be developed and analyzed.

■ TD74

Parc- Mission II

Stochastic Programming for Planning Electricity Supply

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Sarah M. Ryan, Professor, Iowa State University, 3004 Black Engineering Bldg., Ames, United States of America, smryan@iastate.edu

1 - Capacity Planning in Power Systems with High Solar Energy Penetration using Stochastic Programming
Cesar Silva-Monroy, Senior Member of Technical Staff, Sandia National Laboratories, PO Box 5800, Albuquerque, NM, 87185-1140, United States of America, casilv@sandia.gov, Jean-Paul Watson, Andrew Mills, Richard Li-Yang Chen, Ali Pinar, Francisco Munoz

Uncertainty such as fuel prices and load growth exists when selecting new generators. At current low penetration, the amount of solar energy available during high load periods (i.e., capacity value) is treated as deterministic. However, at levels set by renewable portfolio standard the above approach can result in suboptimal expansion plans. We present a stochastic programming formulation of this problem that includes treatment of solar capacity value as one of several sources of uncertainty.

2 - Solution Sensitivity Based Scenario Reduction for Stochastic Unit Commitment
Yonghan Feng, Iowa State University, 0076 Black Engineering Bldg, Ames, IA, 50010, United States of America, yhfeng@iastate.edu, Sarah M. Ryan

A two-stage stochastic program is formulated for day-ahead commitment of thermal units to minimize the total expected cost when uncertain load and variable generation resources are considered. A heuristic scenario reduction method that selects scenarios based on their cost and reliability impacts helps to alleviate the computational burden. In instances derived from a US system operator, the proposed method maintains solution quality even when the reduction is substantial.

3 - Economic Assessment of Energy Storage in Integration of High Levels of Renewable Generation
Nan Li, PhD Student, Arizona State University, 1151 South Forest Avenue, Tempe, AZ, 85287, United States of America, nan.li24@asu.edu, Audun Botterud, John Birge, Canan Uckun, Kory Hedman

The fast-growing expansion of renewable energy increases the complexities in balancing generation and demand in the power systems. The energy-shifting and fast-ramping capability of energy storage technologies has led to increasing interest in energy storage for grid integration of renewable energy. We present a stochastic programming framework to evaluate and investigate the potential value of energy storage in power systems with high renewable penetration levels.

4 - Robust Optimization or Stochastic Programming for Unit Commitment?
Sarah M. Ryan, Professor, Iowa State University, 3004 Black Engineering Bldg., Ames, United States of America, smryan@iastate.edu, Narges Kazemzadeh

We study stochastic programming and robust optimization in the unit commitment problem for a multi-bus power system under net load uncertainty. The stochastic programming model aims to minimize a combination of expected value and CVaR of the costs, while the robust model objective reflects the commitment cost and the worst case dispatch cost. We compare the performance of these approaches in different aspects including economic efficiency as well as the risk associated with the decisions.

■ TD75

Parc- Mission III

Reliability II

Contributed Session

Chair: Wei Xie, Adjunct Assistant Professor, University of Arizona, 1127 E. James E. Rogers Way, Tucson, AZ, 85721, United States of America, shallwe123@gmail.com

1 - Multi-phase Spare Parts Provisioning for Warranty Service Demand
Wei Xie, Adjunct Assistant Professor, University of Arizona, 1127 E. James E. Rogers Way, Tucson, AZ, 85721, United States of America, shallwe123@gmail.com

In this paper, we study spare parts inventory control for warranty repairs. This study is focused on a new product covered by a non-renewable free-replacement warranty policy. We consider time-varying warranty demand rate based on stochastic sales and out-of-service units. Specifically, a multi-phase inventory model is developed to provide an effective support for the warranty service.

2 - A Condition-Based Maintenance Policy for a Multi-Unit System with Aperiodic Inspections
Minou Olde Keizer, University of Groningen, Nettelbosje 2, Groningen, 9747 AE, Netherlands, m.c.a.olde.keizer@rug.nl, Ruud Teunter

In condition-based maintenance (CBM) a certain condition, e.g., vibration, is monitored to estimate the moment of failure. Maintenance is then performed right before that moment. We consider an advanced, existing, CBM optimization approach in which the aperiodic inspection moments and condition thresholds are jointly optimized for a two-unit series system. We analyze an adapted version of the system where two units operate in parallel, and provide new insights on CBM for systems with redundancy.

3 - Multi-stage Reliability Growth Planning Using Dynamic Programming
Zhaojun Li, Assistant Professor, Western New England University, 1215 Wilbraham Rd, Springfield, MA, 01119, United States of America, zhaojun.li@wne.edu

This research formulates the multi-stage reliability growth planning using dynamic programming. Product development usually experiences multiple stages and optimal resources allocation including testing time and units for each stage can lead to higher projected reliability. One stage's reliability growth depends on previous stages' reliability growth, which forms a sequential decision process. The approach for reliability growth planning is demonstrated through an engine development example.

■ TD76

Parc- Embarcadero

Revenue Management Applications for Non-Travel Industries

Sponsor: The Practice Track

Sponsored Session

Chair: Bruce Patty, Vice President, Veritec Solutions, 75 Lochinvar Road, San Rafael, Ca, 94901, United States of America, BPatty@veritecsolutions.com

1 - Revenue Management in the Self Storage Industry
Bruce Patty, Vice President, Veritec Solutions, 75 Lochinvar Road, San Rafael, Ca, 94901, United States of America, BPatty@veritecsolutions.com

The Self Storage industry presents several problems of interest from setting starting rates to making rate changes for existing customers. In this presentation, an overview of the decisions to be made will be provided as well as a detailed look into the existing customer rate change decision.

2 - Price and Revenue Optimization in the Rental Industry
Hossam Zaki, Vice President of Pricing Science, Zilliant, hossam_zaki@yahoo.com

This presentation will provide insights into and comparisons between two Price and Revenue Optimization (PRO) problems in the rental vertical. The first is PRO for the B2C One-Way Truck Rental industry. The second is PRO for the B2B Equipment Rental industry. We will contrast between the B2C aspects of the first and the B2B aspects of the second and how these aspects affect the solution design.

■ TD77

Parc- Market Street

Joint Session Analytics/SPPNS: Analytics in Government, Defense, and National Security

Sponsor: Analytics & Public Programs, Service and Needs

Sponsored Session

Chair: Natalie Scala, Assistant Professor, Towson University, Dept. of e-Business and Technology Manag, 8000 York Road, Towson, MD, 21252, United States of America, nscala@towson.edu

1 - Making the Case for Case Management: Identifying High Risk Diabetes Patients
David Anderson, Assistant Professor, Baruch College, Zicklin School of Business, 1 Bernard Baruch Way, New York, NY, 10010, United States of America, david.anderson@baruch.cuny.edu, Margrét Bjarnadöttir

In this paper we show that insurance claims data can be used to identify diabetes patients who are relatively healthy and low cost, but are at risk of having high costs in the following year. Using a mix of regression analysis and other data mining techniques, we are able to identify a patient cohort that has low costs in the observation year, but have high costs the next year. We identify a group of patients who go from an average cost of under $5,500 to over $12,000 in the following year.

2 - Simulating Carrier Strike Group Manning
Hoda Parvin, Research Analyst, CNA, 4825 Mark Center Dr, Alexandria, VA, 22311, United States of America, Parvinh@cna.org, Edward Schmitz, David Rodney

We present a discrete event simulation model to study the impact of enhanced carrier strike group (CSG) presence on Navy's personnel. We develop several manning policies to assess how enhancing CSG presence affect various aspects of Navy manpower. The model informs policy makers on optimal points of CSG manning without degrading other sea billets. We show the impact of changing manning priorities over the deployment cycle and produce both immediate and long-term estimates of the impacts.

3 - Fortification of Network Components against Intentional Disruptions
Gokhan Karakose, University of Missouri, Columbia, MO, United States of America, gkz7c@mail.missouri.edu, Ronald McGarvey, Mustafa Y. Sir

In this paper, a methodology to protect a transportation network components against interdictors (i.e. attacks) is proposed to minimize the economic impact of network disruption. Here, the cost of network disruption is defined as the number of users who are unable to reach their destinations because of the cut in the network. This cost is integrated to maintenance optimization models which are developed in a game theoretic perspective.

■ TD78

Parc- Mason

Decision Analysis 5

Contributed Session

Chair: Vijitashwa Pandey, Assistant Professor, Oakland University, 2200 N Squirrel Rd, Rochester, MI, 48309, United States of America, pandey2@oakland.edu

1 - Collaborative Decision Analysis for Stakeholder Agency Engagement in Resource Management
Matthew Wood, Research Psychologist, US Army Engineer Research & Development Center, USACE New England District, 696 Virginia Road, Concord, MA, 01742, United States of America, matthew.d.wood@usace.army.mil, Keith Rudie, Mandy Michalsen, Leah Wickstrom, Matthew Bates, Igor Linkov

Decision making in resource management contexts requires the coordinated effort of a variety of organizations tasked with different regulatory missions. We describe an effort using multi-criteria decision analysis to structure discussion and promote collaboration between these groups, and facilitate development of conceptual design alternatives for improving the Green River in Kent, WA to effectively balance concerns (e.g, flood risk, ecology) shared across these organizations.

2 - Heterogeneity Based Grading
Deokkyo Oh, Researach fellow, Korea Corporate Governance Service, 76 yeouinaru-ro, youngdeungpo-gu, Seoul, 150977, Korea, Republic of, deokkyo.oh@gmail.com

Conventional grading models generally follow the percentile rule but sometimes make a problem in interpreting the grading result as each grade is not so identically explanary. Therfore, in this research, heterogeneity based grading model will be developed with the cluster analysis. The number of grade suitalbe to data set will be found first and more specifically, two-stage cluster analysis shall be adopted in this research to identify the "good" and "bad" groups first and detailed grades.

3 - Experiment Design for Multiple Attribute Selection Problems
Dennis Leber, NIST, 100 Bureau Drive, Gaithersburg, MD, 20899, United States of America, dennis.leber@nist.gov, Jeffrey Herrmann

When collecting data to support a selection decision, the decision-maker must decide which data to collect. Ranking and Selection methods provide guidance on such experiment designs with focus on allocating data collection across the alternatives. We present work on allocating a fixed data collection budget across multiple attributes. We developed several allocation rules and tested their performance. The better allocation rules considerably increased the probability of correct selection.

4 - Antibiotic Stewardship: A Decision Analytic Approach
Vijitashwa Pandey, Assistant Professor, Oakland University, 2200 N Squirrel Rd, Rochester, MI, 48309, United States of America, pandey2@oakland.edu, Vipul Shukla

Antibiotic stewardship, a sequential decision-making process used to delineate and assess antibiotic treatment regimens, is an essential tool utilized in health-care. Evolving antibiotic resistance mechanisms and profiles of pathogenic microorganisms require alteration of treatment regimens. This presentation will discuss a decision theoretic framework for optimizing antibiotic stewardship.

■ TD79

Parc- Powell I

Forecasts and Judgments

Sponsor: Decision Analysis

Sponsored Session

Chair: Asa Palley, Duke University, The Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, asa.palley@duke.edu

1 - The Benefits of Eliciting, Evaluating, and Aggregating Forecasters' Quantiles
Casey Lichtendahl, University of Virginia, 100 Darden Blvd, Charlottesville, United States of America, LichtendahlC@darden.virginia.edu, Yael Grushka-Cockayne, Robert Winkler

We present the benefits of eliciting, evaluating, and aggregating forecasters' quantiles, rather than their probabilities. We characterize the class of proper scoring rules for multiple quantiles. By applying the idea of bracketing to quantiles, we propose new measures for evaluating the quality of a crowd's forecasts. In aggregating quantiles, we show that averaging quantiles can be consistent with a Bayesian updating process.

2 - Measuring Advice Taking
Jack Soll, Associate Professor, Duke University: Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, jsoll@duke.edu, Min Bang, Asa Palley, Christina Rader

We introduce a new measure of advice taking, IOA (influence of advice). IOA more completely measures influence compared to extant alternatives, because it applies to entire probability distributions and not just point estimates. We discuss the properties of IOA, and the new insights it reveals about behavior.

3 - Eliciting and Aggregating Forecasts when Information is Shared
Asa Palley, Duke University, The Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, asa.palley@duke.edu, Jack Soll

Dependence in forecast errors greatly limits the ability of the wisdom of crowds to recover the truth. This dependence often emerges because information is shared: forecasters may draw on the same data when formulating their responses. We present an elicitation procedure in which forecasters also guess how others will respond. An assessor can aggregate these responses through a technique called pivoting. We discuss the results of several studies examining the accuracy of the aggregate forecasts.

■ TD80

Parc- Powell II

Graphical Models in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Wenhao Liu, PhD Candidate, Stanford University, 475 Via Ortega, Stanford, Ca, 94305, United States of America, owenliu@stanford.edu

1 - Facilitating the Construction of Bayesian Networks from the Literature
Lea Deleris, IBM, Dublin Research Lab, Dublin, Ireland lea.deleris@ie.ibm.com, Stephane Deparis, Bogdan Sacaleanu, Charles Jochim

We have built information extraction and aggregation algorithms to facilitate the construction of Bayesian networks (BNs) from information contained in the literature. Specifically, we extract probabilities and dependence/independence statements from a set of specified academic papers, aggregate the statements into a BN structure and make use of the probabilities to determine the parameters of the conditional probability tables. We illustrate our approach with papers related to breast cancer.

2 - Inference in Hybrid Influence Diagrams with Deterministic Conditionals
Prakash P. Shenoy, Ronald G. Harper Distinguished Professor of Artificial Intelligence, Univ. of Kansas Business School, 1300 Sunnyside Ave, Summerfield Hall, Lawrence, KS, 66045-7601, United States of America, pshenoy@ku.edu

We discuss some challenges associated with making inferences in hybrid influence diagrams with deterministic conditionals. For problems that can be solved without arc-reversals, these challenges can be overcome by approximating conditionals probability density and utility functions by mixtures of polynomials. A framework for making inferences is described and illustrated with examples.

3 - Extending Influence Diagram Graphics
Jim Matheson, Chairman, SmartOrg, Inc., 855 Oak Grove Ave, Ste 202, Menlo Park, CA, 94025, United States of America, jmatheson@smartorg.com

The original conceptualization of influence diagrams had only Decision and Chance Nodes (sometimes deterministic), and values were thought to be in another third dimension. Then explicit Value Nodes allowed automatic generation of complete decision models. An extension is to add "data analytic" nodes, which usually point into a chance node to be further evaluated and interpreted by human assessments. Human interpretation gives a view of where you are going: a "windshield" above the "dashboard.

4 - Efficient Observation Set Selection for Bayesian Networks, with Application in Petroleum Prospecting
Marie Lilleborge, PhD Student, Norwegian Computing Center, P.O. Box 114 Blindern, Oslo, NO-0314, Norway, lilleborge@nr.no

We try to speed up observation set selection for BNs, while still ensuring optimality of the information gathering. Probability updates must be calculated many times, so it is crucial to use fast routines such as the Junction Tree Algorithm even for small BNs. For larger BNs, we use upper and lower bounds inspired by JTA.

5 - Complexity of the Exact Solution to the Test Sequencing Problem
Wenhao Liu, PhD Candidate, Stanford University, 475 Via Ortega, Stanford, Ca, 94305, United States of America, owenliu@stanford.edu, Ross Shachter

We analyze the complexity of decision tree and influence diagram solutions to the test sequencing problem. We develop an MDP influence diagram formulation that scales better, and show how a decision circuit formulation improves on the decision tree solution through recursive coalescence. We prove that this decision circuit formulation achieves the lower bound complexity for the general test sequencing problem and renders this problem tractable for more tests than has been possible to date.

■ TD81

Parc- Divisadero

Time Series Data Mining

Sponsor: Data Mining

Sponsored Session

Chair: Mustafa Gökce Baydogan, Assistant Professor, Department of Industrial Engineering, Bogaziçi University, Bebek, Istanbul, 34342, Turkey, mustafa.baydogan@boun.edu.tr

1 - Regularization Methods for Virtual Metrology Modeling

Seoung Bum Kim, Associate Professor, Korea University, Anam-Dong, Seongbuk-Gu, Seoul 136-713, Seoul, Korea, Republic of, sbkim1@korea.ac.kr, Chan Hee Park

In this study, we present various regularization algorithms for virtual metrology modeling in semiconductor manufacturing processes. Advantages and disadvantages of each method are discussed.

2 - Clustering of Short Time-Course Gene Expression Data with Dissimilar Replicates

Cem Iyigün, Assistant Professor, Middle East Technical University, Endustri Muhendisligi, ODTU, ANKARA, 06800, Turkey, iyigun@metu.edu.tr, Ozlem Ilk Dag, Ozan Cinar

In this study, we propose a clustering method where every gene is considered as a collection of short time-series of replications by using a distance measure coupling the Euclidean distance and slope changes. The numerical experiments showed that the proposed approach can find the clusters very fast with a low percentage of misclassification. Furthermore, various criteria are proposed for finding the number of clusters.

3 - Ensemble Learning Strategies for Large-scale Time Series Analysis and Data Mining

Mustafa Gökçe Baydogan, Assistant Professor, Department of Industrial Engineering, Bogaziçi University, Bebek, Istanbul, 34342, Turkey, mustafa.baydogan@boun.edu.tr

We introduce a novel time series (TS) representation based on a tree-based ensemble learning strategy. Earlier, many high-level representations have been proposed for TS data mining but they require many parameters and have problems with generalizability. Our proposed approach is scalable, imposes no constraints and has only one parameter. Benefits of our approach are illustrated on 45 TS classification problems. The approach has promising extensions to clustering, anomaly detection etc.

■ TD82

Parc- Haight

Building MCDM Models: Practical and Methodological Issues

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Danielle Morais, daniellemorais@yahoo.com.br

Co-Chair: Adiel Teixeira Almeida, Professor, Universidade Federal de Pernambuco, Recife, PE, Brazil, almeidaatd@gmail.com

1 - Resolving Evaluation of Criteria Weights by Interactive Flexible Elicitation

Adiel Teixeira Almeida, Professor, Universidade Federal de Pernambuco, Recife, PE, Brazil, almeidaatd@gmail.com, Ana Paula Costa, Adiel T. de Almeida Filho, Jonatas Almeida

The paper deals with the elicitation of weights of multicriteria additive models, which is one of the most relevant issues in additive models. The tradeoff elicitation procedure is one of the approaches with strongest theoretical foundation. This paper presents a method based on flexible elicitation for the tradeoff procedure so as to reduce the DM effort in the process. The use of the DSS is illustrated by an application.

2 - Selecting Suppliers with an Additive-veto Multicriteria Model

Luciana Hazin, UFPE, Av. Académico Hélio Ramos, Recife, Brazil, alencarlh@gmail.com, Adiel Teixeira Almeida

Organizations have taken an increasing interest in analyzing outsourcing, particularly with regard to selecting suppliers. Thus, this study puts forward a multicriteria decision aid model to assist companies to select suppliers, using an additive-veto model. An application for selecting contractors for a building site using this model is presented.

3 - A Multi Criteria Failure Mode Effects and Criticality Analysis Approach

Adiel T. de Almeida-Filho, Assistant Professor, Universidade Federal de Pernambuco, Caixa Postal 7471,cordeiro, Recife, PE, 50630971, Brazil, atalmeidafilho@yahoo.com.br, Marcelo Alencar, Adiel Teixeira Almeida

This work presents a multi criteria failure mode effects and criticality analysis (FMECA) approach. FMECA provides a critical and systematic evaluation of potential failure modes and its causes with respect to an industrial plant or a specific equipment by considering a risk priority number (RPN). The approach proposed can be used to rank potential causes from FMECA providing managerial information for resources allocation amongst failure prevention, inspections and preventive maintenance.

4 - A Multi-criteria Decision Model for Technology Readiness Assessment

Danielle Morais, Federal University of Pernambuco, Production Engineering Department, Brazil, daniellemorais@yahoo.com.br, Adiel Teixeira Almeida, Ceres Cavalcanti

The Brazilian energy production is traditionally generated by hydroelectricity. However, the actual challenge of the sector is to identify new technologies for supply energy for the country. This study deals with a multicriteria decision model for Technology Readiness Assessment in order to improve the decision making in this sector.

■ TD83

Parc- Sutro

Advances in Business Data Analytics

Sponsor: Data Mining

Sponsored Session

Chair: Nick Street, Professor and Departmental Executive Officer, The University of Iowa, S210 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, nick-street@uiowa.edu

1 - The Effect of Diversity in Dynamic Class Prediction

Senay Yasar Saglam, Graduate Student, University of Iowa, S210 John Pappajohn Business Building, Iowa City, IA, 52242, United States of America, senay-yasarsaglam@uiowa.edu, Nick Street

Dynamic class prediction has taken great attention for the last couple of decades. Accuracy and prediction confidence are used to evaluate ensemble performance. In this study, we analyze the effect of diversity in three experimental settings. For each new point, we choose ensembles via: random assignment, heuristic search process, and a two-phase framework using probability-based distance measure. After accounting for certain features of the ensembles, we find that diversity remains useful.

2 - On Over-Specialization and Popularity Biases of Recommender Systems

Panagiotis Adamopoulos, PhD Candidate, New York University, 4 4 W 4th Street, New York, NY, 10012, United States of America, padamopo@stern.nyu.edu, Alexander Tuzhilin

Focusing on the problems of over-specialization and concentration bias in recommender systems, we propose a novel probabilistic method in the neighborhood-based collaborative filtering framework. We conduct an empirical study showing that the proposed method increases the diversity, dispersion, and mobility of recommendations by selecting diverse sets of neighbors. This performance improvement is in accordance with ensemble learning theory and the phenomenon of "hubness" in recommender systems.

3 - Building Interpretable Descriptive Patterns for Discrete Linear Classification

Tong Wang, Student, MIT, 70 Pacific St Apt 242a, Cambridge, Ma, 02139, United States of America, tongwang@mit.edu, Cynthia Rudin

Descriptive Pattern (DP) sets are a collection of rules used to characterize groups of objects in data. We present a MIP model to create accurate and interpretable DP sets. Our model penalizes the lengths of the rules, the number of features per rule, and the total number of features to create collections of rules that are more understandable to human experts. We show how DP rules can be used for classification, and introduce extensions to improve the predictive accuracy of these models.

Wednesday, 8:00am - 9:30am

■ WA01

Hilton- Golden Gate 6

Mathematical Modeling and Operations Research in Military Decision Making II

Sponsor: Military Applications Society

Sponsored Session

Chair: William Fox, Professor, Naval Postgraduate School, Department of Defense Analysis, Monterey, CA, 93943, United States of America, wpfox@nps.edu

1 - Military Capital Budgeting with Risk and Effectiveness

Mike Teter, PhD Candidate, Colorado School of Mines, 1500 Illinois St, Golden, CO, 80401, United States of America, mteter@mymail.mines.edu

We consider a new approach to modeling military capital budgeting with minimum risk while meeting an acceptable effectiveness level. We build a framework for computational methods, e.g., decision analysis and mathematical programming, used in deriving risk and effectiveness. We apply the corresponding framework to plan future procurement purchases of the US Army. We employ visualization techniques to demonstrate the results to senior-level planners.

2 - using Mathematical Models in Decision Making Methodologies to Find Node Influences in the Noordin Dark Network

William Fox, Professor, Naval Postgraduate School, Department of Defense Analysis, Monterey, CA, 93943, United States of America, wpfox@nps.edu

In dark network analysis, we use SNA measures and metrics. We use these in decision making concerning disrupting or deceiving a given network. We explore methods to identify the key nodes such as an average ranking scheme, AHP, and TOPSIS. We compare these methods using the Noordin Dark Network with seventy nine nodes.

3 - Sense Making of Narratives: Informing a Rapid Fielding Process

Michael Jaye, Associate professor, Naval Postgraduate School, Dept of Defense Analysis, Monterey, CA, United States of America, mjjaye@nps.edu

The Warfighter Technology Tradespace Methodolgy applies a construct that relies on technical, logistics, and user factors. The intent is to maximize the likelihood of technology acceptance upon fielding. To inform that process as feedback, we gathered and analyzed narratives from soldier end users. We present the narrative collection process and results. The intent is to highlight user dispositions as well as those factors influencing acceptance or rejection of the newly fielded equipment.

4 - The Value of a Whisper in Changing the Attitudes and Opinions of a Population

COL (R) Robert Burks, Department of Defense Analysis, NPS, 5125 Ocean Bluff Court, Seaside, 93955, United States of America, reburks@nps.edu

This research seeks to develop a planning aid to facilitate the disruption of a dark network by triggering a cascade of influence in a competing environment by which individuals accept and spread a negative message to other individuals in the network as fast and efficient as possible. Presented is the progress and efforts to identify the key individuals in a network to ensure the dissemination of a rumor reaches and triggers a cascade eroding confidence and trust in the dark network.

■ WA02

Hilton- Golden Gate 7

Knowledge, Learning and Intellectual Capital (KLIC)

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Charles Weber, Associate Professor, Portland State University, PO Box 751 ETM, Engineering and Technology Management, Portland, OR, 97207, United States of America, webercm@gmail.com

1 - Product Innovation through SMEs' Learning in Alliances with Buyers and Their Directives

Ricarda Bouncken, Professor Dr., University of Bayreuth, Universitatsstr. 30, Bayreuth, 95447, Germany, bouncken@uni-bayreuth.de, Robin Pesch, Manish K. Srivastava, Boris D. Plüschke

By discriminating two types - inlearning and combinative learning - this study clarifies ambivalent results of prior studies on learning in alliances on product innovation. Results of our survey on 459 SMEs show that inlearning and combinative learning poles apart on SME's speed to market and product innovativeness. The effectiveness of inlearning and combinative learning further is affected by directives set by buyer firms.

2 - What Impact Does Intellectual Property Have on the Business Performance of Technology Firms?

Kelvin Willoughby, Professor, Innovation & Entrepreneurship, Skolkovo Institute of Science and Technology, 100 Novaya Street, Skolkovo, Odintsovsky District, Moscow Region, 143025, Russian Federation, ProfessorWilloughby@mac.com

This paper reports the results of a study of technology firms in the bio industries in which a statistically significant positive relationship was found between investment in intellectual property and business performance. The financial benefits of a strong intellectual property portfolio were observable regardless of whether the firms were strategically oriented towards R&D or strategically oriented towards the commercial production of products and services.

3 - Selective Absorption of Knowledge in the National Laboratories

Charles Weber, Associate Professor, Portland State University, PO Box 751 ETM, Engineering and Technology Management, Portland, OR, 97207, United States of America, webercm@gmail.com, Pattravadee Ploykitikoon

An empirical study of the national laboratories of a technology latecomer country shows that the absorptive capacity of project groups is highly differentiated. Internal factors determine what kind of external knowledge is allowed to flow into the project group.

■ WA03

Hilton- Golden Gate 7

The Economic and Social Impacts of Mobile Apps

Sponsor: eBusiness

Sponsored Session

Chair: Sang Pil Han, Assistant Professor, Arizona State University, W.P. Carey School of Business, Tempe, AZ, United States of America, sangpil78@gmail.com

1 - Do App Descriptions Matter? Evidence from a Mobile App Store Market

Gunwoong Lee, Doctoral Candidate, Arizona State University, W.P. Carey School of Business, Tempe, AZ, 85287-4606, United States of America, gunwoong.lee@asu.edu, Raghu Santanam, Sungho Park

Mobile App markets enable developers to deliver an array of App-related attributes and/or marketing messages through the head of product descriptions. We evaluate whether extrinsic and intrinsic cues in App descriptions significantly impact App sales and whether they can complement the cues offered from a product page. Our results suggest that extrinsic cues are strongly related to App rankings, and substantiate the complementarities between extrinsic cues in App description and market formats.

2 - The Impact of the Freemium Strategy on the Adoption of Mobile Apps in Google Play Market

Charles Liu, Associate Professor, University of Texas at San Antonio, 1 UTSA Circle, College of Business, UTSA, San Antonio, TX, 78249, United States of America, Charles.Liu@utsa.edu, Yoris Au

This study empirically examines the impact of offering free mobile apps on the adoption of their paid version in Google Play mobile app market. By analyzing a large panel dataset consisting of 1922 free and paid mobile apps, we found that the adoption of a paid mobile app is significantly accelerated when a high quality free mobile app is offered, and the lifecycle of a paid version of a mobile app is highly associated with the lifecycle of its free version. However, the effect of the freemium strategy is significantly reduced when free apps are prevalent in the same app category or when there is high quality differentiation between the free and paid versions of an app (e.g., limited time or limited functionality of the free version). Moreover, we found that such quality differentiation also has a significant impact on the revenue from the paid apps.

3 - Nature or Nurture? An Analysis of Rational Addiction to Mobile Platform Apps

Hyeokkoo Eric Kwon, Doctoral Candidate, KAIST School of Business, Korea Advanced Institute of Science, Cheongnyangni-dong, Dongdaemun-gu, Seoul, 130-722, Korea, Republic of, hkkwon7@business.kaist.ac.kr, Hyunji So, Sang Pil Han, Wonseok Oh

We extend the rational addiction model of Becker and Murphy (1988) to three types of mobile social apps (e.g., SNS, Social Game (SG), and Instant Messaging Service (IMS)) that are offered at a free of charge. Furthermore, using unique panel data set, we investigate their rational addictiveness. The initial findings suggest that all three apps are addictive. However, only users of SG are found to be rational, while such rational behaviors are not evident among users of SNS and those of IMS.

4 - An Empirical Analysis of Mobile App Time Use: Are Facebook and YouTube App Use Complements?

Sang Pil Han, Assistant Professor, Arizona State University, W.P. Carey School of Business, Tempe, AZ, United States of America, sangpil78@gmail.com, Sungho Park, Wonseok Oh

In this study, we use a unique panel data set detailing individual-level mobile app time-use and build a utility theory-based model for multiple discrete/continuous choice of app use. We quantify the baseline utility and satiation levels of different mobile app categories and examine how these vary with user demographics. To allow for category (dis)similarity in unobserved attributes, we employ a factor analytic structure in our multiple discrete/continuous model.

■ WA04

Hilton- Continental 1

Entrepreneurial/Innovative Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Onesun Steve Yoo, Assistant Professor, University College London, Gower Street, London, United Kingdom, o.yoo@ucl.ac.uk

1 - Optimal Learning and Development Strategy for Entrepreneurial Product Launch

Onesun Steve Yoo, Assistant Professor, University College London, Gower Street, London, United Kingdom, o.yoo@ucl.ac.uk, Tingliang Huang, Kenan Arifoglu

We examine the setting of an entrepreneurial firm engaged in an early product development process. We adopt a Bayesian approach and present a formal model of learning and development in the entrepreneurial firm's product development process. We examine whether or not such frequent developing and learning cycles are beneficial for the entrepreneur, and if so, when.

2 - Dynamic or Persistent? How to Spend on R&D

Christophe Pennetier, Student, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Christophe.Pennetier@insead.edu, Karan Girotra, Jurgen Mihm

We study the impact of R&D spend variability on the R&D performance of publicly traded US firms. Using a novel dataset that combines Compustat data with patent outcomes, we find that controlling for the level of total R&D spend, firms that employ more year-to-year variation get significantly lower R&D outcomes (patent+citation counts). Further dissecting the results, we identify their root causes. A steady hand approach in R&D spend is most productive, while responsiveness can hurt the firm.

3 - Supervising Major Projects You Do Not Fully understand

Svenja Sommer, HEC Paris, 1 Rue de la Libération, Jouy en Josas, France, sommers@hec.fr, Magnus Mahring, Christoph Loch

This study addresses the challenges facing senior executives who serve on supervising bodies of large and strategically important initiatives. They ultimately bear responsibility, but cannot understand all the details of what is going on. In this situation, how can executives provide the necessary guidance and supervision? Based on interviews with senior managers, we discover strategies on how to set targets, evaluate progress, respond to surprises and evaluate the people.

4 - When is Necessity the Mother of Invention?

Stelios Kavadias, Margaret Thatcher Professor Innovation and Growth, Cambridge Judge Business School, Trumpington Street, Cambridge, UK, CB2 1AG, United Kingdom, s.kavadias@jbs.cam.ac.uk, Sezer Ulkü

Many claim that "necessity if the mother of invention" and that adverse conditions induce creative thinking (e.g., Jugaad innovation). Yet, the unknowns of every innovation context, point to the need for unbounded, and thus unconstrained, search and exploration; constraints should(?) make it difficult for the firm to change direction in response to new information, resulting in inferior solutions. We explore how different types of constraints affect the performance of entrepreneurial efforts.

■ WA05

Hilton- Continental 2

Supply Chain Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Elodie Adida, University of California at Riverside, School of Business Administration, Riverside, United States of America, elodie.goodman@ucr.edu

1 - When Dynamic Pricing Meets Graph Theory

Georgia Perakis, William F. Pounds Professor, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, 02142, United States of America, georgiap@mit.edu, Swati Gupta, Maxime Cohen

We introduce a class of dynamic programs for multi-period pricing problems based on an equivalent graphical reformulation. Our formulation can handle several business rules that arise in practice and considers demand models that capture the stockpiling behavior of consumers through dependence on past prices. For fixed memory, we propose a polynomial time algorithm but also illustrate that when the memory is large the problem is NP hard. We introduce approximation schemes for solving the problem.

2 - Advance Demand Information in a Multi-Product System

Fernando Bernstein, Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, fernando.bernstein@duke.edu, Greg DeCroix

We examine the impact of different types of advance demand information on firm profit and on the benefits of resource flexibility. The firm receives information revealing either the total volume of demand across products or the mix of demand between products. We examine two scenarios: a setting with dedicated resources and one with a common resource. Mix and volume information are complements in systems with dedicated resources, but they are substitutes in a system with a common resource.

3 - Competition and Coordination in a Two-channel Supply Chain

Elodie Adida, University of California at Riverside, School of Business Administration, Riverside, United States of America, elodie.goodman@ucr.edu, Amy David

We study competition and coordination in a supply chain in which a single supplier both operates a direct channel and sells its product through multiple retailers competing in quantities. We find that the two-channel supply chain may be subject to inefficiencies not present in the traditional supply chain, and study its coordination both with symmetric and asymmetric retailers.

■ WA06

Hilton- Continental 3

Data-Driven Methods in Inventory Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Alp Akcay, Assistant Professor, Bilkent University, Ankara, 06800, Turkey, alp.akcay@bilkent.edu.tr

1 - Demand Fulfillment Probability under Parameter Uncertainty

Canan Gunes Corlu, Boston University, 808 Commonwealth Avenue, Boston, United States of America, canan@bu.edu, Bahar Biller, Sridhar Tayur

In a budget-constrained multi-item inventory system, we consider the case of unknown demand parameters estimated from historical data. The objective is to identify the inventory targets that maximize the demand fulfillment probability subject to a budget constraint on the total inventory investment. We show that the inventory targets accounting for parameter uncertainty achieve an increase of up to 6% in the expectation and a reduction of up to 86% in the variance of the fulfillment probability.

2 - Partner Evaluation in Continuous Replenishment Programs

Manuel Rossetti, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, rossetti@uark.edu, Shengfan Zhang, Payam Parsa, Edward Pohl

A continuous replenishment program (CRP) is a supply chain initiative in which the manufacturer manages the replenishment process using shared demand information provided by the customer. This paper is focused on quantifying the partner selection process from the perspective of the manufacturer, who faces a set of customers. Several factors such as volume, customer location, requested product mix and desired service level are considered as inputs for this selection process.

3 - The Newsvendor under Demand Ambiguity: Combining Data with Moment and Tail Information

Soroush Saghafian, Arizona State University, Tempe AZ, United States of America, Soroush.Saghafian@asu.edu, Brian Tomlin

Data-driven approaches typically assume that the planner has no information beyond the evolving history of demand observations. The planner may, however, have partial information about the demand distribution in addition to demand observations. We propose a non-parametric, maximum-entropy based technique, termed SOBME (Second Order Belief Maximum Entropy), which allows the planner to effectively combine demand observations with partial distributional information.

4 - A Novel Aggregation Method for Assemble-to-Order Systems

Emre Nadar, Assistant Professor, Bilkent University, Bilkent University, Ankara, Turkey, emre.nadar@bilkent.edu.tr, Mustafa Akan, Alan Scheller-Wolf, Alp Akcay

We present an approximate dynamic programming method to the inventory control of large assemble-to-order (ATO) systems, under Markovian assumptions on production and demand. We approximate the optimal cost function by reducing the state space of the original problem via a novel aggregation technique. We show the optimality of a lattice-dependent base-stock and rationing policy for the aggregate problem. We establish error bounds for this approximation and provide computational results.

■ WA07

Hilton- Continental 4

Supply Chain Management I

Contributed Session

Chair: Susan A. Slotnick, Professor, Cleveland State University, Monte Ahuja College of Business, 1860 E. 18th Street, Cleveland, OH, 44115, United States of America, s.slotnick@csuohio.edu

1 - A Supply Chain with Third-party Reverse Logistics for Product Returns

Yertai Tanai, Kent State University, P.O. Box 5190, Department of Management and Information, Kent, OH, 44242, United States of America, ytanai@kent.edu, Butje Eddy Patuwo, Alfred L Guiffrida

We consider a two-echelon supply chain with reverse logistics. It consists of a supplier, a retailer and a 3PL provider that processes the product returns independently. The product flow is initiated by the supplier that directly supplies the retailer, which services the customers. Based on Markov processes and queuing network, we seek to find a base-stock level that minimizes the expected total cost for the retailer and a capacity that minimizes the total expected cost for the 3PL.

2 - The Value of Information Sharing in Supply Chains Facing Seasonal Demand

Vladimir Kovtun, Sy Syms School of Business, 500 W 185th Street, New York, NY, 10033, United States of America, vladimir.kovtun@yu.edu, Avi Giloni, Clifford Hurvich

We study the value of information sharing in a two player supply chain where the most downstream player (retailer) observes external demand that is generated by one of several seasonal autoregressive processes. We find that information sharing is valuable only in the presence of strong seasonality in the demand observed by the retailer. Furthermore there is never value in information sharing when the retailer and its supplier observe peak and low seasons at the same time.

3 - Practice of Supply Chain Management in Small- and Medium-sized Enterprise

Mi-Ae Kim, Ph.D. Candidate, Kyungpook National University, 80 Daehak-ro, Buk-gu, Daegu, 702-701, Korea, Republic of, olive5263@naver.com, Chang-Kyo Suh

The purpose of this study is to determine the underlying dimensions of supply chain management(SCM) practice in small- and medium sized enterprise(SEM). The study identifies current trends and adoption of SEM's SCM in South Korea. The results reveal the perceived benefits and major barriers of SCM to SEMs. The study provides thoughts on how SMEs can improve SCM within their own organizations and supply chain.

4 - Reverse Supply Chain for Remanufacturing with Uncertain Demand and Return Product Yield

Samar Mukhopadhyay, SKK University GSB, 53 Myungryun-dong 3-ga, Jongno gu, Seoul, Se, 110-745, Korea, Republic of, samar@skku.edu, Huafan Ma

Remanufacturing as a means of sustainability is increasingly resorted to. But it brings in the problem of uncertain yield, unlike new parts. We design a supply chain contract that also takes into account short and long manufacturing lead times. We consider two popular types of contracts, a push or a pull contract. We obtain optimal supply chain contracts for these contract types, and a random yield rate and demand. We compare the results of different scenarios and develop managerial insights.

5 - Supply Chain Transparency and Ethical Sourcing

Susan A. Slotnick, Professor, Cleveland State University, Monte Ahuja College of Business, 1860 E. 18th Street, Cleveland, OH, 44115, United States of America, s.slotnick@csuohio.edu, Jen-Yi Chen

Two firms produce the same product. One sources ethically and the second does not, and market share is affected by the nature of their sources and whether or not they disclose them. Costs include procurement, disclosure and discovery. We investigate the tradeoffs involved and the incentives for a firm to disclose the nature of its sourcing in response to its cost and market structure, as well as the characteristics of its competitors.

■ WA08

Hilton- Continental 5

Military Application 1

Contributed Session

Chair: Timothy Chung, Assistant Professor, Naval Postgraduate School, 777 Dyer Road, BU-218, Monterey, CA, 93943, United States of America, thchung@nps.edu

1 - Modeling of Probabilistic Search with Uncertain Prior Information

Timothy Chung, Assistant Professor, Naval Postgraduate School, 777 Dyer Road, BU-218, Monterey, CA, 93943, United States of America, thchung@nps.edu

This work investigates the impact of variability in the prior information in the probabilistic Bayesian search for a target. This analysis offers insights into the search process, and provides enhanced guidance to improve search performance. We present heuristics that inform the initialization and execution of the search process that address the uncertainty present in the initial probability values, and demonstrate the efficacy of the proposed search strategies through simulation studies.

2 - Inventory Optimization for the United States Navy Destroyer Fleet

Andrew Johnson, PhD Candidate, Rutgers Business School, 1 Washington Road, Newark, NJ, United States of America, andrew.johnson@rutgers.edu, Yao Zhao

A general problem that the US Navy has encountered is the need to optimize a set of mission critical parts, which make up the Ballistic Missile Defense System. Because of the low demand nature, the part(s) may not be readily available and can render the vessel non-operational. Also, an additional issue that leadership is having is quantifying the cost of not having a vessel at a designated location or region of responsibility because of the missing part(s).

3 - Analytical Models for Sea-Based Logistics Operations

Jennifer Pazour, University of Central Florida, 4000 Central Florida Blvd, Building 91 R, Orlando, Fl, 32816, United States of America, Jennifer.Pazour@ucf.edu

Sea Basing is a concept of the United States Navy that allows the Joint Forces to be supported from the sea. From a logistics perspective, sea-basing will require ship-to-objective locations, selective offloading, and transfer of cargo between ships. We develop models to quantify and evaluate sea-based logistic system design and to aid in analyzing the trade-offs associated with operating in a complex and uncertain environment where decisions must be made in the face of imperfect information.

4 - Advancing the State of the Art in Applying Network Science to Command and Control (C2)

Herman Monsuur, Netherlands Defence Academy, Faculty of Military Sciences, Enys House, Het Nieuwe Diep 8, Den Helder, 1781 AC, Netherlands, H.Monsuur@nlda.nl, Rene Janssen, Tim Grant

Modern C2 systems link tens of thousands of computers and their users. Network science provides the mathematical techniques for representing and analyzing networks with millions of nodes. C2 has been making a transformation from top-down, directive command to Network Enabled Capability (NEC), self-synchronization, and agility. Therefore C2 systems are regarded as networks, rather than a hierarchy. It is appropriate to view these processes and systems through the lens of network science.

5 - Risk-averse Stochastic Network Interdiction

Churlzu Lim, Associate Professor, University of North Carolina at Charlotte, 9201 University City Blvd., Charlotte, NC, 28269, United States of America, clim2@uncc.edu

We consider a stochastic network interdiction problem, where the leader interdicts arcs assuming the follower solves an optimization problem having stochastic parameters. In order to make a risk-averse interdiction, we propose to use CVaR, a popular financial risk measure, as the objective function. The efficacy of the risk-averse interdiction using CVaR will be discussed via numerical examples.

■ WA09

Hilton- Continental 6

Applications of Cognitive Analytics

Cluster: Cognitive Analytics

Invited Session

Chair: Horst Samulowitz, IBM Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, samulowitz@us.ibm.com

1 - Medical Sieve: A Multimodal Cognitive Assistant for Radiologists and Cardiologists

Tanveer Syeda-Mahmood, Chief Scientist & Research Manager, IBM Research, 650 Harry Road, San Jose, CA, 95120, United States of America, stf@us.ibm.com

Medical Sieve is a new cognitive assistant system that filters the essential clinical information from patient records for diagnosis and treatment planning. It uses sophisticated medical text and image processing, pattern recognition and machine learning techniques guided by advanced clinical knowledge to process clinical data about the patient to extract meaningful summaries indicating the anomalies, and comparisons to similar patients.

2 - Measuring and Predicting Personal Traits and Behavior from Social Media

Eben Haber, Research Staff Member, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, ehaber@us.ibm.com

Psycholinguistic research has shown that traits such as personality affect a person's language, and that it is possible to infer those traits from samples of a person's writing. Social media makes millions of writing samples available, this has huge implications in areas from marketing to enterprise team building. We present the results of several studies in this area, showing what we can learn about people through social media and how we can use that information to better engage with them.

3 - FoodSIS: A Text Mining System to Improve the State of Food Safety in Singapore

Jayant Kalagnanam, Chief Scientist, IBM Research, Yorktown Heights, NY, 10598, United States of America, jayant@us.ibm.com, Sneha Chaudhari, Andy Prapanca, Kiran Kate

FoodSIS improves efficiency of such focused information gathering process with the use of machine learning techniques to identify and rank relevant content. We discuss the challenges in building such a system and describe how thoughtful system design and recent advances in machine learning provide a framework that synthesizes interactive learning with classification to provide a system that is used in daily operations.

■ WA10

Hilton- Continental 7

Operations/Sustainability 1

Contributed Session

Chair: Eylem Koca, Assistant Professor, Fairleigh Dickinson University, 1000 River Road, H-DH2-06, Teaneck, NJ, 07666, United States of America, koca@fdu.edu

1 - A Factorial Design for Factory Demand Response with Onsite Wind and Solar Energy

Victor Santana-Viera, Student, Texas State University - San Marcos, 601 University Drive, San Marcos, TX, 78666, United States of America, vas41@txstate.edu, Jesus Jimenez, Jose Espiritu, Tongdan Jin

We implement a demand response program for large industry consumers to meet the uncertain load curtailment requirement using onsite renewables generation as power backup. Instead of shutting down machines, onsite wind-solar generation allows the manufacturers to meet the curtailment goal while maintaining the normal production. We use design-of-experiment methodology to size the wind and solar generators such that the DR benefit is maximized under uncertain wind speed and weather condition.

2 - A New Modeling Approach to Waste Management

Mariapaola Testa, Research Assistant, Massachusetts Institute of Technology - Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, mptesta@mit.edu, Stephen Graves, Timothy Gutowski

Waste treatment facilities receive municipal solid waste as input and separate it according to its recyclable and non-recyclable components, facing the challenge of operating with high variable inputs in a commodity market. So far, only a few studies have tried to optimize the waste separation process. In our work, we propose a network-flow modeling approach to increase the plant efficiency and the recovery of valuable recyclable material.

3 - Operations Strategy under Environmental Uncertainty

Baris Yalabik, University of Bath, School of Management, Claverton Down, Bath, BA2 7AY, United Kingdom, by212@management.bath.ac.uk, Gulsun Nakiboglu, Michael Lewis

Carbon price scenarios are used to investigate the likely impact of a range of operations strategies. We develop a simulation model (based initially on the characteristics of the iron and steel industry) to examine process improvement strategies in response to the uncertain nature of carbon prices and the trajectory of best available technology over time. The results compare and contrast two types of strategies: environmental investment strategies and production reduction strategies.

4 - How Green Policy Affect Market Share? An Empirical Study of European Automobile Industry

Kejia Hu, Northwestern University, 2001 Sheridan RD, Evanston, United States of America, kejia.hu@northwestern.edu, Yuche Chen

We investigate the lead-lag effect of a company's implementation of green policy on its market share in auto industry. From a dataset composed of 14-years real-world vehicle emission records in Europe, we extract two time series of emission indexes and market share for each car model. Then we examine the lead-lag effect by Spearman Rank Correlation and change point detection methods. The results show that implementation of green policy has effects on the market share in the auto industry.

5 - The Role of Ecolabels in Consumer Markets

Eylem Koca, Assistant Professor, Fairleigh Dickinson University, 1000 River Road, H-DH2-06, Teaneck, NJ, 07666, United States of America, koca@fdu.edu, Gil Souza

The proliferation of legitimate and false ecolabels has been reported to cause confusion as to the effectiveness of ecolabels in signaling and bolstering sustainability. Using an analytical model built on recent empirical findings, we investigate why and how firms adopt ecolabels, how consumers react to ecolabels and information provided, and the implications of ecolabels from a supply chain management perspective.

■ WA11

Hilton- Continental 8

Supply Chain, Risk Management I

Contributed Session

Chair: Shyam Mohan, London Business School, NW1 4SA, London, London, United Kingdom, smohan@london.edu

1 - using Influence Diagrams to Effectively Manage Supply Chain Risks

Xiaojuan Wang, Tsinghua University, Department of Industrial Engineering, Room 530, Shunde Building, Beijing, 100084, China, wxj13@mails.tsinghua.edu.cn, Wancheng Feng, Jeffrey David Tew, Wanshan Zhu

Supply chain risks have a very significant impact on a firm's vulnerability which can adversely affect its financial performance. This research attempts to reduce supply chain vulnerability via a coordinated holistic approach, involving all supply chain stakeholders. Specifically, we utilize the method of Influence Diagrams to build a decision support tool which identifies and analyzes the possible risks associated with each particular supplier in a given supply chain.

2 - On Cascading Disruptions in Interconnected Supply-chain Networks

Shyam Mohan, London Business School, NW1 4SA, London, London, United Kingdom, smohan@london.edu, Nitin Bakshi

Nearly 40% of all supply chain disruptions are said to originate in tier 2 and beyond. We propose an analytical framework to study the cascading of disruptions in supply-chain networks. We formalise the notion of supply-chain resilience as a measure of how quickly firms in a supply chain recover from a disruption. We also provide a comparative metric termed relative vulnerability to identify firms which are expected to suffer greater downtimes and consequently more losses due to disruptions.

3 - Credit-constrained Suppliers, Bankruptcy and the Use of Reverse Factoring

Ram Bala, Professor, Santa Clara University, 500 El Camino Real, Santa Clara, CA, United States of America, rbala@scu.edu, Sripad Devalkar

Trade credit is a commonly observed form of financing in many supply chains. However, many big retailers source their products from small suppliers in developing countries who are significantly credit constrained and have a high probability of bankruptcy. In such cases, buyers have begun to provide 'reverse-factoring' programs to help their small suppliers get access to capital. We study the efficacy of such reverse factoring programs.

4 - Contracting for Continuity of Mission Critical Services
Marc Jansen, PhD Candidate, University of Cambridge, Judge Business School, Trumpington Street, Cambridge, CB2 1AG, United Kingdom, mcj32@cam.ac.uk, Nektarios Oraiopoulos, Daniel Ralph

Major interruptions to outsourced IT services are high-profile and costly, with costs increasing in frequency and duration of outages. This paper examines how contract decisions between an IT vendor and client across a sales and after-sales phase can mitigate downtime costs through appropriate system design and response capacity investments.

■ WA12

Hilton- Continental 9

Sustainable Operations in Electric Vehicle and Electricity Generation Systems

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Yangfang Zhou, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, helenzhou@smu.edu.sg

1 - To Sell and to Provide? The Implications of the Auto Manufacturer's Involvement in Car Sharing
Ioannis Bellos, Assistant Professor, George Mason University, 4400 University Drive, MS 5F4, Fairfax, VA, 22030, United States of America, ibellos@gmu.edu, Beril Toktay, Mark Ferguson

We study the auto manufacturer's choice regarding whether to offer a car sharing business model in conjunction with the traditional sales channel. We explicitly model the consumer's choice of transportation mode as well as vehicle usage decisions and we characterize the environmental and economic implications of the auto manufacturer's strategy.

2 - A Framework for the Analysis of Probabilistic Demand Response Schemes
Mayank Sharma, IBM, mxsharma@us.ibm.com, Pavithra Harsha, Soumyadip Ghosh, Ramesh Natarajan

We describe the class of probabilistic demand response (PDR) schemes that are particularly suited for dynamic load management in the residential sector. Our main contribution is a new method for implementing and analyzing these schemes based on an operational objective that balances the total cost and revenue of meeting demand. We evaluate the suitability of various PDR schemes and illustrate the effectiveness of the method for a collection of thermostatically controlled loads with simulations.

3 - Service Region Design for Urban Electric Vehicle Sharing Systems
Long He, PhD Candidate, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, CA, 94720, United States of America, longhe@berkeley.edu, Ho-Yin Mak, Ying Rong, Zuo-Jun Max Shen

We consider a service area design problem of an electric car sharing business model that is subject to uncertain driver usage behavior, for which only limited knowledge may be inferred from survey data. With partial distributional information, we obtain a robust formulation as a mixed integer second-order cone program. Using data from California Household Travel Survey, we demonstrate the impacts of factors such as fleet size, battery capacity and charging time on the expansion of service area.

■ WA13

Imperial A

Education 1

Contributed Session

Chair: Walter A Garrett, Jr, Instructor of Decision Sciences, Saint Louis University, 221 N Grand Blvd, Saint Louis, MO, 63103, United States of America, wgarrett@slu.edu

1 - Meta-Analysis in Online Engineering Education
Ling Zu, Clemson University, 2517 Moorcroft Ln, duluth, GA, 30096, United States of America, lzu@g.clemson.edu, Mary Elizabeth Kurz, Wennian Li

There is limited meta-analysis of online engineering education research especially focused in two-year colleges. This study considers online engineering education papers since 1998 and conducts meta-analysis to explore possible factors that could affect students' preferences in choosing e-learning instead of traditional education. As a result, demographic factors such as social status including ethnicity, race, gender, financial status are considered as well as the effectiveness of education.

2 - The Appointment Scheduling Game
Antoine Sauré, Post-Doctoral Fellow, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, antoine.saure@sauder.ubc.ca, Martin Puterman, Charles Ko, Drew Paulin

We describe the Appointment Scheduling Game (ASG), an easy to use teaching tool that reveals the main challenges in managing advance patient scheduling systems and provides an introduction to simulation and decision analysis. The ASG simulates a system with limited service capacity in which daily appointment requests, characterized by their urgency, arrive randomly. Students assume the role of a scheduling clerk who must assign appointment dates to these requests without knowing future demand.

3 - An Innovative Approach to Teaching Operations Management through Experiential & Online Learning
Kristen Sosulski, Assistant Professor, NYU Stern, 40 West 4th Street, Suite 509, New York, NY, 10012, United States of America, ksosulsk@stern.nyu.edu, Harry Chernoff

The authors present an experiential approach to teaching operations management through the study of business processes in situ. There is no classroom; instead a flipped-classroom model is employed where students learn new topics through faculty-led online videos and exercises. Class meeting time is used to observe a company's operations process in practice. Results suggest that students better synthesize their knowledge of operations through the study of processes in a real business setting.

4 - Incorporating Content Balancing with Ant Colony Optimization for a Balanced Incomplete Block Design Exam
Pei-Hua Chen, National Chiao Tung University, 1001 University Rd, Dept. of Management Science, Hsin-Chu, 300, Taiwan - ROC, peihuamail@gmail.com, Shu-Wei Huang, Wan-Yu Tsai, Pei-Ru Hong

We proposed three content balancing methods and incorporated them with the Ant Colony Optimization approach to construct balanced incomplete block design forms. 13 blocks with 65 items were constructed from a 292-item bank. Three proposed methods will be evaluated in terms of their computation time and measurement precision.

5 - A Systemic Model of Public School Failure
Walter A Garrett, Jr, Instructor of Decision Sciences, Saint Louis University, 221 N Grand Blvd, Saint Louis, MO, 63103, United States of America, wgarrett@slu.edu

The identification of at-risk schools is a desirable public-policy objective; early intervention may reduce the consequences and costs of school failure. This paper presents a general-systems model of public school performance, in which failure" is one of several output states. Various economic, social, political, financial, and achievement variables are used as inputs to an Ordered Logistic Regression to build a prescriptive model. The model is tested using data from Missouri school districts.

■ WA15

Hilton- Exec. Boardroom

Revenue/Yield Management II

Contributed Session

Chair: Wei Zhang, University of California, Los Angeles, 110 Westwood Plaza, B501, Los Angeles, CA, 90095, United States of America, zhangw.03@gmail.com

1 - Influencing Adoption Patterns via Contract Structures in Hi-Tech Supply Chains
Wei Zhang, University of California, Los Angeles, 110 Westwood Plaza, B501, Los Angeles, CA, 90095, United States of America, zhangw.03@gmail.com, Reza Ahmadi, Sriram Dasu

An OEM who adopts a new product may bring various externalities to other OEMs and incentivize them to make similar adoption decisions. Positive correlation of adoptions can be harmful for the seller and OEMs, as it can lead to adoption rush or delay, which results in demand-supply mismatch and may undermine the seller's ability to reinvest in R&D. We propose that sellers can influence buyer behavior through the structure of contract.

2 - Dynamic Pricing and Capacity Management for Stochastic Rental System with Advance Demand Information
Wen Jiao, The Hong Kong Polytechnic University, Dept. of Logistics & Maritime Studies, Kowloon, Hong Kong - PRC, wendy.j@connect.polyu.hk, Hong Yan

This paper examines the pricing and capacity management problem for a car rental company facing advance demand information (ADI) and walk-in customers. ADI customers request a booking by paying the booking fee in advance and enjoy a discounted price at demand realization, while walk-in customers require immediate service. At each period, the company decides the booking limit for ADI customers and current unit price. We characterized the structure of the optimal pricing and booking limit policy.

3 - Competitor-Risk Optimized Price Matching in an Omni-Channel Environment

Shiva Subramanian, IBM Research, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, subshiva@us.ibm.com, Markus Ettl, Joline Uichanco, Pavithra Harsha

Consumers browse products and prices across multiple channels and retailers to finalize purchases today. To remain competitive, retailers have adopted either a risk-averse price strategy of matching competitor prices, or a high-risk strategy that focuses on profit margin. In our work, we use real data from a retailer to demonstrate the business impact of a novel prediction-optimization based price-matching approach that profitably manages a retailer's value-at-risk due to competition.

4 - A New Predictive Model Application in Social Networking Revenue Management

Yingying Kang, Principal Operations Research Consultant, Sabre Holdings Inc., 3150 Sabre Drive, Southlake, TX, 76092, United States of America, Yingying.Kang@sabre.com

Accurately predicting the customer behavior and CTR is a key factor for maximizing the revenue of a social network. The classic models like logistic regression model rely on the accurate estimation of significant factors and their coefficients. And it relies on the accuracy of historical data. We propose a Bayesian Inference based predictive model to estimate parameters of network attractiveness distribution based on the observed CTR distribution. It is proven effective under highly uncertainty.

■ WA16

Hilton- Franciscan A

Returns Management at the Operations-Marketing Interface

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Tolga Aydinliyim, Assistant Professor, Baruch College, CUNY, Zicklin School of Business, Box B9-240, New York, NY, 10010, United States of America, tolga.aydinliyim@baruch.cuny.edu

1 - Savvy Consumers, Lenient Return Policies: Mitigating Strategic Waiting in Online Retailing

Tolga Aydinliyim, Assistant Professor, Baruch College, CUNY, Zicklin School of Business, Box B9-240, New York, NY, 10010, United States of America, tolga.aydinliyim@baruch.cuny.edu, Mehmet Sekip Altug

In an online retailing context, we study return management decisions when consumers are discount seeking and sensitive to stock-outs. We find that allowing returns enhances profit if the retailer can salvage with a mild discount, and the ability to do so is a strategic advantage in case of competing retailers.

2 - Optimal Pricing and Return Policies for Loss Averse Customers

Wenjing Shen, Drexel University, 3200 Market Street, 735, Philadelphia, PA, 19104, United States of America, ws84@drexel.edu, Gulay Samantli, Ben Lev

Customer return policies reduce product misfit uncertainty and improve customer satisfaction. Previous studies on customer return have assumed loss neutral customers. In this paper, we study the impact of customer loss aversion on the optimal price, inventory, and return policies.

3 - An Empirical Analysis of Product Return Episodes

Paul Messinger, University of Alberta, Edmonton, AB, Canada paulm@ualberta.ca, Michele Samorani, Aydin Alptekinoglu

A product return episode is a sequence of transactions composed of the purchase of a product, a return of that product, a repurchase of a similar product, etc., concluding with a final purchase or return. We empirically study return episodes using data from a national consumer electronics retailer.

4 - Intertemporal Pricing and Return Policies for Strategic Consumers

Wenbo (Selina) Cai, Assistant Professor, New Jersey Institute of Technology, MEC 308, University Heights, Newark, NJ, 07102, United States of America, cai@njit.edu, Ying-Ju Chen

We develop a model that takes into account both consumer valuation uncertainty and strategic consumer behavior, and derive the optimal pricing and return policy for a retailer. We find that a generous return policy encourages high-valued consumers to purchase early, but lessens the capacity rationing effect in the latter period and consequently may induce some consumers to wait.

■ WA17

Hilton- Franciscan B

Managing Queues in Service Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Philipp Aféche, Rotman School of Management; University of Toronto, 105 St.George Street, Toronto, Canada, Philipp.Afeche@Rotman.Utoronto.Ca

1 - Robust Capacity Planning under Service Constraints

Hussein Naseraldin, Professor, Ort Braude College, Snunit St, Karmiel, 21982, Israel, nhussein1@braude.ac.il, Opher Baron

Capacity decisions are strategic in nature and are determined at the beginning of the horizon. Then it constrains the possible capacity in any single period. Data uncertainty plays a key role in such decisions. We propose optimal robust capacity decisions subject to service requirements. We adopt a Robust Optimization approach in which one searches for a feasible solution that is at least as good as all other feasible solutions for most data realizations.

2 - Information Sharing in the Presence of Loss Averse Customers

Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Pengfei Guo

We study the impact of information sharing in the presence of loss averse customers in a service system.

3 - Allocation Policies in Blood Transfusion

Vahid Sarhangian, Rotman School of Management; University of Toronto, 105 St.George Street, Toronto, ON, Canada, vahid.sarhangian11@rotman.utoronto.ca, Hossein Abouee Mehrizi, Opher Baron, Oded Berman

Recent studies suggest an increased risk of adverse clinical outcomes in patients receiving transfusions of older" blood. We analyze a stylized queueing model of a hospital blood bank and investigate the potential of a family of allocation policies in reducing the age of transfused blood without significantly affecting its availability. We evaluate the outcome of the policies and investigate when they are more likely to be effective as an alternative to reducing the shelf-life.

4 - Designing, Scheduling, and Pricing Differentiated Services under Quality-Speed Tradeoffs

Sherwin Doroudi, Tepper School of Business; Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, sdoroudi@andrew.cmu.edu, Philipp AfËche, Mustafa Akan, Mor Harchol-Balter

Quality-speed tradeoffs are inherent in designing and providing various products and services: longer processing increases quality and allows customization, but also increases utilization and waiting times. We consider a queueing model with utility-maximizing, time-sensitive customers whose service valuations are increasing in processing time. We study the problem of optimally designing, scheduling, and pricing the set of differentiated services, both under welfare- and revenue-maximization.

■ WA18

Hilton- Franciscan C

Data-driven Revenue Management Studies

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, serguei.netessine@insead.edu

1 - Cost Efficient Cloud Resource Virtualization

Andrew Li, MIT, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, aali@mit.edu, Devavrat Shah, Muhammad J. Amjad, Vivek Farias

The Cloud has become synonymous with virtual computing, and users now face the challenging problem of choosing from a vast array of compute resources differing in price and quality. In this work, we present policies for efficient use of cloud resources by dynamically maintaining a portfolio of resources. Experiments on Amazon's EC2 cloud platform show that this achieves significant cost savings with negligible loss in quality.

2 - The Value of Clickstream Data in the Competitive Analysis: Evidence from Hotel Bookings

Sergei Koulayev, Economist, CFPB, 1700 G st NW, Washington, DC, 20002, United States of America, sergei.koulayev@gmail.com, Serguei Netessine, Jun Li

Today, half of hotel bookings are originated in the online channel. A major role in the online distribution is played by OTAs: two-sided platforms that connect travelers and hotel properties. Consumer activity on such platforms leaves a trace of clickstream data, combined with displays of hotel options presented to the user. We show that such data provides an insight into the structure of hotel's competition set, in addition to traditional datasets of prices and sales volumes.

3 - Two Sided Platforms: Case of Service Level Tradeoff

Ashish Kabra, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Ashish.KABRA@insead.edu, Karan Girotra, Elena Belavina

Recently there has been a rapid rise of online intermediaries that match offline supply and demand in transportation, delivery and hospitality (such as Uber, Beauty Bureau). In these system "service level" to one side of the platform comes at the expense of "service level" to other side. Using data from a Taxi demand-supply matching app we estimate how past experience of the supply and demand predict their future usage of the platform. We use these estimates to improve system design.

4 - The Impact of Returning Customers at an Internet Fashion Retailer

Ngai-Hang Leung, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Bldg. E40-14, Boston, MA, 02139, United States of America, zacleung@mit.edu, Georgia Perakis, Pavithra Harsha

Our analysis of clickstream data collected from an online fashion retailer shows that a significant number of sales are due to returning customers. We propose a demand model where customers may not buy the item on their initial visit, but may return and purchase the item in a subsequent visit. We propose and analyze a markdown optimization pricing model with returning customers. We estimate our demand model and quantify the benefit of applying our pricing model.

■ WA19

Hilton- Franciscan D

Innovative Applications in Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Pelin Pekgun, Assistant Professor, University of South Carolina, 1014 Greene Street, Moore School of Business, Columbia, SC, 29208, United States of America, pelin.pekgun@moore.sc.edu

1 - Taking it to a Higher Level: Integrated Revenue Management from Vision to Reality

Jon Higbie, Managing Partner & Chief Scientist, Revenue Analytics, Inc., 3100 Cumberland Blvd., Suite 1000, Atlanta, GA, 30339, United States of America, jhigbie@revenueanalytics.com, Vedat Akgun

Revenue management began as a specialized function buried deep in the organization. Through case studies we will describe how revenue management has elevated its game to a higher level and is evolving into the analytics center of excellence for organizations who are seeking a unified view of their business data, one version of the truth, and prescriptive capabilities that serve strategic planning, finance, sales, marketing, and distribution.

2 - Notes on the Journey Towards Total Hotel Revenue Management

Tudor Bodea, InterContinental Hotels Group, 3 Ravinia Drive, Atlanta, GA, 30346, United States of America, tudor.bodea@ihg.com, Alex Kao, Dev Koushik, Christy Zhao, Darlene Fenix, Quentin Taylor, Clint Nall, Ying Song

Organizations in industries as diverse as airline, hospitality or television broadcasting use revenue management (RM) tactics to maximize their revenue growth. In the hospitality industry, hotel companies have long implemented RM decision support systems that optimize the availability and prices of their retail transient products. In this work, we offer opinions on what hotel companies that consider moving towards a Total Hotel RM framework may witness along the way.

3 - Hotel Standby Upgrades - How and When Do They Work?

Ovunc Yilmaz, PhD Student, University of South Carolina, 1705 College Street, Columbia, SC, 29201, United States of America, oyilmaz@email.sc.edu, Mark Ferguson, Pelin Pekgun

Inspired by e-standby upgrades" in the hotel industry, this study examines how and when these upgrades can provide additional revenue for a hotel. We develop optimal pricing strategies under both myopic and strategic customer behavior through an analytical model. Using data from a major hotel chain, we also provide some empirical findings.

4 - Customer Choice Modeling in Revenue Management Systems

Shadi Sharif Azadeh, Polytechnique Montreal, Apt 108, 50 Willowdale, Montreal, Canada, shadi.sharifazadeh@polymtl.ca, Gilles Savard, Patrice Marcotte

One of the main challenges in Revenue Management systems is to estimate demand of each product at a given time when some products in the choice set are not available (censored demand). Most of choice-based RM researches assume that choice parameters are known a priori. However, in reality, the only information at hand is the registered transactions. In this research, we estimate product utilities for different customer segments as well as daily potential demand using registered bookings.

5 - An Empirical Study of Price Movements of Airlines Industry in Indian Market

Goutam Dutta, Professor, Indian Institute of Management, Ahmedabad, Wing 3, Room No 3H, PMQ Area, Ahmedabad, 380015, India, goutam@iimahd.ernet.in, Sumitro Santra

We analyze the movement of airline prices of Indian domestic sector. We first conduct a detailed econometric analysis of five domestic routes. Next we develop the power divergence statistic (PDS) for each route and built a direct comparison study on average PDS and average prices. Our research suggests that the competition and price dispersion steps up as departure date comes closer. It also shows that route characteristics affect price movement as well as price dispersion in different routes.

■ WA20

Hilton- Yosemite A

Analytics for the Tactical Edge: Better Business through Operations Research in the DoD

Sponsor: Military Applications Society

Sponsored Session

Chair: Aaron Burciaga, Senior Manager, North America Inventory Analytics Lead, Accenture, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, adburciaga@gmail.com

1 - The Influence of Cognition on Decision Making & Decision-Making Support Methods

Rafael Matos, President, Military Operations Research Society, 2111 Wilson Boulevard, Suite 700, Arlington, VA, 22201, United States of America, president@mors.org

Continued advances in decision analysis and decision making support systems, with rigorous mathematical approaches, are very important. It is also important to create consciousness on the cognitive elements that affect the individual and collective decision-making process. This lecture explores the way we think and some of the most common heuristics and biases that affect our problem solving and decision-making activities, and how they can affect the results of rigorous quantitative methods.

2 - The Marine Corps Way: using Maneuver Warfare to Lead Analytics

Aaron Burciaga, Senior Manager, North America Inventory Analytics Lead, Accenture, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, adburciaga@gmail.com

Over its storied 238-year history the Marine Corps has built a powerful brand ñ one that connotes leadership, discipline, training, and management. We present how proven battlefield practices empower success in analytics where "fog of war" and "asymmetric threats" also characterize business opportunities, data, and adoption.

3 - Ready, Fire, Aim – Executing Before Planning

Josh Janes, Consultant, Accenture, 1936 North Clark Street, Apt. 516, Chicago, IL, 60614, United States of America, janesj@gmail.com

Organizations often execute actions before completing a plan. Once actions are executed, the team responsible for the project's success must determine how to overcome the hasty start. Case studies impacting the DoD are presented comparing courses of action to mitigate the rash decisions which diminish mission or project success. Courses of action are rated on a cost, timeline, and customer confidence scale.

■ WA21

Hilton- Union Sq 1

Maritime Logistics and Operation

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Deniz Ozdemir, Yasar University, Universite Caddesi, No:35-37, Agacli Yol, Bornova, Izmir, 35100, Turkey, deniz.ozdemir@yasar.edu.tr

1 - Vessel Crew Scheduling: Formulations and Heuristics

Kerem Akartunali, Lecturer, Department of Management Science, University of Strathclyde, 40 George Street, Glasgow, G1 1QE, United Kingdom, kerem.akartunali@strath.ac.uk, Alex Leggate, Seda Sucu, Robert Van Der Meer

Crew scheduling is a well-studied area of research, in particular for airlines, but very little attention has been given to companies operating fleets of vessels. The maritime setting presents its own challenges such as long duty times and weather uncertainties. In this talk, we discuss different formulations and solution methods (including customized heuristics and approximate formulations) for solving these problems. We will conclude with preliminary computational results and a case study.

2 - Yard Assignment in Bulk Material Terminals

Ceyda Oguz, Koc University, College of Engineering, Istanbul, Turkey, coguz@ku.edu.tr, Isil Koyuncu

We developed a mathematical model for the yard assignment of bulk materials, such as coal, to determine the location of loading and unloading vessels while minimizing the total distance traveled in ports. The model also determines the dimensions of the bulks given that the area of each bulk is fixed.

3 - Heterogeneous Bulk Service Queuing Models with Applications to Transportation Systems

Nishant Mishra, Assistant Professor, Erasmus University Rotterdam, Rotterdam School of Management (RSM) Erasmus University Rotterdam, Burgemeester Oudlaan 50, 3062 PA, Rotterdam, Netherlands, nmishra@rsm.nl, Niek Baer, Debjit Roy, J an-Kees van Ommeren

We study multi-server queuing models with heterogeneous servers, and specifically, show that the steady state waiting time in a queuing system with two types of servers has a phase-type distribution. We then present approximations for heterogeneous bulk service queues for a semi-open queuing network with batch-size dependent service time, and finally, conclude by discussing an application of the model for a container transportation system at the Port of Rotterdam.

4 - Stochastic Berth Allocation and Quay Crane Assignment for Quayside Operations

Deniz Ozdemir, Yasar University, Universite Caddesi, No:35-37, Agacli Yol, Bornova, Izmir, 35100, Turkey, deniz.ozdemir@yasar.edu.tr, Gokberk Ozsakalli, Huseyin Gencer

Traditional planning of quayside operations cause unnecessary waiting of vessels and inefficient utilization of resources. Moreover, most of the integrated approaches consider deterministic vessel arrivals and quay crane handling time which is actually not realistic in practice. To this end, an integrated stochastic multi objective model has been developed to minimize the vessel service time and quay crane movement. The mixed integer model was solved by using stochastic programming and applied at Izmir Container Terminal based on the historical data. It has shown promising results.

■ WA22

Hilton- Union Sq 2

Business and the Bottom of the Pyramid

Sponsor: Organization Science

Sponsored Session

Chair: Emily Block, Assistant Professor of Management, University of Notre Dame, Notre Dame IN 46556, United States of America, esblock@gmail.com

1 - The Impact of Community and MFI Logics in Shaping KIVA Loan Framing

Todd Moss, Emily Block

The purpose of this paper is to consider the relative strength of institutions in directing the activities of organizations in a field. We seek to understand the conditions under which one institution is likely to dominate the behavior of organizations over another. Specifically, we consider the relative impact of professional and national institutions on hybrid microfinance organizations. We suggest that temporal, organizational and field characteristics are likely to influence the power of professional and national institutions on not only the activities that microfinance organizations engage and the language that they use to describe themselves, but also the timing of their responses to external events. We hypothesize the effect of organizational form, ownership structure, timing of founding, peer effects, strength of national institutions and governance and community characteristics.

2 - Implications of Chinese Investment in Africa on Social, Environmental and Economic Vulnerability

Emily Block, Assistant Professor of Management, University of Notre Dame, Notre Dame IN 46556, United States of America, esblock@gmail.com, Viva Bartkus, Taylor Boyd, Jessica Helmann, Kerri Martin, Todd Moss

Despite its late entry into the market, China has become the largest trading partner with sub-Saharan African countries. In fact, China pumped over $210 million into Africa last year. The consequence of this recent trend, for both African countries and MNCs looking to invest there, has been widely debated and speculated. This paper empirically investigates the economic, development, and environmental consequences of Chinese investment in a full population of sub-Saharan African countries. We discuss implications for Base of the Pyramid and strategy research, seeking to understand the conditions under which different foreign investments are likely to be profitable.

3 - Organizational Responses to Public and Private Politics: An Analysis of Climate Change Activists and U.S. Oil & Gas Firms

Shon Hiatt

Abstract is not available at this time.

■ WA23

Hilton- Union Sq 3

Sustainable Logistics: Models and Applications

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: M. Ali Ulku, Associate Professor, Rowe School of Business, Dalhousie University, Halifax, NS, Canada, ulku@dal.ca

1 - Carbon Allocation in Traveling Salesman Problems

Josue Velazquez-Martinez, Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Santa Fe, Mexico City, Mexico, josue.velazquez@itesm.mx, Jan C. Fransoo, Bart Leenders

We develop a methodology to allocate carbon to multiple clients that are being served on a single route. We demonstrate analytically a number of desirable properties of the allocation mechanism, and apply the mechanism in a European retail distribution setting.

2 - Carbon Emissions Considerations in Joint Replenishment Problems: Direct vs. Indirect Grouping

Dincer Konur, Assistant Professor, Missouri University of Science and Technology, Engineering Mgmt. & Systems Engineering, Rolla, MO, 65406, United States of America, konurd@mst.edu, Brian Schaefer

In this study, we model and solve a bi-objective joint replenishment problem with cost and carbon emissions minimization for each of the two common grouping strategies: direct and indirect. An evolutionary heuristic method is discussed for each strategy. A set of numerical studies demonstrates that a retailer's preference for a specific grouping strategy depends on not only economical but also environmental objectives.

3 - Carbon Emissions Comparison of Third Party Last Mile Delivery Versus Customer Pickup

Jay R. Brown, Assistant Professor, Loyola University Maryland, Sellinger School of Business and Mgmt., Baltimore, MD, 21210, United States of America, jbrown11@loyola.edu, Alfred L Guiffrida

Carbon emissions resulting from conventional shopping involving customer pickup with trip chaining is compared to e-commerce-based online retailing involving third party last mile delivery to customers' homes. The break-even number of customers for carbon emissions equivalence is approximated and analyzed for feasibility. A methodology for calculating the difference in expected carbon emissions is formulated and demonstrated.

4 - Supply Chain Management of a Modular Product with Returns

M. Ali Ulku, Associate Professor, Rowe School of Business, Dalhousie University, Halifax, NS, Canada, ulku@dal.ca, Juliana Hsuan, Dennis Yu

Modularity and returns relate to sustainability. In a retailer-manufacturer setting and when the demand for a returnable product depends on both price and modularity level, we develop a profit-maximizing stochastic model. The solution includes optimal expressions for the price, and the order quantity. We derive managerial insights from our structural and numerical results relating to the management of such a perishable product and its implications on sustainable supply chain management.

■ WA24

Hilton- Union Sq 4

Challenges in Dynamic Ride-sharing

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Niels Agatz, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3000DR, Netherlands, nagatz@rsm.nl

1 - A Matching Model and Solution Approach for Ride-sharing with Meeting Points

Mitja Stiglic, Faculty of Economics, University of Ljubljana, Kardeljeva ploöcad 17, Ljubljana, 1000, Slovenia, mitja.stiglic@ef.uni-lj.si, Niels Agatz, Mirko Gradisar

We consider a ridesharing system that uses meeting points to allow more flexibility in the rider's pickup and drop-off locations. Riders can either be picked up from home or from a meeting point that is within a certain acceptable walking distance. We develop a model and devise an exact and a heuristic optimization approach to match drivers and riders and determine their routes.

2 - Finding Optimal Stable Ride Matches for Dynamic Ride-sharing Systems

Xing Wang, GE Global Research, 1 Research Circle, Schenectady, NY, 12309, United States of America, xwstella@gmail.com, Niels Agatz, Alan Erera

Automated ride-share systems provide most convenience to the individual users and provide most potential for vehicle miles savings to the system. However, system optimal matches may not provide the maximum costs savings for each individual. We introduce the notion of stability for ride-share matches and present mathematical programming methods to establish stable matching.

3 - Dynamic Ridesharing: How to Get Started?

Martin Savelsbergh, Professor, University of Newcastle, Callaghan, Newcastle, NSW2308, Australia, martin.savelsbergh@newcastle.edu.au, Alan Lee

Dynamic ridesharing services have now been successfully introduced in several countries. Their ultimate success critically depends on (initial) participation rates. We investigate different ways in which a service provider can attract participants during the start up phase.

4 - Structure of Routes as a Function of Incentives for Ridesharing

Xiaoqing Wang, University of Southern California, 3715 McClintock Ave, OHE 235A, Los Angeles, CA, 90089, United States of America, xiaoqinw@usc.edu, Maged Dessouky, Fernando Ordonez

We consider varying passenger travel time under congestion and load dependent toll cost in a pickup and delivery problem with time windows. The objective is to study how optimal routes change if a cost reduction and time savings are available for ridesharing. Both 0-1 integer programming model and heuristics are developed to solve the problem. A set of computational experiments are performed to explore how the ridesharing are affected by the different time savings on HOV lanes and toll savings.

■ WA25

Hilton- Union Sq 5

Transportation Planning III

Contributed Session

Chair: Milad Keshvari Fard, ESSEC Business School, HB 314-ALEGESSEC- 60 Avenue du Hazay, Cergy, 95000, France, milad.keshvarifard@essec.edu

1 - The Hub Location Problem with Discrete Cost functions

Milad Keshvari Fard, ESSEC Business School, HB 314-ALEGESSEC- 60 Avenue du Hazay, Cergy, 95000, France, milad.keshvarifard@essec.edu, Laurent Alfandari

We propose a new formulation for the Hub Location Problem by considering the cost as a discrete function of the number of vehicles used for transportation. We observe that the difference between the continuous and discrete cost function is too high to be ignored. Moreover, for cost reduction benefits, we study advantages of using direct shipments as well as using simultaneous intermodal transportation. Finally we design a hybrid metaheuristic algorithm to solve large scale problems.

2 - The Identification of Transport Bundling Opportunities in a Horizontal Supply Chain

Gert Woumans, PhD Student, IESEG School of Management, 3, Rue de la Digue, Lille, 59000, France, g.woumans@ieseg.fr, Jeroen Belien, Stefan Creemers, Robert Boute

Horizontal cooperation is a powerful concept to increase supply chain efficiency: by bundling transports and by reducing empty backhauling, efficiency is increased through improved load factors and increased frequency of deliveries. Finding suitable collaboration partners is challenging. We present an algorithm that uses a clever sorting and filtering technique to detect potential partners, based on the geographical compatibility of transports. The algorithm is being used by 4PL TRI-VISOR.

3 - Multiclass O-D Estimation using Probit-Based Stochastic User Equilibrium and Multiple Data Types

Qing Zhao, Cornell University, 220 Hollister Hall, Ithaca, NY, 14850, United States of America, qz74@cornell.edu, Mark Turnquist

This paper proposes a bi-level optimization model and corresponding solution method for static multiclass O-D estimation using various data types. The upper level optimization derives O-D entries by minimizing the sum of squared differences between observations from different data sources and the corresponding predictions. A probit model is used in the lower-level stochastic user equilibrium problem for flow prediction. Extensive experiments have been performed on two test networks.

4 - Risk Equitable Routing and Prohibition Stratesis for Hazardous Materials Transportation

Ashrafur Rahman, Visiting Assistant Professor, Bunknell University, 116 Court Street, New Haven, CT, 06511, United States of America, arahman@engr.uconn.edu, Nicholas Lownes

A new risk measure for hazardous materials transportation is proposed. The new risk measure is used in mathematical modeling considering equity concept to suggest routing and prohibition strategies for hazmat transportation.

■ WA26

Hilton- Union Sq 6

Vehicle Routing I

Contributed Session

Chair: Shong-Iee Su, Professor, Soochow University, No. 56, Sec.1, Kwei-Yang Street, Taipei, 100, Taiwan - ROC, sisu@scu.edu.tw

1 - An ALNS for a Two-echelon Vehicle Routing Problem Arising in City Logistics

Philippe Grangier, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, Nantes, 44300, France, philippe.grangier@mines-nantes.fr, Michel Gendreau, Fabien Lehuédé, Louis-Martin Rousseau

We consider a Two Echelon Vehicle Routing Problem (2E-VRP) which integrates constraints arising in City Logistics such as: time windows, synchronization, and multiple trips for some vehicles. We have developped an ALNS that benefits both from custom ruin and recreate heuristics and an efficient feasibility check.

2 - The Cross-docking Delivery Route Planning for a Supermarket Chain

Shong-Iee Su, Professor, Soochow University, No. 56, Sec.1, Kwei-Yang Street, Taipei, 100, Taiwan - ROC, sisu@scu.edu.tw

This paper presents the delivery route planning background, methodology and results of a study of a new cross-docking logistics center for a large supermarket chain in Taiwan. The number of stores is 274 with revenue at about US$ 9 billion. The transformation of the supermarket from a multi-layer distribution network to a single-layer cross-docking network has shown dramatic improvement on the delivery efficiency, assent productivity, and the reduction of green house gas emissions.

3 - Vehicle Routing with Uncontrolled Batch Arrivals

Wouter van Heeswijk, PhD Candidate, Universiteit Twente, Hallenweg 17, Enschede, Netherlands, w.j.a.vanheeswijk@utwente.nl, Martijn Mes, Marco Schutten

We study a VRP with uncontrolled batch arrivals of LTL goods at an urban consolidation center. These arrivals reflects the delivery of goods by independent carriers. By assessing waiting policies and considering delivery windows at the customers, we propose a heuristic approach aimed at efficiently dispatching city freighters. As such, we facilitate the need for planning at the urban distribution level, where the arrival process of goods at the consolidation center has a significant impact.

4 - The One-to-one Pickup and Delivery Problem with Unloading Considerations

Marjolein Veenstra, University of Groningen, Nettelbosje 2, Groningen, 9747 AE, Netherlands, marjolein.veenstra@rug.nl

We present a new variant of the one-to-one pickup and delivery problem that aims at minimizing the sum of travel, loading and unloading times. The sequence in which locations are visited determines the sequence of packages in the vehicle and thereby the time needed to unload the packages. In this paper, we present models that take into account the effects of loading and unloading times on the vehicle routing decisions.

5 - Multiobjective Green Vehicle Routing Problem under Uncertainty
Nazanin Tajik, Graduate student, ProfessorKash Barker/University of Oklahoma, 202 W. Boyd St., Room 434, Norman, Ok, 73071, United States of America, nazanin.tajik@ou.edu, Kash Barker

The aim of green vehicle routing problems-G-VRP-is to develop technical solutions minimizing not only economic costs but also pollution resulting CO2 emissions.We provide a robust multiobjective G-VRP that accounts for costs such as travel distant,travel time,tardiness/earliness while also minimizing CO2 emissions as a function of acceleration,speed,and loads,among others,accounting for the stochastic nature of inputs.The formulation is solved with MIOCA

■ WA27

Hilton- Union Sq 7

Logistics 1

Contributed Session

Chair: Meltem Peker, Bilkent University, 06800, «ankaya, Ankara, Turkey, meltem.peker@bilkent.edu.tr

1 - A Hierarchical Model for Cash Transfer System Design Problem
Abdullah Dasci, Sabanci University, Orta Mahalle, Tuzla, 34956, Istanbul, Turkey, dasci@sabanciuniv.edu, Engin Topaloglu

We present a model that incorporates location of cash management centers, number and routes of vehicles, and the cash inventory control to minimize the cost of owning and operating while maintaining a pre-defined service level. An iterative solution approach with a feedback mechanism is proposed. Numerical results show that such an approach is quite effective in reaching greatly improved solutions with just a few iterations, making it a promising approach for similar hierarchical models.

2 - Incentive-Compatible, Budget-Balanced Combinatorial Double Auctions for Carrier Collaboration
Su Xiu Xu, The University of Hong Kong, Dept. of IMSE, The University of Hong Kong, Hong Kong, Hong Kong - PRC, xusuxiu@gmail.com, Shuyan Lin

This paper is the first proposing incentive-compatible, budget-balanced combinatorial double auctions (CDA) for the carrier collaboration problem with bilateral exchange (CCPBE), which is generally the problem of how to realize the potential of carrier collaboration over a bilateral exchange transportation network. In the CCPBE, each carrier may ask for or offer a bundle of lanes and each lane may include multiple truckloads. The model realizes asymptotical efficiency in some conditions.

3 - Propagation of Uncertainty in Dense Storage Environments
Patrick Reilly, University of Central Florida, 4000 Central Florida Blvd, Building 91 R, Orlando, Fl, 32816, United States of America, pjreilly@knights.ucf.edu, Jennifer Pazour

In dense storage systems, where all items are not directly accessible, to retrieve an item often requires shifting of other items. In such systems, uncertainty in item location due to a lack of asset tracking results in wasteful search time. The model proposed intends to describe how this uncertainty propagates throughout a dense storage system over time and develops an expected search time for a given item at a certain point in time.

4 - Integer Programming Formulations for Integrated Hub Location and Vehicle Routing Problems
Zuhal Kartal, Anadolu University, Industrial Engineering Departmant, Eskisehir, Turkey, zkartal@anadolu.edu.tr, Andreas Ernst, Servet Hasgul

In this study, we present integer programming formulations of five types 'Integrated Hub Location and Vehicle Routing Problems' which are integrated fixed p-hub location and vehicle routing problem, integrated p-hub location and vehicle routing problem, integrated hub location with fixed costs and vehicle routing problem, integrated p-hub center and vehicle routing problem and lastly, integrated p-hub covering and vehicle routing problem.

■ WA28

Hilton- Union Sq 8

Airline Crew Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Shahram Shahinpour, Senior of Operations Research, Sabre Holdings, Inc, 3150 Sabre Dr., Southlake, TX, 76092, United States of America, Shahram.Shahinpour@sabre.com

1 - Exploiting underlying Network Structures to Solve the Crew Pairing Problem via the Pulse Framework
Daniel Duque, Instructor, Universidad de los Andes, Cra 1 No. 18A-12, Bogota, Colombia, d.duque25@uniandes.edu.co, Daniel Matteo Eslava, Manuel A. BolÌvar, Andrés L. Medaglia

In the airline industry, the crew pairing problem consists in determining the minimum-cost pairings such that every flight is covered exactly once. Under a column generation scheme, it is customary to solve repeatedly a shortest path problem with resource constraints. In this work, we adapt a specialized framework for hard shortest paths that exploits the underlying network structure to efficiently generate diverse and feasible pairings.

2 - The Best Strategy in using an Option-based Mechanism to Reduce Overbooking Risk for Allied Airlines
Xiaojia Wang, PhD Student, City University of Hong Kong, A,14/F,Palatial Stand,118 Wuhu St., Hung Hom, Kowloon, Hong Kong, Hong Kong - PRC, xiaojia.wang@my.cityu.edu.hk, Y.K., Richard Fung

In the context of parallel alliances, we propose an option-based mechanism that allows an airline to transfer bumped passengers to its alliance partner's flight. Based on an analytical model built to calculate the net benefit that the airlines can obtain from the proposed mechanism, we develop a simulation-based algorithm to derive the best strategy in using the mechanism, namely how many options the allied airlines should transact between each other and how much the option should be priced.

3 - Scheduling Aircraft and Personnel to Meet On-station Patrol Requirements
Ramzi Mirshak, Defence R&D Canada, 101 Colonel By Drive, Ottawa, ON, Canada, ramzi.mirshak@drdc-rddc.gc.ca, Alex Bourque, Paul Massel, Bill Ansell, Bao Nguyen

Determining the number of aircraft and personnel required to maintain a given presence on station is an important problem in surveillance contexts. Here, integer programming is used to minimize the number of aircraft and crews required to meet an on-station requirement. Unplanned maintenance is captured with a parameterized serviceability model. As illustrated by a case study, this easy to implement methodology provides quick and insightful results to the decision makers.

4 - Progress in Airline Crew Recovery at Sabre Airline Solutions
Chunhua Gao, Lead Operations Research, Sabre Holdings, 3150 Sabre Drive, Southlake, United States of America, chunhua.gao@sabre.com, Tina Shaw

This presentation will update progress and developments in airline crew recovery at Sabre Airline Solutions. We proposed an approach for handling disruptions during irregular operations that simultaneously solves the crew pairing and roster recovery problems to quickly find solutions that are fully deployable. In this talk, we will introduce how the approach is enriched to meet airline requirements and applied to solve real-time airline crew recovery problems.

■ WA29

Hilton- Union Sq 9

Manufacturing 1

Contributed Session

Chair: Kiwook Jung, Guest Researcher, National Institute of Standards and Technology, 100 bureau drive, Gaithersburg, MD, 20899, United States of America, kiwook.jung@nist.gov

1 - How Does Human Resource Management Influence JIT and TQM Implementation? A Meta-analysis
Yiwen Chen, Tsinghua University, Beijing, China, www.yiwenchen@gmail.com, Sriram Narayanan, Li Zheng, Jayashankar Swaminathan

Through meta-analytic technique employed on a database of 101 studies, we examine how HRM influences the implementation of JIT and TQM. Previous literatures differ on whether, and which, specific HR practice facilitates JIT and TQM implementation. So, we develop a structural equation model to synthesis these studies. We find that all three dimensions of HR system positively influence JIT and TQM implementation, among which opportunity-enhancing HR practices have the strongest effect.

2 - Early Detection of Unforeseen Failure in Seasonal Manufacturing via Control of Sensitivity Parameter

Kiwook Jung, Guest Researcher, National Institute of Standards and Technology, 100 bureau drive, Gaithersburg, MD, 20899, United States of America, kiwook.jung@nist.gov, Hyunbo Cho

The impact of unforeseen failures in seasonal manufacturing is significant. A timely review of failure records to detect failure modes is not always possible. This talk presents several techniques for quantifying failure records in a vector space model to conduct automated cluster analysis. The techniques are validated with real data sets. The proposed model quickly detects unforeseen-failures via control of sensitivity parameters.

3 - Stochastic Assembly Line Design with Work-sharing in the Bottleneck Station for Assembly Planning

Ehsan Nazarian, Post-doctoral Research Associate, University of Nebraska Lincoln, 135 Nebraska Hall, Lincoln, NE, 68588, United States of America, enazarian@unl.edu, Jeonghan Ko, Hui Wang

Processing time variation over a cycle time can result in line stop in synchronous assembly lines, but utility workers and extra offline processing increase costs. We present a stochastic chance-constrained programming model utilizing non-productive times in the next station of the bottleneck to handle the possible overload with preemption allowed. We also present statistical evaluations of stochastic station times. The result can be used for subassembly planning with uncertain joining times.

■ WA30

Hilton- Union Sq 10

Operations Management/Marketing Interface II

Contributed Session

Chair: Emre Ertan, PhD Candidate, University of Texas at Dallas, Sm30, Jindal School of Mgmt, 800W Campbell Road, Richardson, TX, 75080, United States of America, emre.ertan@utdallas.edu

1 - Analysis of Consumers' Purchase Timing Decisions

Emre Ertan, PhD Candidate, University of Texas at Dallas, Sm30, Jindal School of Mgmt, 800W Campbell Road, Richardson, TX, 75080, United States of America, emre.ertan@utdallas.edu, Ozalp Ozer, Kathy Stecke

The consumer purchase timing decision is analyzed by using discounted expected utility theory, where consumers act to maximize their utility over time. The consumer's sequential decision-making process is formalized under uncertain product availability. An optimal purchase timing policy is identified in a market environment, in which a strategic customer knows the markdown pricing scheme, available inventory level, and remaining time to the end of the selling horizon.

2 - Price and Inventory Competition with Customer Switching

Chunyan Gao, Assistant Professor, Southwestern University of Finance and Economics, No. 555 Liutai Avenue, Wenjiang District, Chengdu, 611130, China, gaochy_2007@126.COM, Qiang Gong, Dongling Cai

This paper invests price and inventory competition with market uncertainty. There exist multiple pure strategy sub-game perfect equilibria. It is possible that the profit of retailers with customer switching is Pareto better than that with no customer switching, because the retailer can better take advantage of the inventory pooling in asymmetric equilibrium. In addition, customer switching leads to higher inventory level but not necessary lower price.

3 - Joint Production and Pricing Decisions for Multiple Products with Cap-and-Trade Regulation

Xiaoping Xu, University of Science and Technology of China, School of Management, 96 Jinzhai Road, Hefei, China, xxp2010@mail.ustc.edu.cn

This paper studies the joint production and pricing decisions under cap-and-trade regulation. We find that the emission trading decisions follow a two-threshold policy and the optimal total emissions and production quantities are constants when the cap is low or high. We also find that the profit may increase when the cap is sufficiently large. We then explore the impact of the emission trading prices on the optimal decisions. We finally conduct numerical examples to illustrate our findings.

4 - Dynamic Pricing, Production, and Channel Coordination with Stochastic Learning

Tao Li, Santa Clara University, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, tli1@scu.edu, Xiuli He, Suresh Sethi

We study a decentralized two-period supply chain in which a manufacturer produces a product with stochastic cost learning, and sells it through a retailer facing a price-dependent demand. The manufacturer may or may not have inventory carryover option. We examine the impact of learning on the strategies of channel members. We show the traditional double marginalization problem becomes worse in the presence of learning. We obtain revenue sharing contracts that coordinate the dynamic supply chain.

■ WA31

Hilton- Union Sq 11

Matching-Based Service Allocation Models

Sponsor: Service Science

Sponsored Session

Chair: Yichuan Ding, Assistant Professor, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, Daniel.Ding@sauder.ubc.ca

1 - A Dynamic Pricing Mechanism via Fisher Market Equilibrium

Dragos Florin Ciocan, Assistant Professor, INSEAD, 70 Pacific St, Apt 227, Cambridge, Ma, 02139, United States of America, florin.ciocan@gmail.com, Vivek Farias

We consider a general equilibrium inspired allocation mechanism for online advertising. This allows an ad network to dynamically price impressions achieving several attractive properties. In particular, regardless of inventory uncertainty, the budgets of the advertisers are exhausted, while simultaneously guaranteeing that even in the presence of arbitrarily large inventory volatility, the utility that each advertiser achieves is a constant factor of the offline Pareto optimal.

2 - Dynamic Matching in Overloaded Waiting Lists

Jacob Leshno, Columbia University, 3022 Broadway, Uris Hall, 406, New York, NY, 10027, United States of America, jleshno@columbia.edu

We consider the efficiency of the allocation via waiting lists. Welfare is maximized when agents decline mismatched items; as items can be assigned to others agents and generate higher value without effecting aggregate waiting costs. However, agents may misreport preferences to get an earlier item. Abstract We calculate welfare loss from misallocation of standard waiting lists. Using derive optimal policies which use randomization and present a simple and robust policy.

3 - An Overloaded Bipartite Queueing System with Scoring-Based Priority Rules

Yichuan Ding, Assistant Professor, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, Daniel.Ding@sauder.ubc.ca, Peter Glynn, Stefanos Zenios

We consider an overloaded bipartite queueing system (OBQS) with multitype customers and service providers. Service is provided first to the customer with the highest score, which is computed based on customer type, waiting time, and server type. We characterize the fluid limit process in such a system. This result has three immediate applications: (1)it predicts the outcome of the OBQS; (2) it derives the optimal score formula; (3) it addresses the open question raised by Talreja & Whitt (2008).

■ WA32

Hilton- Union Sq 12

Operations/Service 1

Contributed Session

Chair: Andriy Shapoval, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, ashapoval3@gatech.edu

1 - Empirical Study on Surgery Delays

Elvin Coban, Assistant Professor, Ozyegin University, Orman Sok. Cekmekoy, Istanbul, 34794, Turkey, elvin.coban@ozyegin.edu.tr, Gulsah Alper, Tugce Pinar

We examine delays in surgery schedules using a dataset from a leading hospital in Turkey. Various steps starting from surgery appointment till patient discharge are analyzed for different medical departments. In this talk, we will discuss patterns of existing delays in addition to how we can manage them to compute robust surgery schedules.

2 - On Inpatient Bed Capacity Management by Cluster Analysis

Andriy Shapoval, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, ashapoval3@gatech.edu, Eva Lee

We consider a problem of partitioning clinical services in hospitals into groups with the goal to allocate efficiently inpatient beds. One strategy is pooling the bed capacity. Alternatives include dividing the capacity into groups with restricted access up to the complete specialization, also called focused care. Using the similarity principle from cluster analysis, we propose a two-stage framework with discrete optimization and queueing components.

3 - Trends in Servitization

Jina Kim, PhD Student, Korea University Business School, LG-POSCO Hall, KUBS, 145 Anam-ro Seoungbook-gu, Seoul, Korea, Republic of, jina0810@korea.ac.kr, Hosun Rhim, Kwangtae Park

Servitization is the concept including Product Servitization added service into product and Service Productization added product into service. Manufacturing Company can improve its performance and create customer value by combining service with product. Also, Service Company adds product into service in order to increase financial performance and satisfy customer satisfaction. This paper investigates trends in servitization: Product Servitization and Service Productization. .

4 - The Probabilistic Profitable Tour Problem

Mengying Zhang, University of Science and Technology of China, Jin Zhai Road 96, Hefei, China, zmy0908@mail.ustc.edu.cn

The probabilistic profitable tour problem is the problem of finding an a priori tour which maximizes the difference between the expected profits collected by visiting customers and the corresponding expected traveling costs. We formulate this problem and propose a genetic algorithm to solve it.

■ WA33

Hilton- Union Sq 13

Health Care Modeling Optimization IV

Contributed Session

Chair: Banafsheh Behzad, Assistant Professor, California State University, Long Beach, Department of Information Systems, College of Business Administration, Long Beach, CA, 90840, United States of America, behzad1@illinois.edu

1 - using Subject Specific Data to Improve Biomechanical Modeling

Menekse Salar, PhD Student, Auburn University, 215 S. Gay Street, #204, Auburn, AL, 36830, United States of America, mzs0053@auburn.edu, Richard Sesek, Celal Gungor, Ruoliang Tang

Many bio-mechanical modeling methods rely on oversimplifying assumptions regarding muscle geometry. The aim of this study was to build regression relationships that can predict low back geometry using only easily measured subject parameters such as height, weight and gender. This paper explores the errors that would be expected using this regression relationship as compared to assuming a fixed muscle lever arm based on the population or gender stratified mean values which is typically done.

2 - Hazard Rate Models for Estimating Patient's Length-of-Stay in Emergency Departments

Seung Yup Lee, Wayne State University, Wayne State University, Detroit, MI, 48202, United States of America, seungyup@wayne.edu, Michael Lederle, Ratna Babu Chinnam, Alper Murat, Evrim Dalkiran, Qingyu Yang, Sina Faridimehr, Azade Tabaie, Hakimuddin Neemuchwala

Research suggests that effective prediction of a patient's length-of-stay is an important prerequisite for evaluation of ED service quality as well as the performance of real-time decision support systems for improving patient flow. We present results from statistical and machine learning hazard rate models using data from a VA Medical Center that offer a number of interesting insights.

3 - Capacity Planning of Operating Rooms

Tarun Mohan Lal, Senior Health Services Analyst, Mayo Clinic, Robert D. and Patricia E. Kern, Rochester, MN, United States of America, mohanlal.tarun@mayo.edu, Kal Pasupathy, Narges Hosseini, Jeanne Huddleston

Effective use of operating rooms is critical for meeting the patient demand and for the financial viability of hospitals. This presentation will discuss a decision support system that was developed for Urology practice of a large academic medical center to estimate number of different types of OR's(robotic, non robotic)required considering practice constraints as well as balancing the over and underutilized costs. Future research opportunities to improve the model will also be discussed.

4 - Asymmetric Bertrand-Edgeworth-Chamberlin Competition: A Pediatric Vaccine Pricing Model

Banafsheh Behzad, Assistant Professor, California State University, Long Beach, Department of Information Systems, College of Business Administration, Long Beach, CA, 90840, United States of America, behzad1@illinois.edu, Sheldon Jacobson

The pricing strategies in the United States pediatric vaccines market are studied using a Bertrand-Edgeworth-Chamberlin price game. The game analyzes the competition between asymmetric capacity- constrained manufacturers producing differentiated products. The model completely characterizes the unique pure strategy equilibrium in this game in an oligopoly setting. Complete characterization of mixed strategy equilibrium is provided for a duopoly setting.

5 - Optimal Rotation of Duties of Hemodynamics Units: A Case Study

Giovanni Righini, University of Milan, Via Bramante, 65, Crema, Italy, giovanni.righini@unimi.it

We consider optimization problems arising in the reorganization of the regional health care system in the province of Milan, concerning the treatment of patients affected by acute myocardial infarction. Namely we consider some tactical level problems to suitably define a cyclic schedule of hemodynamics units to be un duty during nights and week-ends. We present integer linear programming models and we provide computational results obtained for the province of Milan.

■ WA34

Hilton- Union Sq 14

Homeland Security and Energy Policy

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Xiaojun Shan, Postdoctoral Research Associate, CEEEP at Rutgers University, 33 Livingston Ave, New Brunswick, NJ, 08901, United States of America, xiaojun.shan@ejb.rutgers.edu

1 - Pareto Optimal Designs for CO2 Cap and Trade Policies on Deregulated Electricity Networks

Felipe Feijoo, University of South Florida, 4202 E. Fowler Ave, ENB118, Tampa, United States of America, felipefeijoo@mail.usf.edu, Tapas Das

This paper presents two layers model to develop Pareto optimal designs for CO2 Cap and Trade policies. The top layer involves design of optimal cap-and-trade policy over a planning horizon. The bottom layer involves, for a given cap-and-trade policy, finding equilibrium bidding strategies of the competing generators while maximizing social welfare via DC-OPF.

2 - The Modern Electric Grid: Implications for National Security

Anu Narayanan, Associate Engineer, RAND corp, 4570 Fifth Avenue, Suite 600, Pittsburgh, PA, 15213, United States of America, anarayan@rand.org

The modernization of the electric power grid includes the deployment of intelligence, controls and distributed generation resources across the power delivery system. These upgrades come with opportunities for increased system resilience and security as well as potential risks. In this talk I will touch on both sides, considering technical, economic and policy issues and identifying questions to ask as we try to make the best use of available and emerging technologies.

3 - Effectiveness of Defensive Investments in the Light of Cascading Failure

Sinan Tas, Penn State University-Berks, 1800 Tulpehocken Road, Reading, Pe, 19610, United States of America, sut12@psu.edu

Limited capacities and old technologies make cascading failure a crucial aspect of our critical infrastructure including power grids and telecommunication networks. In this talk, we will analyze how effective our defensive investments can be when intelligent adversaries consider cascading failure as part of their attack strategies. We will also discuss the practical implications of efficient security investments that may lead to more sustainable security policies.

4 - Designing Intervention Scheme for Public-Interest Goods: California Electric Vehicle Market Case

Ece Demirci, Ph.D. Student, Bilkent University, Department of Industrial Engineering, Ankara, 06800, Turkey, edemirci@bilkent.edu.tr, Nesim K. Erkip

This study explores the problem of designing an intervention scheme for public-interest goods. We consider a system composed of a retailer and a central authority with fixed budget. The central authority regulates the system by two intervention tools: investment on demand increasing strategies and subsidies. We use bi-level programming for modeling the system, provide some structural properties and calibrate our model with California electric vehicle market data.

■ WA35

Hilton- Union Sq 15

Healthcare and Humanitarian Logistics

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Maria Besiou, Associate Professor of Humanitarian Logistics, Kuehne Logistics University, Grosser Grasbrook 17, Hamburg, 20457, Germany, maria.besiou@the-klu.org

1 - Global Vehicle Supply Chain Management in Humanitarian Operations

Alfonso Pedraza-Martinez, Assistant Professor, Kelley School of Business, Indiana University, 1309 E 10th Street, Kelley School of Business, IU, Bloomington, In, 47405, United States of America, alpedraz@indiana.edu, Luk Van Wassenhove, Jon Stauffer

We use dynamic hub location models to investigate the vehicle supply chain of an international humanitarian organization. Using real data we obtain vehicle demand following the Haiti earthquake and multiple development programs. We show how temporary hubs in major disaster areas can balance costs and responsiveness in global humanitarian supply chains.

2 - Predicting the Unpredictable: Deciding Where to Locate Strategic Stock using Real Data

Marianne Jahre, Professor, BI Norwegian Business School, Visiting Researcher MIT Humanitarian Response Lab, Sorgenfrigata 18a, Oslo, Ch, 0365, Norway, marianne.jahre@bi.no, Stein Erik Grönland

The Humanitarian Assistance Demand Forecast (HADF) is a tool to establish annual global demand for disaster relief goods and logistics services in international assistance. IFRC used HADF as a decision support tool to make evidence based decisions on locations and volumes of relief items to be prepositioned, thus forming their new global structure of physical, human and financial resources. The paper presents how real data helped IFRC make optimal decisions in designing their network.

3 - Humanitarian Transportation Planning: Human and Modeling Approaches

Erica Gralla, Assistant Professor, George Washington University, 1776 G St NW Suite 101, Washington, DC, 20052, United States of America, egralla@email.gwu.edu

A key logistics challenge in disaster response is planning and prioritizing the use of trucks and helicopters to transport humanitarian aid to affected communities. This paper explores ways to improve humanitarian transportation planning by building on the strengths of both humans and models. We identify decision-making algorithms, prioritization policies, and organizational structures that are nearly as effective as optimizers, but much simpler to implement in the humanitarian context.

4 - Patients with Chronic Disease: A System Dynamics Approach

Maria Besiou, Associate Professor of Humanitarian Logistics, Kuehne Logistics University, Grosser Grasbrook 17, Hamburg, 20457, Germany, maria.besiou@the-klu.org, Charalampos Tziogas, Patroklos Georgiadis, Reinhard Angelmar

Chronic diseases are lifelong medical conditions that evolve over a person's lifespan. Even if they can be treated and controlled, their long-term effects pose great pressure to the global healthcare sector. Motivated by the need for active and sustainable interventions in the healthcare sector, we develop a system dynamics model to capture the chronic disease patient flow. We also use a numerical example to study the non-linear complex dynamic behavior of the system under study.

■ WA36

Hilton- Union Sq 16

Information Systems 3

Contributed Session

Chair: Zsolt Ugray, Utah State University, 3515 Old Main Hill, MIS Department, Logan, UT, 84322-3515, United States of America, zsolt.ugray@usu.edu

1 - Optimized Autoscaling in Cloud Computing

Parijat Dube, IBM, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, pdube@us.ibm.com, Anshul Gandhi, Alexei Karve, Andrzej Kochut, Li Zhang

We develop a Kalman-filtering based automated solution to dynamically scale cloud deployments to meet application-level performance targets. Our solution leverages resource-level and application-level statistics to determine the required scaling actions in a cost-effective manner. The core of DC2 is a modeling and execution engine that internalizes the monitored statistics and infers the necessary system parameters.

2 - What Value Does Management Expect from BI/BA Projects? – Findings from Qualitative Case Studies

Zsolt Ugray, Utah State University, 3515 Old Main Hill, MIS Department, Logan, UT, 84322-3515, United States of America, zsolt.ugray@usu.edu, David Paper, Jeffrey Johnson

The use of business intelligence and business analytics (BI/BA) tools has become quite common in the past two decades. Some companies choose to make big investments in resources to support these efforts, while others approach possible investments very cautiously. We report on findings from our qualitative case studies of a variety of firms where our focus is to investigate management's perceptions of the value they can gain from BI/BA projects.

3 - How Strategic IT Organizations Enable Business Teams to Make Well-informed Business Decisions

Phil Weinzimer, President, Strategere Consulting, Alltentown, PA, 18104, United States of America, pweinzimer@strategere.com

The power of Information is valuable if it enhances the knowledge and enables operational personnel, business unit management, and executives to make well-informed business decisions that lead to significant business outcomes. A new book, The Strategic CIO; Changing the Dynamics of the Business Enterprise, based upon 150 CIO and business Executive interviews, explores, via case studies, how CIOs, using a common four-phase methodology, leverage information/technology for competitive advantage.

4 - Crowdsourced Digital Goods and Firm Productivity

Frank Nagle, Harvard Business School, Wyss 100, Soldiers Field, Boston, MA, 02163, United States of America, fnagle@hbs.edu

Crowdsourced digital goods are becoming more freely available and more frequently used as inputs by firms. However, the current literature on the returns to IT investment mismeasures non-pecuniary digital inputs. I measure the impact of one such good, open source software (OSS), on firm productivity. I find a positive and significant return to the usage of OSS. I address endogeneity concerns by using an instrumental variable approach and a matching estimation.

■ WA37

Hilton- Union Sq 17

Big Data 2

Contributed Session

Chair: Hing Kai Chan, Associate Professor, University of Nottingham Ningbo China, Business School China, Ningbo 315100, China, hingkai.chan@nottingham.edu.cn

1 - A Multi-disciplinary Approach to Quantify Social Media Data

Hing Kai Chan, Associate Professor, University of Nottingham Ningbo China, Business School China, Ningbo 315100, China, hingkai.chan@nottingham.edu.cn

Social media data are freely available and lots of useful data are available. Unfortunately, they are not fully utilized partly because of their nature: unstructured, subjective, and massive size. The proposed approach makes use of multiple research methods to process the social media. First part of the method is exploratory in nature, followed by statistical cluster analysis. The exact meaning of the data will then be extracted by entropy concept.

2 - A Knowledge Driven Hypotheses Generation Method to Uncover Actionable Information from Medical Data

Nuo Xu, Assistant Professor, University of Alabama at Birmingham, 1150 10th Ave South, Birmingham, AL, United States of America, nuoxu@uab.edu, Xuan Huang

The greatest challenge in utilizing Big-Data in healthcare is the hypotheses-driven paradigm that dominates clinical practice and research and its incompatibility to data driven paradigm. We propose an expert knowledge driven hypotheses generation mechanism to discover actionable knowledge based on two techniques, 1) knowledge driven feature creation and 2) model-free feature selection. We demonstrate the effectiveness of our approach with a 2-year diabetic intervention study at UAB hospital.

3 - Antecedences and Consequences of Multichannel Sharing Behaviors

Tianshu Sun, PhD Candidate, Smith School of Business, University of Maryland, 3330 Van Munching Hall, PhD Student Office, College Park, MD, 20742, United States of America, tianshusun@rhsmith.umd.edu, Elena Zheleva, Siva Viswanathan

With the rapid rise of the "sharing economy" there has been a renewed interest in understanding the antecedents and consequences of information sharing behaviors. We examine how product and social network characteristics drive information sharing across channels and before/after purchase. Using a granular dataset on customer sharing of daily deals and a rich set of product and social network characteristics our study provides novel insights into multi-channel sharing behaviors

4 - Clickstream Big Data and Delivery before Order Making" Mode for Online Retailers

Yeming Gong, EMLYON Business School, Rue Dunoir 12, Lyon, 69003, France, gong@em-lyon.com, Haoxuan Xu

Our research is inspired by a leading online retailer using clickstream big data to estimate customer demand and then ship items to customers or hubs near customers by a mode of "delivery before order making" (DBOM) mode. Using clickstream data to obtain advance demand information in order quantities, we integrate the forecasting with a single-item uncapacitated dynamic lot sizing problem in a rolling-horizon environment.

5 - A One-shot Approach to Distributed Sparse Regression

Yuekai Sun, Stanford University, 475 Via Ortega, Stanford, United States of America, yuekai@gmail.com, Qiang Liu, Fernando Perez, Jason Lee, Jonathan Taylor

We devise a one-shot approach to distributed sparse regression in the high-dimensional setting. The main idea is to estimate the regression coefficients by averaging corrected lasso estimates. We show the approach recovers the convergence rate of the lasso as long as the number of machines does not grow too quickly.

■ WA38

Hilton- Union Sq 18

Health Care Modeling Optimization VI

Contributed Session

Chair: Michelle Alvarado, PhD Candidate, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, alvarado.michelle.m@gmail.com

1 - Scheduling for a Clinical Network

Dongyang Ester Wang, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, wdy@utexas.edu, Douglas Morrice, Kumar Muthuraman

The process that prepares outpatients for surgery is service intensive and requires timely access to multiple services. However, scheduling outpatient appointments is not coordinated among the clinics. We develop a model that centralizes scheduling for a clinical network and our approach has the potential to identify a system-wide optimal solution.

2 - ICU Nurse Scheduling under Uncertainty

Ece Karpuz, Hazine Mustesarligi, Inonu Bulvari, No: 36, Emek, Ankara, Turkey, ece.karpuz@hazine.gov.tr, Sakine Batun

In this study, we consider the problem of scheduling ICU nurses under uncertainty in the required patient care. We formulate the problem as a two-stage stochastic program that minimizes the expected overtime and undertime hours. We estimate the value of the stochastic solution by considering practical instances constructed based on real data.

3 - Nurse Scheduling in Infusion Center

Kamil Ciftci, Lehigh University, 200 West Packer Avenue, Bethlehem, 18015, United States of America, kac208@lehigh.edu

Recently, it is a big challenge for infusion center management to control the environment in order to reduce operation cost, improve the quality of care, satisfy patients, and provide staff preferences. In this paper, MILP models are developed to find optimal nurse scheduling in an infusion center while minimizing patient waiting time. A heuristic policy is proposed for large problems. We design simulation model to compare proposed models with current practice in a local hospital.

4 - Analyzing the Financial Effects of HIE in a Health Care System using Simulation

Yu Fu, Graduate Student, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, yufu.ise@tamu.edu, Andy Banerjee

A Health Information Exchange (HIE) is expected to improve the effectiveness of healthcare services and reduce cost for the payers and providers. The focus of this research study is to model the complicated interactions of multiple participants in the health care system using simulation, compare the financial outcomes under different scenarios, and therefore analyze the financial effects of HIE in a health care system.

5 - Integrated Simulation and Optimization for Scheduling Chemotherapy Appointments under Uncertainty

Michelle Alvarado, Ph.D. Candidate, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, alvarado.michelle.m@gmail.com, Lewis Ntaimo

Scheduling of chemotherapy appointments is a difficult task due to uncertainty in appointment durations, acuity levels, and resource availability. To address this problem, we developed a new methodology that integrates a discrete event system specification (DEVS) simulation model with a stochastic mixed integer programming model (SMIP). The methodology and SMIP scheduling algorithms are evaluated from both the patient and management perspectives using data from a Texas oncology clinic.

■ WA39

Hilton- Union Sq 19

Inverse Optimization in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Taewoo Lee, PhD candidate, University of Toronto, 5 King's College Road, Toronto, Canada, taewoo.lee@mail.utoronto.ca

Co-Chair: Timothy C. Y. Chan, University of Toronto, 5 King's College Rd., Toronto, Canada, tcychan@mie.utoronto.ca

1 - Eliciting Cholesterol Management Guidelines' Valuation of Future Life

Iakovos Toumazis, PhD Student, University at Buffalo (SUNY), Buffalo, NY, United States of America, iakovost@buffalo.edu, Osman Ozaltin, Murat Kurt, Nilay Shah, Brian Denton

Lipid abnormalities increase the risk of heart attack and stroke. Treatment guidelines are developed to deal with the complexity of treating these abnormalities. We consider the trade-off between the benefits and side effects of statins, and develop an inverse stochastic dynamic program to elicit time valuation of current guidelines. We use clinical data to illustrate the outcomes on Type 2 diabetes patients.

2 - Estimating Lipid Management Guidelines' Risk Value of a Life Year on Treatment

Niraj Kumar Pandey, University at Buffalo (SUNY), 342 Bell Hall, University at Buffalo(SUNY), Buffalo, NY, 142602050, United States of America, npandey@buffalo.edu, Murat Kurt, Mark Karwan

Statins reduce the risk of coronary heart disease and stroke, but may have adverse side effects. Except for some surveys there has not been any emphasis on the measurement of these side effects to be used for better decision making. In this study, we develop an inverse dynamic programming model to quantify the side effects of statin treatment from a central policy maker's point of view. We present computational results based on the national lipid management guidelines from several countries.

3 - Reverse Engineering Bacterial Metabolism via Inverse Optimization

Ioannis Paschalidis, Professor, Boston University, Dept of ECE, 8 Saint Mary's St, Boston, MA, 02215, United States of America, yannisp@bu.edu

We develop an Inverse Flux Balance Analysis (IFBA) method which is a novel inverse linear optimization framework for inferring the metabolic objective function. Understanding the structure of the cell's objective can help reverse engineer" a bacterium of interest and infer useful information regarding its evolution. We validate IFBA under both simulated (E. coli and Yeast) and experimental data (TEAM) with excellent results. (Joint work with Q. Zhao, A. Stettner, and D. Segre)

4 - Preference Preservation in Inverse Optimization for Radiation Therapy Treatment Planning

Taewoo Lee, PhD Candidate, University of Toronto, 5 King's College Road, Toronto, Canada, taewoo.lee@mail.utoronto.ca, Timothy C. Y. Chan

We present a new inverse convex optimization model that accommodates any input solution, including one that cannot be optimal for the forward problem, and determines a nonzero weight vector that preserves the original preference of the decision maker who generated the solution. We show how a linear approximation to the model and a successive linear programming algorithm can trade off between preference preservation and computational efficiency, using prostate cancer radiation therapy data.

■ WA40

Hilton- Union Sq 20

HSEA -I- Undergraduate Projects in Healthcare Engineering

Sponsor: Health Applications

Sponsored Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, amycohn@med.umich.edu

1 - Using Multidisciplinary Group to Create a Simulation Tool to Help Surgeons understand Uncertainty

Nathan Janes, University of Michigan, Ann Arbor, MI, United States of America, njanes@umich.edu, Amy Cohn

We present our multidisciplinary project comprised of engineering, medical, and nursing students and faculty on helping a cardiothoracic surgeon to understand the impact of stochasticity on training programs for surgical residents. The design and implementation of the tool has been impacted by the input of all involved in the project and this has allowed for an intuitive, user-friendly design that may be used by both clinical and administrative personnel to assess their own programs.

2 - Predicting Disposition for Pediatric Asthma Patients

Vanessa Morales, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, vmorales@umich.edu, Amy Cohn, Elizabeth Olin

We present predictive modeling based approaches to determine the disposition for children arriving to a pediatric emergency department with respiratory illnesses.

■ WA41

Hilton- Union Sq 21

Health Care, Public Health

Contributed Session

Chair: Alexander Rothkopf, Post Doc, Julius-Maximilians-University, Stephanstrafle 1, Wuerzburg, 97070, Germany, alexander.rothkopf@uni-wuerzburg.de

1 - Bayesian Network Detection of Breast Cancer Treatment Disparities

Milton Soto-Ferrari, Western Michigan University, 4601 Campus Drive, Kalamazoo, MI, 49008, United States of America, miltonrene.sotoferrari@wmich.edu, Diana Prieto, Lorena Pena

We developed a Bayesian network (BN) and a logistic regression model (LR) that simulate the decision process of physicians in diagnosing a hormone therapy treatment, and the effect of non-clinical factors in the final receipt of the treatment in breast cancer patients. The clinical factors include: post-menopausal and hormone receptor status, treatment and adjuvant treatment received. We calculate the statistical power of the two methods and compare their results and performance.

2 - Profiling and Visualizing Utilization and Cost for Pediatric Asthma Care in the Medicaid System

Ross Hilton, PhD Candidate, Georgia Institute of Technology, 755 Ferst Dr. NE, Atlanta, GA, 30332, United States of America, rhilton3@gatech.edu

We summarize the utilization and cost relational system between providers for pediatric asthma care in the Medicaid system using large patient-level claims data. We apply sequence clustering analysis to the utilization profiles and derive a probabilistic network of care and a cost relational system for each cluster. ED visits contribute a large portion of the total cost while the majority of ED costs-per-visit are similar to other care types suggesting that many ED visits are for routine care.

3 - Drug Procurement with Long Term Considerations: Volume Splits and Volume Guarantees

Alexander Rothkopf, Post Doc, Julius-Maximilians-University, Stephanstrafle 1, Wuerzburg, 97070, Germany, alexander.rothkopf@uni-wuerzburg.de, Eirini Spiliotopoulou

Our analysis is motivated by recent decisions of global health procurement organizations to grant volume guarantees to existing suppliers: in addition to awarding the volume of the upcoming procurement cycle to incumbent suppliers a procurer also guarantees a specific volume of future procurement cycles to these suppliers today. With this mechanism organizations aim to reduce prices through competition and higher economies of scale at the suppliers.

4 - Random Acts of Violence: Examining Mass Killing Events in the United States as a Stochastic Process

Douglas King, University of Illinois at Urbana-Champaign, 117 Transportation Bldg., 104 S. Mathews Ave., MC-238, Urbana, IL, 61801, United States of America, dmking@illinois.edu, Sheldon Jacobson

Recent mass killings such as those in Newtown, CT and Aurora, CO, have brought attention to mass killings in the United States. This talk examines 236 mass killings between 2006 and 2014, finding that they do not significantly differ from a homogeneous Poisson process. This implies a stable frequency of mass killings from 2006 to 2014, and that mass killing events are random in the sense that the occurrence of one mass killing event does not signal whether another mass killing event is imminent.

■ WA42

Hilton- Union Sq 22

System Dynamics in Health I

Sponsor: Health Applications

Sponsored Session

Chair: Mohammad S. Jalali, Virginia Tech / MIT, 113 Harvard St, Apt 1, Cambridge, MA, 02139, United States of America, mj@vt.edu

1 - Increasing Healthy Food Access and Equity? Dynamics of Nutritious Food Innovation

Jeroen Struben, Assistant Professor, Desautels Faculty of Management - McGill University, 1001 Sherbrooke Street W, Montreal, QC, H3A1G5, Canada, jeroen.struben@mcgill.ca, Derek Chan, Laurette Dube

We examine dynamics of and trade-offs between market-driven and social innovations in efforts to increase healthy food consumption, especially within disadvantaged populations. We develop a behavioral, dynamic, and empirically grounded nutrition market transformation model with population socio-demographically disaggregated. We identify conditions under which single-faceted or collaborative policies, involving multiple stakeholders promoting nutritious food and healthy lifestyles, are effective.

2 - Impact of Patient Non-compliance on Diabetes Care System

Sahar Hashmi, MD, PhD candidate, Massachusetts Institute of Technology, 10 Emerson Place, 16C, Boston, MA, 02114, United States of America, drhashmi@mit.edu

We studied the effect of diabetes patients with increased missed appointments on their disease progression with different insurance coverage. We measured the impact of disease progression on the cost of the diabetes management system. We have developed a system dynamic model, which identifies the key variables and causal loops involved. We suggest better aligning of the insurance coverage on preventive and counseling services to save the cost of overall spending in the diabetes clinic services.

3 - Optimal Screening Policy for Post-Traumatic Stress (PTS)

Navid Ghaffarzadegan, Assistant Professor, Virginia Tech, Blacksburg, VA, United States of America, navidg@vt.edu, Richard Larson

We develop a screening policy model for PTS including social forces that inhibit receiving early care. We simulate to analyze the characteristics of the optimal" screening policy for PTS. We show that there is a tipping point in this system, and to make a long-term difference, the screening rate should be much higher than the current numbers. Otherwise, investments only have short term effects. Implications include potentially screening everyone and tolerating false positives.

4 - System Dynamic Models of Dengue Fever

Kun (Maggie) Hu, Research Scientist, IBM, 650 Harry Rd, San Jose, CA, 95120, United States of America, khu@us.ibm.com, James Kaufman

Dengue is a major international public health concern with no vaccine. Infection with one strain affords temporary cross immunity (CI) to other strains which increases the risk of having lethal complications due to antibody-dependent enhancement (ADE). We propose two SD models of dengue fever which exhibit a transition from steady state to periodic dynamics as a function of CI and ADE. Our results show the need for ADE to explain the dynamics of the epidemiological behaviors observed in reality.

■ WA43

Hilton- Union Sq 23

Applications and Computation

Sponsor: Computing Society

Sponsored Session

Chair: Todd Trautman, Sr. Manager, Kaiser Permanente, Colorado, 2530 S. Parker Rd, CIDS, Aurora, Co, 80014, United States of America, todd.c.trautman@kp.org

1 - Optimal Order Splitting on a Multi-slot Machine in the Printing Industry

Philipp Baumann, University of Bern, Department of Business Administration, Schuetzenmattstrasse 14, Bern, 3012, Switzerland, philipp.baumann@pqm.unibe.ch, Salome Forrer, Norbert Trautmann

In the real-world offset printing process under study, customer-specific designs are imprinted on napkin pouches. For the planning of this process, given customer orders are to be split among several slots of printing plates, such that the total costs are minimized subject to several technological and organizational constraints. We present two alternative MILP formulations and analyze how symmetric solutions can be removed efficiently from the search space.

2 - Media Selection with Yield Uncertainty

Justin Goodson, Assistant Professor, Saint Louis University, 3674 Lindell Blvd., St. Louis, MO, 63108, United States of America, goodson@slu.edu, Reuven Levary, Luca Bertazzi

Firms advertising a product or service seeking to maximize target audience exposure often face yield uncertainties, i.e., indeterminate future events resulting in bumped media spots. Yield may be affected by breaking news, natural disasters, or political events. Although advertisers may receive refunds for bumped spots, it is difficult to recover lost exposure. We consider strategies to hedge against yield uncertainty, developing upper and lower bounds on the value of an optimal policy.

3 - Weighted Target Set Selection

Rui Zhang, University of Maryland, R. H. Smith Business School, College Park, MD, United States of America, ruizhang@rhsmith.umd.edu, Raghu Raghavan

The Target Set Selection (TSS) problem is a fundamental problem about the diffusion of influence in social networks. In our work, we consider the weighted version of it (WTSS problem). Motivated by the desire to develop mathematical programming approaches, we first focus on developing a strong formulation for the problem on trees. We present a tight and compact extended formulation for it. Furthermore, based on this strong formulation, a branch and cut approach is proposed for general networks.

4 - Assortment Optimization in Fashion Retail

Marie-Claude Côté, JDA Software, 4200 st-laurent, Montreal, Canada, marie-claude.cote@jda.com, Louis-Martin Rousseau, Marc Brisson, Eric Prescott-Gagnon, Vincent Raymond

The assortment problem aims at selecting the best set of items to be carried in each store of an chain for a future season based on user-defined constraints. To support the particularity of the fashion industry where items can change significantly from one season to another, we use a genetic algorith, a MIP and a Neural Network to create new interesting items and items with similar characteristics considering the constraints to give the user a meaningful set of product to create his assortment.

■ WA44

Hilton- Union Sq 24

Strategic Value of IT/IS

Sponsor: Information Systems

Sponsored Session

Chair: Ling Xue, Assistant Professor, University of North Carolina at Greensboro, 479 Bryan Building, Dept. of ISSCM, UNC-Greensboro, Greensboro, NC, 27402, United States of America, l_xue@uncg.edu

1 - Are You on the Edge of Failure? Let the Customer Checkin Tell You

Lei Wang, Assistant Professor, Pennsylvania State University, 454 Business Building, University Park, PA, 16802, United States of America, Lei.Wang@business.uconn.edu, Joseph Pancras, Ramesh Shankar, Ram Gopal

It is vital to understand how businesses can leverage the real-time data generated by location-based services. Using data collected from Foursquare and Yelp, we aim to find out the predictive power of customer checkins on business failure for restaurants in New York City. We find that customer checkin data from the focal restaurant and its neighbors have shown strong predictive power on business failure. Incorporating customer checkins data gives a remarkable improvement on predictive accuracy.

2 - Push or Pull? Design of Content Delivery Systems

Sean Marston, Assistant Professor, Western Kentucky University, 1906 College Heights Blvd. #21058, Bowling Green, KY, 42101, United States of America, Sean.marston@wku.edu, Hong Guo, Yuwen Chen

Advances in information technology, especially the expansion of cellular and WiFi networks, are dramatically changing how people consume digital content. This paper addresses this challenge by identifying the key factors for the design of content delivery systems and explicitly modeling their interactions. We investigate two content delivery systems ñ push and pull systems, and solve for the content provider's optimal push frequency decision and consumers' push versus pull decision.

3 - Information Technology and Transformation of Government Services

Min-Seok Pang, Assistant Professor, Temple University, United States of America, mins.pang@gmail.com, Henry C. Lucas, Jr., Sunil Mithas

In the context of U.S. Social Security, we study how use of online self-service technologies (SST) is associated with customer satisfaction. Using a large-scale individual-level dataset with more than 2,700 respondents, we find that successful use of SST in Social Security benefit applications is associated with higher levels of service satisfaction, compared to the in-person channel. We also show that a service failure on the online channel is related to customer dissatisfaction.

■ WA45

Hilton- Union Sq 25

Behavior, Queueing, and Processing Times

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Ken Schultz, Associate Professor, Air Force Institute of Technology, 4950 Hobson Way, WPAFB, OH, 45433, United States of America, kenneth.schultz@afit.edu

1 - Individual Behavior and Supplier Pricing to a Newsvendor

Julie Niederhoff, Syracuse University, Syracuse, NY, United States of America, Jniederh@syr.edu, Panos Kouvelis

Previous studies have examined pricing in contracts to find that they are on average sub-optimally set. However, current literature is primarily focused on average behavior. This neglects the heterogeneity of decision makers. We explore 3 individual biases within a price-setting supplier context to better understand which decision makers get it right, which deviate, and why..

2 - Data Analysis of Service Times in Call Centers

Noah Gans, OPIM Department, Wharton - University of Pennsylvania, Philadelphia, PA, United States of America, gans@wharton.upenn.edu, Haipeng Shen, Han Ye

We have been analyzing large datasets from telephone call centers to better characterize pervasive but little-studied phenomena that affect their operations. In this talk, we'll discuss agent call times, which show considerable heterogeneity and evolve according to somewhat predictable patterns.

3 - A General Framework for the Influence of Load on Service Time

Ken Schultz, Associate Professor, Air Force Institute of Technology, 4950 Hobson Way, WPAFB, OH, 45433, United States of America, kenneth.schultz@afit.edu, Bora Kolfal, Mahammad Delasay, Armann Ingolfsson

Do service times increase or decrease with load? The answer is "Yes" or, more accurately, "It depends". We construct a general framework that is useful to both researches and practictioners investigating the affects of load on service times. We propose a thorough examination of the interactions of "load characteristics," "system components," and "service time determinants.

■ WA46

Hilton- Lombard

Games and Optimization over Networks

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Swati Gupta, Graduate Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, MIT ORC, E40-149, Cambridge, MA, 02139, United States of America, swatig@mit.edu

1 - On the Quickest Flow Problem in Dynamic Networks – A Parametric Min-cost Flow Approach

Maokai Lin, Massachusetts Institute of Technology, 7 7 Massachusetts Avenue,MIT ORC,, Cambridge, MA, 02139, United States of America, lmk@mit.edu, Patrick Jaillet

We consider the quickest flow problem in dynamic networks: given flow F, find the minimum time to send it through a network over time. We introduce a new linear programming model for the problem. Using the parametric nature of the model, we develop a cost-scaling algorithm that runs in O(nmlog(n^2/m)log(nC)) time, where C is the maximum arc cost. This result shows for the first time that the quickest flow problem is no harder than the min-cost flow problem in static networks.

2 - A Decentralized Coalition Loyalty Program using Credit Networks

Arpit Goel, Student, Stanford, 1520 Sand Hill Road, Apt 302, Palo Alto, Ca, 94304, United States of America, argoel@stanford.edu, Pranav Dandekar, Ashish Goel

We propose a decentralized system for forming coalition loyalty programs by extending the model of 'credit networks'. We show two important properties of the proposed `path independence' and `no arbitrage'. We introduce a model of customer utility in frequency loyalty program, and show under what conditions coalitions perform better than individual programs.

3 - Finding Small Stabilizers for Unstable Graphs

Karthekeyan Chandrasekaran, Harvard University, 19 Pleasant St, Apt 12, Cambridge, MA, 02139, United States of America, karthe@gatech.edu, Britta Peis, Jochen Koenemann, Laura Sanita, Adrian Bock

Stable graphs play an important role in cooperative game theory. An undirected graph is stable if its inessential vertices (those that are exposed by at least one maximum matching) form a stable set. In this work we study the following edge-deletion question: given a graph G, can we find a minimum-cardinality subset of edges whose removal from G yields a stable graph? We show hardness results and efficient approximation algorithms for sparse graphs and for regular graphs.

4 - Games People (could not) Play

Swati Gupta, Graduate Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, MIT ORC, E40-149, Cambridge, MA, 02139, United States of America, swatig@mit.edu, Patrick Jaillet, Michel Goemans

Every 2-player zero-sum game has an optimal mixed strategy that can be found by solving an LP. But this approach fails to give a polytime algorithm when the number of pure strategies for each player is exponential in the representation of the game, e.g. if players play spanning trees of a graph. We give fast algorithms to compute approximate Nash-equilibria for exponential succinct games for a class of payoff functions using ideas from convex and combinatorial optimization and machine learning.

■ WA47

Hilton- Mason A

Computational Challenges for Sequential Stochastic Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu

1 - Multiple Timescale Stochastic Optimization for Integrating Renewable Resources

Suvrajeet Sen, Professor, University of Southern California, University Park Campus, LA, CA, 90089, United States of America, s.sen@usc.edu, Harsha Gangammanavar

We present a stochastic optimization model which accommodates decisions at multiple timescales: a coarse timescale for thermal generation decisions and a fine timescale to control of renewable resources, storage devices etc. This model is solved using a joint stochastic decomposition-approximate dynamic programming algorithm. Our computational results are based on incorporating wind simulation into this algorithm.

2 - Dynamic Measures of Risk on Dynamic Programs

Ricardo Collado, Assistant Professor, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ, 07030, United States of America, ricardo.collado@stevens.edu, Warren Powell

We discuss dynamic measures of risk on finite and infinite horizon dynamic programs. We focus our attention on identifying main properties of such dynamic risk measures and its implementation challenges. We finish our presentation with a discussion of threshold risk measures and its application to finite and infinite horizon dynamic programs.

3 - Approximation Strategies for Multistage Stochastic Programs

Tsvetan Asamov, Post-doctoral associate, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, tasamov@princeton.edu, Warren Powell

Using the contextual setting of optimizing grid-level energy storage, we study the effect of dimensionality on the performance of different approximation strategies. We build on the algorithmic framework of approximate dynamic programming to introduce novel machine learning strategies which overcome the curse of dimensionality inherent in scenario trees. The energy storage setting is used to create families of problems which exhibit different characteristics of the information state.

4 - A Nested Newsvendor Model to Integrate Rolling Wind Forecasts in the Energy Commitment Problem

Genna Gliner, Graduate student, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, genna@princeton.edu, Warren Powell

We formulate the energy commitment problem with wind energy as a lagged, nested newsvendor problem in the presence of rolling forecasts. We present a stochastic model of the rolling forecasts, and show how these can be used to produce an analytical solution of the energy commitment problem. We then study the sensitivity of the solution to changes in forecasts and use the model to predict how these changes affect the commitment decisions and the objective function value.

■ WA48

Hilton- Mason B

Optimization, Robust 2

Contributed Session

Chair: Dimitri Papadimitriou, Pr.Eng.Research, Bell Labs, Copernicuslaan 50, Antwerp, 2018, Belgium, dimitri.papadimitriou@alcatel-lucent.com

1 - Multi-agent Probe Localization/Configuration Problem

Dimitri Papadimitriou, Pr.Eng.Research, Bell Labs, Copernicuslaan 50, Antwerp, 2018, Belgium, dimitri.papadimitriou@alcatel-lucent.com

The probe localization/configuration problem aims at minimizing the number of probes/workload together with their placement to realize a measurement task under various spatial and resource constraints. When applied to systems subject to uncertainty, one often lacks full information on the nature of this uncertainty. We propose a multi-agent computational method capable to resolve large-scale instances of this problem over time for any realization of uncertainty (in a given set).

2 - Robust Optimization and Predictive Model: A Marketing Use Case

Oliver Bastert, FICO, Maximilianstr. 35a, Munich, Germany, OliverBastert@fico.com, Sébastien Lannez, Shalini Raghavan, Susanne Heipcke

In this paper we present FICO's solution to optimize marketing campaigns, and describe an extension that is used to take into account information about the forecast accuracy during the optimization process. The scalability of the tool is ensured by FICO Xpress Optimization Suite and its distributed computation capability.

3 - Robust Optimization Formulations for Planning Problems

Susanne Heipcke, FICO, Starley Way, Birmingham, United Kingdom, susanneheipcke@fico.com, Zsolt Csizmadia, Pietro Belotti, Sébastien Lannez

Planning, whether long-term or short-term, typically involves uncertain data: demand forecasts rarely are fixed values, availability of resources or raw materials may be uncertain. Robust Optimization provides a means of incorporating such uncertainties into standard" optimization problems. We discuss robust formulations for examples from various application domains, including production planning, logistics, and power generation, and comment on their implementation with Xpress-Mosel.

4 - Options-Mix Demand Specification for Robust Assembly Line Rebalancing

Bryan Pearce, Clemson University, Freeman Hall, Clemson, SC, 29634, United States of America, bpearce@g.clemson.edu, Mary Elizabeth Kurz, Laine Mears, Kavit Antani

We consider the assembly line rebalancing problem that emerges in make to order facilities. Specification of the demand model-mix becomes intractable with very large product customization options. An options-mix demand structure is presented instead, for a single period forecast. A two-stage robust optimization procedure is applied to maximize line efficiency and a horizontal balancing metric.

■ WA49

Hilton- Powell A

Routing Problems

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Kelly Sullivan, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, United States of America, ksulliv@uark.edu

1 - The Shortest Path Problem with Replenishment

Sarah Nurre, Assistant Professor, Graduate School of Engineering & Management, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Sarah.Nurre@afit.edu, Brian Lunday

We examine the problem of identifying a path through a network from a start node to a terminus node, wherein traversing any arc both increments the length of the path traveled and depletes a capacitated resource. Such a resource is necessary for arc traversal, but it may be replenished at any one or more of a subset of the nodes. We seek to minimize a combination of the path length and number of replenishments. Three exact methods which map the efficient frontier are computationally compared.

2 - Hybrid Optimization Approaches for Dynamic Network Interdiction Models

Chase Rainwater, University of Arkansas, Bell Engineering Center, Office #4207, Fayetteville, AR, 72701, United States of America, cer@uark.edu, Thomas Sharkey, Forough Enayaty

We consider a dynamic network interdiction problem in which adversarial actors seek to maximize illegal flow while protective actors utilize resources to minimize this flow. We discuss an integer programming representation of our problem and then explore hybrid constraint and integer programming techniques for solving larger problem variants. We conclude with a discussion of the role that information plays when our problem is applied to a law enforcement application.

3 - Study on Multi-objective Home Health Care Nurse Routing Problem

Kunlei Lian, Graduate Student, University of Arkansas, Bell 4130, 1 University of Arkansas, Fayetteville, AR, 72701, United States of America, klian@email.uark.edu, Ashlea Milburn, Ronald Rardin

The nurse routing problems in this research involves providing consistent service to patients with the objectives of minimizing traveling cost and improving service quality. An improved non-dominated sorting genetic algorithm is proposed to find the trade-offs between these objectives. Large neighborhood search is employed to improve solution diversity and quality. Computational results are presented and observations regarding tradeoffs among the competing objectives are made.

■ WA50

Hilton- Powell B

Optimization, Integer 1

Contributed Session

Chair: Pierre Le Bodic, School of Industrial Systems and Engineering, Georgia Institute of Technology, Atlanta, 30332, United States of America, lebodic@gatech.edu

1 - Insights on Branching in MIP Solvers

Pierre Le Bodic, School of Industrial Systems and Engineering, Georgia Institute of Technology, Atlanta, 30332, United States of America, lebodic@gatech.edu, George Nemhauser

The branch and bound algorithm is the standard component around which MIP solvers are designed. We will give insights on branching and show the importance of taking good branching decisions. In particular, we will exhibit a family of instances for which a fixed-size branch-and-bound tree exists, but for which state-of-the-art MIP solvers need an increasing amount of resources.

2 - Cloud Branching – How to Exploit Dual Degeneracy in Global Search

Timo Berthold, Fair Isaac Europe Ltd, Takustr. 7, Berlin, 10551, Germany, timoberthold@fico.com

We study branching strategies for mixed-integer programs that exploit the knowledge of *multiple* alternative optimal solutions (of the current LP relaxation. They naturally extend state-of-the-art methods like strong branching, pseudocost branching, and their hybrids. We show that by exploiting dual degeneracy (thus, alternative optima) it is possible to enhance traditional methods.

3 - Inequality Merging in the Multiple Knapsack Polyhedron

Randal Hickman, Assistant Professor, United States Military Academy, 3428 Westbaker St., Manhattan, KS, 66503, United States of America, hickman97@earthlink.net, Todd Easton

Inequality merging constructs a new category of cutting planes for IP problems. The technique merges two or more valid inequalities into a single cutting plane. Theoretical results related to merging cover inequalities for the multiple knapsack (MK) polyhedron are presented. A computational study demonstrates an average decrease of about 9% in computational effort for some benchmark MK instances.

4 - The Multi-Point Separation Strategy as a Column Generation Stabilization Technique

Francois Vanderbeck, Prof, University of Bordeaux & INRIA, 351, Cours de la Libération, Talence, 33405, France, fv@math.u-bordeaux1.fr, Ruslan Sadykov, Eduardo Uchoa, Artur Pessoa

Column generation suffers from slow convergence. Algorithmic strategies have been designed to accelerate convergence of cutting plane algorithms in mixed integer programming. They have their counterpart in column generation. We show that the Multi-Point Separation" strategy translates into a column generation stabilization technique that consists in restricting the dual solution to be in the convex hull of the selected multi-point set.

■ WA51

Hilton- Sutter A

Operations/Quality Management

Contributed Session

Chair: Miri Gilenson, Technion - Israel Institute of Technology, Industrial Engineering and Management, Technion City, Haifa, 3200003, Israel, miray.g@gmail.com

1 - In-Situ Quality Control of High Concentration CNT Suspension and Multistage Buckypaper Manufacturing

Mingchia (Dawn) Yang, Florida State University/High Performance Material Institute, 2005 Levy Ave, Tallahassee, Fl, 32310, United States of America, myang@fsu.edu, Sida Luo, Richard Liang, Michael Moench, Brian Wiesner, Arda Vanli

A multistage quality monitoring approach is proposed to achieve reproducible and repeatable buckypaper manufacturing with the aid of UV-vis-NIR spectroscopy and Dynamic Light Scattering (DLS) techniques to quantify dispersion quality of high concentration CNT suspensions. Process variables in different stages are specified and studied through in-situ suspension characterization, design of experiments statistical modeling and process control techniques.

2 - Setting Quality Control Requirements to Balance Cycle Time and Yield

Miri Gilenson, Technion - Israel Institute of Technology, Industrial Engineering and Management, Technion City, Haifa, 3200003, Israel, miray.g@gmail.com, Michael Hassoun, Liron Yedidsion

The design of quality monitoring operations has direct impact on cycle time and yield. A major design factor of these operations is the control limits, traditionally set by yield requirements. To challenge this concept, we develop a bi-criteria trade-off formulation between yield and cycle time in a system monitored by inspection stations, where the control limits are decision variables. Our model enables decision makers to knowingly sacrifice yield to shorten cycle time and vice versa.

3 - The Supply Chain Construct Imbedded within the Malcolm Baldridge National Quality Award

Xianghui Peng, University of North Texas, 1155 Union Circle #311396, Denton, TX, 76203, United States of America, xianghui.peng@unt.edu, Victor Prybutok

In this research, we examine the conceptual framework of the Malcolm Baldridge National Quality Award (MBNQA) and the items associated with supply chain issues. This examination resulted in the positing of a restructured MBNQA model that includes and emphasizes the supply chain construct.

4 - Managing Service Delivery Contracts
Ray Strong, Research Staff Member, IBM, Almaden Research Center, 650 Harry Rd, San Jose, CA, 95120, United States of America, hrstrong@us.ibm.com

We describe how to convert the business process for worldwide delivery of long term service contracts into a comparative management technique using historical financial data.

■ WA52

Hilton- Sutter B

Optimization, Heuristic

Contributed Session

Chair: Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Information Workflow Optimization with Bandwidth Constraints
Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com, Hector Ortiz-Pena

Workflow management systems allow for visibility, control, and automation of some of the business processes. Recently, nonbusiness domains have taken an interest in the management of workflows. In this research we have developed a rigorous mathematical programming formulation of the information workflow optimization problem, incorporating bandwidth constraints. Multiple heuristics have been developed to solve this problem, and results will be presented.

2 - Heuristic Approach to Navigation Dredge Scheduling
Furkan Oztanriseven, University of Arkansas, BELL Engineering Center, Office #4207, Fayetteville, AR, 72701, United States of America, foztanri@uark.edu, Heather Nachtmann, Edward Pohl, Ridvan Gedik

Dredging operations are necessary to maintain the navigation channels within the U.S. maritime transportation system. Due to budget limitations, equipment availability, and environmental restricted periods, there is a need for system-level dredge project scheduling and vessel assignment. We present a simulated annealing-based heuristic approach to this problem.

3 - A Parallel Heuristic Solution to the Quadratic Assignment Problem
Clara Novoa, Associate Professor, Texas State University, 601 University Dr, San Marcos, TX, 78666, United States of America, cn17@txstate.edu, Apan Qasem, Abhilash Chaparala

We solve a Quadratic Assignment Problem by developing a parallel 2-opt heuristic that runs in the Graphical Processing Unit (GPU). We fine tune the thread block configuration and exploit inter-thread data locality through improved shared memory allocation. We experiment with 17 QAPLIB data sets. Our algorithm on average, outperforms an OpenMP implementation by a factor of 16.31. Algorithm accuracy is satisfactory. It is contrasted to a Tabu search GPU implementation performed by other authors.

4 - Unitload Warehouse Control: A Time Based Approach for Routing
Nadeepa Wickramage, Graduate Student, Clemson University, 110 Freeman Hall, Clemson, SC, 29631, United States of America, nwickra@g.clemson.edu, William Ferrell Jr.

Most unitload containers are capable of being stacked on each other. We explore the ability to improve the efficiency of storing and picking unit-load operations in a warehouse by stacking containers. A time-based approach is used to generate pick and store routes that minimizes total routing and handling time. For warehouses that have millions of trips per year, the multiplicative effect of small time saving in each trip can have a dramatic cumulative effect on the cost savings.

5 - Concurrent Generation of Feasible Integer Solutions using Random Walks
Utku Koc, Post Doctoral Fellow, Northwestern University, 2145 Sheridan Rd, Industrial Engineering and Mgmt Sciences, Evanston, IL, United States of America, utkukoc@northwestern.edu, Sanjay Mehrotra, Kuo-Ling Huang

We present an approach to parallelize generation of feasible solutions for mixed integer linear programs. The approach runs multiple feasibility pump instances concurrently, with different starting solutions generated by random walks, and allowing them to share information. Computational results suggest that the improvement resulting from parallelization is statistically significant. The heuristic starting from vertices generated by random walk points outperforms other heuristics tested.

■ WA53

Hilton- Taylor A

Finance, Financial Engineering 1

Contributed Session

Chair: Joongyeub Yeo, PhD Student, Institute for Computational and Mathematical Engineering, Stanford University, 88 Hulme Court, Apt 107, Stanford, CA, 94305, United States of America, yeo@stanford.edu

1 - Regime Change in Dynamic Correlation Matrices of Financial Data
Joongyeub Yeo, PhD Student, Institute for Computational and Mathematical Engineering, Stanford University, 88 Hulme Court, Apt 107, Stanford, CA, 94305, United States of America, yeo@stanford.edu

We propose a new computational method to estimate the correlation structure of high-dimensional financial data. We use free random variable techniques and minimize the spectral distance between the theoretical and empirical spectral density. The comparison between the estimated parameters and the mean-reversion time from an Ornstein-Uhlenbeck model give consistent results for regime changes in residuals. We discuss applications in algorithmic trading. Joint work with George Papanicolaou.

2 - Limit Order Books with Stochastic Market Depth
Ningyuan Chen, Columbia University, 321 S. W. Mudd Building, 500 W. 120th Street, NEW YORK, NY, 100275811, United States of America, nc2462@columbia.edu, Steven Kou, Chun Wang

We propose a model for limit order books with stochastic market depth, consistent with empirical studies. To show the analytical tractability of the model, in addition to a dynamic programming formulation of the optimal execution problem, we provide easily computable and tight upper and lower bounds for the optimal execution cost, as well as their resulting trading strategies via quadratic programming and jump-linear-quadratic control.

3 - Investment Decisions and Debt Priority Structure: Straight Debt and Convertible Debt
Kyoko Yagi, Akita Prefectural University, 84-4 Ebinokuchi, Tsuchiya, Honjo, Akita, 015-0055, Japan, yagi@akita-pu.ac.jp, Ryuta Takashima

In this paper we consider an investment problem of a firm with outstanding straight debt. The firm finances the investment cost with convertible debt. We explore the interaction between financing and investment decision. Furthermore, we discuss the effect of the debt priority structure on the agency cost of debt and the some consistencies of results in our theoretical model with empirical evidences.

4 - Perpetual Game Call Options with Jumps
Atsuo Suzuki, Meijo University, Nijigaoka 4-3-3, Kani, Gifu, Japan, atsuo@urban.meijo-u.ac.jp, Katsushige Sawaki

In this paper, we deal with perpetual game call options with jumps. Game option is a contact that the seller and the buyer have the rights to cancel and to exercise it at any time, respectively. We give the optimal boundaries for the seller and buyer and present the value function of perpetual game call option with jumps. The pricing of this option can be formulated as a coupled optimal stopping problem which is analyzed as Dynkin game.

5 - On the Impulse Control Problem with Outside Jumps
Makoto Goto, Hokkaido University, Kita 9, Nishi 7, Kita-ku, Sapporo, Japan, goto@econ.hokudai.ac.jp

In this paper, we study the impulse control problem with oudside jumps. As represented by (s,S) policies, impulse control problems usually have inside jumps. Namely, when the inventory level goes down and hits a threshold, it jumps up by the order placement. However, in terms of capacity choice problems, firms should install additional capacities when the demand is increasing. That is, the impulse control problem we consider has outside jumps, which is hard to solve through usual approaches.

■ WA54

Hilton- Taylor B

Behavioral Portfolio Selection and Asset Pricing

Sponsor: Financial Services Section

Sponsored Session

Chair: Xuedong He, Assistant Professor, Columbia University, 316 Mudd, 500 W. 120th street, New York, NY, 10027, United States of America, xh2140@columbia.edu

1 - Equilibrium Asset Pricing with Rational and Irrational Investors
Jing Guo, Columbia University, 500 W 122nd Street, Apt. 1E, New York, NY, 10027, United States of America, jg3222@columbia.edu, Xuedong He

We study multi-period asset pricing with rational and irrational investor. The rational investor maximizes log utility and the irrational has additional cumulative-prospect-theory utility. We prove the existence and uniqueness of equilibrium price. We derive a stock performance measure and show that irrational investor invests less if and only if his loss-aversion degree is higher than the measure. We show the market dominance of rational investor. We do numeric analysis for polynomial utility.

2 - A Processing-Consistent Non-Bayesian Inference Model
Di Xiao, Columbia University, United States of America, dx2125@columbia.edu, Xuedong He

We consider a generic dynamic inference model, which is a generalization of the Bayesian model by applying distortion on the prior density and replacing likelihood with quasi-likelihood. We show this model is processing consistent, i.e., the posterior density resulting from this model does not depend on how the samples are grouped and processed, if and only if there is no distortion on the prior density at any time except for the initial time and the quasi-likelihood satisfies a product rule.

3 - Sensitivity Analysis of Nonlinear Behavior with Distorted Probability
Xiangwei Wan, Assistant Professor, Shanghai Jiao Tong University, RM108, 4 Building, 535 Fahuazhen Road, Shanghai, 200052, China, xwwan@sjtu.edu.cn, Xi-Ren Cao

We propose a sensitivity-based analysis to study portfolio selection problem under non-expected utility with probability distortions. For the complete markets case, the first-order condition is derived and optimal wealth deduced. For the incomplete markets case, a dual characterization of optimal policies is provided; a solvable incomplete market example with unhedgeable interest rate risk is also presented.

4 - Self-control in Time Inconsistent Decision Making via Commitment by Punishment
Duan Li, Professor, The Chinese University of Hong Kong, Dept. of Syst. Eng. & Eng. Manag., Shatin, Hong Kong - PRC, dli@se.cuhk.edu.hk, Xiangyu Cui, Yun Shi

To cope with time inconsistent dynamic decision problems, we develop a planner-doer two-tier game model with self-control, where planner and doers represent different facets of the same decision maker at different time instants and the planner can manipulate the decisions of the doers through commitment by punishment. This strategy of self-control enables an optimal decision to attain a degree of coordination between inherently conflicting long- and short-term objectives.

■ WA55

Hilton- Van Ness

Industrial Applications of MINLP

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Claudia D'Ambrosio, CNRS & LIX, Ecole Polytechnique, Batiment A. Turing, Palaiseau CEDEX, 91128, France, dambrosio@lix.polytechnique.fr

1 - Short-term Hydro Scheduling and Unit Commitment with Head-Dependent Reservoirs
Raouia Taktak, LIX, Ecole Polytechnique, 91128 Palaiseau CEDEX, Palaiseau, France, taktak@lix.polytechnique.fr, Wim van Ackooij, Claudia D'Ambrosio, Claudio Gentile, Antonio Frangioni, Kostas Tavlaridis-Gyparakis

The problem we study consists in finding an optimal short-term scheduling of a multi-unit power stations in hydro valleys. The problem is extremely hard due to its strong non-linearity and its combinatorial constraints. Using an enhanced linearization technique, we model the problem as a MILP that takes into account the head effects on power production. We also devise an algorithm based on decomposition techniques and Lagrangian relaxation in order to solve real-world instances.

2 - Optimal Location of Smart Technologies within an Electrical Distribution Network
Sonia Toubaline, LIX - Ecole Polytechnique, 91128 Plaiseau Cedex, Palaiseau, France, s.toubaline@gmail.com, Pierre-Louis Poirion, Leo Liberti, Claudia D'Ambrosio

Reporting from the SO-grid project: we discuss a mixed-combinatorial optimization problem occurring in running smart grids, i.e. the optimal positioning of electrical equipment on a power distribution network, some algorithmic ideas, and preliminary computational results.

3 - A Robust Optimal Placement of Smart Technologies within an Electrical Distribution Network
Pierre-Louis Poirion, LIX - Polytechnique, LIX - UMR 7161 Ecole Polytechnique, 91128 Palaiseau, France, Pierre-Louis.Poirion@ensta-paristech.fr, Leo Liberti, Sonia Toubaline, Claudia D'Ambrosio

Reporting from the SO-grid project: we continue Dr. Toubaline's presentation by discussing aspects related to solution robustness for a localization problem in a power distribution network. We will present a mathematical model which takes into account uncertainties in the demand and production of electricity, and some algorithmic ideas to solve the problem.

■ WA56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Cogentus - Smart Decisions End-to-End Problem Solving
Ian Seed, Vice President, Cogentus LLC, Washington, DC, United States of America, iseed@cogentus.co.uk

The presentation will explain how Smart Decisions can benefit organizations by enhancing a systematic approach to problem solving. Each step in the framework and some of the tools available in the software will be demonstrated. Attendees will be able to see the value added of this end-to-end approach, how the software aids each step, how it can speed up the overall process dramatically without compromising quality and how it works in a collaborative environment.

■ WA57

Hilton- Golden Gate 1

Teaching Sustainability

Sponsor: INFORM-ED

Sponsored Session

Chair: Michael Racer, Assistant Professor, University of Memphis, 334 Fogelman, Memphis, Te, 38135, United States of America, mracer@memphis.edu

1 - Georgia Tech's Quality Enhancement Plan: Community, Sustainability, Service Learning
Beril Toktay, Professor, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, beril.toktay@scheller.gatech.edu, Ellen Zegura

As part of the 10-year reaffirmation of its accreditation, Georgia Tech has selected a Quality Enhancement Plan (QEP) for student learning that focuses on learning anchored in real-world sustainability problems and that emphasizes community engagement through service learning. This presentation will outline the high-level objectives and structure of the QEP.

2 - Useful Tools in Teaching Sustainability
Xu Yang, Assistant Professor, San Jose State University, Dept of Marketing and Decision Sciences, San Jose State University, San Jose, CA, United States of America, xu.yang@sjsu.edu

Topics can be included in the sustainability curricular need to be defined and discussed. Several tools were introduced in an undergraduate business logistics course (under the topic of sustainability). Examples include: EIO-LCA, "sourcemap", and EPA GHG Equivalencies Calculator. Students applied these tools in a course project and demonstrated the effectiveness of teaching/learning sustainability.

3 - Teaching Sustainable Operations to MBAs at Tepper
Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu

I will share some successes, failures, insights and lessons I have learned from teaching the MBA elective Sustainable Operations at Tepper.

4 - Integrating Sustainability Concepts within a Traditional Operations Management Course

Ravi Subramanian, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree NW, Atlanta, GA, 30318, United States of America, ravi.subramanian@scheller.gatech.edu

This presentation will discuss how sustainability and ethics issues have been integrated within the core MBA-level Operations Management course offered at the Scheller College of Business at Georgia Tech. This curriculum development was supported by the Rich Foundation.

■ WA58

Hilton- Golden Gate 2

Scheduling II

Contributed Session

Chair: Seyedehfarzaneh Nojabaei, PhD Candidate/Researcher, University of Toledo, 2255 University Hills Apt,# F206, Toledo, 43606, United States of America, farzanehn25@gmail.com

1 - Optimizing of Efficiency Supply Chain System via Development of Priority Oriented Scheduling Method

Seyedehfarzaneh Nojabaei, PhD Candidate/Researcher, University of Toledo, 2255 University Hills Apt,# F206, Toledo, 43606, United States of America, farzanehn25@gmail.com, Matthew Franchetti

Optimization of supply chain is becoming a pivotal aspect for each manufacturing system and scheduling plays a crucial role in sustaining it. The applicability of distributed computing to coordinate and execute jobs has been investigated in the past literature. Moreover, it is ostensible that even for sensitive industrial systems the only criterion of allocating jobs to appropriate machines is based on the FIFO policy. On the other flip, many researchers are of the opinion that the main reason behind failing to provide fairness in distributed systems is considering the only criterion of time stamp to judge upon and form the queue of jobs with the aim of allocating those jobs to the machines. In order to increase the efficiency of supply chain in industrial system, this paper takes into consideration of three criteria of each job including priority, time action and time stamp. The methodology adopted by this paper is definition of job scheduler and positioning jobs in temporary queue and sorting via developing bubble sort. In sorting algorithm criterion of priority, time action should be considered besides time stamp to recognize the tense jobs for processing earlier. To evaluate this algorithm first a numerical test case (simulation) is programmed and then the case study performing in order to optimize supply chain efficiency in real manufacturing system. Eventually the results of this study provided evidence on that the rate of supply chain efficiency is increased.

2 - Major Systems Acquisition Planning as a Resource-Constrained Project Scheduling Problem (RCPSP)

Roger Burk, Associate Professor, US Military Academy, Dept of Systems Engineering, West Point, NY, 10996, United States of America, Roger.Burk@usma.edu, Abram Gross

The US Army has been exploring how to formulate its long-range acquisition plan as a variation of the RCPSP and using a heuristic to quickly build schedules based on system priority. We show how this procedure can save both time and money, which making the long-range planning process quicker, more accurate, and easier.

3 - Job Shop Scheduling with Machine Breakdowns by using Risk Assessment

Shudong Sun, Professor, Northwestern Polytechnical University, No.127 West Youyi RD, Xi'an, 710072, China, sdsun@nwpu.edu.cn

The paper considers makespan and risk assessment simultaneously. Risk assessment is determined by the expected value of the difference between the deterministic and actual makespans. The probability models of the occurrence and degree of machine breakdowns are constructed. A risk assessment model of machine breakdowns is set up. A schedule with a better efficiency and robustness is finded. Simulation results shown that the proposed method has good performance and robustness.

4 - Single Machine Scheduling under Availability Constraints

Mohamed Labidi, Assistant Professor, King Saud University, King Abdallah Road, Riyadh, Saudi Arabia, mlabidi@ksu.edu.sa, Anis Gharbi, Mohamed Haouari

We investigate the one machine problem under availability constraints.It arises in the context of machine scheduling with planned preventive maintenance.A new lower bound based on the concept of semi-preempton is proposed (SPLB) and an exact algorithm that requires solving a sequence of one-machine problems without availability constraints is developed.Experiments show that the SPLB is very tight and that our algorithm consistently delivers optimal solution for big instances with short CPU times.

■ WA59

Hilton- Golden Gate 3

Inventory Management V

Contributed Session

Chair: Emre Berk, Professor, Bilkent University, Department of Management,, Bilkent University, Central Campus, Ankara, 06800, Turkey, eberk@bilkent.edu.tr

1 - Optimal Policies for a Dual-Sourcing Inventory Problem with Stochastic Leadtimes

Li Xiao, National University of Singapore, BIZ 2 Building,Basement B2-03, 1 Business Link, NUS Business School, singapore, Singapore, lixiao@nus.edu.sg, Hanqin Zhang, Paul Zipkin, Jing-Sheng Song

We consider a single-product dual-source system. The normal supply system consists of a two-stage tandem queue with finite capacity. However, we can expedite an order by skipping the first stage of the supply process with a fee. We characterize the optimal ordering policy that minimizes the discounted system cost.

2 - Leadtime Backordering in Multiechelon Systems: A Simulation Assessment

Emre Berk, Professor, Bilkent University, Department of Management,, Bilkent University, Central Campus, Ankara, 06800, Turkey, eberk@bilkent.edu.tr, Ozgur Toy

We study via simulation divergent two-echelon inventory systems in the presence of Poisson demands and lead time dependent backordering. Based on a large experimental set, we investigate the sensitivity of the policy parameters and system structures, impact of information content and its managerial implications, and dynamic assignment policies.

3 - Net Effect of Batching on the Expected on-hand Stock in (r,q) Policies with Fixed Service Level

Agustin Bompadre, SAP Labs, LLC, 1251 Waterfront Place, Third Floor, Pittsburgh, PA, 15222-4212, United States of America, abompadr@gmail.com

In Reorder-Point/Order-Quantity policies with fixed service level target, the effect of the batch size on the expected on-hand stock is twofold. On the one hand, it increases the on-hand stock by creating cycle stock. On the other hand, because of the presence of the cycle stock, there is less need of safety stock. We show that, under certain conditions, increasing the batch size never decreases the expected on-hand stock.

4 - Segmentation Methods for Large-Scale Service Parts Performance Based Logistics Systems

Alireza Sheikhzadeh, Graduate Student, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, 72701, United States of America, asheikhz@uark.edu, Manuel Rossetti

Performance based logistic (PBL) is a new generation of after-sale repair, maintenance and spare part provisioning contracts. The purpose of this research is to create, analyze new methods that can significantly improve the management of service parts systems within the context of performance based logistics. Innovative approaches that significantly reduce the size and complexity of problems through the use of inventory segmentation methods.

5 - Integrated Optimization of Safety Stock and Transportation Capacit

Horst Tempelmeier, Professor, University of Cologne, Albertus Magnus-Platz, Koeln, 50923, Germany, tempelmeier@wiso.uni-koeln.de, Oliver Bantel

We consider an inventory and a transportation system facing random demands. A given in-house transportation capacity can be extended by costly external transportation capacity. We show that stock-outs introduce volatility in the workload of the transportation system. Geunes and Zeng 2001 have shown for a base-stock system, that backordering decreases the variability of transportation orders. We show that in inventory systems with order cycles longer than one period the opposite is true.

■ WA60

Hilton- Golden Gate 4

Inventory Management IV

Contributed Session

Chair: Atri Mahapatra, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, mahap010@umn.edu

1 - A Hybrid Joint Replenishment Policy for A Stochastic Inventory System with Lost Sales

Ulku Gurler, Professor, Bilkent University, Department of Industrial Engineering,, Bilkent University, Central Campus, Ankara, 06800, Turkey, ulku@bilkent.edu.tr, Emre Berk, deniz yenigun

We consider a stochastic inventory problem with multiple products and negligible lead times under a hybrid periodic review joint replenishment policy, where the unsatisfied demand is lost. The proposed control policy classifies the items into two sets - a leader set and a follower set - and employs two separate control policies for each set conjunctively. We derive the operating characteristics and provide numerical results.

2 - Inventory Optimization for the U.S. Navy

Javier Salmeron, Associate Professor, Naval Postgraduate School, Operations Research Dept., Glasgow Hall, Monterey, CA, 93943, United States of America, jsalmero@nps.edu, Emily Craparo

We present a mixed-integer linear optimization model designed to guide wholesale inventory decisions for the Naval Supply Systems Command (NAVSUP), Weapons Systems Support. Optimal reorder points minimize deviations from target fill rates for tens of thousands of repairable and consumable items while modeling demand uncertainty and budget constraints. We solve the problem using Lagrangian relaxation and compare our results with those of other tools used by NAVSUP.

3 - A Risk-averse Inventory Model with Fluctuating Purchasing Costs

Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonseidae-gil, Wonju, 220-710, Korea, Republic of, sungyongchoi@gmail.com

I study a dynamic risk-averse inventory model using additive utility functions. I also assume Markovian behavior of purchasing costs. For finite-time models, I first prove (joint) concavity of the model for each state and obtain a (modified) base-stock optimal policy. Then, I conduct comparative static analysis for model parameters and derive monotone properties to the optimal solutions. For infinite-time models as a limiting case, I show that stationary base-stock optimal policies exist.

4 - Inventory Control for Spectrally Positive Levy Demand Processes

Kazutoshi Yamazaki, Associate Professor, Kansai University, Faculty of Engineering Science, 3-3-35 Yamate-cho, Suita, 606-8354, Japan, kyamazak@kansai-u.ac.jp

We revisit the single item continuous-time inventory model. In the same problem setting as in Bensoussan et al. (2005), we show the optimality of an (s,S)-policy for a general spectrally positive Levy demand process. Using the fluctuation theory of spectrally one-sided Levy processes, we express the value function analytically using the scale function. The case with no fixed ordering costs is also studied.

5 - Ordering Problem with Updated Demand Forecast and Quantity Constraints

Meimei Zheng, PhD Student, Nanyang Technological University, #0544, Jurong West Avenue 5, blk 19, Singapore, 649492, Singapore, meimeizheng2009@gmail.com, Kan Wu

When facing highly uncertain demand, a retailer can utilize an emergency order to enhance his responsiveness. However, the emergency ordering quantity is constrained due to the short lead time. This study analyzes a two-stage system with regular and emergency orders under demand forecast updating and quantity constraints. Through dynamic programming, the optimal ordering policy is obtained, and the properties of the optimal solutions are derived. Some insights are gained from numerical results.

■ WA61

Hilton- Golden Gate 5

Organization Theory 1

Contributed Session

Chair: Zhehui Xiao, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, China, zhehuixiao@gmail.com

1 - The Role of Entrepreneurial Leadership in New Ventures

Shenglan Huang, University of Science and Technology of China, School of Management, Hefei, 230026, China, Huangsl@mail.ustc.edu.cn

The literature has called for more research on entrepreneurial leadership. However, few studies has investigated entrepreneurial leadership in entrepreneurial context. This paper will explore the influence mechanisms of entreprenrial leadership on new venture performance.

2 - Cross-Functional Integration, Organizational Transactive Memory Systems and Performance

Diogo Cotta, PhD Candidate, IE Business School, Calle Maria de Molina, 12, bajo, PhD office, Madrid, 28005, Spain, dcotta.phd2015@student.ie.edu, Fabrizio Salvador

How do firms integrate organizationally dispersed knowledge? This research shows that firms facing high levels of cross-functional interdependence manifest the operation of distinct Transactive Memory Systems acting as integration devices in the execution of different organizational routines. However, contrary to what is posited by both TMS and integration literature, the research finds evidence that the concurrent deployment of several TMSs may have detrimental effects on performance.

3 - A Conceptual Framework of Talent Management in Virtual Organization

Muhammad Yasir, Assistant Professor, Hazara University Mansehra, Department of Management Sciences,, Hazara University Mansehra, Mansehra, 21300, Pakistan, Abdul Majid, Philip Johnson

In this paper we have developed a conceptual framework for talent management (TM) in virtual organization (VO) which explains that process of TM must be performed at three levels i.e. individual-level; organization-level; and extra-organization level for outsourced operations. We argue that VOs require special emphasis on the development of media and social talent to maintain effective communication and collaboration. We conclude that effective TM strategies could improve the performance of VOs.

■ WA62

Hilton- Plaza A

Applied Probability 1

Contributed Session

Chair: Harsha Honnappa, University of Southern California, 3740 McClintock Ave, Los Angeles, CA, 90089, United States of America, honnappa@usc.edu

1 - Assessing the Additional Information Obtained by an Ultrasound Following a Mammogram in BCS Problem

Sait Tunc, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, stunc@wisc.edu, Oguzhan Alagoz, Elizabeth Burnside

We construct an information-theoretic framework to assess the additional information obtained by an ultrasound following a mammogram in Breast Cancer Screening (BCS) problem to understand ultrasound recommendation. We provide a new information function, a modified version of Shannon's mutual information and determine the relation between this function and BCS performance measures like false positive rate with the assumption that screening decisions are described by a linear regression function.

2 - Generalized Empirical Process Limits

Harsha Honnappa, University of Southern California, 3740 McClintock Ave, Los Angeles, CA, 90089, United States of America, honnappa@usc.edu

We develop generalizations of the well known Glivenko-Cantelli and Donsker's Theorems in empirical process theory, where in samples are non-i.i.d. By using the notion of a random distribution function (Dubins and Freedman 1963), we provide constructive proofs of the limit theorems. These results have interesting implications for mean field theory in games and queues, that we discuss in detail.

3 - Optimal Maintenance Policy for the Repairable System under Warranty

Minjae Park, Hongik University, 72-1 Sangsu-dong Mapo-gu, Seoul, Korea, Republic of, mjpark@hongik.ac.kr, Ki Mun Jung, Dong Ho Park

The effects of renewable free-replacement warranty are investigated on the classical age replacement policy for a repairable product with an increasing failure rate. The expected cost rates are developed for two cases: when the preventive replacement age occurs before or after the warranty expires. The optimal replacement ages that minimized the cost rates are determined and the impact of a warranty on the optimal replacement age is illustrated with a numerical example.

4 - A General Intuitive Design Pattern for Optimally Sequencing Treatment Combinations in 2^k DOE

H,-S. Jacob Tsao, Professor, San Jose State University, 1 Washington Square, Industrial & Systems Engineering Dept., San Jose, CA, 95192-0085, United States of America, jacob.tsao@sjsu.edu, Minnie Patel

Parameter count of a 2^k experiment grows exponentially. Conventional methods seek a fractional/partial design that best fits the problem. Necessary number of treatment combinations (TCs) for estimability of significant parameters is often exceeded; confounding often results. Given a parameter sequence in decreasing significance, we propose a general design pattern to produce a corresponding sequence of TCs for estimability of significant parameters with least TCs and without confounding.

5 - Evaluating the Performance of Various Control Charts for Short Production Runs

Ioannis Nikolaidis, Assistant Professor, University of Macedonia, Applied Informatics Department, Egnatia 156, Thessaloniki, 54636, Greece, nikolai@uom.gr, Mingyuan Chen

In aerospace manufacturing the application of SPC tools is challenging because usually these processes produce large size items with slow production rates. Consequently there cannot be the Phase I period when control chart parameters are estimated. In this paper several types of control charts for self-starting production runs are evaluated using simulation, such as simple, CUSUM and EWMA X and Q charts, with various control limit and parameter (e.g. K for CUSUM, ? for EWMA etc.) values.

■ WA63

Hilton- Plaza B

Dynamic Programming/ Control 1

Contributed Session

Chair: Marek Petrik, IBM, 1101 Kitchawan Rd, Yorktown, NY, United States of America, mpetrik@us.ibm.com

1 - Dynamic Information Acquisition for Emissions Control

Viet Anh Nguyen, Ecole Polytechnique Federale de Lausanne, EPFL CDM MTEI OES, Odyssea, Station 5, Lausanne, 1015, Switzerland, viet-anh.nguyen@epfl.ch, Thomas Weber

To implement emissions-reduction targets, regulators can impose state-contingent taxes. At each time period, policy makers obtain a current estimate of the pollution state and decide whether to acquire costly information of a chosen precision. We show that information collection is optimal whenever the current state-variance estimate is above a threshold and provide analytical results for the value function. We also provide optimality conditions when information collection involves fixed cost.

2 - Approximate Dynamic Programming for Lateral Transshipment Problem in Multilocation Inventory Systems

Olga Rusyaeva, Kuehne Logistics University, Grofler Grasbrook 17, Hamburg, Germany, olga.rusyaeva@the-klu.org, Joern Meissner

To fix the mismatch between actual customer demand and the available stock in multiple locations, companies often turn to lateral transshipments. We introduce a transshipment policy that answers questions ñ when, how much, and from which location to transship in advance to maximize the revenue of the network and to avoid stock outs. For high-dimensional instances, we develop a heuristic that constructs a concave piecewise-linear approximation and updates it using stochastic sample gradients.

3 - Using ANN in Approximate Dynamic Programming for Controlling Complex Production Systems

Han Wu, Student, University of Louisville, 2301 S 3rd St, Louisville, KY, 40294, United States of America, h0wu0009@louisville.edu, Gerald Evans

Development of efficient production and inventory control policies for complex and dynamic production systems is very difficult. The uncertain demands and large changeover times at the work stations cause significant problems. In this research, an Artificial Neural Network (ANN) model is embedded in approximate dynamic programming algorithm to approximate the state value of the system and look for a better production and inventory control policy for a dishwasher wire rack production system.

4 - New Cuts for Unbounded Knapsack Problem with Dynamic Programming

Xueqi He, University of Florida, 3800 SW 34th St, Apt. P138, Gainesville, FL, 32608, United States of America, xueqihe@gmail.com

We present a new cut-and-branch approach for solving the unbounded knapsack problem, where valid inequalities are generated for an integer programming formulation based on intermediate solutions of an equivalent dynamic programming formulation. These inequalities provide more accurate description for the feasible region defined in the equivalent integer programming formulation, and therefore improve the computational efficiency.

5 - Approximate Dynamic Programming by Robust Markov Decision Processes

Marek Petrik, IBM, 1101 Kitchawan Rd, Yorktown, NY, United States of America, mpetrik@us.ibm.com

State aggregation is one of the simplest forms of value function approximation for solving large Markov decision processes (MDPs). A major improvement in approximation error bounds can be achieved if aggregation weights are based on the limiting state occupancy distribution. However the the state occupancy distribution is not known apriori. In this paper, we show that the same error bounds can be achieved when robust Markov decision processes are used for the approximation.

■ WA64

Parc- Cyril Magnin I

Flexibility, Inventory and Resource Pooling

Sponsor: Applied Probability Society

Sponsored Session

Chair: Yehua Wei, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yehua.wei@duke.edu

1 - Retailing with Opaque Products

Adam Elmachtoub, Ph.D. Candidate, MIT, 77 Mass. Ave., Cambridge, MA, 02139, United States of America, adamelmachtoub@gmail.com, Yehua Wei

A product is said to be opaque when the customer only knows what they have purchased after the transaction is complete. Opaque products have been used in the hotel industry where customers purchase rooms without knowing the brand name. Here we propose the use of opaque products in the retail industry, where there are nonperishable goods and supply chain costs. We show that a small amount of opaque selling can achieve significant ordering and holding costs savings for the supply chain.

2 - Optimal Sparse Designs for Process Flexibility via Probabilistic Expanders

Yuan Zhou, Carnegie mellon University, 5840 Alderson Street, Apt 1, Pittsburgh, PA, 15217, United States of America, yuanzhou@cs.cmu.edu, Xi Chen, Jiawei Zhang

We study the problem of designing a sparse flexible process structure in a balanced and symmetrical production system to match supply with random demand more effectively. By introducing a new concept called probabilistic graph expanders, we provide an optimal design, i.e., the sparsest design, to achieve (1-eps)-optimality relative to the fully flexible system, improving the previous result by Chou et al. We also show the analysis for chaining systems by Wang and Zhang is asymptotically tight.

3 - Optimality Gap of Constant-order Policies Decays Exponentially in the Leadtime for Lost Sales Models

Linwei Xin, PhD Student, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, lwxin@gatech.edu, David A. Goldberg

Recently, Goldberg et al. (2012) laid the foundations for a new approach to solving lost sales inventory models with lead times, by proving as the lead time grows large, a simple constant-order policy is asymptotically optimal. However, the bounds proven there are impractical. In this work, we prove that the optimality gap of the same constant-order policy actually converges exponentially fast to zero. We also derive explicit bounds which make the result practical for realistic lead time values.

4 - Inventory Allocation: Analysis of Myopic Policies under Sparse Preferences

Arash Asadpour, NYU Stern, New York, NY, United States of America, aasadpou@stern.nyu.edu, Jiawei Zhang, Xuan Wang

We study the effect of consumer substitution behavior on the performance of inventory policies. In particular, we investigate the number of stock-outs under a simple myopic offline policy. We show that even with sparse, local, and deterministic customers' preferences, the total number of stock-outs only depends on the number of variants in the choice model — and not the size of the market. We will provide experimental results that suggest a similar effect under myopic online policies.

■ WA65

Parc- Cyril Magnin II

Learning in Stochastic Systems

Sponsor: Applied Probability Society

Sponsored Session

Chair: John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - Designing Selling Mechanisms to Learn and Earn

Bora Keskin, The University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, bora.keskin@chicagobooth.edu, John Birge

We consider a dynamic mechanism design problem in which a firm sells multiple products to a population of potential customers that are heterogeneous in terms of their price-sensitivity. We show how the firm should design a selling mechanism that can dynamically identify customers' price-sensitivities, and accumulate revenues in the optimal way.

2 - Learning by Competing: Dynamic Duopoly Pricing with Unknown Linear Demands

Matthew Stern, University of Chicago - Booth School of Business, 5807 S Woodlawn Ave, Chicago, 60637, United States of America, stern@chicagobooth.edu, John Birge

We consider the problem of dynamic pricing under uncertainty while competing against a rival product. Observing the prices in each period, as well as their own private demand realizations, firms compete for profits while learning the parameters of their linear demand curves. We examine pricing policies that balance the tradeoffs between actively learning the demand parameters, pricing to optimize current period rewards and favorably influencing the rival firm's future prices.

3 - Demand Model Estimation for a Competitive Airline Market

Xinchang Wang, Georgia Institute of Technology, School of Industrial and Systems Enginee, Atlanta, GA, 30332-0205, United States of America, xwang336@gatech.edu, Anton Kleywegt

We describe various models of customer booking choices in a competitive airline market, and the estimation of the models with available data. The models are designed to capture several important aspects, such as customer sensitivity to price and change refund, and unobserved heterogeneous customer preferences for different departure times. We also compare the revenues obtained using the choice models in optimization problems with the actual revenue.

4 - A Leader-Follower Partially Observed Markov Game: Value of Information

Yanling Chang, Georgia Institute of Technology, North Avenue, Atlanta, GA, 30324, United States of America, changyanling@gatech.edu, Alan Erera, Chelsea White

We consider a partially observed Markov game involving two agents: a leader and a follower. The follower selects its policy knowing the leader's policy. Each agent inaccurately observes the other's state at each epoch. We investigate how the leader's criterion value changes due to changes in the leader's quality of observation of the follower.

5 - Fast Demand Learning for Ad Allocation

Vivek Farias, MIT, 100 Main Street, E62-566, Cambridge, MA, 02139, United States of America, vivekf@mit.edu, Dragos Florin Ciocan

This talk is motivated by Ad-Display type network RM problems, where each impression (demand) type is a vector in a high-dimensional user feature space. We show that such demand spaces can still be estimated efficiently with a sample complexity scaling polynomially in the feature dimension. We use importance sampling to construct a demand estimator that informs a simple near-optimal bid-price allocation policy.

■ WA66

Parc- Cyril Magnin III

Journal of Quality Technology Invited Session

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Bradley Jones, SAS/JMP, Bradley.Jones@jmp.com

1 - Some Current Directions in the Theory and Application of Statistical Process Monitoring

William Woodall, Virginia Tech, Blacksburg, VA, United States of America, bwoodall@vt.edu, Douglas Montgomery

The purpose of this talk is to provide an overview of recent research and applications of statistical process monitoring. The focus is on work done over the past decade or so. We review briefly a number of important areas and offer some ideas for further research.

2 - Bayesian Binomial Assurance Tests for System Reliability using Component Data

Brian Weaver, theguz@lanl.gov, H. F. Martz, Alyson Wilson, Randy Griffiths, Michael Hamada

This talk illustrates the development of Bayesian assurance test plans for system reliability assuming that binomial data will be collected on the system and that previous information is available from component testing. The posterior consumer's and producer's risks are used as the criteria for developing the test plan. Using the previous component information reduces the number of tests needed to achieve the same levels of risk. The proposed methodology is illustrated with examples.

■ WA67

Parc- Balboa

Gaussian Process and Spatial Data Analysis (I)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Chia-Jung Chang, Assistant Professor, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16802, United States of America, cchang@psu.edu

Co-Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, kbwang@tsinghua.edu.cn

1 - Manifold Learning and Visualization of Variation Sources in Dimensional Metrology Data

Daniel Apley, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, apley@northwestern.edu, Zhenyu Shi, George Runger

Spatially dense dimensional metrology data (e.g., laser or machine vision) is prevalent in manufacturing quality control. Although fitting parametric features like circles and planes to individual parts is common, there has been little prior research on how to utilize the data to discover the nature of part-to-part variation patterns that are more nuanced than simple, premodeled parametric patterns. We propose the use of manifold learning techniques to extract and visualize such information.

2 - Control Charts for Spatial Data

Scott Grimshaw, Professor, Brigham Young University, Statistics Department, Provo, UT, 84602, United States of America, grimshaw@byu.edu

New technology provides the opportunity to obtain multiple measurements at different locations on the same unit. While the hope is that control charts using more measurements will be more sensitive to detecting flaws in local regions, the intuition is that measurements close together will be correlated. Multivariate SPC is extended to spatial data by modeling the covariance matrix with a semivariogram. The spatial control chart is illustrated with an application from bottle manufacturing.

3 - Approximating and Calibrating a Computer Model with Non-Gaussian Spatial Output

Murali Haran, Associate Professor, Statistics, 326 Thomas Building, University Park, PA, 16802, United States of America, mharan@stat.psu.edu, Won Chang, Patrick Applegate, Klaus Keller

Predicting the future behavior of the Greenland ice sheet is a difficult problem that involves combining output from a Greenland ice sheet model with observational data regarding the past and present state of the ice sheet. Emulation and calibration for the ice sheet model is challenging due to the nature and size of the spatial data and model output. I will describe a computationally expedient Gaussian process-based approach to address these challenges.

4 - Unaligned Profile Monitoring with Fused LASSO

Yangyang Zang, PhD Student, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, zangyy12@mails.tsinghua.edu.cn

It's common that the means of a profile change or shift from a change point. Under this practical assumption, we proposed a monitoring profiles method with the equal lengths. The profiles are firstly aligned by using the adaptive DTW. And then monitoring the GLRT statistic to the aligned curve, in which, the process mean is estimated by the fused LASSO algorithm. Both the simulation studies and a real example are used to demonstrate the effectiveness of the proposed monitoring procedure.

■ WA68

Parc- Davidson

Recent Advances in Stochastic Simulation

Sponsor: Simulation

Sponsored Session

Chair: Henry Lam, Boston University, 111 Cummington Mall, Boston, United States of America, khlam@bu.edu

1 - Ordinal Optimization and Pure Exploration Multi-armed Bandit Methods

Sandeep Juneja, Professor, Tata Institute of Fundamental Research, HB Road, Colaba, Mumbai, 400005, India, juneja@tifr.res.in, Peter Glynn

Consider finding a design amongst many with largest mean when means are unknown but design samples can be simulated. Typically, by selecting design with largest sample mean, false selection probability Pf decays exponentially. Lately researchers have sought algorithms to get guarantees on Pf by estimating its large dev rate function. We argue that such guarantees are misleading. We adapt methods from multi-armed bandit literature to devise algorithms with exponential decay guarantees on Pf.

2 - Rare-event Simulation for Stochastic Korteweg-de Vries (KdV) Equation

Jingchen Liu, Columbia University, 1255 Amsterdam Ave, Room 1030, New York, NY, 10027, United States of America, jcliu@stat.columbia.edu, Gongjun Xu

We consider the dynamics of a soliton wave that is described by the stochastic Korteweg-de Vries Equation with homogeneous Dirichlet boundary conditions under a stochastic time-dependent force. The random force is modeled as a time-dependent Gaussian noise. The asymptotic approximation and an efficient rare-event simulation algorithm of the probabilities that the soliton wave exceeds a high-level is derived.

3 - Epsilon-Strong Simulation for Multidimensional SDEs via Rough Path Analysis

Jing Dong, Northwestern University, 2145 Sheridan Road, Evanston, 60208, United States of America, jdong028@gmail.com, Jose Blanchet, Xinyun Chen

Under standard regularity conditions for SDEs, we construct a probability space, supporting both the SDE and a piecewise constant, fully simulatable process which is within epsilon bound from the SDE with probability one. Our construction requires a detailed study of continuity estimates of the Ito map using Lyon's theory of Rough Paths. We approximate the underlying Brownian motion, jointly with the Levy areas with a deterministic error in the corresponding rough path metric.

4 - Sampling Rare Events of Random Walks with Regularly Varying Increments: A Dichotomy

Guido Lagos, Georgia Institute of Technolgy, 755 Ferst Drive NW Room 326, Atlanta, GA, 30332-0205, United States of America, glagos@gatech.edu, Ton Dieker

We consider the problem of sampling paths up to the maximum of a random walk and study the case where the step-sizes are regularly varying with parameter alpha. The threshold alpha=3/2 appears in several papers that develop the framework of Blanchet and Glynn (2008), and we reveal how it is connected to a sharp dichotomy related to the boundedness of the likelihood ratio. Our work has implications for Acceptance-Rejection type algorithms for sampling heavy-tailed random walks.

■ WA69

Parc- Fillmore

OR for the Developing World

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Carlos Abad, IEOR, Columbia University, 321 S. W. Mudd Building, 500 W 120th St, New York, NY, 10027, United States of America, ca2446@columbia.edu

1 - Macro-level Hybrid Energy Planning Model with Pumped Hydro Storage – India Case Study

A. Selin Kocaman, askocaman@gmail.com, Tim Huh, Vijay Modi

Fast depleting fossils fuels and their environmental hazards increase the importance of renewable sources for sustainable energy planning. However, renewable energy sources are intermittent and heavily dependent on spatial location. Here, we address the problem of modeling hydro and solar energy production and allocation, including pumped hydro storage. We examine the role of solar energy and high hydropower potential in Himalaya Mountains in meeting the growing electricity demand of India.

2 - Two-Stage Stochastic Model for Optimal Operation of Combined Wind-Pumped Storage System in Kenya

Maureen Murage, Graduate Student, Cornell University, 319 Riley Robb, Ithaca, United States of America, mwm88@cornell.edu, Gabriela Martinez, C. Lindsay Anderson

Wind power in Kenya will contribute approximately 17% of the total installed electricity capacity once the Lake Turkana Wind Power (LTWP) project is completed. High wind penetration may lead to curtailment of wind power, especially during surplus periods. Pairing of the wind farm with storage could mitigate this problem, and provide enhanced reliability. We therefore propose a two-stage stochastic model for the optimal operation of the LTWP coupled with pumped hydro storage system.

3 - Dynamic Power Allocation in Solar Micro-grids

Carlos Abad, IEOR, Columbia University, 321 S. W. Mudd Building, 500 W 120th St, New York, NY, 10027, United States of America, ca2446@columbia.edu, Garud Iyengar, Vijay Modi

Solar micro-grids are currently being deployed in Sub-Saharan Africa. These micro-grids service 10-20 customers, have a storage backup, and use very simple control algorithms. Customers are assigned constant power limits and daily energy limits and, whenever their consumption exceeds these values, they are shut off. The algorithm we propose dynamically sets the limits in order to maximize the profit of the operator while maintaining system reliability.

■ WA70

Parc- Hearst

Economics

Contributed Session

Chair: Indranil Chakraborty, Professor, National University of Singapore, Department of Economics, 1 Arts Link, AS2 #06-02, Singapore, 117570, Singapore, indro@nus.edu.sg

1 - Screening in Auctions with Risk Averse Bidders

Indranil Chakraborty, Professor, National University of Singapore, Department of Economics, 1 Arts Link, AS2 #06-02, Singapore, 117570, Singapore, indro@nus.edu.sg

Revenue-optimal IPV-auctions involve screen bidders via equivalent tools of reserve and bidding fee. This is inefficient. Not screening becomes optimal if the seller can charge an ex ante entry fee before bidders become privately informed. We show that when bidders are risk averse it is optimal for the seller to screen even if she can charge ex ante fee. Reserve price and bidding fees are also not equivalent for screening and which is better varies under first- and second-price rules.

2 - Sentiments, Systemic Risk and Financial Stability

Diego Feijer, Massachusetts Institute of Technology, 32 Vassar St. D758, Cambridge, MA, 02139, United States of America, feijer@mit.edu, Munther Dahleh

We study welfare of competitive equilibria in an economy with banks runs and costly fire sales, formalizing the importance of ''animal spirits" for financial stability. Feedback between financial constraints and market prices results in a systemic externality not internalized by banks in the process of private money creation. Macroprudential policies that acommodate to fluctuations in market confidence can restore constrained efficiency.

3 - Optimal Government Debt Management: Currency Portfolio and Payments

Ricardo Huaman-Aguilar, PhD Student, University of Alberta, 632 Central Academic Building, Edmonton, AB, T6G 2G1, Canada, huamnagu@ualberta.ca, Abel Cadenillas

We develop a theoretical model for optimal currency government debt portfolio and debt payments, which allows both jumps in the exchange rates and aversion of the government to debt. We derive first a stochastic differential equation for public debt, and then solve explicitly the optimal currency debt problem. This is the first theoretical model that provides a rigorous explanation of why developing countries have reduced consistently their proportion of foreign debt in their portfolios.

■ WA71

Parc - Lombard

Ad Auctions

Cluster: Auctions

Invited Session

Chair: Eric Sodomka, Facebook, 1601 Willow Rd, Menlo Park, Ca, 94025, United States of America, eric.sodomka@gmail.com

1 - Partner-Tiering in Display Ads

Anand Bhalgat, bhalgat@fb.com

In display ads delivery system, the ad allocation engine assigns ads to satisfy contracts between advertisers and publishers, at the same time, try to maximize the overall quality of assignment. The classical online-matching model of this problem misses an important aspect that a set of varying quality of publishers are presented by middle-man, and advertsiers prefer these publishers differently. We formulate this problem as a hierarchical online matching problem and study its properties.

2 - Lessons from Agent Design for the Online Advertising Trading Agent Competitions

Elizabeth Hilliard, Brown University, Providence, RI, United States of America, betsy@cs.brown.edu

We present algorithms and analysis of bidding strategies for the two Trading Agent Competitions which simulate the two predominate methods of auctioning online advertisement impressions, keyword auctions and ad exchange bidding. Focusing on the optimization step of agent design for these two scenarios, we show how these problems can be modeled as a knapsack problem and weighted matching problem and then analyze the performance of classic and modified algorithmic solutions to these problems.

3 - Approximate Revenue Maximization in Interdependent Value Settings

Hu Fu, Microsoft Research, Cambridge, MA, United States of America, hufu@microsoft.com

We study revenue maximization in settings where agents' values are interdependent: each agent receives a signal drawn from a correlated distribution and agents' values are functions of all of the signals. We introduce a variant of the generalized VCG auction with reserve prices and random admission, and show that this auction gives a constant approximation to the optimal expected revenue in matroid environments.

4 - Advertising in a Stream

Samuel Ieong, Stanford University, Stanford, CA, United States of America, sieong@cs.stanford.edu

We formulate an optimization problem that captures how to place ads in a streaming setting, such as a news feed. We give an approximation algorithm that provably achieves a value close to the optimal, and show how this algorithm can be turned into an incentive compatible mechanism. We also give a simple practical algorithm that makes the allocation decisions in an online fashion. We prove this algorithm to be approximately welfare-maximizing and show that it also has good incentive properties.

■ WA72

Parc- Stockton

Energy V

Contributed Session

Chair: Alcides Santander-Mercado, Universidad del Norte, Km 5 Via Pto. Colombia, 8-44 K, Barranquilla, Colombia, asantand@uninorte.edu.co

1 - Bundle Methods for Convex Hull Pricing in Energy Markets

Yu Zhang, University of Minnesota, 117 Pleasant St, SE, Room 450, Minneapolis, MN, 55455, United States of America, zhan1220@umn.edu, Georgios Giannakis

Leveraging dual variables associated with the supply-demand constraints of unit commitment problems, convex hull pricing (CHP) minimizes uplift payments. A dual decomposition based distributed approach is formulated for CHP with large-scale demand response in day-ahead energy markets. A convergence-guaranteed bundle method is also developed for solving the dual problem. Numerical results corroborate the improved convergence of the novel approach which results in reduced communication overhead.

2 - A Multiobjective Program with Equilibrium Constraints to Determine Volume Requirements for the RFS

Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N Charles St, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu, Adam Christensen

The Renewable Fuel Standard (RFS) ensures that a minimum volume of renewable fuel is included in transportation fuel sold in the United States. Determining the RFS volume requirements involves anticipating market reaction as well as balancing policy objectives. We present a multiobjective program with equilibrium constraints to model the biofuels market, with the upper-level giving policy choices of volume obligations for the RFS.

3 - Distributed Coordination of DERs in Imperfect Information Regimes

Hesamoddin Ahmadi, Student, Penn State University, 107 Holderman Hall, University Park, PA, 16802, United States of America, hza108@psu.edu

We investigated the distributed management of distributed energy resources (DERs) in settings when cost functions or demand are unavailable but may be learnt by a distinct learning process. We develop distributed joint first order schemes in which optimization and learning is coupled. Preliminary numerics suggest the schemes perform well.

4 - Integration of Clean Energy Sources into a Power Grid using Optimal Control Theory

Maryam Parsa, PhD Student, Purdue University, 550 Stadium Mall Dr., West Lafayette, IN, 47907, United States of America, mparsa@purdue.edu, Nasir Uddin Ahmed, Mustapha C.E. Yagoub, Srinivas Peeta

Pontryagin Minimum Principle of Optimal Control Theory is utilized to find the optimum strategy for integration of all currently available renewable energy sources into a power grid. The ultimate goal is to eliminate production from fossil fuels while minimizing the implementation costs. Dynamic Lotka-Volterra model represents the level of power generation from each energy source at any time. Official released data from the U.S. Energy Information Administration is used as a case study.

5 - A Bat-inspired Algorithm for the Solution of a Location and Sizing of Distributed Generation Units

Alcides Santander-Mercado, Universidad del Norte, Km 5 Via Pto. Colombia, 8-44 K, Barranquilla, Colombia, asantand@uninorte.edu.co, John Candelo, Helman Hern·ndez

Location of distributed generation units for renewable energy has important technical and economic benefits for the performance of energy distribution systems. This research presents the development of a bat-inspired algorithm (BA) for the solution of a multiobjective problem, considering location and sizing, of distributed generation units for renewable energy and capacitors. The results show that BA obtains good solutions regarding the minimization of power loss as well as generation cost.

■ WA73

Parc- Mission I

Models and Algorithms for Renewable Energy Integration

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Neng Fan, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, nfan@email.arizona.edu

1 - Production-Inventory Planning with Integration of Onsite and Grid Renewable Energy

Mehdi Golari, Graduate Research Assistant, University of Arizona, Systems and Industrial Engineering Department, Tucson, AZ, 85719, United States of America, golari@email.arizona.edu, Tongdan Jin, Neng Fan

Recently a growing number of companies see low-carbon manufacturing as a new competitive edge in the global market and directly invest in onsite wind and solar technologies for powering their energy-intensive facilities. In this talk, we present a multistage stochastic optimization model to guide the manufacturers how to design and operate the production system under intermittent power as well as an efficient decomposition algorithm to tackle this problem.

2 - Limited Corrective Actions for the Security-constrained Optimal Power Flow Problem

Dzung Phan, Reseach Staff Member, IBM Research, 1101 Kitchawan Rd, Yorktown Heights, NY, 10598, United States of America, phandu@us.ibm.com, Andy Sun

We present a new model for the corrective security-constrained optimal power flow problem. The main purpose of our study is to reduce the number of corrective actions and run time by using sparse optimization techniques and an efficient decomposition algorithm.

3 - Two-Stage Robust Unit Commitment Considering Fast Generators
Bokan Chen, Iowa State University, 203 Campus Ave, Unit 4, Ames, IA, 50014, United States of America, bokanc@iastate.edu, Lizhi Wang

Robust optimization is a popular method for stochastic power system operation problems. In this project, we take fast-responding generators into consideration and present a new two-stage robust unit commitment model. The resulting trilevel optimization problem is decomposed into a master problem and a bilevel subproblem. To solve the bilevel mixed-integer subproblem, we also developed a new branch and cut algorithm, which is among the first algorithms to solve such problems.

4 - A Decision Dependent Power Generation Expansion Model with Wind Power
Yiduo Zhan, University of Central Florida, 4000 Central Florida Blvd, P.O. BOX 162993, Orlando, FL, 32816, United States of America, yzhan@knights.ucf.edu, Jianhui Wang, Qipeng Zheng

Decision dependent stochastic model has played an important role on expansion planning for wind power generation dealing with future uncertainty. Here we present a discrete choice model with non-fixed stochastic probability in the multi-stage stochastic model to provide decision dependent information to the decision makers.

■ WA74

Parc- Mission II

Advanced Algorithms for Power System Operations

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Anna Danandeh, University of South Florida, 4202 E Fowler Ave, Tampa, FL, United States of America, annadanandeh@mail.usf.edu

1 - Optimal Distributed Control of Power Systems
Ghazal Fazelnia, Columbia University, 120th St, New York, NY, 10027, United States of America, ghazal.fazelnia@gmail.com, Ramtin Madani, Abdulrahman Kalbat, Javad Lavaei

This talk studies the optimal distributed control of power systems. Since future power networks will have a large number of controllable distributed devices, the objective is to design an optimal distributed control to guarantee some global performance. We show that there is an effective convex relaxation for this NP-hard problem. The efficacy of our method will be demonstrated in several examples, including the frequency control of the New England system and optimal penetration of renewables.

2 - Coordinated Scheduling of Electric Vehicle Fleets and Wind Generation in Power Systems
Mohammad Khodayar, Assistant Professor, Southern Methodist University, 62, Dallas, TX, 75205, United States of America, mkhodayar@smu.edu

The increase in penetration level of variable wind energy resources affects the hourly schedule of thermal power generation in electricity markets and brings significant challenges in power system operation and control. The proposed approach for the coordinated operation of wind generation and charging/discharging scheduling of plug-in electric vehicle fleets mitigates the variability of the wind energy, decreases the operation cost, and reduces the spinning reserve capacity in power grids.

3 - Improved Formulations for the Unit Commitment Problem
Semih Atakan, PhD Student, University of Southern California, University Park Campus, Los Angeles, CA, 90089, United States of America, atakan@usc.edu, Guglielmo Lulli, Suvrajeet Sen

In this talk, we propose alternative formulations to the Unit Commitment problem that lead to significant time savings, when compared to the state-of-the-art formulations in the literature. We emphasize that these savings carry great potential for efficiently solving more sophisticated models, such as the ones that consider uncertainty in the problem parameters.

4 - Concentric Relaxations and Transmission Switching
Mike Hare, University of Tennessee, 525K John D. Tickle Building, 851 Neyland Drive, Knoxville, Tn, 37996, United States of America, mhare1@utk.edu, Jim Ostrowski, Jianhui Wang

Transmission switching (TS) alters the structure of an electrical network to reroute flow. For a large network, the problem becomes computationally difficult. To combat this problem, we use the fact that switching a line typically only affects the local neighborhood of that line. We use TS in the relaxation neighborhood to reduce the number of switched lines. This will render a problem that is more computationally tractable.

■ WA75

Parc- Mission III

Reliability III

Contributed Session

Chair: David Han, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, david.han@utsa.edu

1 - Multi-objective Optimization of Degrading System Considering System Reliability and Redundancy Cost
Sanling Song, PhD Candidate, Rutgers University, 707B, Donaldson St, Highland Park, NJ, 08904, United States of America, sanling@eden.rutgers.edu, David Coit, Qing Li

In this research, we propose a method to optimization system maintenance cost as well as performance by determine the number of standby units for subsystem/component.We develop an integer programming model to maintain high and up-to-date system reliability while saving system maintenance cost, and the model also uses the number of standby for each component as decision variables. The developed techniques are illustrated by numerical examples of a multi-component degrading system.

2 - A Capacity and Travel Time Reliability Analysis on Transportation Networks for Emergency Operations
Ayberk Kocatepe, Doctorate Student, Florida State University Civil Engineering Department, Florida State University, 2525 Pottsdamer St, Tallahassee, FL, 32310, United States of America, ak13y@my.fsu.edu, Eren Ozguven, Arda Vanli

This research presents a network capacity and travel time reliability analysis on transportation networks in the aftermath of a disaster focusing on the stochastic conditions where some or all links of a roadway network cannot be fully utilized due to extreme events such as flooding or hurricanes.

3 - Applying Trend Analysis Methods in Degradation-based Prognostics
Seyed Niknam, Western New England University, 1215 Wilbraham Road, Springfield, MA, 01119, United States of America, seyed.niknam@wne.edu, John Kobza, J Wesley Hines

In degradation-based prognostic, monotonicity is an important parameter feature that deals with underlying positive or negative trend of parameters assuming that systems do not experience any form of healing. The objective of this research is to minimize the uncertainty in remaining life estimation by means of trend analysis techniques, estimation of monotonic trends and trend-based segmentation of degradation data for repairable systems with potential non-monotonic prognostic parameters.

4 - Spatio-temporal Monitoring for Highway Safety
Rupert Giroux, Florida State University and Florida Department of Transportation, 2525 Pottsdamer St, Tallahassee, United States of America, Rupert.Giroux@dot.state.fl.us, Eren Ozguven, Arda Vanli

Highway safety is part of the Strategic Highway Research Program (SHRP) and monitoring crash hot spots is a critical component of ensuring transportation safety. In this talk we present a multivariate CUSUM control chart approach for spatio-temporal monitoring of traffic crash data to identify crash hot spots and determine if significant changes occur. A case study involving data from Leon County, Florida is presented.

5 - Optimal Accelerated Life Tests under a Cost Constraint with Non-uniform Stress Durations
David Han, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, david.han@utsa.edu

Due to constrained resources, several variables such as the allocation proportions and stress durations must be determined carefully at the design stage of ALT. This talk discusses these optimal decision variables based on several optimality criteria under the constraint that the total cost is below a pre-specified budget. A general scale family of distributions is considered to accommodate different lifetime models for flexible modeling with linearly decreasing stress durations.

■ WA77

Parc- Market Street

Exposing Students to Practice with a Case Competition

Sponsor: Analytics

Sponsored Session

Chair: Polly Mitchell-Guthrie, Sr. Manager, Advanced Analytics Customer Liaison, SAS, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com

1 - Creating a Student Case Competition

Polly Mitchell-Guthrie, Sr. Manager, Advanced Analytics Customer Liaison, SAS, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com

SAS and the Analytics Section of INFORMS created the Student Analytical Scholar Competition to help students learn more about the practice of analytics by challenging them to try the process of structuring and presenting a compelling proposal for analytical work. This talk will cover how we went about creating the competition, what benefits students have reported to us from their participation, what we have learned along the way, and implications for teaching and learning of analytical practice.

2 - Choosing Case Studies and Judging Submissions

Ivan Oliveira, SAS, 100 SAS Campus Dr, Raleigh, NC, United States of America, ivan.oliveira@sas.com, Jeff Day

This talk will address the kinds of projects that we use for the case studies in the student competition, what we look for in winning submissions (similar to our recruiting), and the skills we use in working with customers on these kinds of problems.

3 - Creating Big Industry Success Cases through Academic-Industry Collaboration in Business Analytics

Young Jae Jang, Assistant Professor, KAIST, 291 Daehak ro, Industrial and Systems Eng, KAIST, Daejeon, 305701, Korea, Republic of, yjang@kaist.ac.kr, Shin Woong Sung

We present successful industry case studies in Business Analytics through academic-industry collaborations. We particularly discuss the students' role in the industry projects as well as role we believe academia has in relationship to practice. We also present how industry cases are utilized in classroom.

4 - Great Opportunity for Students in Business Analytics

Shin Woong Sung, Ph.D. Candidate, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, sw.sung@kaist.ac.kr, Young Jae Jang

We share the experience on participating SAS and INFORMS Analytics Section Student Analytical Scholar Competition. The motivation to apply to the competition and the solution approach based on the framework of business analytics are presented. We also discuss what we learn through the competition. Finally, we present the current business analytics project with Kolon Sports, the biggest outdoor retailer in Korea.

■ WA78

Parc- Mason

Decision Analysis 6

Contributed Session

Chair: Chao Fang, Associate Professor, Wuhan University, Economics and Management School, Wuhan, 430072, China, chao.c.fang@gmail.com

1 - Ensemble Methods in Credit Scoring

Waldyn Martinez, Assistant Professor Business Analytics, Miami University, 117 Country Club Dr., Oxford, OH, 45056, United States of America, martinwg@miamioh.edu

Credit Scoring refers to the utilization of analytical techniques to determine the creditworthiness of a person. In this research we explore the use of ensemble methods in this area. Ensemble methods generally perform better than individual classifiers and have been shown to possess some desirable statistical properties. Specifically, we explore the most common ensemble methods and compare them to the more traditional statistical techniques used in credit scoring.

2 - Risk Analysis and Management for Critical Infrastructures in the Age of Complexity

Chao Fang, Associate Professor, Wuhan University, Economics and Management School, Wuhan, 430072, China, chao.c.fang@gmail.com

The growing complexity renders the engineering systems exposed to more risks of interdependency. Under complexity, the nature and assessment of the identified risks would change. This paper presents some work about using network theory and importance measures for risk analysis in critical infrastructures. The approach shall be used for identifying key risk factors or vulnerabilities in the system. It brings innovative insights on risks and guides the subsequent managerial decision-makings.

3 - Modelling Latent Preferences in Discrete Choice Analysis.

Martin Spollen, Dr, Queens University Belfast, David Bates Building, University Road, Belfast, BT7 1NN, United Kingdom, martin.spollen@gmail.com, Karen Cairns, Adele Marshall

The observed outcome of consumer choice behavior may conceal true (or latent) preferences when the availability of some popular alternatives is insufficient to meet market demand. Standard RP studies will return biased parameter estimates in these circumstances. We present three models to analyse latent preference data that correct for such bias; with potential for application to non-market situations or where price may not clear the market efficiently.

4 - A Real Options Analysis Framework Based on Managerial Cash-Flow Estimates Accounting for Timing Risk

Yuri Lawryshyn, Associate Professor, University of Toronto, 200 College Street, Toronto, ON, M5S3E5, Canada, yuri.lawryshyn@utoronto.ca, Matt Davison

We propose a real options (RO) approach which utilizes cash-flow and timing estimates from managers as key inputs. We introduce an observable, non-traded indicator process. The process is partially correlated to a traded index. By applying the minimum martingale measure, we are able to develop a financially consistent RO model ñ properly accounting for market and private risk. We introduce a second process, to account for timing risk. We apply our model to an actual drug development project.

5 - Characterizing Hidden Risks using Knowledge Gap and Separation Principles

Seong Dae Kim, assistant professor, University of Alaska Anchorage, 3211 Providence Dr. University Center R, Anchorage, AK, 99508, United States of America, sdkim2@uaa.alaska.edu

Unidentified risks have traditionally been underemphasized by risk management. Most of them are believed to be impossible to find or imagine in advance. But this study reveals that many are not truly unidentifiable. After comprehensive literature review, this study develops a model using different types of knowledge gap and separation principles of TRIZ to explain the mechanism that makes some risks hard to find in advance and show potential areas for identifying hidden risks.

■ WA79

Parc- Powell I

Joint Session DAS/MAS: Game Theory, Decision Analysis, and Homeland Security, Part I

Sponsor: Decision Analysis & Military Applications Society

Sponsored Session

Chair: Jun Zhuang, University at Buffalo, 317 Bell Hall, Buffalo, NY, 14260, United States of America, jzhuang@buffalo.edu

1 - Improving the Value of Analysis for Biosurveillance

Henry Willis, Director, RAND Homeland Security and Defense Center, RAND Corporation, 4570 Fifth Avenue, Pittsburgh, PA, 15217, United States of America, hwillis@rand.org

Biosurveillance provides information that improves decisions about mitigating the effects of disease outbreaks and bioterrorism. Applying two standard risk and decision analysis tools to biosurveillance -decision trees and value-of-information analysis. I demonstrate an approach for evaluating strategies to enhance biosurveillance and to improve decisions about whether and how to act after detection of a biosurveillance signal.

2 - Regret-based Optimization and Preference Elicitation for Stackelberg Security Games with Uncertainty

Thanh Nguyen, USC, 3737 Watt Way, Los Angeles, United States of America, nguyenhongthanh87@gmail.com, Milind Tambe

Stackelberg security games (SSGs) have been deployed in a number of real-world domains. One key challenge in these applications is the uncertainty in attacker payoffs. Previous work has studied SSGs with uncertain payoffs modeled by interval uncertainty and provided maximin-based robust solutions. In contrast, in this work we propose the use of the less conservative minimax regret decision criterion and address the challenge of preference elicitation, using minimax regret.

3 - Combating Nuclear Materials Smuggling: Making Effective Use of Container Inspection History

Gary Gaukler, Associate Professor, Peter F. Drucker Graduate School of Management, Claremont Graduate University, Claremont, CA, 91711, United States of America, Gary.Gaukler@cgu.edu, Yu Ding, Chenhua Li

DHS and other agencies are concerned about adversaries attempting to smuggle special nuclear materials into the US. In response, both domestic and overseas ports have been equipped with radiation detection equipment, providing distributed detection data. In this talk, we provide insights into two primary questions: First, how should a decision maker at a domestic port use detection data from an overseas port? Second, can the use of prior data actually harm decision making at the domestic port?

4 - Multi and Parallel Stage Screening Strategies in the Face of Strategic Applicants

Cen Song, University at Buffalo, 317 bell hall, Buffalo, censong@buffalo.edu, Christopher Diaz, Jun Zhuang

This paper analyzes the optimal screening policy in an imperfect screening system, balancing security and congestion in the face of strategic normal and adversary applicants. We provide analytical optimal level of screening strategies for the approver and best application strategies, integrating game theory and queueing theory. We extend the basic model to: (a) comparison between one-stage and two-stage screening systems; and (b) parallel model.

5 - Choosing What to Protect, and How: Resource Allocation Among Countermeasures With Multiple Attribute

Elisabeth Paulson, Department of Mathematics, The Pennsylvania State University, 201 Old Main, University Park, PA, 16802, United States of America, elisabethpaulson63@gmail.com, Jeffrey Keisler, Igor Linkov

We study a sequential game between an attacker and defender. The defender allocates resources amongst countermeasures and targets, and the attacker chooses a threat and target. We propose a model for optimal resource allocation by combining game theory with a multi-attribute utility model. We find that (i) losses are worst in a zero-sum game, (ii) the defender makes the attacker indifferent between multiple attacks, and (iii) secret/target-independent countermeasures increase cost-effectiveness.

■ WA80

Parc- Powell II

How Sound Decision-making Can be Taught and Measured

Sponsor: Decision Analysis

Sponsored Session

Chair: Nadine Oeser, PhD Candidate, LSE, Rheinstrasse 63, Berlin, 12159, Germany, N.Oeser@lse.ac.uk

1 - On the use of Team-Based Learning (TBL), Games and Clickers for Teaching Analytics

Michael Johnson, Simon Fraser University, 8888 University Dr, Burnaby, BC, V5A 1S6, Canada, mjohn@sfu.ca

There is a growing body of evidence that classroom engagement and learning can be stimulated through the use of a variety of pedagogical approaches. In this study, we discuss and evaluate student perceptions of three interactive approaches (TBL, games and clickers) that were utilized in a third year analytics class in a school of business.

2 - Challenges and Successes in Teaching and Assessing Decision Skills

Chris Spetzler, Executive Director, Decision Education Foundation, 2 Oak Forest Ct, Portola Valley, CA, 94028, United States of America, Chris@decisioneducation.org

Decision Education Foundation has made assessment and evaluation an ongoing commitment and goal of our programs. This talk will highlight both our successes and our struggles to capture measurable changes in Decision Competence. Two core issues - what is being taught and what is being measured - are at the heart of this quest as we seek to both improve curriculum and prove the value of tools to capture the essence of executive function.

3 - Developing the Multidimensional Proactive Decision-Making Scale

Johannes Siebert, Habilitand, University of Bayreuth, Universitatsstr. 30, Bayreuth, Germany, johannes.siebert@uni-bayreuth.de, Reinhardt Kunz

We conducted two studies for developing a theoretically consistent and psychometrically-sound scale of proactive decision-making (PDM). PDM consists of four proactive cognitive skills 'systematical identification of objectives', 'systematical search for information', 'systematical creation of alternatives', 'decision radar', and two proactive personality traits 'striving for improvement' and 'showing initiative'. Individuals with high PDM scores show higher decision satisfaction.

4 - Individual Decision-Making Competence (IDMC) – Validation of a Psychometric Test

Nadine Oeser, PhD Candidate, LSE, Rheinstrasse 63, Berlin, 12159, Germany, N.Oeser@lse.ac.uk

Most advanced research defines IDMC mainly in terms of an individual's ability to resist decision biases, a concept that is derived from behavioral decision theory. This approach does not cover decision analytical components such as the ability to envision one's objectives. To provide a broader understanding of IDMC from a DA perspective, this research aims to validate a psychometric test that allows one to measure decision-making performance on various decision analytic components.

■ WA81

Parc- Divisadero

Data Analytics for Manufacturing System Design

Sponsor: Data Mining

Sponsored Session

Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, United States of America, kliu8@wisc.edu

1 - An Integrated Monitoring and Scheduling System for Energy Reduction of Machine Shop Operations

Chao Meng, The University of Arizona, 1127 E. James E. Rogers Way Room 162, Tucson, AZ, 85721, United States of America, meng@email.arizona.edu, Sung Joong Kim, Young-Jun Son, Sojung Kim

A real-time monitoring and scheduling system for machine shop operations is proposed to reduce their energy consumption while enhancing the productivity. The proposed system consists of 1) power meter to monitor the energy consumption, 2) in-line refractometer to monitor the machine coolant concentration, 3) smartphone apps for alert notification and automatic machine control, and 4) simulation for operation scheduling. The proposed system is demonstrated at a manufacturing company in Arizona.

2 - Adaptive Data Collection Algorithm for Decision Making of Manufacturing System

Leyuan Shi, Professor, Department of Industrial and System Engineering, University of Wisconsin-Madison, 1513 University Avenue,Madison,Wisconsin, Madison, WI, 53706, United States of America, leyuan@engr.wisc.edu, Xianchao Zhang

The data used for decision making of manufacturing system are from a variety of sources, including process data, manufacturing data, operations data, etc. We study an algorithm of adaptive data collection guided by the decision making based on Nested-Partitions Method and Nonlinear Programming to increase the accuracy of data, reduce collecting time and improve decision quality. Some cases are shown to demonstrate the validity of the algorithm.

3 - Analytics in Smart Manufacturing

Soundar Kumara, Allen E. Pearce/Allen M. Pearce Professor, The Pennsylvania State University, 222 Leonhard Building, Industrial Engineering, University Park, PA, 16802, United States of America, skumara@psu.edu, Sudarsan Rachuri, Christopher Saldana

The advent of Internet of Things and the advances in network science has triggered new directions of research in manufacturing systems design. In this work we look at the use of clustering in large scale networks and develop a novel application in the smart manufacturing context. We develop the framework from a sustainability point of view and discuss the modeling methodology, and implementation details.

4 - A Systematic Approach for Business Data Analytics with a Real Case Study

Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, United States of America, kliu8@wisc.edu, Jianjun Shi

Business data analytics is a process of utilizing analytic techniques for resolving business issues based on the business performance data. In this talk, we propose a systematic step-by-step procedure for business data analytics. This proposed framework is illustrated and validated by a real case study involving choosing an optimal location for opening of a new retail site.

■ WA82

Parc- Haight

Multicriteria Decision Making 1

Contributed Session

Chair: Jian Hu, Assistant Professor, University of Michigan - Dearborn, 4901 Evergreen Rd., HPEC 2220, Dearborn, MI, 48128, United States of America, jianhu@umich.edu

1 - Evaluating Efficiency under Uncertainty with a GPDEA Model & Fuzzy Theory: A Real Application

Fernando Marins, Full Professor, UNESP, Rua Vigario Martiniano, 74, Centro, Guaratinguet·, SP, 12501060, Brazil, fmarins@feg.unesp.br, Marcos Santos, José Roberto Luche, Aneirson Silva

The paper proposes a new model, called Fuzzy Goal Programming & Data Envelopment Analysis (FGPDEA) to aid in determining efficiencies of DMUs (Decision Making Units) in environments subject to uncertainty. A real application of the FGPDEA model was carried out to evaluate the efficiency of seven automotive component mini-factories. Results obtained identified which mini-factories were efficient and which were more sensitive to the uncertainty effect.

2 - An Improved PROMETHEE III Based on DMs' Risk Preferences

Yu-Ting Chang, Tamkang University, Dept. of Management Science, 151 Yingzhuan Road, Taipei, 25137, Taiwan - ROC, balindachang@gmail.com, Hsu-Shih Shih

The study tries to integrate S-shaped value functions with gains and losses into PROMETHEE III for considering the risk preferences of DMs. In addition to the risk preference incorporation, the proposed method has an ability to differentiate many more alternatives. An evaluation of E-waste recycling plants is illustrated.

3 - Synergy of Multicriteria Methods for Common Agricultural Policy's Reform

Athanasios Valiakos, University of Piraeus, 80, Karaoli & Dimitriou Street, Piraeus, 18534, Greece, avaliakos@unipi.gr, Yannis Siskos

Under the Common Agricultural Policy's reform, governments take action to distribute correctly the direct payments to farmers. A framework is proposed to calculate the direct payment, based on evaluation of agricultural units using robust ordinal regression (ROR) approach. The synergy of two methods, additive evaluation model and goal programming regression model is proposed to measure the final financial aid. Post-optimality analyses are applied by computing complementary robustness measures.

4 - A Robust Additive Multiattribute Preference Model using a Nonparametric Shape-Preserving Perturbation

Jian Hu, Assistant Professor, University of Michigan - Dearborn, 4901 Evergreen Rd., HPEC 2220, Dearborn, MI, 48128, United States of America, jianhu@umich.edu, Yung-Wen Liu, Sanjay Mehrotra

We develop a multiattribute preference ranking rule in the context of robustness. A nonparametric perturbation of a given additive reference utility function is specified to solve the problem of ambiguity and inconsistency in utility assessments, while preserving the additive structure and the decision maker's risk preference under each criterion. A concept of robust preference value is defined using the worst expected utility of an alternative incurred by the perturbation.

5 - Generating Natural Language Explanations for MCDM Problems

K.Nadia Papamichail, Associate Professor in Information and Decision Systems, The University of Manchester, Manchester Business School, Booth Street East, Manchester, M15 6PB, United Kingdom, nadia.papamichail@mbs.ac.uk, Theodor J. Stewart

This paper discusses a method for developing explanation facilities in MCDM tools. We present a system that generates natural language explanations for interpreting MCDM decisions. We focus firstly, on explanations that support the choice of a single alternative and secondly, on explanations of pairwise comparisons. Finally, we explain how we have designed a text planner to structure the content of the explanations and a sentence generator to produce the explanatory text.

■ WA83

Parc- Sutro

Data Mining 1

Contributed Session

Chair: Jeaha Yang, IBM Research, Thomas J Watson Research Center, Yorktown Heights, NY, 10598, United States of America, jeaha@us.ibm.com

1 - Bounded Isotonic Regression

Ronny Luss, IBM, 1101 Kitchawan Rd Route 134, Po Box 218, Yorktown Heights, NY, United States of America, rluss@us.ibm.com, Saharon Rosset

Isotonic regression offers a flexible modeling approach under monotonicity assumptions, however often suffers from overfitting as the monotonicity constraints do not offer sufficient complexity control. We propose regularization using the range of the fitted model (i.e., the difference between the maximal and minimal predictions). Given the non-regularized solution, we show how to easily derive a path of range-regularized solutions, making this approach applicable to large datasets.

2 - A Cloud-Based Hub of Incident Analytics in IT Services

Jeaha Yang, IBM Research, Thomas J Watson Research Center, Yorktown Heights, NY, 10598, United States of America, jeaha@us.ibm.com, Ta-Hsin Li, Juhnyoung Lee

An important IT service is to resolve incidents related to IT infrastructures. Incidents are recorded as structured and unstructured ticket data, which contain characteristics such as timestamps, problem description and resolution. This cloud-based hub facilitates in-depth statistical analysis of incident tickets, enables root-cause analytics and benchmarking across accounts. Actionable insights are also provided.

3 - A Heuristic Boosting Algorithm for Classification and Regression Trees with Reserved-judgment Region

Abdolmanaf Zargoush, PhD Candidate, McGill University, 1001 Sherbrooke, Montreal, QC, H3A1G5, Canada, abdolmanaf.zargoush@mcgill.ca, Vincenzo Esposito Vinzi, Farrokh Alemi

We propose a heuristic algorithm for boosting the accuracy of CART methods. As we show through extensive simulated and real experiments, this algorithm not only improves the classification accuracy of CART in majority of instances, but it also retains the graphical strength of CART by providing few ensemble of trees. This is a key advantage over the competing ensemble methods like Boosting and Bagging, which deliver too many small tree classifiers that can't be used for scientific reasoning.

4 - Control Charts Pattern Recognition and Fault Diagnostic in Multivariate Process

Parvaneh Jahani, PhD Student, University of Louisville, Department of Industrial Engineering, JB Speed School of Engineering, U of L, Louisville, KY, 40292, United States of America, p0jaha01@louisville.edu, Suraj Alexander

SPC methods for detecting process mean shift have high computational costs and they are not effective in detecting trends. We propose a new methodology to recognize the abnormal patterns of multivariate process using Control Charts Pattern Recognition (CCPR). Two strategies of fault diagnostics after failure occurrence are presented and compared in term of accuracy. The validation of the model is tested in a real world case study.

Wednesday, 11:00am - 12:30pm

■ WB01

Hilton- Golden Gate 6

New Voices in Military Operations Research

Sponsor: Military Applications Society

Sponsored Session

Chair: Harrison Schramm, Campaign Analysis Deputy, OPNAV N81, 1507 22nd Street South, Arlington, VA, 22202, United States of America, Harrison.Schramm@gmail.com

1 - Theory-Driven Modeling and Big Data in the Quest to Identify Threats to US National Security

Robert Lantz, Manager and Operations Analyst, Sentinel Applied Analytics, 8618 Westwood Center Drive, Suite 315, Vienna, VA, 22182, United States of America, rob.lantz@sentinelappliedanalytics.com, Jennifer Stave, Alonzo Barnett

Using the illegal proliferation of unmanned aerial systems (UAS) as an example, we explain how agencies can use big data to augment their operations. We investigate data-driven techniques to find illicit shipments of military equipment to foreign destinations. We show that big data can reveal threat signal from the abstracted perspective of a predictive model that would not otherwise be evident. Finally, we explain how these techniques can be used to address other threats to national security.

2 - Evaluating Structural Disruption in Adaptive Networks

Jon Roginski, PhD Student, Naval Postgraduate School, 833 Dyer Road, BLDG 232, Spanagel 249B, Monterey, CA, 93940, United States of America, roginskij21@gmail.com, Erik Rye

The promise of network science is to provide a foundation that supports understanding the large, dynamic, complex networks that characterize life today. In the military, as in any competitive pursuit, we seek to leverage this understanding toward insight into how we may influence tomorrow. Ongoing research at the Naval Postgraduate School contributes by providing a means to compare the structures of graphs and networks-as in determining how a network is structurally different after an attack.

■ WB02

Hilton- Golden Gate 7

Modularity in the Context of Service Management

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Juliana Hsuan, Professor, Copenhagen Business School, Dept. of Operations Management, Solbjerg Plads 3, Frederiksberg, DK-2000, Denmark, jh.om@cbs.dk

1 - The Impact of Product and Service Modularity on Servitization Strategy

Thomas Frandsen, Assistant Professor, Copenhagen Business School, Dept. of Operations Management, Solbjerg Plads 3, Frederiksberg, DK-2000, Denmark, tfr.om@cbs.dk, Juliana Hsuan

Manufacturers are increasingly bundling products with service offerings as integrated solutions to improve competitiveness. Based on case research and an industry workshop, we report on how value propositions can be extended through servitization, and how companies should strategize in order to move forward through the lenses of product and service modularity.

2 - Commonalities and Differences in Measuring Service Modularity and Related Effects

Tilo Boehmann, Professor, University of Hamburg, Department of Informatics, Vogt-Koelln-Str. 30, Hamburg, 22527, Germany, Tilo.Boehmann@uni-hamburg.de, Regine Dˆrbecker

The principle of modularity has become increasingly important as service providers seek to reduce time and cost of delivering customized services. Extant research on the topic has mainly conceptual character and there is a dearth of empirical studies on the antecedents and effects. We study the measurement of service modularity and its effects in comparison to other contexts like product or software development. We particularly analyse whether a service-specific measurement concept is needed.

3 - Innovation, Modularity and Standardization in KIBS: The Performance Implications

Anna Cabigiosu, Assistant Professor, Universita Ca' Foscari, San Giobbe Dorsoduro 873, Venezia, 30121, Italy, diego.campagnolo@unipd.it, Diego Campagnolo

Using fs/QCA on a sample of 319 KIBS, we explore how innovation and service types interact in firm's performance. Our results highlight complementarity between process innovations and service standardization on a firm's profitability, while they emphasize complementarity between process innovations, service customization, and modularity of a firm's growth.

4 - Modularity used as a Pricing Model in a Software Company

Eric Bentzen, Associate Professor, Copenhagen Business School, Dept. of Operations Management, Solbjerg Plads 3, Frederiksberg, DK-2000, Denmark, eb.om@cbs.dk

In this paper we will look at a pricing model used in a software company that use the principle of modularity in their pricing of products. The company has many available software products and with the use of modularity they have now moved further from originally software algorithm and procedures to software applications.

■ WB03

Hilton- Golden Gate 7

Social Media and Business Analytics

Sponsor: eBusiness

Sponsored Session

Chair: Hailiang Chen, City University of Hong Kong, Department of Information Systems, Kowloon, Hong Kong - PRC, hailchen@cityu.edu.hk

1 - Nudging Consumers' Behaviors in Recommender Systems with Capacity Constraints

Na Zhang, Purdue University, nancy.zhangna@gmail.com, Karthik Kannan, George Shanthikumar

This paper investigates how customers may be nudged by information and coupons to purchase products with capacity constraints. A Support Vector Machine based recommender system is developed to rank order customers based on their purchase potential and identify targeted customers. We compared our technique with standard ones using a rolling time window based on data from an online grocery store. A field experiment was also conducted to evaluate our approach and found consistent results.

2 - Relationships among Minimum Requirements, Facebook Likes, and Groupon Deal Outcomes

Gang Wang, University of Connecticut, 2100 Hillside road, Storrs, CT, 06269, United States of America, Gang.Wang@business.uconn.edu, Bill Ross, James Marsden, Xue Bai

The empirical work examines the relationships between minimum requirements and social media linkages and deal outcomes for one major daily deal site, Groupon. Using time-stamped empirical data we captured electronically, we complete an initial high-level statistical analysis followed by a propensity score approach to analyze causal effects for four major Groupon product categories. We find that the presence of a minimum requirement increases Facebook likes, and coupon outcomes.

3 - Dynamics among Social Media Marketing, Word of Mouth, and Movie Revenues

Hailiang Chen, City University of Hong Kong, Department of Information Systems, Kowloon, Hong Kong - PRC, hailchen@cityu.edu.hk

Social media sites have recently become a venue for firms to interact with consumers and influence their conversations. This study explores how firms could influence word-of-mouth (WOM) among consumers through proactive social media marketing efforts. The dynamics among movie studios' marketing communication, consumer-to-consumer communication, and box office sales are examined.

■ WB04

Hilton- Continental 1

Operations Management and Marketing Interface

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Hamed Mamani, Assistant Professor, University of Washington, Foster School of Business, ISOM Department, Seattle, WA, 98195, United States of America, hmamani@uw.edu

Co-Chair: Foad Iravani, Assistant Professor, University of Washington, Foster School of Business, Seattle, WA, 98195, United States of America, firavani@uw.edu

1 - Gray Markets, Contracts and Supply Chain Coordination

Foad Iravani, Assistant Professor, University of Washington, Foster School of Business, Seattle, WA, 98195, United States of America, firavani@uw.edu, Hamed Mamani, Reza Ahmadi

The diversion of genuine products to gray markets continues to challenge many companies. Industry surveys report that the abuse of channel incentives contributes to the growth of gray markets. We analyze the impact of gray markets on classic contracts. We show contracts that solely depend on order quantity cannot coordinate the supply chain and propose priceñdependent quantity discount contracts to coordinate the supply chain. Our proposed contracts also enhance consumer welfare.

2 - Optimizing Product Launches in the Presence of Strategic Consumers

Ilan Lobel, Assistant Professor, NYU Stern School of Business, 44 W 4th St, New York, NY, 10012-1126, United States of America, ilobel@stern.nyu.edu, Jigar Patel, Gustavo Vulcano, Jiawei Zhang

We consider the problem of a technology firm deciding the optimal timing of its product launches. Consumers are strategic and weigh the value of purchasing improved products in light of future technological improvements. We characterize the optimal launch policies for two cases: one where the firm pre-announces the product launch times in the market, and the second where no information about the future launches is divulged.

3 - Optimal Design of Crowdfunding Campaigns

Saeed Alaei, Cornell University, Upson Hall, Ithaca, United States of America, saeed@cs.cornell.edu, Azarakhsh Malekian, Mohamed Mostagir

Crowdfunding is quickly emerging as an alternative to traditional methods of funding new products. In a crowdfunding environment, a producer solicits financial contributions from consumers in the form of pre-purchasing a still-unrealized product. These contributions are collected only if a pre-determined funding goal is met before a deadline. We model the social dynamics of contributors and show how they are affected by the funding goal, the price of the product, and the campaign duration.

4 - Collaboration between Competitors through Inventory Exchange

Liang Ding, University of Michigan, 701 Tappan Street, R0400, Ann Arbor, MI, 48109, United States of America, lgding@umich.edu, Roman Kapuscinski, Ozge Sahin

An increasing number of companies establish some level of partnership with their competitors. This paper studies the effect of collaboration and competition by a resource exchange model. We explore that whether/when a resource exchange contract can help both firms and what is the influence on consumer surplus. The results show that the resource exchange is a win-win solution when there is no competition, or when purchasing cost is neither very low nor very high given strong competition.

■ WB05

Hilton- Continental 2

Economics in Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Manu Goyal, Assistant Professor, University of Utah, College Of Business, Salt Lake City, UT, United States of America, Manu.Goyal@business.utah.edu

1 - On the use of Public Warnings in Counterterrorism Operations

Nitin Bakshi, Assistant Professor, London Business School, NW1 4SA, London, United Kingdom, nbakshi@london.edu, Edieal Pinker

Public warnings have long been deemed an effective lever to ward off terrorist threats. Paradoxically, warnings might be a victim of their own success. Previous alerts that negated an attack result in the perception of a false alarm. Going forward, when a warning is issued, people would be less inclined to believe that an attack will materialize. We study the trade-off between the short-term benefit of a deferred attack, and long-term costs such as erosion of credibility through false alarms.

2 - Stage-Gate Contracts for New Product Development

Chunlin Wang, PhD Candidate, David Eccles School of Business, University of Utah, 1655 East Campus Center Drive, Salt Lake City, UT, 84112, United States of America, chunlin.wang@business.utah.edu, Glen Schmidt, Krishnan Anand

In the setting of outsourcing an NPD project, either the agent or the principal can have inside information on the project's viability. We study the principal's use of stage-gate contracts as a screening device in the former scenario and as a tool of achieving separating and pooling equilibria in the latter, and compare the performance of stage-gate contracts with traditional outsourcing contracts.

3 - Honesty in Incomplete Supply Chain Contracts

Manu Goyal, Assistant Professor, University of Utah, College Of Business, Salt Lake City, United States of America, Manu.Goyal@business.utah.edu, Krishnan Anand, He Chen

In a world with bounded rationality, we study a multi-period (incomplete) contractual relationship between a manufacturer and his supplier. We prove that a profit-maximizing manufacturer, who is constrained by honesty, can outperform the quintessential unconstrained profit-maximizer, even though the unconstrained manufacturer can mimic the honest manufacturer. Thus, honesty emerges endogenously as an optimal policy.

■ WB06

Hilton- Continental 3

Urban Spatial Issues

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Elena Belavina, Assistant Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, United States of America, belavina@uchicago.edu

Co-Chair: Karan Girotra, Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, karan.girotra@insead.edu

1 - Bike Share: Accessibility and Availability

Karan Girotra, Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, karan.girotra@insead.edu, Ashish Kabra

We study bike-share systems as implemented in large cities such as Paris, London, New York. We develop a structural empirical model that captures the elasticity of user demand w.r.t. distance to a station as well as long-term and short-term effects of service level. We exploit changing choice set due to stockouts as well as instrument variables for identification. To deal with computational challenges, we transform our estimation problem from the time-domain to the system state-space domain.

2 - Which is Environmentally Friendlier- Online Retailing or Brick-and-Mortar Retailing?

Gerard Cachon, Wharton University, Philadelphia, PA, United States of America, cachon@wharton.upenn.edu

Products can travel from suppliers to consumers via on-line retailers or brick-and-mortar retailers. Traditional brick-and-mortar retailing involves consumers completing the final mile" to their home, whereas with on-line retailing products arrive at a consumer's doorstep. This paper discusses which distribution approach is better from the point of view of carbon emissions.

3 - Household-level Economies of Scale and Package Delivery

John Carlsson, Assistant Professor, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, jgc@umn.edu

One of the fundamental concerns in the analysis of logistical systems is the trade-off between localized, independent provision of goods and services versus provision along a centralized infrastructure such as a backbone network. We study the mini-economies" of scale that arise when households make multi-stop trips rather than using package delivery services.

4 - Pricing for Grocery Delivery: Subscription of Per-Order Pricing

Elena Belavina, Assistant Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, United States of America, belavina@uchicago.edu, Karan Girotra

Grocery delivery is a market that many try to conquer. Appropriate pricing is key for success. There is little consensus among different players (at times even within one firm operating in different locations) on what is the best pricing scheme. For example, Amazon Fresh in Seattle is using per order pricing while in San Francisco - subscription fee. We provide recommendation for the preferred pricing scheme based on various characteristics (delivery logistics, demand variability etc.).

■ WB07

Hilton- Continental 4

Supply Chain Management III

Contributed Session

Chair: Xiaojuan Zhang, Xi'an Jiaotong University, School of Management, No.28, Xianning West Road, Xi'an, China, xiaojuanzh@stu.xjtu.edu.cn

1 - Newsvendor Game with Limited Supply and Inventory Transshipment

Ziteng Wang, North Carolina State University, Daniels 443, North Carolina State University, Raleigh, NC, 27695, United States of America, zwang23@ncsu.edu, Sha Luo, Tiantian Nie, Jian Luo, Shu-Cherng Fang

When the supply is limited, the newsvendors may manipulate their orders to receive a preferred inventory allocation. Inventory transshipment can satisfy more demand and complicate newsvendors' decisions. In such a game, Nash equilibrium exists under certain conditions and its uniqueness depends on the supply capacity. A larger supply capacity brings more profit to the newsvendors and the supply chain. The newsvendors can be coordinated if they are allowed to negotiate the transshipment prices.

2 - A Stochastic Facility Location Problem with Supply Chain Risk Propagation

Myles Garvey, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, myles.garvey@rutgers.edu, Steven Carnovale

Many current FLP in the extant literature have either single objectives such as cost or distance minimization or multiple objectives. However, much of the literature does not capture the intricacies of risk for supply chain disruption and it's potential to propagate through a supply network due to its structure. In this paper, we develop a model and a solution methodology to solve the capacitated and constrained FLP problem by considering risk propagation as the main objective.

3 - Measuring Resilience in an Agricultural Supply Chain

Daniel Romero, PhD Student, University of South Florida/ Universidad Autonoma del Caribe, East Fowler Avenue, SVC1034, Tampa, FL, 4202, United States of America, danielromero@mail.usf.edu, Fabian Sanchez, Fernando Gonzalez, Alex Savachkin, Weimar Ardila

Resilience has been measured in different type of systems but is not clear the differences between the different types of metrics in real settings. The following research is a case study of an agricultural supply chain in Colombia were resilience is measured using different metrics in order to establish advantages and disadvantages of each approach.

4 - Competition and Cooperation in a Duopoly Transportation Market with Empty Equipment Repositioning

Xiaojuan Zhang, Xi'an Jiaotong University, School of Management, No.28, Xianning West Road, Xi'an, China, xiaojuanzh@stu.xjtu.edu.cn, Sheng Hao Zhang

We consider a transportation market with two firms providing service between two locations. Their realized demands in both directions depend on the price decisions of both firms. Because equipment is needed to transport goods, each firm may face unbalanced demands and has to reposition empty equipment. Cooperation on empty equipment repositioning reduces both firms' cost. We study firms' competition and cooperation strategies and their impact on environments such as carbon emission.

■ WB08

Hilton- Continental 5

Text Analytics Applications in Social Media

Cluster: Social Media Analytics

Invited Session

Chair: Praveen Lakkaraju, Manager, Advanced Analytics R&D, SAS, SAS Campus Dr, Cary, NC, 27513, United States of America, Praveen.Lakkaraju@sas.com

1 - Identifying Emerging Researchers using Social Network Analysis

Syed Billah, University of Arkansas, 41 Fireside Ln, East Setauket, NY, United States of America, syed.masum.billah@gmail.com, Susan Gauch

Finding rising stars in academia early in their careers has many implications. Typically, the impact of a researcher is assessed by a measurement called h-index that grows linearly with the academic age. Therefore, h-indices of researchers in the early stages of their careers are almost uniformly low, making it difficult to identify those who will emerge as influential leaders. Here, we make use of social network analysis to identify young researchers most likely to become successful.

2 - Sports Analytics - Uncovering Patterns in Social Media

Dan Zaratsian, Text Analytics Consultant, SAS Institute, 100 SAS Campus Dr, Cary, NC, 27513, United States of America, Dan.Zaratsian@sas.com

If you take a look at all of your customer touch-points, all of the opportunities that your business has to interact with customers, what percentage are you leveraging today? Analyzing online conversations for major sporting events can drive fan engagement, understand fan sentiment, enhance marketing campaigns and more. Through this process we are able to identify trends and opportunities within social media relating to sports analytics that deliver business value.

3 - Analyzing Tweets: Text Mining and Sentiment Mining

Goutam Chakraborty, Professor (Marketing), Oklahoma State University, 420 A Spears School of Business, Stillwater, OK, 74078, United States of America, goutam.chakraborty@okstate.edu

In this presentation, we will discuss results from analyzing tweets that provide insights on the impact of the Digital Rights Management (DRM) policies of a major software manufacturer on their customers' reactions. Results from sentiment analysis of tweets pre-post of a launch of a new product by the manufacturer will also be presented.

4 - Probabilistic Semantics for Customizable Social Media Analytics

Viswanath Avasarala, Manager, SAS, World Headquarters, SAS Campus drive, Cary, NC, 27513, United States of America, Viswanath.Avasarala@sas.com, Praveen Lakkaraju, David Styles, Richard Crowell, Saratendu Sethi, James Tetterson

SAS provides sophisticated rule-based natural language processing (NLP) technology to enable accurate categorization and identification of complex relationships within unstructured data. In this paper, we will discuss the design of our new technology, the semantic framework, that allows enterprise analysts to build powerful social media applications with minimal configuration.

■ WB09

Hilton- Continental 6

Meta-Algorithms – Algorithms That Improve Other Algorithms

Cluster: Cognitive Analytics

Invited Session

Chair: Meinolf Sellmann, Co-Lead Global Technology Outlook, IBM Research Headquarters, 1101 Kitchawan Rd, Yorktown, NY, United States of America, meinolf@us.ibm.com

1 - Programming by Optimization: A Practical Paradigm for Computer-Aided Algorithm Design

Kevin Leyton-Brown, Professor, University of British Columbia, 2366 Main Mall, Vancouver, BC, V6T1Z4, Canada, kevinlb@cs.ubc.ca, Holger Hoos, Frank Hutter

Programming by Optimization means specifying a large design space and then applying machine learning and optimization to find a design that will perform well in a given use context. This talk will share the vision of PbO, describe key algorithmic techniques that make PbO practical, and illustrate the power of the approach. Specifically, it will describe some state-of-the-art methods for automated algorithm configuration, portfolio-based algorithm selection, and automated portfolio construction.

2 - Algorithm Portfolios Based on Cost-Sensitive Hierarchical Clustering

Horst Samulowitz, IBM Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, samulowitz@us.ibm.com, Meinolf Sellmann, Ashish Sabharwal, Yuri Malitsky

Different solution approaches for combinatorial problems often exhibit incomparable performance that depends on the concrete problem instance to be solved. Algorithm portfolios aim to combine the strengths of multiple algorithmic approaches by training a classifier that selects solvers dependent on the given instance. We discuss a classifier that selects solvers based on a cost-sensitive hierarchical clustering model.

3 - Instance-Specific Algorithm Tuning

Yuri Malitsky, Cork Constraint Computation Centre, School of Computer Science & IT, Cork, Ireland, Yuri.Malitsky@gmail.com, Carlos Ansötegui, Meinolf Sellmann

We present ISAC++, a tool for tuning algorithms instance-specifically. ISAC++ is based on the instance-oblivious algorithm tuner GGA and the CSHC algorithm portfolio methodology. A portfolio of MaxSAT solvers was tuned with ISAC++ and won six out of eleven categories at the 2013 International MaxSAT Evaluation.

■ WB10

Hilton- Continental 7

Operations/Sustainability 2

Contributed Session

Chair: Adam Ng, National University of Singapore, 1 Engineering Drive 2, Singapore, 025874, Singapore, isentsa@nus.edu.sg

1 - Linear Programming Models for Resilient Supply Systems Planning

Adam Ng, National University of Singapore, 1 Engineering Drive 2, Singapore, 025874, Singapore, isentsa@nus.edu.sg, Muchen Tang

We consider linear programming models of general supply systems subject to supply disruptions. Our objective is to develop a framework to measure supply resilience for such models. We first propose axiomatic characterizations of resilience measures, and then show their representation using adjustable uncertainty sets. We next develop algorithms for evaluating resilience measures defined by some simple adjustable sets, and present computational studies on a natural gas supply network.

2 - Green Procurement Behaviors Observation from Game Theory Perspective

Ping JI, The Hong Kong Polytechnic University, EF606, Hung Hom, Hong Kong, Hong Kong - PRC, p.ji@polyu.edu.hk, Xin Ma

An increasing number of manufacturers pay more attention to green procurement. Selection green supplier has become an important issue in supply chain management. A game model is proposed to study the relationship between manufacturers and green suppliers. Behaviors of two players are presented by using different strategies, which also be demonstrated by simulation.

3 - Analysis of Recycled Content Claims under Supply Uncertainty and Demand Benefit

Aditya Vedantam, Doctoral Student, Krannert School of Management,Purdue University, 147 Arnold Drive Apt 14, West Lafayette, IN, 47906, United States of America, avedanta@purdue.edu, Ananth Iyer, Paul Lacourbe

Manufacturers making claims regarding recycled content on product packaging, see demand from Environmentally Preferable Purchasing (EPP) and industry buy recycled procurement. However, the availability of quality post-consumer recycled content is cause for concern due to contamination in the municipal waste stream. We study the impact of uncertain supply and demand benefit and show that concerted effort to ease supply constraints and create demand side incentives can lead to win-win conditions.

4 - Collaborative Planning to Increase Resource Efficiency in Industrial Symbiosis

Renzo Akkerman, Professor, Technische Universitat München, Arcisstrafle 21, München, 80333, Germany, renzo.akkerman@tum.de, Gabor Herczeg

Resource efficiency is a key aspect in relation to economic and environmental performance in sustainable supply chains. To improve resource efficiency in industrial symbiosis, one company's production waste substitutes virgin resources in another company's production process. Tactical planning activities need to include waste treatment, storage, as well as resource procurement. We develop collaborative planning models that consider the matching of waste supply and demand.

■ WB11

Hilton- Continental 8

Supply Chain, Risk Management II

Contributed Session

Chair: Seyed Vahid Rez Nooraie, PhD Student, North Carolina A&T State University, 1601 E Market Street, Greensboro, NC, 27411, United States of America, vnooraie@gmail.com

1 - Backup Sourcing Model with Credit Guarantee Mechanism

Cheng-Feng Wu, National Taiwan University, College of Management, Floor 9, Taipei, Taiwan - ROC, d99741006@ntu.edu.tw, David Chiang

The strait of capital shortage in SMEs causes them difficult to fulfill orders, resulting in poor performance of the supply chain. Therefore, obtaining and operating financial support for SMEs is a significant issue. This study attempts to develop the dual sourcing model with a backup supplier under trade guarantee mechanism by applying incentive theory from manufacturer's perspectives.

2 - Innovative Menu of Contracts for Coordinating a Supply Chain with Multiple Mean-Variance Retailers

Chun-Hung Chiu, Associate Professor, Sun Yat-sen Business School, Business School, Sun Yat-sen University, No. 135 Xingang West Road, Guangzhou, 510275, China, chchiu2000@gmail.com, Tsan-Ming Choi, Gang Hao, Xun Li

We consider the coordination challenge with a risk-neutral manufacturer which supplies to multiple heterogeneously mean-variance (MV) retailers. To achieve coordination, we develop an innovative menu of TSR contracts. All contracts in the menu that achieves SCC must be non-MV inferior and non-dominated, and the associated conditions are examined.

3 - Mitigating Supply Chain Risks through the Assessment of Trade-off among Investment in Capabilities

Seyed Vahid Rez Nooraie, PhD Student, North Carolina A&T State University, 1601 E Market Street, Greensboro, NC, 27411, United States of America, vnooraie@gmail.com, Mahour Parast, Saeed Zamiri Marvizadeh

One of the central questions in supply chain design is how to properly invest in supply chain capabilities in order to be more responsive to supply chain disruptions.

■ WB12

Hilton- Continental 9

Incentive Issues in Sustainable Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Luyi Gui, luyig@uci.edu

1 - On the Effectiveness of Emission Penalties in Decentralzied Supply Chains

Saif Benjaafar, Distinguished McKnight University Professor Professor, University of Minnesota, 111 Church St SE, Minneapolis, MN, 55455, United States of America, saif@umn.edu, Xi Chen

We show that pricing emissions in a decentralized supply chain can paradoxically lead to higher overall supply chain emissions and for this emission to increase in the emission price. We discuss potential remedies and the social welfare implications of each. We illustrate our analysis with several applications.

2 - Manufacturers' Recycling Strategies: Competition and Cooperation in Sustainability

Fang Tian, Ph.D. Candidate, Department of Data Sciences and Operations, Marshall School of Business, University of Southern California, Los Angeles, CA, 90089, United States of America, tianfang@usc.edu, Greys Sosic, Laurens Debo

We study recycling of products from two categories, each with (possibly) multiple brands, and focus on product heterogeneity vs. economies of scale. Our analysis suggests that recycling organized by government disregards product brands, and either focuses on categories or takes advantage of economies of scale (through all-inclusive recycling). On the other hand, if competing manufacturers form recycling coalitions, all products from the same brand may be recycled together regardless of category.

3 - Supply Chain Design for Unlocking the Value of Remanufacturing under Uncertainty

Wenyi Chen, MIT-Zaragoza, C/ Bari 55, Edificio N·yade 5, Zaragoza Logistics Center, Zaragoza, 50197, Spain, wchen@zlc.edu.es, Maria Jesus Saenz, Beste Kucukyazici, Vedat Verter

We present a two-stage stochastic closed-loop supply chain design model that incorporates uncertainties as well as the differences in customer valuations of new and remanufactured products. We integrate SAA with integer L-shaped to tackle the arising mixed integer quadratic program, which we implement in a German company.

4 - The Value of Product Returns: Intertemporal Product Management with Strategic Consumers

Narendra Singh, Narendra.Singh@scheller.gatech.edu, Karthik Ramachandran, Ravi Subramanian

Consumer product returns are a significant and growing concern in many industries, and firms typically deem returns to be undesirable. We study the impact of returns on the intertemporal product strategy of a firm facing strategic consumers. Importantly, we show that returns may act as a device for the firm to mitigate the well-known time inconsistency problem, and firm profit could increase with the return rate.

■ WB13

Imperial A

Education 2

Contributed Session

Chair: Fikret Korhan Turan, Asst. Professor Dr., Istanbul Kemerburgaz University, Mahmutbey Dilmenler Cad., No:26 Bagcilar, Istanbul, 34217, Turkey, korhan.turan@kemerburgaz.edu.tr

1 - using Predictive Analytics to Increase Graduation Rates

Helmut Schneider, Professor, Louisiana State University, LSU BEC, Baton Rouge, LA, 70803, United States of America, hschnei@lsu.edu, Xuan Wang

Predictive analytics will be used to deploy advising and mentoring to increase graduation rates. We also employ Bayesian networks and simulation to gain further insight into what drives graduation rates. Using four years of data this paper also identifies key performance indicators that affect graduation rates.

2 - A Learner-Analytics Based Approach for Attenuating the Course-Level Dropout Rate

Aysegul Demirtas, Arizona State University, 1055 W 5th St, Apt 10, Tempe, AZ, 85281, United States of America, Aysegul.Demirtas@asu.edu, Esma Gel, Jennifer Bekki, George Runger

Despite their potential to attract large numbers of diverse students, online courses remain plagued by a critical student attrition problem. Using data from three different online undergraduate courses, we apply data mining techniques to model the relationship between learner interactions with the Learning Management System (LMS) and course level dropout. The findings serve as the basis for incorporating earlier detection of at-risk students in online courses.

3 - OR Education with LEGO Mindstorms EV3

Young Jae Jang, Assistant Professor, KAIST, 291 Daehak ro, Industrial and Systems Eng, KAIST, Daejeon, 305701, Korea, Republic of, yjang@kaist.ac.kr

The Industrial and Systems Engineering at KAIST recently developed Automated Manufacturing Systems with LEGO Mindstorms EVS. With the tool kit, a physical production line was constructed that produce a multiple products with automated material handling systems. We explain how the system has been applied to OR classrooms. The motivational benefit and pedagogical implication of the system are also discussed.

4 - Sustainability in Higher Education: A Statistical Analysis of Stakeholder Needs for Group Decision

Fikret Korhan Turan, Asst. Professor Dr., Istanbul Kemerburgaz University, Mahmutbey Dilmenler Cad., No:26 Bagcilar, Istanbul, 34217, Turkey, korhan.turan@kemerburgaz.edu.tr, Saadet Cetinkaya, Ceyda Ustun

Istanbul Kemerburgaz University management considers implementing a set of projects to improve the university's sustainability performance as a higher education institute. Using analytic hierarchy and network processes, we conduct a 30-participant stakeholder survey whose results will be used in a multi-objective stochastic program to find an optimal portfolio. Survey results show statistical differences in stakeholder needs, and how they change under low, medium and high financial constraints.

5 - Capturing Heterogeneity in University Choice

Ricardo Paredes, Prof Economics, PUC, Vicuna Mackenna 4860, Macul, Santiago, Chile, rparedes@ing.puc.cl, Alejandro Schmidt, Juan de Dios Ortuzar

Considering the possibility groups differ on their preferences, we estimate a latent-class logit model to analyse the determinants of university choice in Chile, and show how these vary depending on group characteristics. We conclude that groups of individuals with different selection patterns exist, that those groups are not only differentiated by their income and that their choice sensitivity to different university characteristics (cost, quality, and location).

■ WB14

Imperial B

Supply Chain, Practice, Empirics

Contributed Session

Chair: Jing Zhou, Associate Professor, UNC Charlotte, 9201 University City Blvd, Belk College of Business, Charlotte, NC, 28223, United States of America, jzhou7@uncc.edu

1 - Lean Supply Chain in Small Businesses

Steve Zhou, University of Houston Downtown, One Main Street, Houston, TX, United States of America, drbinzhou@yahoo.com

This research investigates lean supply chain management and its impacts on small businesses' performance. It has provided insights into the current status of lean supply chain practices and related implementation issues in small businesses.

2 - Generational Shift and Consumer Complaints in Automobile Industry

Sourish Sarkar, Penn State Erie, 4701 College Drive, Erie, PA, 16563, United States of America, szs15@psu.edu, Balaji Rajagopalan

We analyze consumer complaints data for light vehicles sold in U.S. during the years 2002-2013 by 41 major brands. Based upon this data, we investigate the factors that influence the number of complaints for any specific car-model. Factors that significantly contribute to the complaints are analyzed.

3 - Who Should Build the Network of Charging Stations for Electric Vehicles, Manufacturers or Dealers?

Tian Wang, School of Management, Huazhong University of Science of Technology, 1037 Luoyu Road, Wuhan City, Hu, 430074, China, wangtian3261@gmail.com, Shiming Deng

We investigate the issue of how to facilitate the expansion of the network of charging stations for Electric Vehicles (EVs). In particular, who should take the lead to build and own the network of charging station, manufacturers or dealers, to achieve a larger network to alleviate consumers' driving range anxiety? We study this from the supply chain perspective and provide strategies that may lead to a large market acceptance of EVs.

4 - Penalty – Reward Contracts to Coordinate a Manufacturer and its Logistics Service Provider

Emel Aktas, Senior Lecturer, Cranfield University, Cranfield School of Management, Cranfield, United Kingdom, emel.aktas@cranfield.ac.uk, Fusun Ulengin, Seda Yanik

Contracts coordinate disparate but interdependent members of the supply chain. Conflicting objectives of members and lack of coordination among them lead to inefficiencies in matching supply with demand. We model the logistics contract between a manufacturer and its service provider. We examine delivery order, penalty, and reward as contract parameters and report contract efficiency relative to full and no coordination. Delivery order, penalty, and reward contracts help achieve coordination.

■ WB15

Hilton- Exec. Boardroom

Revenue/Yield Management III

Contributed Session

Chair: Yalcin Akcay, Assoc. Professor, Koc University, Sariyer, Rumelifeneri Yolu Sariyer, Istanbul, 34450, Turkey, yakcay@ku.edu.tr

1 - Approximate Dynamic Programming for Network Revenue Management under Substitution

David Sayah, Johannes Gutenberg University Mainz, Chair of Logistics Management, Jakob-Welder-Weg 9, Mainz, 55129, Germany, sayah@uni-mainz.de

In network revenue management, algorithms producing high-fidelity value function approximations like approximate linear programming and Lagrangean decomposition recently have been the centre of attention within the community. This presentation will show extensions of some of these approaches to generalized problem settings in which the assortment may consist of flexible products allowing companies to choose a specific execution mode from a given set of alternative modes.

2 - Joint Pricing and Sourcing under Supply and Demand Risk

Amirmohsen Golmohammadi, McMaster University, 1280 Main Street West, DeGroote School of Business, Hamilton, ON, L8S4M4, Canada, golmoha@mcmaster.ca, Elkafi Hassini

We consider a newsvendor sourcing and pricing problem in a single and multiple period models. We present new results on joint optimal prices and order quantities when both supply and demand are uncertain. We present the concept of expected lost sale fill rate elasticity and show how it can be used to find the optimum policy in both single and multiple period cases. We also show how some of the previous results in the deterministic yield case relate to our models.

3 - How to Use Dynamic Local Knowledge: The Case for Intermodal Revenue Management

Yalcin Akcay, Assoc. Professor, Koc University, Sariyer, Rumelifeneri Yolu Sariyer, Istanbul, 34450, Turkey, yakcay@ku.edu.tr, Long Gao, Ting Luo

We focus on core operations of a local manager for an intermodal transportation company, load acceptance and container leasing/repositioning, over a short horizon. We develop a decentralized framework that jointly optimizes local operations and achieves network coordination. We introduce an MDP-based scarcity pricing scheme which self-regulates how each location interacts with the transportation network. We characterize the impact of dynamic forecasting on profitability and policy choice.

4 - Supply Allocation under Advance Demand Information
Felix Papier, Associate Professor, ESSEC Business School, Av. Bernard Hirsch, Cergy, 95021, France, papier@essec.edu

We study the problem of allocating limited supply to different markets with uncertain demand but for which advance demand information (ADI) can be obtained. Our research is motivated by an agri-food manufacturer that operates in several European countries and tries to maximize revenues. We use Markov Decision Processes to model the problem, develop an efficient heuristic solution, and derive structural properties that lead to several insights for supply chain managers in the agri-food industry.

5 - Analysis of Optimal Threshold in Batch Service Queueing Systems
Yun Zeng, Ohio State University, OH, United States of America, zeng.153@buckeyemail.osu.edu, Cathy Xia

In delivery systems with limited resources, one critical issue is to properly schedule the service so as to ensure customer satisfaction. We consider a batch service queueing system with Poisson arrivals and infinite holding/serving capacity, and study the optimal batching policy so as to minimize the expected waiting time of customers. Through closed-form analysis, we reveal the structure of the optimal policy and propose a simple strategy to find the optimal threshold. The results are further supported by simulation and can be applied to various practical delivery systems.

■ WB16

Hilton- Franciscan A

Behavorial Bias and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Michael Z. F. Li, Professor, Nanyang Technological University, Nanyang Business School, Nanyang Avenue, Singapore, 639798, Singapore, zfli@ntu.edu.sg

1 - Advance Selling with Overconfident Consumers
Michael Z. F. Li, Professor, Nanyang Technological University, Nanyang Business School, Nanyang Avenue, Singapore, 639798, Singapore, zfli@ntu.edu.sg

We study a retailer's advance selling strategy when some consumers are overconfidence in their valuations. We prove that advance selling is not always beneficial to retailer. The retailer should do advance selling when the difference of the regular consumers' expected valuation and expected surplus when not buying in advance is no less than a threshold.

2 - When Fixed Pricing Meets Priority Auction: Dual Modes of Service Systems
Jiayang Gao, Cornell University, 296 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, jg838@cornell.edu, Huseyin Topaloglu, Krishnamurthy Iyer

Consider a service center operating both a fixed price, FIFO market (pay as you go, PAYG), and a spot market running priority auction. We derive the unique equilibrium, in which customers with both high and low patience participate in spot market and the rest goes to PAYG. We discuss the social optimality of operating only the spot market, and the revenue maximizing price and server allocation.

3 - Pricing Product Versions for Strategic Impatient Customers
Vinod Cheriyan, School of Industrial and Systems Engineering, Georgia Tech, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, vinod.cheriyan@gatech.edu, Anton Kleywegt, Ravi Subramanian

We consider a monopolist who regularly introduces new product versions. Potential buyers anticipate new versions, and are heterogeneous in their ownership of versions and in their impatience to own a new version. The seller has to decide what discount to offer for the current version before each new version is introduced or what trade-in discount to offer after each new version is introduced. We characterize the seller's optimal pricing decisions and buyers' optimal purchase decisions.

4 - Estimating Elasticity of Demand for Commodity-based Manufacturers
David Rodriguez-Gomez, Director, PROS, 101 Montgomery Street, Suite 400, San Francisco, CA, 94104, United States of America, drodriguez@pros.com

We describe an econometric model that predicts the quantity demanded of a product in a demand segment at a certain time period given a particular lead time. The quantity demanded is a function of the net price quoted, history, trends, seasonality and the customer's elastic response to price and other marketing drivers. We discuss the methodology for estimating the parameters of the model given observed transactional data, with a focus on the own-price elasticity of demand.

■ WB17

Hilton- Franciscan B

Reducing and Accommodating Customer Variability in Services

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu

1 - Collection Control with Customer Choice Behavior for Rental Companies
Marco Bijvank, University of Calgary, Haskayne School of Business, Calfary, AB, T2N1N4, Netherlands, marco.bijvank@haskayne.ucalgary.ca, Iris Vis, Jaap Boter

We study the availability of items within a collection of items in a setting of public libraries, where we include the behavior of customers in case of a stock out. Next to field experiments about customer behavior, we model the setting as a continuous review inventory system with base-stock levels and emergency lateral transshipments to analyze library collections. A case study demonstrates the performance of our heuristic procedure to redistribute books over the different branches.

2 - On the Value of Customer Flexibility in (Electrified) Car-sharing
Philipp Ströhle, Karlsruhe Institute of Technology, Englerstr. 14, Karlsruhe, 76131, Germany, philipp.stroehle@partner.kit.edu, Christoph Flath

We present a multi-objective scheduling model that lets car-sharing providers decide between fleet utilization and customer walkways. We evaluate the model based on real-world customer reservation behavior and estimate the value of spatial flexibility to the provider. Moreover, we show to what extent flexibility can assist in introducing electric vehicles into car-sharing fleets. Our results show that car-sharing poses a promising field for the electrification of individual transportation.

3 - When and How to Differentiate? Implications for Strategic Delay, Prioritization, and Free Service
Arvind Sainathan, Nanyang Business School, NTU, S3-B2A-03 50 Nanyang Avenue, Singapore, Singapore, asainathan@ntu.edu.sg

We consider customers purchasing a service from a retailer/service provider. They may be heterogeneous both in their delay sensitivity and how much they value this service. We analyze the retailer's problem of minimizing her cost while providing them adequate service. Strategic delay and prioritization are two simple ways of differentiating customers, while a free service has key implications for marketing. We find conditions under which these features are optimal for the retailer.

4 - Staffing Service Systems when Capacity has a Mind of its Own
Itai Gurvich, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu, Antonio Moreno-Garcia, Martin Lariviere

We study capacity optimization when (nonsalaried) workers determine their own work schedule. Our study is motivated by recent innovations in service delivery such as work-from-home call centers and ride-sharing services. The provider in these settings cannot directly assign agents to time intervals but has to guarantee sufficient participation. Tensions between profit maximization and agent-earning constraints lead to departures from standard operations both in terms of decisions and outcomes.

■ WB18

Hilton- Franciscan C

Joint Session RM/TSL: Pricing Applications in Logistics: Inventory Control, Distribution, and Transportation

Sponsor: Revenue Management & Pricing & Transportation Science & Logistics

Sponsored Session

Chair: Sila Cetinkaya, Cecil H. Green Professor, SMU, Lyle EMIS and Cox ITOM, Dallas, TX, United States of America, sila@smu.edu

Co-Chair: Fatih Mutlu, Qatar University, MIE Department, Doha, 2713, Qatar, fatihmutlu@qu.edu.qa

1 - Linearly Decreasing Pricing for Shipment Consolidation

Bo Wei, research assistant, Dept of ISEN at Texas A&M, 1501 Holleman Dr Apt 166, college station, TX, 77840, United States of America, feixianxing@neo.tamu.edu, Lin Feng, Sila Cetinkaya

In this work, we study the optimal pricing strategies in the pure shipment consolidation model with linear demand function. We propose a linearly decreasing pricing strategy and analytically show that it achieves more profit than the optimal static price strategy. Finally, we prove rigorously that the linearly decreasing pricing strategy is optimal by using Pontryagin's maximum principle.

2 - Optimal Inventory and Warranty Pricing for Items with Imperfect Quality under Trade Credit

Yi Zhang, ISE Department, Texas A&M University, 1001 Harvey Rd. Apt. 50, College Station, TX, 77840, United States of America, dolphinazy@neo.tamu.edu, Sila Cetinkaya, Elif Akcali

Trade credit and warranty compensation are ubiquitous in B2B transactions. Trade credit can ease the financial burden of large upfront payments for purchasing the goods. Warranty compensation provides protection against potential losses due to imperfect quality of the goods. We develop a stochastic model to determine the optimal inventory and warranty pricing decisions in a two-stage supply chain to model and investigate the impact of imperfect quality and the duration of trade credit period.

3 - Contractual Pricing for a Carrier under Vendor-Managed-Inventory (VMI)

Sila Cetinkaya, Cecil H. Green Professor, SMU, Lyle EMIS and Cox ITOM, Dallas, United States of America, sila@itu.edu, Fatih Mutlu

We address channel coordination issues in a simple yet practical setting where a carrier is to ship the items within a two-echelon supply channel consisting of a supplier and a buyer. We consider the case where the supplier-buyer pair is operated under a VMI agreement whereas the carrier is a separate entity. We develop alternative transportation pricing contracts between the carrier and VMI partnership.

■ WB19

Hilton- Franciscan D

Revenue Optimization under Uncertainty in Healthcare

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Aurelie Thiele, Visiting Associate Professor, MIT, 77 Mass Ave Rm E40-121, Cambridge, MA, 02139, United States of America, aut204@lehigh.edu

Co-Chair: Tengjiao Xiao, Doctoral student, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, tex209@lehigh.edu

1 - A Forward Looking Risk Adjustment Approach using Markov Chains

Gregory McKinney, Business Analytics Consultant, Kaiser Foundation Healthplan, Inc., 1950 Franklin St. (MIA/MARS), Oakland, CA, 94612, United States of America, gmckinne@pacbell.net

Risk Adjustment models are used to set payments so health plans receive more for members with multiple chronic conditions compared to healthier members. The Centers for Medicare & Medicaid Services (CMS) define a model for payments covering over 15 million members. CMS payments use diagnoses from the prior year leading to a backward looking process. Revenue planning requires future risk score prediction. This paper offers an approach to predict future risk scores using Markov Chains.

2 - Robust Optimization Models in Healthcare Finance: The Role of Community Benefit Programs

Shuyi Wang, Doctoral student, Lehigh University, 217 W Packer Ave, Room 201, Bethlehem, PA, 18015, United States of America, shw210@lehigh.edu, Aurelie Thiele

Most hospitals in United States are non-profit and are federal tax exempt. In order to maintain their tax exempt status, these hospitals must contribute part of their revenue to benefit their communities. Most of the contributions are in the form of direct financial assistance. Many believe that if we can shift that amount of money upstream to invest in community-based activities that can prevent disease, we can improve people's health while decrease the rising healthcare cost.

3 - Robust Hospital Readmission Payment Adjustment

Tengjiao Xiao, Doctoral student, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, tex209@lehigh.edu, Aurelie Thiele

This paper introduces robust optimization models to address uncertainty in hospital readmission reduction, which imposes a financial penalty on hospitals with excess readmissions. We investigate the level of nurse staffing to minimize the probability of being penalized, while balancing between provider margins and payer costs. The impact lag is also incorporated in the models to ensure the financial viability of the hospital as the benefits are slower to materialize than expected.

■ WB20

Hilton- Yosemite A

Analysis

Contributed Session

Chair: Fethi Calisir, Industrial Eng. Department, Istanbul Technical University, Istanbul, Turkey, calisirfet@itu.edu.tr

1 - Assessment of Intellectual Capital (IC) Efficiency of Food Industry with DEA

Fethi Calisir, Industrial Eng. Department, Istanbul Technical U., Istanbul, Turkey, calisirfet@itu.edu.tr, Ayse Elvan Bayraktaroglu, Mine Isik

In this work, the Value-Added Intellectual Coefficient (VAIC) method that deals with financial, structural and human capitals are used to evaluate the efficiency of value creation. Then, DEA is used to reveal the relative performance of 12 companies on the Istanbul Stock Exchange. The IC performances and efficiency values of the companies are gathered by means of Charnes Cooper Rhodes methods. The benchmark set and the input, output evaluations are depicted by the efficient frontier. Additionally, the change of VAIC during the years 2009 to 2012 is compared with utilizing Malmquist index.

2 - Intellectual Capital and Firm Performance in Turkish Chemicals, Petroleum, Plastic Products Industry

Ayse Elvan Bayraktaroglu, Industrial Eng. Department, Istanbul Technical U., Istanbul, Turkey, ayseelvan@gmail.com, Murat Baskak, Fethi Calisir

Using the VAIC approach, the relationship between intellectual capital performance and firm performance for some firms listed in Istanbul Stock Exchange is analyzed. The relationship between VAIC components (human capital efficiency: HCE, structural capital efficiency: SCE, capital employed efficiency: CEE) and firm performance indicators are examined using canonical correlation analysis and commonality analysis. The common contribution of the three VAIC dimensions is found to be more decisive on the firms' performance compared to the individual effects of HCE, SCE, and CCE.

3 - The Use of Qualitative Data When Managing External Variety for Configurable Products

Erkin Isiklie, Bogazici University, Department of Industrial Engineering, Bebek, Istanbul, 34342, Turkey, ErkinIsiklie@itu.edu.tr

The reduction of external variety is a strategic decision that is made under the consideration of various factors. In this study, using online consumer reviews on a configurable product, text mining techniques were employed with the aim of helping this decision making process by shrinking the set of product variants without losing too much critical information. The results indicate that when building demand models, such qualitative models should Definitely be utilized in order to obtain better insights.

■ WB21

Hilton- Union Sq 1

Maritime Transportation

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Harilaos Psaraftis, Professor, Technical University of Denmark, Bygningstorvet 1, Lyngby, 2800, Denmark, hnpsar@transport.dtu.dk

1 - Optimal Compliance Strategies to Shipping Emission Regulation

Michele Acciaro, Assist. Professor of Maritime Logistics, The Kuehne Logistics University (KLU), Grosser Grasbrook 17, Hamburg, 20459, Germany, michele.acciaro@the-klu.org, J. Rod Franklin

The development of emission regulation in shipping has increased managerial complexity. In order to provide support to shipping firms, this paper presents an application of decisions analysis under technology and fuel price uncertainty. Results show that operational strategies are optimal only as long as fuel price variability remains high.

2 - Practical Applications of Operations Research Tools in Marine Transportation

Henry Chen, Chief Naval Architect, Jeppesen Marine, 1000 Atlantic Avenue, Suite 108, Alameda, CA, 94501, United States of America, henry.chen@jeppesen.com

More than 90% of world's cargo are carried by ships. Optimizing design, operations and logistics can greatly improve the efficiency and safety of this supply chain, especially in today's high fuel cost and restricted carbon emission. Examples are: Voyage simulations for comparing ship designs, and establishing METOCEAN criteria for tows; Minimizing fuel consumption on a given schedule, specific ship loading conditions under a set of response based constraints and weather forecast.

3 - Planning Liner Shipping Services

Christian Vad Karsten, The Technical University of Denmark, Produktionstorvet Bygning 426, Kgs. Lyngby, 2800, Denmark, chrkr@dtu.dk, Anant Balakrishnan

We address the Liner Shipping Service Selection Problem that entails selecting the best subset of sailing routes from a pool of candidate routes to maximize the satisfied demand subject to limits on the number of transshipments and routing constraints. We propose a hop-constrained multi-commodity arc flow model on an augmented network, and outline a preprocessing procedure to reduce problem size. We present computational results for problems from the LINER-LIB benchmark suite.

4 - Efficient Dynamic Programming Approach for the Container Relocation Problem

Virgile Galle, MIT Operations Research Center, Cambridge, United States of America, vgalle@mit.edu, Cynthia Barnhart, Setareh Borjian, Vahideh Manshadi, Patrick Jaillet

We propose a fast and efficient Dynamic Programming approach for optimally solving the container relocation problem (also referred to as block relocation problem). Our method is capable of obtaining optimal solutions in a reasonably short time and is thus applicable in real time operations. Further, we extend our solution approach to a new version of the container relocation problem: the incomplete information case when the entire departure schedule of containers is not known beforehand.

5 - Emissions Minimization Ship Routing Problem

Christos Kontovas, Assistant Professor, Technical University of Denmark, Bygningstorvet 115, Lyngby, 2880, xkontovas@gmail.com, Harilaos Psaraftis

We investigate some possible reformulations of existing ship routing and scheduling models so as to incorporate emissions considerations. Speed decisions are also taken into account. Because of the non-linear relationship between speed and fuel consumption, it is obvious that a ship that goes slower will emit much less than the same ship going faster. In that context, some fundamentals are outlined, the main trade-offs are analysed, and some decision models are presented.

■ WB22

Hilton- Union Sq 2

Identity and Change in Organization Science

Sponsor: Organization Science

Sponsored Session

Chair: Emily Block, Assistant Professor of Management, University of Notre Dame, Notre Dame IN 46556, United States of America, esblock@gmail.com

1 - The Identity of Religious Research Universities in the Face of Secularization

Dave Whetten, Emily Block, Alan Wilkins

Abstract is not available at this time.

2 - Bottle Revolution: Constructing Consumer and Producer Identities in the Craft Brewery Industry

Cameron Verhall, Emily Block, Michaela DeSoucay, Jo-Ellen Pozner, Katarina Sikavika

This paper considers the conundrum that in a market that co-evolved with an identity movement and that possesses a clearly defined organizational form identity, how do market participants manage to de-partition the market to the point that generalists and specialists compete directly? We believe this unexpected dynamic is driven by the intentional use of language on the part of both generalist and specialist producers, and aided by the evolution of the identity movement itself. We investigate the ways that language drives market structure, drawing on organizational ecology, neo-institutional theory, and theories of linguistic and cultural framing. We focus on language as a set of shared meanings that mobilize actors in support of change, propagate new identities, and help actors make or dispute claims of legitimacy.

3 - Coopting Contention: The Rise and Routinization of Corporate-Sponsored Insurgency

Mae McDonnell

Abstract is not available at this time.

4 - Embeddedness and Borrowed Identitiy: The Case for California Franchisee Restaurant

Nydia McGregor

Abstract is not available at this time.

■ WB23

Hilton- Union Sq 3

Container Supply Chain Coordination

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Jan C. Fransoo, Professor, Eindhoven University of Technology, School of Industrial Engineering, PO Box 513, Pav F4, Eindhoven, 5223 GV, Netherlands, j.c.fransoo@tue.nl

1 - Cost, Carbon Emissions and Modal Shift in Intermodal Network Design Decisions

Yann Bouchery, Ecole de Management de Normandie, 30, Rue de Richelieu, Le Havre, 76087, France, y.bouchery@tue.nl, Jan C. Fransoo

Intermodal transportation is generally considered as efficient for reducing carbon emissions without compromising economic growth. In this article, we present a new intermodal network design model in which the terminal location and the allocation between direct truck transportation and intermodal transportation are optimized. The model allows for studying the dynamics of intermodal transportation in the context of hinterland networks from a cost, carbon emissions and modal shift perspective.

2 - The Impact of Demurrage and Detention Tariffs on Hinterland Container Planning

Jan C. Fransoo, Professor, Eindhoven University of Technology, School of Industrial Engineering, PO Box 513, Pav F4, Eindhoven, 5223 GV, Netherlands, j.c.fransoo@tue.nl, Stefano Fazi, Tom Van Woensel

Demurrage and detention are charged to shippers and freight forwarders for the usage of containers between the port of arrival and unloading at the receiver's location. In this study, we investigate the consequences of D&D, based on actual tariff structures in Rotterdam. Our findings show that the tariff structure leads to increased overall costs of transportation and to excessive storage of containers in the scarce space of the deepsea quay.

3 - Barge Port-Hinterland Container Network Design with Synchronization Constraints

Rob Zuidwijk, Professor, Rotterdam School of Management, PO Box 1738, Rotterdam, 3000 DR, Netherlands, rzuidwijk@rsm.nl, Panagiotis Ypsilantis

A barge operator schedules its minimum cost barge services at the tactical level to accommodate container transport between seaport and its hinterland. He decides on deployment and routing of his barge fleet exploiting economies of scale. The corresponding MIP problem is solved for a particular real-life case in the Netherlands. Our results show the effects of economies of scale, number of calls per trip, and required service frequency on total costs.

4 - Carrier Portfolio Management in Liner Shipping

Tao Lu, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, tluaa@ust.hk, Chung-Yee Lee, Jan C. Fransoo

We study a shipper transporting seasonal products from overseas to the destination market. In addition to spreading the risk arising from uncertain transit times, we find that using a combination of fast and slow liner services can help tackle the demand uncertainty in the destination. When carriers' arrival sequence is fixed, we fully characterize the optimal solution with an efficient frontier. A DP-based algorithm is further proposed to optimally solve the problem with setup costs.

5 - Fractional Price Matching Policies Arising from the Ocean Freight Service Industry

Rui Yin, Associate Professor, Arizona State University, Dept of Supply Chain Management, W.P.Carey School of Business, Tempe, AZ, 85287, United States of America, rui.yin@asu.edu, Jaehyung An, Chung-Yee Lee, Chris Tang

We consider a situation in which shippers can purchase ocean freight services either directly from a carrier in advance or from the spot market just before the departure of an ocean liner. The price is known in the former case, while the spot price is uncertain ex-ante in the latter case. We examine if the carrier should bear some of the price risk by offering a "fractional" price matching contract that will "partially match" the realized spot price when it is lower than the regular price.

■ WB24

Hilton- Union Sq 4

Transportation, Intelligent Systems I

Contributed Session

Chair: Young-Ji Byon, Khalifa University (KUSTAR), Al Saada St. and Muroor Rd., Abu Dhabi, United Arab Emirates, youngji.byon@kustar.ac.ae

1 - using Smartphones to Improving Safety and Mobility for Pedestrians

Sara Khosravi, Research Assistant, University of Arizona, 811 E Prince Rd #221, Tucson, AZ, 85719, United States of America, sarakhosravi@email.arizona.edu, Larry Head, Navin Katta

The purpose of this project is to make use of emerging and state-of-the-art technologies including Smartphones and 3G/4G/LTE, Wi-Fi, and DSRC communications, to find innovative and effective ways to improve pedestrian safety and mobility. These improvements can be achieved by integrating pedestrian information with the Connected Vehicle system to provide effective and timely warnings to both pedestrians and motorists.

2 - Finding the Distribution of Maximum Queue Length using Probe Vehicle Data with Low Penetration Rate

Xin Qi, Tsinghua University, Shunde Building 519A, Beijing, 100084, China, x-qi12@mails.tsinghua.edu.cn, Hai Jiang

We develop a model to estimate the distribution of queue lengths at signalized intersections using GPS data from probe vehicles. We validate our model using data from both microscopic simulation and NGSIM. Results show that our model can produce satisfactory results.

3 - Comparing Efficiency of Different Intelligent Transportation Systems using Agent Based Simulation

Amirhosein Gholami, State University of New Yourk at Binghamton, 13 Goethe St., Binghamton, United States of America, agholam1@binghamton.edu, Nasim Nezamoddini

The traffic congestion problem in urban areas has been addressed by developing different types of intelligent systems. Agent based modeling has been applied to model systems including system with intelligent traffic signal timing and dynamic route guide and combination of them. Efficiency of each system, has been tested in presence of the unexpected events with different failures rates. Proposed transportation management systems have been tested under different assumption and traffic situations.

4 - Determination of Noise Accumulation using ADS-B Signals and Geographic Information Systems

Young-Ji Byon, Khalifa University (KUSTAR), Al Saada St. and Muroor Rd., Abu Dhabi, United Arab Emirates, youngji.byon@kustar.ac.ae, Joonsang Baek, Young-Seon Jeong

Emerging ADS-B technologies enable transportation engineers access real-time trajectories of airplanes. Near airports, the density of such signals are higher. Since ADS-B passively emits information about type of each airplane, it is possible to estimate the amount of noise accumulation that affects the nearby grounds. By using DEM in GIS, more accurate distribution of the noise can be determined.

5 - Semi-quantitative Risk Assessment of Adjacent Track Accidents on Shared-use Rail Corridors

Chen-Yu Lin, Graduate Research Assistant, University of Illinois at Urbana-Champaign, Room B-118, 205 N. Mathews Ave., Urbana, IL, 61801, United States of America, clin69@illinois.edu, Mohd Rapik Saat

Adjacent track accident (ATA) is one of the most important safety concerns on shared-use rail corridors. ATA refers to train accident scenarios where a derailed equipment intrudes adjacent tracks. The research described in this paper presents a comprehensive risk assessment to identify factors affecting the likelihood and consequence of ATA. A semi-quantitative risk analysis model is developed to evaluate the ATA risk.

■ WB25

Hilton- Union Sq 5

Transportation Planning IV

Contributed Session

Chair: Seong Wook Hwang, The Pennsylvania State University, 232 Leonhard Building, The Pennsylvania State University, University Park, PA, 16802, United States of America, soh5223@psu.edu

1 - An Global Approximation Model for the Continuous Network Design Problem

BO DU, Nanyang Technological University, N1-B4b-07, 50 Nanyang Avenue, Singapore, 639798, Singapore, bdu1@e.ntu.edu.sg, Zhiwei Wang

Continuous network design problem is often formulated as a bi-level program with equilibrium constraints, and only approximation solution can be obtained due to its non-convexity. Based on geometric programming, this paper develops an equivalent single-level model to find an approximated global optimal solution. The principle of solving this problem is to apply a monomial approximation method to transform it to an equivalent nonlinear but convex problem, which is amenable to a global solution.

2 - Temporal Analysis of Origin-destination Matrices Estimation based on Passenger Cars Traffic Counts

Carlos Gonzalez-Calderon, Postdoctoral Research Associate, Rensselaer Polytechnic Institute, 110 8TH ST, JEC 4037, TROY, NY, 12180, United States of America, gonzac8@rpi.edu, Susana Restrepo Morantes, John Jairo Posada Henao, Catalina Osorio

This research introduces an entropy maximization demand model to estimate origin-destination matrices for passenger vehicles on the basis of traffic counts for different years. The performing of the formulation for the different time periods (2001-2008) is tested in the Medellin, Colombia network.

3 - Unit-Train Multiple Car Expected Quantity of Release Modeling

Hsiao-Hsuan Liu, Graduate Research Assistant, University of Illinois at Urbana-Champaign, 205 North Mathews Avenue, Urbana, Il, 61801, United States of America, hliu70@illinois.edu, Jesus Aguilar Serrano, Christopher PL Barkan, Mohd Rapik Saat

Railroads transport large quantities of hazardous materials over long distance in North America. The release size of an incident is a crucial factor for hazardous materials transportation risk. A probabilistic methodology is developed in this study to estimate the expected quantity of release based on the number of tank cars releasing.

4 - On-route Ride Sharing in Closed User Groups

Rick van Urk, University of Twente, P.O. Box 217, Enschede, 7500AE, Netherlands, r.vanurk@utwente.nl, Martijn Mes, Marco Schutten

A challenge ride sharing initiatives face is to encourage users to accept a shared ride even though this results in longer travel times. To solve this, we propose a method where only on-route ride sharing is allowed. We consider a closed user group, which creates a network of trusted drivers using the ride sharing network. We match users using the arcs of individual optimal routes of users.

5 - Robust Strategy for Alternative Fuel Refueling Station Location under Demand Uncertainty

Seong Wook Hwang, The Pennsylvania State University, 232 Leonhard Building, The Pennsylvania State University, University Park, PA, 16802, United States of America, soh5223@psu.edu, Sang Jin Kweon, Jose A. Ventura

In this research, we apply robust optimization to a multi-period planning problem of locating refueling stations on a transportation network with uncertain alternative fuel vehicle (AFV) demand. Forecasting AFV demand over multiple periods, we consider a refueling station location problem to find the number of stations and their locations over each period.

■ WB26

Hilton- Union Sq 6

Vehicle Routing II

Contributed Session

Chair: Wei Zhou, Research Assistant, University of Illinois at Chicago, 892 W Taylor St, Chicago, IL, 60607, United States of America, wzhou27@uic.edu

1 - An Adaptive Large Neighborhood Search Method for Solving the Electric Vehicle Routing Problem

Bulent Catay, Sabanci University, FENS, Tuzla, Istanbul, 34956, Turkey, catay@sabanciuniv.edu, Merve Keskin

The Electric Vehicle Routing Problem with Time Windows is a new variant of the classical Vehicle Routing Problem with Time Windows where the vehicles are routed to service a set of customers under recharging constraints. In this study, we propose an Adaptive Large Neighborhood Search method to solve this problem. Our initial results show the proposed method is effective in finding good solutions.

2 - A New Fuzzy Modeling Approach for Joint Manufacturing Scheduling and Shipping Decisions

Can Celikbilek, PhD Candidate, Ohio University, 285 Stocker Center Ohio University, Athens, OH, 45701, United States of America, cc340609@ohio.edu, Gursel A. Suer

This study discusses a new fuzzy modeling approach for joint manufacturing scheduling and shipment decisions within a supply chain network. The aim of this study is to maximize the total net profit while minimizing the risks caused by selecting alternative transportation modes. Different transportation modes are considered in this study. This study will be unique in the sense of considering an integrated fuzzy approach with manufacturing scheduling and transportation mode selections.

3 - The Parking Time Dilemma and Chinese Postman's Revenue

Nichalin Summerfield, Full Time Lecturer, University of Massachusetts Dartmouth, 285 Old Westport Rd, North Dartmouth, MA, 02747, United States of America, nsummerfield@umassd.edu, Moshe Dror, Morris Cohen

We model an administrative activity of issuing parking tickets in a dense city street grid as a revenue collection Chinese Postman Problem. After demonstrating that our design of inspection routes maximizes the expected revenue we investigate decision rules that allow the officers to adjust online their inspection routes in response to the observed parking permits' times. A simulation study concludes that allowing the officer to selectively wait by parked cars increases the expected revenue.

4 - The Dynamic Pollution-Routing Problem with Time-dependent Travel Time

Wei Zhou, Research Assistant, University of Illinois at Chicago, 892 W Taylor St, Chicago, IL, 60607, United States of America, wzhou27@uic.edu

This paper presents the so-called Dynamic Pollution-Routing Problem, a coupling of Dynamic Vehicle Routing Problem and Pollution-Routing Problem. In urban areas, travel speed and changes drastically during the day because of congestion, thus DPRP treats the travel time functions as step functions. In this paper, mathematical models under dynamic context are presented for the time-dependent DPRP. A mixed integer linear programming approach is developed to solve the problem.

5 - A Branch-and-Price Algorithm for Vehicle Routing with Demand Allocation Considerations

Ahmed Ghoniem, Assistant Professor, Isenberg School of Management, 121 Presidents Dr., University of Massachusetts Amherst, Amherst, MA, 01003, United States of America, aghoniem@isenberg.umass.edu, Mohammad Reihaneh

We develop a branch-and-price algorithm for vehicle routing with demand allocation problems (VRDAP) which arise in food bank operations, the delivery of healthcare services in developing countries, and beyond. The VRDAP selects distribution sites, allocates "customers" to the latter, and optimizes the routes of delivery vehicles. The objective function minimizes a weighted average of the distance traveled by customers to reach distribution sites and that traveled by delivery vehichles.

■ WB27

Hilton- Union Sq 7

Logistics 2

Contributed Session

Chair: Youssef Boulaksil, Assistant Professor, UAE University, College of Business and Economics, P.O. Box 15551, Al Ain, United Arab Emirates, youssef.boulaksil@gmail.com

1 - Reliable Intermodal Freight Network Expansion: Case with Uncertain Network Disruptions

Fateme Fotuhiardakani, Research Assistant, University of South Carolina, 300 Main st, Columbia, SC, 29208, United States of America, fotuhiar@email.sc.edu, Nathan Huynh

This paper develops a robust model to improve the reliability of an intermodal network to enable it to perform well in normal and disrupted situations. The objective of the model is to identify critical links to "harden", locations to establish new terminals, and existing terminals to expand, within a given budget. We propose a Hybrid Genetic Algorithm (HGA) to solve the model. The experimental results demonstrate the efficacy and computational efficiency of the proposed HGA.

2 - A Stochastic Programming Model for Yard Storage Allocation under Uncertainty

Yue Wu, University of Southampton, School of Management, Southampton, SO17 1BJ, United Kingdom, y.wu@soton.ac.uk

This paper investigates allocation of yard space to containers under uncertainty. Two types of stacks are defined: containers with the same destination are assigned to dedicated stacks in the same block; containers in shared stacks have different destinations. A two-stage stochastic model is developed to determine an optimal storage strategy. The first-stage decision is to allocate containers to dedicated stacks and the second-stage decision is to place additional containers to shared stacks.

3 - Maintenance and Service Logistics Planning in the Maritime Sector: A Research Agenda

Ayse Sena Eruguz, Postdoc, Eindhoven University of Technology, P. O. Box 513, Eindhoven, 5600 MB, Netherlands, a.s.eruguz@tue.nl, Tarkan Tan, Geert-Jan Van Houtum

Maintenance and service logistics support are required to ensure high availability and reliability for maritime assets and represent a significant part of exploitation costs. In this talk, we will present a classification of the maintenance and service logistics literature considering the specific characteristics of the maritime sector. We will discuss unexplored issues and shortcomings of existing models and suggest a research agenda.

4 - Distributing FMCG to Small Retailers in Emerging Markets

Youssef Boulaksil, Assistant Professor, UAE University, College of Business and Economics, P.O. Box 15551, Al Ain, United Arab Emirates, youssef.boulaksil@gmail.com

Distributing fast moving consumer goods to small retailers in emerging markets is a challenging task. The small retailers offer informal credits to their customers, which makes them operate with limited and uncertain availability of cash. Since distributors require payment in cash at the moment of delivery, 'empty deliveries' may result in case of insufficient amount of cash available. We conduct a simulation study to better understand empty deliveries, which reveals interesting insights.

■ WB28

Hilton- Union Sq 8

Breaking the Silos in Airline Crew Scheduling

Sponsor: Aviation Applications

Sponsored Session

Chair: Norbert Lingaya, Manager of Optimization Technologies, Ad OPT, a Division of Kronos, 3535 Queen Mary Rd, Suite 650, Montreal, QC, h3v1h8, Canada, nlingaya@Kronos.com

1 - Thinking out of the Box by Breaking the Silos

Norbert Lingaya, Manager of Optimization Technologies, Ad OPT,a Division of Kronos, 3535 Queen Mary Rd, Suite 650, Montreal, QC, h3v1h8, Canada, nlingaya@Kronos.com

"Think outside the box" is a catchphrase that has become somewhat cliché and void. In this talk we focus on "breaking the silos" as one way to think outside the box when applied to optimized Crew Planning. We present a rationale for the opportunity to break some silos, the challenges to be addressed and the expected benefits.

2 - Integrated Crew Paring and Crew Assignment by Dynamic Constraint Aggregation

Mohammed Saddoune, Université Hassan II, Mohammedia, Casablanca, Morocco, mohammed.saddoune@gerad.ca

The crew scheduling problem is commonly decomposed into two stages which are solved sequentially. Crew pairing generates a set of pairings covering all flight legs. Crew assignment generates anonymous blocks covering all pairings. The simultaneous problem generates a set of blocks covering all flight legs. It is a large set covering problem highly degenerated. We solve it with column generation and the dynamic constraint aggregation and save up to 9% on real-life problems.

3 - Simultaneous Optimization of Crew Pairing and Personalized Monthly Schedules

Atoosa Kasirzadeh, Ecole Polytechnique de Montreal & GERAD, 2900 Boulevard Edouard-Montpetit,, Montreal, QC, H3Z 1J9, Canada, Atoosa.Kasirzadeh@gerad.ca, Francois Soumis, Mohammed Saddoune

We present a set-covering formulation and an iterative heuristic algorithm for personalized integrated cockpit pairing and assignment problems. The objective is having as much as possible similar pairings between pilots and co-pilots to increase the schedules robustness, even if pilots and co-pilots monthly schedules are different to satisfy their preferences. We use a solution approach based on column generation and numerical results are provided based on a major US carrier data set.

4 - Integrated Aircraft Routing, Maintenance Planning and Robustness for Operation

Francois Soumis, Ecole Polytechnique, Cp. 6079, Montreal, QC, H3C 3A7, Canada, francois.soumis@gerad.ca, Stephen Maher, a Division of Kronos, 3535 Queen Mary Rd, Suite 650, a Division of Kronos, 3535 Queen Mary Rd, Suite 650, Montreal, QC , h3v1h8, Canada, nlingaya@Kronos.com, Montreal, QC, h3v1h8, Canada, nlingaya@Kronos.com, Guy Desaulniers

It is common to solve the aircraft routing and maintenance planning problems many months in advance but infeasibilities appear due to perturbations in operations. We present a novel approach generating aircraft routes for a single day and ensuring a sufficient number of routes from each city going to maintenance next night. The solution is protected from disruptions by applying a recoverable robustness framework. Tests on large scale problems demonstrate significant reduction in recovery costs.

■ WB29

Hilton- Union Sq 9

Manufacturing 2

Contributed Session

Chair: Xi Gu, PhD Candidate, University of Michigan, 1210 H. H. Dow, 2300 Hayward Street, Ann Arbor, MI, 48109, a Division of Kronos, 3535 Queen Mary Rd, Suite 650, Montreal, Q , h3v1h8, Canada, nlingaya@Kronos.com, United States of America, xig@umich.edu

1 - Resilient Design for Manufacturing Systems

Xi Gu, Ph.D. Candidate, University of Michigan, 1210 H. H. Dow, 2300 Hayward Street, Ann Arbor, MI, 48109, United States of America, xig@umich.edu, Jun Ni, Xiaoning Jin

Resilience is regarded as a competitive advantage of manufacturing systems. A resilient system has the ability to quickly recover from faults/failures to normal conditions with no or least performance loss. The objective of this research is to model and analyze the resilience measures of manufacturing systems with unreliable machines and finite buffers. Both the steady-state and transient behavior of such systems is studied, and system design strategies are investigated.

2 - Ergonomic Risk Mapping at the Refrigerator Company

Ilgin Acar, Anadolu University, Faculty of Eng. Dept. of Industrial Eng., Eskisehir, Turkey, ipoyraz@anadolu.edu.tr, Gizem Deniz, Ozlem Urem, Ibrahim Yilmaz

As is known, there could be discomfort in almost every job due to the heavy and repetitive workload. We consider a production line at the refrigerator company that has 110 work stations to assess the ergonomic risk. NISOH, REBA and Lumbar Motion Monitor (LMM) are used to map the ergonomic risk at the work stations. Improvements are offered based on the findings of related methods.

3 - Simultaneous Line Balancing and Worker Allocation in a U-shaped Production Line

Joseph Ekong, Auburn University, 2319 Shelby Center, Auburn, AL, 36849, United States of America, jje0003@auburn.edu

An MIP model for a simultaneous U-shaped assembly line balancing and worker allocation problem is proposed. Tasks are assigned to stations and workers are assigned to the stations resulting in a global solution. The objective is to minimize deviation of operation times of workers. Impact of variability is investigated.

4 - Applying Six Sigma Techniques to Reduce Defect Rate of Deep Drawing Process for Aluminum Products

Theyab Alhwiti, Auburn University, 362 W Glenn Ave APT 104, Auburn, Al, 36830, United States of America, tza0002@auburn.edu, Nader Al Theeb

Sheet metal deep drawing is an important process to produce many products. The goal of this research is to improve this process to reduce the defective percentage rate of scratches, flange wrinkling, and earing defects appear in aluminum deep drawn products from 3% to 0.8% by adopting new mold with an excellent parameter values and control. A design of experiment phase is conducted to find the best factorial level combination of the clearness, holding force, speed, and lubricant parameters.

5 - Comparison of Simulation and Optimization Models to Support Decisions in Semiconductor at Operations

Shihui Jia, Graduate Research Assitant, The University of Texas at Austin, Graduate program in IE/OR, University of Texas at Austin, Austin, TX, 78712, United States of America, sjia@utexas.edu, Jonathan Bard

This talk presents simulation and optimization models to support machine setup and lot dispatching decisions for assembly & test operations in semiconductor manufacturing. The simulation model was built in AutoSched AP and improved by incorporating setup output from the optimization model and customizing the dispatch rules. Experiments were conducted on six datasets and results compared using the following metrics: hot lot shortages, weighted throughput, resource usage, and machine utilization.

■ WB31

Hilton- Union Sq 11

Applying Computational Creativity in Service Industries

Sponsor: Service Science

Sponsored Session

Chair: Ying Li, Research Staff Member, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, yingli@us.ibm.com

1 - Computational Creativity for Personalized Artifact Creation

Nan Shao, Research Staff Member, IBM T. J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, nanshao@us.ibm.com, Pavankumar Murali, Anshul Sheopuri

Can a computer create an artifact which is judged to be creative by a targeted group of individuals? We explore data-driven computational creativity for personalized artifact design based on two key attributes, quality and novelty. We present the methodology, comment on the available data sources, and illustrate the concept using an example in the culinary recipe creation.

2 - Intelligent Search Methods for Computational Creativity

Pavankumar Murali, Research Staff Member, IBM T. J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, pavanm@us.ibm.com, Nan Shao, Anshul Sheopuri

Computational creativity for designing artifacts requires searching through a combinatorially complex design space. Traditional methods resort to greedy heuristics to identify and evaluate artifacts for creativity. We present an alternative optimization framework where the evaluation metrics are used to prune the design space subject to theoretical underpinnings. We evaluate the performance of the proposed solution using public datasets on food recipes, cuisines, ingredients and chemistry.

3 - Assessing Aesthetics of Food Dishes using Computational Methods

Ying Li, Research Staff Member, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, yingli@us.ibm.com, Anshul Sheopuri

We propose and implement a novel approach to assess the aesthetics of food dishes. Our framework builds upon work in the area of color science, psychology and statistics to enable users to computationally assess whether the image of a dish is unique and visually appealing with the appropriate texture. Using Google Glass as an innovative way to interact with consumers on this application is also under active investigation, which will bring us a new dimension from wearable computing.

4 - Can Computational Creativity Produce a Commercially Successful Artificial Songwriter?

Dan Ventura, Professor, Brigham Young University, Provo, UT, 84602, United States of America, ventura@cs.byu.edu

Music is a promising domain for studying computational creativity. Music is also a huge industry, and the potential of a computational song-writing system that can produce consumable music is enticing from both a research standpoint and an economic one. We will discuss some of the challenges involved in building such a system and some approaches to their solution, including incorporation of affect, discovery of musical motifs, flexible style composition, and the combination of music with lyrics.

5 - Computational Narrative Intelligence: Opportunities and Challenges for Sense-Making with Data

Mark Riedl, Professor, Georgia Institute of Technology, 85 5th Street NW, Atlanta, GA, 30308, United States of America, riedl@cc.gatech.edu

Narrative intelligence is an entity's ability to organize, explain, and generate experiences in narrative terms. Computational story understanding and generation can be used to automatically seek familiar and novel patterns in data, create human-readable explanations of temporal changes in data, and hypothesize about occurrences in missing data.

6 - An Optimization Model for Determining Assortment of New Product at Store Level for Fashion Retailers

Dingding Lin, IBM Research - China, Building 19A, Dongbeiwang West Rd 8#, Zhongguancun Software Park, Beijing, 100193, China, ddlin@cn.ibm.com, Yongqing Xue, Ganggang Niu, Yue Tong

Store assortment is critical to help achieve retail success. However, due to highly volatile demand, short lifecycle of products, and high ratio of new styles, fast fashion retailers are facing great challenges on store assortment planning. An assortment optimization model for new products is proposed and a planning system based on this model is developed to aid fast fashion retailers in decisions of which new products to stock at store level.

■ WB32

Hilton- Union Sq 12

Operations/Service 2

Contributed Session

Chair: Zainab Al Balushi, Assistant Professor, Sultan Qaboos University, College of Economics PO BOX 20, Operations Mangement, AL Khoudh, 123, Oman, zainab.albalushi@gmail.com

1 - Optimal Dynamic Pricing of Mobile Data Plans in Wireless Communications

Xiaoyu Ma, Tsinghua University, Haidian District, Beijing, China, maxythu@gmail.com, Tianhu Deng

With smartphones sweeping the world, customers use much more data service than voice service nowadays. Because mobile data service occupies much more network capacity than voice, wireless network is frequently congested. We build a dynamic cell phone plan control model where the service provider can decide a subset of plans to open at the beginning of each period. In a case study, we analyze a large mobile service provider in Asia using 10,000 real individual-level data.

2 - Planning and Competition in Information Chain

Boyoun Choi, UCLA Anderson School, 110 Westwood Blvd, Gold Hall, Suite B-512, Los Angeles, CA, 90095, United States of America, bchoi@anderson.ucla.edu, Uday Karmarkar

We examine aspects of information chains, which process and distribute digital content in a way analogous to goods in supply chain. We consider the capacity planning problem for information content, where we decide in each period how many workers to utilize and how many items to process to make them available in the database, which is then available to customers. On competitive side, we investigate optimal release time and pricing of content such as video and model competition among vendors.

3 - Operations Management Practices in Service and Performance

Asma Al Zaidi, Assistant Professor, Sultan Qaboos University, CEPS, PO Box 20 PC123, Alkhoudh, Muscat, 123, Oman, alzidia@squ.edu.om, Zainab Al Balushi

This study proposes a model that conceptualizes the dimensions of operations management practices in managing the service quality. The model also tests the hypothesized relations between the operations management practices and performance. The results have confirmed the conceptualized model and its relations.

4 - Contract for Professional Services

Ting Luo, The University of Texas at Dallas, 7208 Fair Valley Way, Plano, TX, 75024, United States of America, ting.luo@utdallas.edu

Professional service firms turn human capital into specialized service where their clients couldn't but hope to duplicate. When they enter the contract, the client can't verify everything not because of costly observation but the disparity in expertise. The literature assumes the agent reveals true type under IC and IR constraints, but what if the principal can't understand the exact type? A principal and agent model will be presented where the principal is less knowledgeable than the agent.

5 - A Network Economic Model of a Service-Oriented Internet with Choices and Quality Competition

Sara Saberi, Isenberg School of Management, University of Massachusetts, 121 Presidents Drive, Amherst, MA, 01002, United States of America, ssaberi@som.umass.edu, Anna Nagurney, Dong Li, Tilman Wolf

A dynamic network economic model is developed for a service oriented Internet with service differentiation. We utilize variational inequality theory for formulation of Nash equilibrium. The projected dynamical systems provide a continuous-time evolution of service volumes and quality levels. We recall stability analysis results and construct a discrete-time version of the adjustment process that yields an algorithm. The algorithm is utilized to solve several examples with sensitivity analysis.

■ WB33

Hilton- Union Sq 13

New Product Development 1

Contributed Session

Chair: Niharika Garud, Postdoctoral Research Fellow, IIM Bangalore, M213 Madhav Nagar, Gwalior, MP, 474002, India, niharika.garud@gmail.com

1 - A Dynamic Model for Trade-off Analysis of New Green Products

Mohammad Reza Gholizadeh Toochaei, Student, Concordia University, 1455 De Maisonneuve Blvd. west, Montreal, QC, H3G 1M8, Canada, gholizadeh.mr@gmail.com, Nadia Bhuiyan

Companies can design their products for the environment based on different strategies. It is imperative for companies to forecast their profit at the design stage through a trade-off analysis in the new product development process. This paper is an attempt to introduce a dynamic model that considers effective factors that impact the total yearly profit based on managers' decisions regarding the level of development when products are designed for resource and energy efficiency or recyclability.

2 - Development of Customer Satisfaction Function Based on Kano's Quality Model

Daisuke Amano, student, Tokyo Metropolitan University, 6-6, Asahigaoka, Hino, 191-0065, Japan, amano_daisuke_1023@yahoo.co.jp, Yasutaka Kainuma

In this study, we suggest the way of determining which quality element by identifying the degree of importance of a product's quality element and identifying the functional relationship by conforming to the Target Planning V-model. In the analysis process, we combined the AHP and the Kano's quality model so that it can be able to grasp the weights of importance and quality model. In the synthesis process, we conduct group decision making passed through consensus building.

3 - New Product Design Evaluation and Flexibility Planning under Technological and Market Uncertainty

Amir Sanayei, Wayne State University, 4815 Fourth St., Detroit, MI, 48202, United States of America, sanayei@wayne.edu, Leslie Monplaisir

Product architecture decisions are one of the most critical decisions that are maid in early stages of the new product development with huge impact on all downstream activities and product success in the market. In this research we propose a frame work to evaluate the new product design in order to incorporate managerial flexibility into NPD projects and decrease technical and market risks, while increasing potential market value.

4 - In-depth Features of the IBM CPLEX Optimization Studio IDE

Frederic Delhoume, Software Engineer, IBM, 9 Rue de Verdun, Gentilly, 94253, France, delhoume@fr.ibm.com

We will present many features that allow IBM CPLEX Optimization Studio IDE users to accelerate their model development. Tips and tricks will be presented, related to editing models, viewing results, debugging and writing custom scripting code, profiling. This presentation will also introduce the Eclipse environment IBM CPLEX Optimization Studio is based on.

■ WB34

Hilton- Union Sq 14

Session

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Paulo Goncalves, University of Lugano, Via Giuseppe Buffi 13, Lugano, TI, 6900, Switzerland, paulo.goncalves@usi.ch

1 - Multi-preposition Decisions under Resource Constraints

José Gonçalves, U. of Porto, Rua Dr. Farias, s/n, Porto, Portugal, jfgoncal@fep.up.pt, Jarrod Goentzel, Jaime Andrés Acevedo Casta-eda

The subject of this study is a Newsstand (multi-item Newsvendor) setting under resource constraints in the context of preposition decisions. The authors explore how individuals react to different resource levels when they preposition multiple emergency supplies that differ in their cost levels, assessing thus how constrained resources affect preposition decisions.

2 - Supply Chain Optimization of the Distribution of Mosquito Nets in Ivory Coast

Paulo Gonçalves, University of Lugano, Via Giuseppe Buffi 13, Lugano TI 6900, Switzerland

The use of insecticide-treated mosquito nets is one of the most effective ways to reduce malaria deaths. To help plan UNICEF's distribution of 12 million bed-nets in Ivory Coast, we developed a model to optimize the costs from purchasing and prepositioning at Districts level, achieving 7% logistics cost reduction.

■ WB35

Hilton- Union Sq 15

Next Generation Decision Support for the Next Pandemic

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Samuel V Scarpino, Omidyar Fellow, Santa Fe Insitute, 1399 Hyde Park Road, Santa Fe, NM, 87501, United States of America, scarpino@santafe.edu

1 - Detecting Epidemics using Wikipedia Article Views using Language as a Proxy for Location

Geoffrey Fairchild, Los Alamos National Laboratory, P.O. Box 1663, Mailstop P939, Los Alamos, NM, 87545, United States of America, gfairchild@lanl.gov, Sara Del Valle, Reid Priedhorsky, Nicholas Generous, Alina Deshpande

We propose an open data source previously unexplored for infectious disease surveillance: Wikipedia access logs. We demonstrate that these data feasibly support an approach that overcomes challenges traditional systems face. Specifically, our proof-of-concept yields models with r^2 up to 0.92, forecasting value up to the 28 days tested, and several pairs of models similar enough to suggest that transferring models from one location to another without re-training is feasible.

2 - An Integrative Surveillance System for Influenza-associated Hospitalizations in at Risk Populations

Samuel V Scarpino, Omidyar Fellow, Santa Fe Insitute, 1399 Hyde Park Road, Santa Fe, NM, 87501, United States of America, scarpino@santafe.edu, James Scott, Rosalind Eggo, Lauren Meyers, Nedialko Dimitrov

Influenza hospitalizations are positively associated local measures of poverty. We developed a framework for combining multiple data sources to predict influenza outbreaks in at-risk populations. The data sources considered were: emergency department visits, primary healthcare providers, and Google Flu Trends. We demonstrate that out-of-sample performance was lowest in the most at-risk zip codes, which highlights the importance of understanding the dynamics of influenza in these populations.

3 - Optimizing Vaccine Allocations for Pandemic Influenza

Bismark Singh, The University of Texas at Austin, 204 E. Dean Keeton St., Austin, TX, 78712-0292, United States of America, bismark.singh@utexas.edu, Hsin-Chan Huang, David Morton, Lauren Meyers

We develop a decision-support tool to optimize vaccine allocations during an influenza pandemic. Our allocation is proportionally fair for user-specified target populations, and we further analyze a weighted proportionally fair allocation. Using 2009 H1N1 data in the state of Texas, we show how the Texas Department of State Health Services can reserve a small percentage of doses and achieve fair coverage, while most vaccines are allocated based on healthcare provider requests.

4 - Epidemiological Consequences of An Ineffective Bordetella Pertussis Vaccine and an Option for Reducing Rising Whooping Cough Incidence

Ben Althouse, Santa Fe Institute, Santa Fe, NM, United States of America, althouse@santafe.edu, Haedi DeAngelis, Samuel V Scarpino

The recent increase in Bordetella pertussis incidence (whooping cough) presents a challenge to global health. Recent studies have called into question the effectiveness of acellular pertussis vaccination in reducing transmission. Here we examine the epidemiological consequences of an ineffective pertussis vaccine and present a cost-benefit analysis of an alternative scenario – priming individuals with one dose of the older, side effect-prone whole-cell vaccine. Using dynamic transmission models, we find that: 1) an ineffective vaccine can account for the observed increase in pertussis incidence; 2) asymptomatic infections can bias surveillance and upset situational awareness of pertussis, including obfuscating assessment of the population-level effectiveness of vaccination programs; 3) vaccinating individuals in close contact with infants too young to receive vaccine (so called "cocooning" unvaccinated children) may be ineffective; and 4) priming individuals with a single dose of whole-cell vaccine can reduce overall pertussis morbidity and may provide up to a 10-fold reduction in societal costs of pertussis infection. Our results have important implications for pertussis vaccination policy and present a complicated scenario for achieving herd immunity and pertussis eradication.

■ WB36

Hilton- Union Sq 16

Information Systems 4

Contributed Session

Chair: Wael Jabr, Assistant Professor, University of Calgary, 2500 University Dr NW, Calgary, AB, T2N1N4, Canada, wjabr@ucalgary.ca

1 - Firm Transition into Hybrid Systems as a Function of Exploration and Exploitation

Sukruth Suresh, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, 12180, United States of America, suress@rpi.edu

IT firm offerings have transitioned from only products or services to one of a hybrid model encompassing both. This is attained by organic growth, by acquisitions or through alliances with firms that have strong service or product backgrounds. While organic growth can be seen as exploitative in nature, acquisitions or alliances are explorative. We posit that the attributes of industry concentration and firm prestige moderate the mode in which firms choose between exploration and exploitation.

2 - Hand Anthropometry: A Missing Construct in Technology Acceptance Model

Pei-Lee Teh, Senior Lecturer, Monash University, Jalan Lagoon Selatan, Bandar Sunway, Selangor, 46150, Malaysia, teh.pei.lee@monash.edu, Soon-Nyean Cheong, Emily Yim Lee Au, Wen-Jiun Yap, Pervaiz K. Ahmed, Ravindra S. Goonetilleke

Technology Acceptance Model (TAM) is regarded as a robust theoretical model for predicting technology usage. Given that more technologies are operated by gesture-based Interface, it is surprising that no study of the hand anthropometry effects on TAM has been conducted. This study examines how hand anthropometry influences user technology acceptance.

3 - Theorizing Information Systems as Technology: Might it be Fruitful?

E. Burton Swanson, Research Professor, UCLA Anderson School, 110 Westwood Plaza, Ste. D502, Los Angeles, CA, 90095, United States of America, burt.swanson@anderson.ucla.edu

Information systems scholars have struggled with the field's fundamental relationship to technology. They have debated whether the IT artifact is unwisely taken for granted and whether it lies at the field's core. Here, applying Arthur's general theory of technology,it is suggested that IS may itself be theorized as technology, opening up new avenues for research, where the unit of analysis is the technology itself and the focus is its evolution.

4 - Research on Construction & Techniques of Social Manufacturing-driven Personalized Enterprise Space

Zhen Zhao, Arizona State University, 2343 W main St, Apt 1048, Mesa, AZ, 85201, United States of America, reebokalone2001@gmail.com, Pingyu Jiang, Mei Zheng

The paper proposed personalized enterprise space (PES) which is the basic node of social manufacturing network (SMN) by 1.establishing framework of PES to illustrate its configuration and operation method; 2.discussing four key enabling technologies in detail, including role-based access control model, manufacturing capability assessment, context-based information recommendation, order generation & tracking; 3.developing a prototype platform to verify the feasibility and practicability.

■ WB37

Hilton- Union Sq 17

Big Data 3

Contributed Session

Chair: Samik Raychaudhuri, 24/7 Customer Pvt. Ltd., EGL Business Park, Off Intermediate Ring Road, Bangalore, 560071, India, samikr@gmail.com

1 - Design of Palatable Credit Scorecards as a Highly Automated Analytic Service

Gerald Fahner, FICO, 181 Metro Drive, San Jose, United States of America, ehershman@iqprinc.com

Lenders require accurate and interpretable credit scoring models. Scorecards fulfill these needs. Designing such models has remained a laborious data-guided task. With new data sources abounding and environments changing fast, lenders would like to design, update and test models, predictors and segmentation schemes frequently, objectively and cost-effectively. We propose designing scorecards as an automated analytic service.

2 - using Predictive Analytics for Customer Intent Mining

Samik Raychaudhuri, 24/7 Customer Pvt. Ltd., EGL Business Park, Off Intermediate Ring Road, Bangalore, 560071, India, samikr@gmail.com, Ravi Vijayaraghavan

In this presentation, we discuss about an emerging and niche area of application of predictive analytics with big data, known as customer intent mining. We serve millions of end customers through various channels on behalf of our clients. We provide an intuitive experience when the customers contact us by leveraging the rich interaction data that we come across through various customer touchpoints, and predicting intent in real time using machine learning models on big data.

3 - Intelligent Data Management through the Data Burst (Best Practices)

Hussain Alajmi, Team Leader, Kuwait Oil Company, Poboc 9758, Ahmadi, 61008, Kuwait, hussain@kockw.com

In KOC we achieved the better data management through different projects to overcome the data burst, which represents the main challenge in the decision making process. Our solution started with the conformance analysis to have a detailed numerical description and statistics of different data issues. The workflows nature depend on the nature of data itself and the issue.

■ WB38

Hilton- Union Sq 18

Health Care Modeling Optimization VII

Contributed Session

Chair: Steven Cohen, AHRQ, 540 Gaither Road, Rockville, MD, 20850, United States of America, steven.cohen@ahrq.hhs.gov

1 - The Impact of Misclassification and Nonresponse Errors when Oversampling Dynamic Populations

Steven Cohen, AHRQ, 540 Gaither Road, Rockville, MD, 20850, United States of America, steven.cohen@ahrq.hhs.gov

Achieving sample size targets for population subgroups that are dynamic in nature is a difficult enterprise.Attention is given to the utility of a model-based approach to oversample dynamic populations.Model performance is evaluated in terms of predictive capacity, sensitivity and specificity, assessing levels of misclassification errors inherent in alternative model specifications and its impact on precision targets and survey cost.

2 - Using Simulation to Advocate Process Improvement at a Clinical Lab

Yang Sun, Sacramento State College of Business, 6000 J St, Sacramento, United States of America, suny@csus.edu

Clinical lab testing is central to many healthcare processes. As this industry is experiencing rapid demand growth, job arrivals have reached such a high level at a large clinical lab in a southwestern state that it simply cannot process them in a timely and efficient manner. In order to gain management support on a heuristics-based process remodeling solution, simulation is used as an advocating tool to demonstrate potential benefits of the renovated design of the specimen area of the lab.

3 - Mixed Integer Programming Approaches for Two-Step Multiple Provider Practices

Hari Balasubramanian, University of Massachusetts Amherst, 160 Governors Drive Amherst MA 01003, Amherst, MA, 01002, United States of America, hbalasub@admin.umass.edu, Hyun-Jung Oh, Ana Muriel

We propose mathematical programming formulations for scheduling patient appointments in primary care with nurse and provider steps, stochastic service times at both steps, and flexibility in the nursing step.

4 - Managing Bouncebacks to a Cardiac Intensive Care Unit

Yazan F. Roumani, Assistant Professor, Oakland University, 342 Elliot Hall, Rochester, MI, 48309, United States of America, roumani@oakland.edu, Yaman Roumani, Luis Vargas

Bounce backs increase the complexity of managing ICUs. We propose a strategy to reduce the probability of bouncing back by setting a minimum required initial length of stay for patients visiting a cardiac ICU. We find no statistically significant increase in means of: time spent in hospital, immediate upstream unit and all upstream units of the intensive care unit after implementing the proposed strategy.

5 - A Novel Approach for Vascular Sounds of Arteriovenous Fistulas and Vascular Stenoses

Wheyming Song, Professor, National Tsing Hua University, 101, Sec. 2, Kuang-Fu Rd., Hsinchu, 30013, Taiwan - ROC, wheyming_song@yahoo.com

This research focuses on increasing the sensitivity and specificity of existing approaches on analyzing vascular Sounds of arteriovenous fistulas and vascular stenosis. The proposed approach is based on a series of scientific procedures, including (1) design of analysis (2) independent component analysis. Results show that the sensitivity and specificity of the proposed approach are all above 99% and 98%, respectively.

■ WB39

Hilton- Union Sq 19

HSEA - II — Spotlight on HSEA Student Research

Sponsor: Health Applications

Sponsored Session

Chair: Julie Ivy, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, United States of America, jsivy@ncsu.edu

1 - Spotlight on HSEA Student Research

Julie Ivy, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, United States of America, jsivy@ncsu.edu

This session will highlight student research in Health Systems from HSEA member institutions with a focus on undergraduate and early stage graduate research. There will be five student lead research presentations.

■ WB40

Hilton- Union Sq 20

Inverse Planning for Cancer Treatment

Sponsor: Health Applications

Sponsored Session

Chair: Dionne Aleman, Associate Professor, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, aleman@mie.utoronto.ca

1 - Pareto Robust Optimality in Breast Cancer Radiation Therapy Treatment

Houra Mahmoudzadeh, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, houra@mie.utoronto.ca, Thomas G. Purdie, Timothy C. Y. Chan

We quantify the benefit of applying the concept of Pareto robust optimality to radiation therapy treatment planning of breast cancer where the uncertainty is in the patient's breathing. Pareto robust optimal solutions have the same performance as robust optimal solutions under worst-case, but may perform better under non-worst case scenarios. We apply this method for different patients and compare the results with those of robust optimization and current clinical treatment methods.

2 - Mixed-integer Methods for Radiation Therapy with Continuous Beams

Kimia Ghobadi, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, kimia@mie.utoronto.ca, Dionne Aleman, David Jaffray

We explore exact and heuristic methods in modelling treatment planning for Gamma Knife Perfexion, where the radiation is delivered with a continuous beam instead of conventional discrete beams. We explore artificial intelligent path finding methods, and formulate mixed-integer models to find beam times for the selected path. We discuss challenges and advantages of our proposed method and explore practicality of implementing it on conventional radiation units.

3 - Inverse Planning for Focal Ablation in Liver Cancer Treatment

Shefali Kulkarni-Thaker, Graduate Student, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, shefali@mie.utoronto.ca, Aaron Fenster, Dionne Aleman

In focal ablation, current is passed through a needle inserted into a tumor to generate heat, killing the tumor. We develop a mathematical framework to design optimal ablation treatments. First, we obtain the needle position and orientation using optimization and geometric approximations. Next, we solve a thermal dose optimization (TDO) to obtain the treatment time for adequate thermal dose delivery. We also propose an approximation for TDO to obtain a lower bound on the treatment time.

■ WB41

Hilton- Union Sq 21

Supply Chain Management II

Contributed Session

Chair: Kai Hoberg, Kühne Logistics University, Grofler Grasbrook 17, Hamburg, 20457, Germany, kai.hoberg@the-klu.org

1 - What Drives Supplier Selection Decisions? A Firm-Level Investigation in the Automotive Industry

Kai Hoberg, Kühne Logistics University, Grofler Grasbrook 17, Hamburg, 20457, Germany, kai.hoberg@the-klu.org, Florian Badorf, Felix Papier

We empirically analyze the relationship between firm-level factors such as relationship strengths, market share, and financial stability and the probability that a supplier is selected for a sourcing project. We use empirical data from the automotive industry with more than 60,000 supplier selection decisions. We develop a regression model, test its robustness, and analyze it in different industry contexts. Furthermore, we present a prediction model for supplier selections with high accuracy.

2 - Selecting Suppliers

Serhat Yilmaz, Graduate Student, Texas State University, 902 Sagewood Trl., San Marcos, TX, 78666, United States of America, s_y29@txstate.edu

One of the most important issue that supply chain manager faces is selecting the right suppliers. This project presents the important effect of supply selection on the supply as a whole. It also presents the supplier selection criteria by reviewing and analyzing the qualitative criteria.

3 - Supply Chain Coordination under Moral Hazard

Taesu Cheong, Assistant Professor, National University of Singapore, 1 Engineering Drive 2, Blk E1A #06-25, Singapore, Singapore, taesu.cheong@outlook.com, Sang Hwa Song

We address moral hazard issues in supply chain contract. It has been discussed that risk sharing among supply chain players through contracts such as buyback contract can help coordinating a supply chain. However, we present a negative example of buyback contract in practice due to moral hazard stemming from incentive conflicts among participants in a supply chain and further discuss how well it could be possibly managed and coordinated by the base stock policy under the moral hazard problem.

4 - Optimal Procurement Strategies for Contractual Assembly System with Fluctuant Procurement Price

Yi Yang, Associate Professor, Zhejiang University, School of Management, Hangzhou, China, yangyicuhk@gmail.com

We consider a multi-component assembly system in which the assembler produces a final product in order to satisfy the one-time demand at a future time. Components can be purchased from outside suppliers with positive leadtimes under either time-inflexible or time-flexible contracts. One of the components faces an uncertainty in its procurement price.The assembler needs to determine how much to purchase and when to purchase each component. We characterize the optimal procurement strategies.

5 - Coordinating a Supply Chain when Consumers Strategically Wait for Sales

Tian Li, East China University of Science and Technology, School of Business, Shanghai, 200237, China, litian@ust.hk, Man Yu

A supply chain consists of a manufacturer and a newsvendor retailer selling a seasonal product to strategic consumers. A simple buyback contract is shown to coordinate the chain, where the aggregate demand is both price-dependent and quantity-dependent. Nevertheless, the set of coordinating buyback contractual terms shrinks as consumers are more willing to wait. The retailer gains from strategic waiting in a coordinated chain.

■ WB42

Hilton- Union Sq 22

System Dynamics in Health II

Sponsor: Health Applications

Sponsored Session

Chair: Mohammad S. Jalali, Virginia Tech / MIT, 113 Harvard St, Apt 1, Cambridge, MA, 02139, United States of America, mj@vt.edu

1 - How Will Mandated Medicare Payment Rate Reductions Affect Hospitals and Patients to 2050?

Jack Homer, Homer Consulting & MIT, 72 Station Hill Road, Barrytown, NY, 12507, United States of America, jhomer@comcast.net, Liming Cai, Gary Hirsch

The Affordable Care Act mandates permanent Medicare payment growth rate reductions to non-physician providers. Medicare's Office of the Actuary initially calculated that these reductions could cause most such providers to become unprofitable by 2040, likely leading to hospital closures and adverse impacts for patients. But this calculation was simplified and ignored several dynamic factors. OACT is using system dynamics modeling to study these factors and develop more nuanced projections.

2 - A Model of Human Growth and Body Weight Dynamics

Hazhir Rahmandad, Associate Professor, Virginia Tech / MIT, MIT Sloan School of Management, Cambridge, MA, 02139, United States of America, hazhir@vt.edu

Quantifying human weight and height dynamics due to growth, aging, and energy balance can inform clinical practice and policy analysis. I present a simulation model of dynamics of body weight, composition and height. The model replicates key trends in human growth including A) Changes in energy requirements from birth to old ages. B) Short and long-term dynamics of body weight and composition. C) Stunted growth with chronic malnutrition and potential for catch up growth.

3 - A System Dynamics Approach to Predict the Overall Impact of Interventions to Improve CKD Care

Hyojung Kang, PhD Candidate, Penn State University, 940 Stratford Ct., State College, PA, 16801, United States of America, hqk5116@psu.edu, Harriet Nembhard

Chronic kidney disease (CKD) is a growing health problem in the U.S. Patients with CKD have had critical care gaps that have perhaps led to a more rapid progression of CKD toward end stage renal disease (ESRD). In response to the need to improve CKD outcomes, we have conducted an interdisciplinary study. Using a system dynamics approach, this research aims to develop a platform for prospective planning of interventions that help slow and prevent the disease progression to ESRD.

4 - Exploring Task-shifting in Primary Care: The Case of the University of Utah Community Clinics

Andrada Tomoaia-Cotisel, PhD Candidate, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London, WC1H 9SH, United Kingdom, andradat@lshtm.ac.uk, Jaewhan Kim, Bernd Rechel, Michael Magill, Karl Blanchet, Jenny Neuburger, Martin McKee, Andy Haines, Samuel Allen, Debra Scammon, Timothy Farrell, Julie Day, Zaid Chalabi

A key element of the patient centered medical home lies in expanding the Medical Assistant role, or task-shifting. System dynamics was used to uncover the causal mechanisms and leverage points resulting in observed tensions and mixed outcomes at an academic medical center. Variation in physicians' estimation of time delays in team learning is hypothesized to drive variations in implementation and patient health. This research is informing management's revised implementation plan.

■ WB43

Hilton- Union Sq 23

Computational Integer Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Yan Xu, Senior Manager, SAS Insitute Inc., 100 SAS Campus Dr., Cary, NC, 27519, United States of America, yan.xu@sas.com

1 - Advances in Convex Quadratic Integer Optimization with Xpress
Michael Perregaard, Xpress Development, FICO, International Square, Starley Way, Birmingham, B15 2EX, United Kingdom, MichaelPerregaard@fico.com

We present recent advances in the solution of mixed integer quadratically constrained programming (MIQCP) problems. We describe solution techniques used by the FICO Xpress solver to efficiently solve various types of MIQCP problems, including those with second-order cone constraints.

2 - New Features and Improvements in SAS/OR 13.2
Imre Polik, SAS Institute, Cary, NC, 27513, United States of America, imre.polik@gmail.com

In this talk we present a summary of the work that went into producing the latest release of the operations research tools in SAS. We will focus mostly on mixed-integer linear optimization.

3 - Recent Developments in the Gurobi Optimizer
Ed Rothberg, Gurobi Optimization, Inc., Houston TX, United States of America, rothberg@gurobi.com

This presentation will talk about new developments in the Gurobi Optimizer, with a particular emphasis on new distributed algorithms.

4 - Recent Advances in IBM ILOG CPLEX Optimization Studio
Andrea Tramontani, CPLEX Optimization, IBM Italy, Via Martin Luther King 38/2, Bologna, 40132, Italy, andrea.tramontani@it.ibm.com

We will present some of the new features that have been added to CPLEX and will give benchmark results that demonstrate the performance improvements on Mixed Integer Linear and Mixed Integer Quadratic models in the recent CPLEX versions.

■ WB44

Hilton- Union Sq 24

The Interface between Information Systems and Operations Management

Sponsor: Information Systems

Sponsored Session

Chair: Oliver Yao, Associate Professor, Lehigh University, 621 Taylor Street, Bethlehem, 18015, United States of America, yuy3@lehigh.edu

1 - Influence of Organizational Design for Enacting IT Complementarities
Kailing Deng, University of Arkansas, WCOB217D, Information System Department, Sam M. Walton College of Business,, Fayetteville, United States of America, Kdeng@walton.uark.edu, Pankaj Setia

This study unravels how organizational design influences enactment of complementarities for capability-building. Due to different micro-level interactions, organizational designs influence match between the use of information technologies and business initiatives. Authors build a computational model that uses survey data to show enactment of complementarities for building demand management capabilities.

2 - Does Logistics Matter in E-commerce? An Empirical Study of the Last Mile Problem
Jifeng Luo, Associate Professor, Shanghai Jiao Tong University, Fahuazhen RD. 535, Shanghai, China, luojf@sjtu.edu.cn, Huan Zheng, Ying Rong

Leading e-commerce companies are rapidly expanding their logistics networks to deliver items faster and more reliably. This improved logistics quality drives customers to share their positive experiences online. Using a dataset from China's largest e-marketplace platform, we empirically explore the role of logistics services and their effects on online consumer purchasing behaviors. We find that consumers do consider both delivery time and WOM about logistics performance.

■ WB45

Hilton- Union Sq 25

From Deadline to Reciprocity: Assorted Topics in Behavioral Operations

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Kay-Yut Chen, University of Texas at Arlington, Arlington, TX, United States of America, kychen@uta.edu

1 - Is a Newsvendor More Bounded Rational Making Two Decisions Instead of One?
Kay-Yut Chen, University of Texas at Arlington, Arlington, TX, United States of America, kychen@uta.edu, Shan Li

The behavior newsvendor literature focuses on scenarios of a single (but repeated) decision. We conduct an experimental study with newsvendor making two unrelated (managing independent stores) and related (via transshipment) decisions simultaneously. We found non-trivial correlations between decisions across stores, and constructed a behavioral/learning model to explain the findings.

2 - Optimizing a Reciprocal Workforce
Cipriano Santos, Deep Analytics Architect, Hewlett-Packard, 3000 Hanover St, Palo Alto, CA, 94304, United States of America, cipriano.santos@hp.com, Alex Zhang, Kay-Yut Chen, Claudia Marquez, Haitao Li

We study a workforce planning problem in which employees reciprocate to higher wages by increasing productivity; we incorporate reciprocity in the form of a productivity response function which is nonlinear. Our problem is to decide on the wage levels and the workforce capacities to minimize the total cost.

3 - Power and Fairness
Diana Wu, University of Kansas, United States of America, dianawu@ku.edu, Tony Cui, Paola Mallucci

Understanding what is "fair" is central to research on fairness. While different theories have been proposed to explain how decision makers evaluate the fairness of an outcome, one important characteristic of social interaction, power, is missing from the picture. In this research, we offer laboratory evidence that power has significant impact on perceptions of fairness.

4 - An Experimental Comparison of Reserve Price Auctions and Auctions with Renegotiation
Lijia Tan, Xiamen University, Wang Yanan Institute for Studies, D109, Economics Building, Xiamen, 361005, China, ljtan.wise@gmail.com, Jason Shachat

We conduct an experimental comparison of auctioneer behavior in reserve price auctions and post-auction decisions to engage the auction winner in ultimatum game bargaining. Both auctions forms, when used optimally, implement the Myerson optimal mechanism. However, subjects fail to act optimally for different behavioral reasons in the two formats as the number of bidders change. We show examples of how this leads to economically significant performance differences in varying costs environments.

■ WB46

Hilton- Lombard

Advances in Mixed-integer Programming Theory

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Dan Steffy, Oakland University, Dept. of Mathematics and Statistics, 2200 N. Squirrel Road., Rochester, MI, 48309, United States of America, steffy@oakland.edu

1 - Optimality Certificates and Sensitivity Analysis for Mixed Integer Programming Problems
Babak Moazzez, Carleton University, 1125 Colonel By Drive, Ottawa, ON, K1S 5B6, Canada, bmoazzez@math.carleton.ca

After solving a mixed integer program, a certificate can be used the check the optimality of the solution at hand. We present generalized subadditive generator functions which can be used as certificates of optimality and also as a tool for sensitivity analysis for MILPs. These are subadditive dual feasible functions with desirable properties. The certificates generated are much easier to check compared with the time needed to solve the optimization problem.

2 - On the Intersection of Two Mixing Sets with a Cardinality Constraint

Kevin Ryan, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, kevin.ryan30@gmail.com, Shabbir Ahmed, Santanu Dey

Mixing sets with cardinality constraints are frequently encountered in integer programming reformulations of chance constrained optimization problems. We study an extended formulation for the polyhedron defined by the intersection of two mixing sets with a cardinality constraint.

3 - On the Complexity of Inverse Optimization Problems

Ted Ralphs, Lehigh University, 200 W Packer Avenue, Bethlehem, PA, 18015, United States of America, ted@lehigh.edu

Inverse optimization is the problem of determining the unknown values of certain problem parameters that are closest to given estimates and will make a given solution optimum. We show that the inverse mixed integer linear optimization problems (MILP) with unknown objective function is coNP-complete. Moreover, we generalize this result to the higher level optimization problems. We also propose a cutting plane algorithm for solving inverse MILPs for practical purposes.

4 - The L-Shape Search Method for Triobjective Integer Programming

Martin Savelsbergh, Professor, University of Newcastle, Callaghan, Newcastle, NSW2308, Australia, martin.savelsbergh@newcastle.edu.au, Hadi Charkhgard, Natashia Boland

We present a new criterion space search method, the L-shape search method, for finding all nondominated points of a triobjective integer program. The method is easy to implement, and is more efficient than existing methods. Moreover, it is intrinsically well-suited for producing high quality approximate nondominated frontiers early in the search process. An extensive computational study demonstrates its efficacy.

■ WB47

Hilton- Mason A

Monte Carlo Simulation-Based Methods for Stochastic Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Güzin Bayraksan, Associate Professor, Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, bayraksan.1@osu.edu

1 - Mitigating Uncertainty via Compromise Decisions in Two-stage Stochastic Linear Programming

Yifan Liu, University of Southern California, University Park Campus, GER 240, Los Angeles, CA, 90089, United States of America, yifanl@usc.edu, Suvrajeet Sen

Stochastic Programming (SP) has long been considered as a well-justified yet computationally challenging paradigm for practical applications. For a class of two stage stochastic linear programming, we present exciting computational results with Stochastic Decomposition (SD). A new solution concept which we refer to as the compromise decision is introduced.

2 - Bias and Variance Reduction when Estimating the Optimal Value of Stochastic Programs

Burak Buke, The University of Edinburgh, School of Mathematics, JCMB King's Buildings, Edinburgh, EH9 3JZ, United Kingdom, b.buke@ed.ac.uk, Lukasz Szpruch

Monte Carlo methods are used extensively for assessing the solution quality in stochastic programs. It is known that the using sample average approximations provide us with a biased estimator of the optimal objective value. In this work, we suggest a Monte Carlo method, which relies on estimating the objective value as a telescopic sum, and discuss how it helps us reduce the bias and variance in an efficient manner.

3 - Variance Reduction Techniques for Non-Sequential and Sequential Sampling in Stochastic Programming

Rebecca Stockbridge, Assistant Professor - Research, Wayne State University, 656 W. Kirby, Detroit, MI, 48202, United States of America, rstockbridge@math.wayne.edu, Güzin Bayraksan

We apply variance reduction techniques, specifically antithetic variates and Latin hypercube sampling, to optimality gap estimators used in standalone procedures as well as sequential sampling algorithms. We discuss both theoretical and computational results on a range of test problems.

4 - Scenario Aggregation Regions for Portfolio Selection with Tail Risk Measures

Jamie Fairbrother, PhD Student, STOR-i CDT, Fylde College, Lancaster University, Lancaster, LA1 4YF, United Kingdom, j.fairbrother@lancaster.ac.uk, Stein W. Wallace

Tail risk measures, such as the conditional Value-at-Risk, are used in stochastic programming to mitigate or reduce the probability of large losses. A key observation about these is that they don't depend on the main body of the loss distribution. A ramification of this is that for scenario-based optimization problems, outcomes never incurring large losses can be aggregated, thus reducing the computational cost of their solution. We demonstrate this principle for a class of portfolio problems.

■ WB48

Hilton- Mason B

Optimization, Robust 3

Contributed Session

Chair: Giovanni Paolo Crespi, Associate Professor, University of Valle d'Aosta, Loc. Grand Chemin 73/75, Saint Christophe, 11020, Italy, g.crespi@univda.it

1 - Quasiconvexity of Set-valued Maps Assures Well-posedness of Robust Vector Optimization

Giovanni Paolo Crespi, Associate Professor, University of Valle d'Aosta, Loc. Grand Chemin 73/75, Saint Christophe, 11020, Italy, g.crespi@univda.it, Matteo Rocca, Daishi Kuroiwa

We formulate robust and the optimistic counterparts of an uncertain non-linear vector optimization problem as set optimization problems, to study well-posedness of both. We apply the embedding technique for set optimization developed by Kuroiwa and Nuriya (2006). To prove our main results we study the notion of quasiconvexity for set-valued maps. We provide a general scheme to define the notion of level sets and we study the relations among different subsequent definitions of quasi-convexity.

2 - Robust Integrated Scheduling of Crane Handling and Truck Transportation in Container Terminals

Narges Kaveshgar, PhD Candidate, University of South Carolina, 300 Main Street, Room C110, Columbia, SC, 29208, United States of America, kaveshga@email.sc.edu, Nathan Huynh

To lower the vessel turn time, the operations of quay cranes, yard cranes and yard trucks need to be coordinated. Most of the studies have optimized these operations individually and have assumed that they have deterministic task processing times. This study develops and solves a robust model that jointly schedules operations while considering non-deterministic processing times and other operational constraints such as tasks precedence relationship, blocking and quay crane interference.

3 - Robust Optimization of Gas Production with Pressure and Routing Constraints

Pelin Cay, Lehigh University, 200 W Packer Ave., Bethlehem, PA, United States of America, pec212@lehigh.edu, Luis Zuluaga, Robert Storer

We consider the problem of optimizing the production of a gas with pressure and routing constraints. In general, this problem can be formulated as a non-linear integer programming problem. We propose a methodology to obtain solutions that avoids drastic changes in production levels in response to forecasted changes in demand and/or production costs. We illustrate our results with relevant numerical experiments.

4 - Two-Stage Robust Optimization and Stochastic Programming: Drawing Parallels and Distinctions

Aldis Jakubovskis, University of Missouri - St. Louis, 229 Express Scripts Hall, One University Boulevard, St. Louis, MO, 63121, United States of America, jakubovskisa@missouri.edu, Haitao Li

A direct comparison of robust optimization (RO) to stochastic programming (SP) is not always a convenient task, as SP and RO rely on two distinct interpretations of uncertainty. A two-stage facility location and capacity planning model with random demands is used to compare RO and SP on four criteria: the type of probability distribution, the ratio of the robust interval in RO and a variability measure in SP, the magnitude of the penalty costs in SP, and the effect of correlated demands.

5 - Price Uncertainty and Robust Planning of Oil Refineries

Jens Bengtsson, Associate Professor, NMBU School of Economics and Business, P.O. Box 5003, Aas, 1432, Norway, jens.bengtsson@nmbu.no, Patrik Flisberg, Mikael R^nnqvist

Several studies indicate relationships between changes in product prices and crude oil prices and vice versa. It is of interest to analyze how these relationships can be formulated in terms of uncertainty constraints used in robust optimization. From there it is also of interest to analyze how different uncertainty constraints will affect the planning of an oil refinery supply chain, risk exposures and the cost of robustness.

■ WB49

Hilton- Powell A

Network Optimization and Its Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Tachun Lin, Assistant Professor, Bradley University, 1501 W Bradley Ave, Peoria, IL, 61625, United States of America, djlin@bradley.edu

1 - Bus Bridging Design for Public Transportation Incident and Event Response

Zhili Zhou, Research Staff Member, IBM Research Collaboratory Singapore, Singapore, Singapore, zhili@sg.ibm.com

The subway system serves as the main component of public transportation system. In this study, bus bridging routes are designed for express buses serving for subway incident/event impacted original-destination (OD) demands. Stochastic models are built to handle uncertain OD demands and uncertain travel time. Column generation based algorithm and pre-processing algorithms are proposed for routing generation and computational complexity reduction. Real Incident scenarios are tested.

2 - Minimum-Cost Lambda-Edge-Connected k-Subgraph Problem

Elham Sadeghi, Graduate Research Assistant, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, sadeghi@email.arizona.edu, Neng Fan

We propose exact algorithms based on integer programming formulations to solve the minimum-cost lambda-edge-connected k-subgraph problem, or the (k,lambda)- subgraph problem. This problem is to find a minimum-cost lambda-edge-connected subgraph with at least k vertices. Numerical experiments are performed on randomly generated graphs.

3 - Robustness of Layered Networks against Failure Probabilities

Tachun Lin, Assistant Professor, Bradley University, 1501 W Bradley Ave, Peoria, IL, 61625, United States of America, djlin@bradley.edu

We study the design of layered networks, where the upper-layer network maintains its connectivity against single and multiple lower-layer network failures with various failure probabilities. We propose integer programming formulations with the objective of guaranteeing the network connectivity with a given probability.

■ WB50

Hilton- Powell B

Optimization, Integer 2

Contributed Session

Chair: Todd Easton, Associate Professor, Kansas State University, 2037 Durland Hall, Manhattan, KS, 66506, United States of America, teaston@ksu.edu

1 - Facets of the Latin Square Polytope

Dimitrios Magos, Professor, Technological Educational Institute of Athens, Ag. Spyridonos Str., Egaleo, 12210, Greece, dmagos@teiath.gr, Ioannis Mourtos

A Latin Square is an n by n matrix where in each row and column every number between 1 and n appears exactly once. Latin squares are pertinent to planar assignment structures. In the current work, we study the facial structure of the polytope associated with Latin Squares. We present families of facet-defining inequalities induced by odd holes of the related column intersection graph. We also report computational experience of odd-hole inequalities when used as cutting planes.

2 - The Existence and Usefulness of Equality Cuts in the Multidemand Multidimensional Knapsack Problem

Todd Easton, Associate Professor, Kansas State University, 2037 Durland Hall, Manhattan, ks, 66506, United States of America, teaston@ksu.edu, Levi Delissa

Valid equality cuts for integer programs are described. Equality cuts decrease the dimension of a linear relaxation space by at least one. Applying the idea of equality cuts to the multidemand multidimensional knapsack problem results in a new class of cutting planes named anticover cover equality (ACE) cuts. ACE cuts can be extended to an infeasibility condition. The cuts are implemented in a branch and cut scenario, which resulted in an 11% improvement to some benchmark instances.

3 - Modeling General Integer Programming Problems using XQX

Vijay Ramalingam, Ph.D. Student, University of Mississippi, School of Business, University, MS, 38677, United States of America, vramalingam@bus.olemiss.edu, Haibo Wang, Bahram Alidaee

We propose a xQx based modeling for general integer programming problems where the constraints could be inequality, equality, or a combination of the both. We present the detailed derivation of our general xQx model and the implementation procedures. We apply our model and solution procedures to multi-dimensional knapsack problems and present results from solving instances of various sizes.

■ WB51

Hilton- Sutter A

Optimization, Nonlinear 1

Contributed Session

Chair: Juliane Mueller, Cornell University, CEE, 220 Hollister Hall, Ithaca, NY, 14853-3501, United States of America, juliane.mueller2901@gmail.com

1 - A Filter-filled Function Method for Nonlinear Global Optimization

Wei Wang, Professor, East China University of Science and Technology, No.130, Meilong Road, Shanghai, China, wangwei@ecust.edu.cn, Xiaoshan Zhang

This work presents a filled function method based on the filter technique for global optimizations. Filled function method is one of effective methods for nonlinear global optimization. Filter technique is usually applied to local optimization methods for its excellent numerical results. In order to optimize the filled function method, the filter method is employed for global optimization. A new filled function is proposed in this manuscript, and the algorithm and its properties are proved.

2 - The Dynamic Lot-sizing Problem with Convex Economic Production Cost

Ramez Kian, Bilkent University, Department of Industrial Engineering, Central Campus, Ankara, 06800, Turkey, ramezk@bilkent.edu.tr, Emre Berk, Ulku Gurler

In this work the deterministic uncapacitated dynamic lot-sizing problem is considered with convex production costs. We formulate the problem as a mixed integer, non-linear programming problem and obtain structural results which are used to construct a forward polynomial time DP algorithm. Additionally, six heuristics with numerical study are provided.

3 - Surrogate Model Framework for Computationally Expensive Mixed-Integer Black-Box Global Optimization

Juliane Mueller, Cornell University, CEE, 220 Hollister Hall, Ithaca, NY, 14853-3501, United States of America, juliane.mueller2901@gmail.com

We consider optimization problems that have computationally expensive objective functions whose analytical description is not available (black-box) and that have integer and continuous variables. We develop a class of algorithms that combines surrogate models and evolutionary strategies to efficiently solve these problems. We introduce a new algorithm that combines a global and a local search in order to obtain solutions of higher accuracy.

4 - Arc Search Methods for Linearly Constrained Optimization

Nicholas Henderson, Stanford University, 3943 El Camino Real #14, Palo Alto, CA, 94306, United States of America, nwh@stanford.edu

We present an arc search algorithm for linearly constrained optimization. The method constructs and searches along smooth arcs that satisfy a small set of properties. When second derivatives are used, the method is shown to converge to a second-order critical point. We introduce a new arc that scales to large problems, does not require modification to the Hessian, and is rarely dependent on the scaling of directions of negative curvature.

5 - Analytical and Computational Study of Ibaraki\rq{}s Modified Binary Search Algorithm

Chong Hyun Park, Graduate Student, Purdue University, 140 Airport Rd APT 5, West Lafayette, IN, 47906, United States of America, park456@purdue.edu

In this paper, the modified binary search (MODBIN) algorithm developed by Ibaraki (1983) for root finding is analyzed and compared to Newton's method and the algorithm of Pardalos and Phillips (1991). Although the MODBIN algorithm was originally proposed for solving fractional programming problems, we study the MODBIN algorithm as a general root finding algorithm. We develop our analysis of the MODBIN algorithm for finding the root of monotonic, convex, and twice differentiable functions.

■ WB52

Hilton- Sutter B

Optimization, Large Scale 1

Contributed Session

Chair: Mojtaba Maghrebi, University of New South Wales, UNSW, Sydney, Australia, maghrebi@unsw.edu.au

1 - Integrating Artificial Intelligence with Optimization for Solving Large Scale Logistic Problems

Mojtaba Maghrebi, University of New South Wales, UNSW, Sydney, Australia, maghrebi@unsw.edu.au, Travis Waller, Claude Sammut

Obtaining exact solution for large scale logistic problems is computationally intractable. Experts are hired in the industry to find practical solutions for these problems. The authors found that there is a chance to reconstruct experts' decisions by machine learning. Real data from a concrete delivery was used for testing the proposed concept. The results show that there is a potential for implementing machine learning techniques in logistic while the competitive solutions have been obtained.

2 - Challenges in Varying Fixed Parameters in a Real-World Large-Scale Army Acquisition Problem

Frank Muldoon, R&D S&E Computer Scientist, Sandia National Laboratories, P.O. Box 5800, MS 1188, Albuquerque, NM, 87185-1188, United States of America, fmmuldo@sandia.gov

Traditional MIP fleet modernization formulations involve systems with fixed parameters, e.g., cost and performance, which answers the question "When to modernize?" but not the question "What should the modernized systems be?" Given a way to define systems in terms of their parameters, we look at the challenge of parameters being variable creating bilinear terms. We consider an Army acquisition problem and explore linearization techniques for the bilinear terms and numerical instability issues.

3 - Optimizing a Class of Generalized Assignment Problems with Location/Allocation Considerations

Tulay Flamand, PhD Student, University of Massachusetts Amherst, Isenberg School of Management, 121 Presidents Drive, Amherst, MA, 01003, United States of America, varol@som.umass.edu, Mohamed Haouari, Ahmed Ghoniem

We address a novel class of generalized assignment problems with location/allocation considerations which is motivated by shelf space allocation decisions in retail stores among other applications. Exact and effective heuristic approaches, including Very Large-Scale Neighborhood Search, are discussed using computationally challenging instances.

4 - Optimal Consolidation of Air Freight for an Intercontinental Cargo Carrier

Guvenc Sahin, Associate Professor, Sabanci University, Orhanli, Tuzla, Istanbul, Turkey, guvencs@sabanciuniv.edu, Birol Yuceoglu, Gorkem Yencak

Air cargo carriers consolidate the freight in order to avoid extra handling effort and cost during transfers as consolidated freight is easier to transfer. All stations may not be equipped with consolidation capability or might have limited facilities. We study a network design problem to determine the stations to be equipped with consolidation capability and their facilities. We formulate the problem as a set-covering problem and solve it using decomposition techniques.

■ WB53

Hilton- Taylor A

Finance, Financial Engineering 2

Contributed Session

Chair: Yue Sun, University of Virginia, 151 Engineer's Way, Charlottesville, United States of America, ys6dn@virginia.edu

1 - Negativity Bias in Attention Allocation: Retail Investors' Reaction to Stock Returns

Tomas Reyes, Assistant Professor, Pontificia Universidad Catolica de Chile, Dpto Ingenierìa Industrial y Sistemas, Av. Vicuna Mackenna 4860, Macul, Santiago, RM, 7820436, Chile, threyes@ing.puc.cl, Isaac Hacamo

We argue negative stock market performance attracts more attention from retail investors than comparable positive performance. Specifically, we test and confirm the hypothesis that retail investors pay more attention to negative than positive extreme returns, using a measure of attention at the aggregate and company specific level from Google.

2 - High-frequency vs. Insider Trading

Yue Sun, University of Virginia, 151 Engineer's Way, Charlottesville, VA, United States of America, ys6dn@virginia.edu, Alfredo Garcia

In recent years, the role of high frequency trading has received increased attention. It is commonly argued that high frequency trading increases market volatility and the probability of mis-pricing. In this paper we study the effects of high frequency trading when there is also insider trading activity in the market. We find that high frequency traders play a beneficial role as they limit the extent of insider trading rents thus protecting noise traders and enhancing market liquidity.

3 - Optimal Claiming Behavior for Third-Party Auto Insurance Market in Turkey

N. Onur Bakir, Istanbul Kemerburgaz University, Mahmutbey Dilmenler Caddesi, No:26, Bagcilar, Istanbul, 34217, Turkey, onur.bakir@kemerburgaz.edu.tr, Salih Tekin, Derya Gülel

In Turkish automobile insurance market with bonus-malus system, the annual premium depends on the insured's claim experience record in addition to other factors. When a motorist has an accident, he is faced with the decision whether to pay all the cost associated with the accident himself, or claims the costs from the insurance company. Based on data obtained from a well-established company in Turkey, we analyze the optimal behavior with a risk-averse Markov decision model.

4 - The Study on Principal-agent Relationship among Venture Capitalist, Bank and Entrepreneur

Zha Bo, School of Management, Xi'an Jiao Tong University, P.O. Box 1851, Xi'an Jiao tong University, Xi'an, Shaanxi Province, 710049, China, zhabo127127@163.com

We establish principal-agent relationship among venture capitalist, bank and entrepreneur, prove that there exist the critical value of venture capitalists' supervision, and then we analyze the impact of overconfidence and supervision on the relationships among venture capitalist, bank and entrepreneur.

5 - Optimal Asset Allocation Strategies for Oil-based Sovereign Wealth Fund

Changle Lin, Princeton University, Princeton Univeristy, Sherrerd Hall, Charlton Street, Princeton, NJ, 08544, United States of America, changlel@princeton.edu, John Mulvey

Oil-exporting countries face two sets of recurring decisions: asset allocation of their sovereign wealth fund, and oil extraction. This paper models these decisions in an integrated fashion via an enterprise risk management system.First, a multi-stage stochastic program optimizes the asset allocation decisions. In a second step, the continuation value of oil reserves is estimated as a real option and linked to the stochastic program.We test the methodology via a case study to show advantages.

■ WB54

Hilton- Taylor B

Control Methods in Finance

Sponsor: Financial Services Section

Sponsored Session

Chair: James Primbs, University of Texas at Dallas, Richardson, TX, United States of America, jap120030@utdallas.edu

1 - Towards Demystification of Technical Analysis: Stock Trading via Feedback Control

Shirzad Malekpour, University of Wisconsin-Madison, 1415 Engineering Dr., Madison, WI, United States of America, smalekpour@wisc.edu, B. Ross Barmish

In the finance literature, statistical analysis of historical data is often used to study the efficacy of technically-based stock-trading. This approach has been criticized due to lack of an explanatory theory for performance. In this paper we describe a new approach aimed at providing such a theory. Simple ideas based on feedback control lead to a theoretical rationale for a class of trend-following strategies. Going forward, our goal is to extend our ideas to demystify" other trading schemes.

2 - Robust Regression to Index Tracking

Jonathan Li, Assistant Professor, Telfer School of Management, 55 Laurier Avenue East Ottawa, Ottawa, Canada, jonathan.li@telfer.uottawa.ca

Constructing a portfolio that replicates the performance of a given financial index can be seen as a linear regression problem with additional constraints. In this work, we present new robust forms of regression models that have intuitive appeal to portfolio managers who intend to fully utilize the data in hand in constructing a tracking portfolio.

3 - Exploring the Dynamics of Order Book Depth
Sean Warnick, Associate Professor, Brigham Young University, 2222 TMCB, Provo, 84604, United States of America, sean.warnick@gmail.com, Scott Condie

Recent interest in high frequency trading has focused broad media attention on the dynamics of market-making and their possible susceptibility to manipulation. Here we explore NASDAQ's Totalview ITCH data, which reveals the full order book depth, and offer an introductory tutorial to the dynamics of market making and the various concerns that have received recent media attention.

4 - Asset Pricing Models with Idiosyncratic Comoments (I-COMs)
Yuji Yamada, Professor, University of Tsukuba, 3-29-1 Otsuka, Bunkyo-ku, Tokyo, 112-0012, Japan, yuji@gssm.otsuka.tsukuba.ac.jp

We propose a new framework in asset pricing models using idiosyncratic comoments (I-COMs), which provides a generalization of CAPM beta for higher order moments. First, we introduce definition of I-COMs and show that individual asset returns depend on not only CAPM beta (being given by the first order I-COM) but also higher order I-COMs. We also demonstrate risk premiums in asset returns using empirical data on Japanese stock markets and compare our framework with Fama-French 3 factor models.

■ WB55

Hilton- Van Ness

Algorithmic and Computational Aspects of Mixed-Integer Nonlinear Optimization

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Aida Khajavirad, Assistant Professor, University of Texas at Austin, Austin, TX, aida.khajavirad@gmail.com

1 - On Feasibility-based Bounds Tightening
Leo Liberti, Research Staff Member, IBM Research, Yorktown Heights, NY, 10598, United States of America, leoliberti@gmail.com, Sonia Cafieri, Jon Lee, Pietro Belotti

Feasibility-based Bounds Tightening (FBBT) is used to tighten the variable ranges at the nodes of spatial Branch-and-Bound (sBB) algorithms for MINLP. FBBT may not converge finitely, even in the case of linear constraints. We model FBBT by using fixed-point equations in terms of the variable ranges. This yields an auxiliary linear program, which can be solved efficiently. We demonstrate the usefulness of our approach by improving the open-source sBB solver Couenne.

2 - Systematic Diagnosis of Infeasible NLP and MINLP Models
Yash Puranik, Carnegie Mellon University, 5000 Forbes Avenue DH 4200, Pittsburgh, PA, 15213, United States of America, ypp@andrew.cmu.edu, Nick Sahinidis

We present an approach for systematic diagnosis of infeasible and nonconvex NLP and MINLP models through the isolation of an IIS (Irreducible Inconsistent Set). Our approach relies on a preprocessing algorithm which uses feasibility based reduction techniques to achieve speedups in IIS isolation. We will present computational results with our compiled library of more than 1000 infeasible models on the efficacy of the proposed preprocessing algorithm as well as comparisons with other algorithms.

3 - On Simultaneous Convexification of Multilinear Functions
Aida Khajavirad, Assistant Professor, University of Texas at Austin, Austin, TX, aida.khajavirad@gmail.com, Alberto Del Pia

We study the polyhedral convex hull of a mixed-integer set defined by a collection of multilinear equations over the unit hypercube. We define an equivalent hypergraph representation of the mixed-integer set, which enables us to derive several classes of facet-defining inequalities, structural properties, decomposition and lifting operations for its convex hull. Our theoretical developments extend several well-known results from the Boolean quadric polytope and the cut polytope literature.

4 - A Lagrangian Relaxation Approach to a Class of Mixed-integer Bilevel Program
Mahdi Hamzeei, University of Wisconsin, Madison, WI, United States of America, hamzeei@wisc.edu, James Luedtke

We study a service network design problem in which a system operator chooses which facilities to open, and the allocation of customer demands to facilities is determined as a solution of an equilibrium problem driven by facility congestion. The problem is formulated as a mixed-integer bilevel programming problem which can be reformulated to a nonconvex MINLP. We use Lagrangian relaxation to obtain a lower bound and candidate feasible solution. Promising computational results will be reported.

■ WB56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - SAS® Global Academic
Mike Speed, Analytical Consultant, SAS Institute, 9312 Lake Forest Ct S, College Station, TX, 77845, United States of America, mike.speed@sas.com, Tom Bohannon

The tutorial will demo SAS Visual Analytics to show you that you can explore all relevant data quickly and easily. You can look at more options, uncover hidden opportunities, identify key relationships and make more precise decisions faster than ever before. Self-service, ad hoc visual data discovery and exploration put lightning-fast insights within everyone's reach.

2 - Forio - Publishing Interactive Analytics or Operations Research Models on the Web
Michael Bean, President, Forio Business Simulations, San Francisco, CA, United States of America, mbean@forio.com

Forio's web platform makes your analytic model available to hundreds of people within your organization through the browser. We will start with an introduction to the platform and example analytics applications. Then we'll divide the workshop into two parts. In the first part we will teach you how to get your analysis on a server so it can be shared. In the second part we'll focus on creating a user interface for your model.

■ WB57

Hilton- Golden Gate 1

Technology in the Classroom

Sponsor: INFORM-ED

Sponsored Session

Chair: David Czerwinski, San Jose State University, One Washington Square, San Jose, CA, 95192-0069, United States of America, david.czerwinski@sjsu.edu

1 - Incorporating Technology in Students' Professional Skills Assessment
Sadan Kulturel-Konak, Pennsylvania State University-Berks, Tulpehocken Rd. PO Box 7009, Reading, PA, United States of America, sadan@psu.edu

In this study, we introduce a web-based application, called Peer Evaluation and Assessment Resource (PEAR), to assess students' development in professional skills, namely in teamwork. PEAR has been designed based on the theory of Model of Domain Learning (MDL); hence, it can help explain the complex interactions among knowledge, interest level, and strategies with which knowledge is gained. We illustrate the workflow of PEAR and how MDL is integrated into the peer assessment process.

2 - Incorporating Technology in Classroom: A Case Study in an Engineering Course
Farnaz Ghazi Nezami, Assistant professor, Kettering University, Industrial and Manufacturing Engineering Department, 1700 University Ave.,, Flint, MI, United States of America, fghazinezami@kettering.edu, M Bayram Yildirim

This study analyzes the impact of education mode, face-to-face vs. online, on student's performance and persistence rate in Engineering Economy course. We also provide some insights about how the student's external characteristics can influence their enrollment decisions about online and face-to-face class options.

3 - POET: An Interactive Web-Based Tool for Learning Optimization Modeling Skills
Nelson Uhan, Mathematics Department, United States Naval Academy, Chauvenet Hall, Annapolis, MD, 21402, United States of America, uhan@usna.edu, Ji Soo Yi, Sung-Hee Kim, Rachael Kenney

POET is an interactive web-based tool designed to help students learn how to formulate optimization models from word problems, by establishing physical meaning for decision variables and constraints, and enabling students to test their models using concrete values for decision variables. We assessed its effectiveness with over 200 engineering students in an undergraduate optimization course over two semesters. Our studies indicate that POET helps students avoid several types of common errors.

4 - Bringing Linear Optimization to Life in the Classroom
David Czerwinski, San Jose State University, One Washington Square, San Jose, CA, 95192-0069, United States of America, david.czerwinski@sjsu.edu

We share two ways we have brought LPs to life in an undergraduate classroom. The first is a simple animation of solving an LP graphically. We discuss how to incorporate the animation in a lecture and touch on some subtle pedagogical points that can be made with it. The second is a project in which students create videos demonstrating optimization concepts. Highlights from some of the more entertaining videos will be shared, along with lessons learned about making the assignment successful.

■ WB58

Hilton- Golden Gate 2

Scheduling III

Contributed Session

Chair: Yasaman Malone, Oregon State University, 2494 NW Garryanna St, Apt. 29, Corvallis, OR, 97330, United States of America, yasaman.malone@oregonstate.edu

1 - Lower Bounding Methods for Solving a Dual Hybrid-flowshop Scheduling Problem
Yasaman Malone, Oregon State University, 2494 NW Garryanna St, Apt. 29, Corvallis, OR, 97330, United States of America, yasaman.malone@oregonstate.edu, Rasaratnam Logendran

This presentation addresses a hybrid-flow shop scheduling problem with both machine and labor as constraints in a supply chain. A linear mixed-integer mathematical programming model along with two lower bounding methods are proposed. In addition, a meta-search heuristic algorithm based on tabu search is developed in order to quickly solve the scheduling problems. The effectiveness and efficiency of the lower bounding methods and search algorithm are shown by using statistical analysis.

2 - Sequence-dependent Batch Scheduling Problem on Unrelated-parallel Machines
Rasaratnam Logendran, Professor, Oregon State University, School of MIME, 204 Rogers Hall, Corvallis, OR, 97331, United States of America, Logen.Logendran@oregonstate.edu, Omid Shahvari

We address a batch scheduling problem on unrelated-parallel machines with the objective of minimizing the weighted sum of weighted completion time and weighted tardiness, to respect the interests of the producer and customers. A mechanism for determining a lower bound on the number of jobs in a batch within the mathematical model is proposed, and dynamic job release and machine availability times are assumed. An example is used to demonstrate the application of tabu search to solve the problem.

3 - The Precedence Properties of the Flowshop Scheduling Problem
Jin-Pin Liou, Associate Professor, I-Shou University, 11F-1, No.9, Aly. 17, Ln. 50, Lida Rd., Kaohsiung, 81356, Taiwan - ROC, jinpin@isu.edu.tw

This research studies the static n-job m-machine permutation flowshop scheduling problems to minimize the makespan. At this study, we propose two precedence properties, which can significantly improve the efficiency of the existing branch and bound algorithms to arrive the optimal solutions of the flowshop scheduling problems. The simulated results are also provided to show the efficiency of these properties.

4 - Minimizing the Number of Tardy Jobs in a Stochastic Single Machine Scheduling Problem
Hossein Soroush, Professor, Kuwait University, Dept. of Statistics & Opns Research, POB 5969, Safat, 13060, Kuwait, h.soroush@ku.edu.kw

We study the problem of scheduling a set of jobs with fixed tardiness penalties and random processing times or due-dates on a single machine. The goal is to derive the sequence that minimizes the expected weighted number of tardy jobs. Special cases of the problem are solvable optimally in polynomial time while the general cases are tackled heuristically.

5 - Scheduling with Step-improving Processing Times
Eun-Seok Kim, Middlesex University, The Burroughs, London, NW4 4BT, United Kingdom, e.kim@mdx.ac.uk, Daniel Oron

We study a single machine scheduling problem of minimizing total completion time with step-improving processing times. For step-improving processing times, job processing times reduce by a job-dependent amount after a common critical date. We show that the problem is NP-hard in general. We formulate a Mixed Integer Programming model and develop an LP-based heuristic for the problem. Finally, we perform computational experiments showing that the heuristic provides effective solutions.

■ WB59

Hilton- Golden Gate 3

Group Decisions and Negotiation

Contributed Session

Chair: Michael Chuang, State University of New York, 1 Hawk Av, New Paltz, NY, United States of America, chuangm@newpaltz.edu

1 - Strong Leadership in Entrepreneurial Firms: The Distribution of Power in Top Management Teams
Martin Peitzner, PhD Candidate, TU Dortmund, Martin-Schmeifler-Weg 12, Dortmund, 44227, Germany, martin.peitzner@tu-dortmund.de, Andreas Engelen

This study examines the relationship between Top Management Team (TMT) power distribution and performance in different markets. To address equivocal results in extant research, it argues that the Entrepreneurial Orientation (EO) of a firm greatly influences how TMT members exercise their power. Based on secondary data of 61 S&P 500 companies, it finds that the more fragmented the market is, the more positively EO moderates the relationship between unequally distributed power and performance.

2 - Personality in Computer-Mediated Communication
Michael Chuang, State University of New York, 1 Hawk Av, New Paltz, NY, United States of America, chuangm@newpaltz.edu

When a group faces a barrage of information pieces for a decision, persuasion is important for reaching a consensus. However, there is lack of related study regarding whether individuals characterized by having different personalities exhibit differences. To fill the gap, this work investigates the impacts of communication modes and personality in computer-mediated communications environments.

3 - Visualizing Alignment to Predict Group Success and Failure
Michael Taylor, Principal, SchellingPoint, 109 Cratin Lane, Suite 200, West Chester, PA, 19380, United States of America, mtaylor@schellingpoint.com

Alignment is vital in collaborative activities yet considered binary - We are aligned or We aren't. False positives cause groups to create logical but flawed plans, the flaws arising in execution. AOT measures the Alignment Index of a group. In 200 uses every group's alignment was 44 to 83 on a 100-point scale. Alignment visualization show the group's path to success and what will cause them to fail, enabling them to pinpoint their necessary conversations.

■ WB60

Hilton- Golden Gate 4

Inventory Management VI

Contributed Session

Chair: Arnab Bisi, Associate Professor of Operations Management, Indian Institute of Management Calcutta, Joka, Diamond Harbour Road, Kolkata, India, abisi@iimcal.ac.in

1 - Alternative Incentives in Inventory Management: How do Performance Metrics Affect Inventory Decision
Michael Becker-Peth, Assistant professor, University of Cologne, Albertus-Magnus-Platz, Cologne, Germany, michael.becker-peth@uni-koeln.de, Kai Hoberg, Margarita Protopapa-Sieke

We analyze the impact of alternative incentive schemes on inventory decisions and the link to the company's performance. We find analytically that commonly used performance metrics focusing on inventory levels at the fiscal year end can seriously harm the overall firm performance. Furthermore we test these incentive schemes in lab experiments and find overreactions to end-of-year incentives as end-of-year-inventory levels are typically dropped significantly below the prescriptive levels.

2 - Resetting Base Stock Levels in Unbalanced Production Systems
Nha Nghi Huynh, University of Hamburg, Von Melle Park 5, Hamburg, 20146, Germany, nha-nghi.huynh@uni-hamburg.de, Hans Daduna

We analyze monotonicity of base stock levels in inventory-production systems and study single- and multi-item systems where demand triggers production of a new unit. Standard queueing theory suggests that the base stock level should increase with the utilization in the system. However, this intuition is not easy to prove. We present a proof of this presumption utilizing stochastic orderings and consider in particular unbalanced production systems.

3 - Pricing and Assortment Decisions for Perishable Products with Price- and Stock-dependent Demand

Erhun Kundakcioglu, Ozyegin University, Faculty of Engineering, Istanbul, Turkey, erhun.kundakcioglu@ozyegin.edu.tr, Arda Yenipazarli, Mehmet Onal

We introduce a product assortment and pricing problem for perishable products. The goal is to maximize the retailer's profit under shelf-space and backroom storage capacity constraints. The demand rate is a deterministic and multivariate function of selling price and on-display stock level. The model is reformulated and a heuristic solution method is proposed. Computational experiments identify how the variation in the total profit is apportioned to changes in demand parameters.

4 - On the Interaction of Service Level and Shelf Life Agreements in Perishable-product Supply Chains

Sandra Transchel, Associate Professor of Supply Chain and Operations Management, Kuehne Logistics University - The KLU, Grofler Grasbrook 17, Hamburg, HH, 20457, Germany, sandra.transchel@the-klu.org

We study a two-stage perishable-product supply chain of a manufacturer and retailer who negotiate a contract comprising a service level and shelf life agreement (remaining shelf life guaranteed by the manufacturer). The manufacturer has an incentive to produces larger batches that negatively impacts the remaining shelf life and thus the contract agreement. We investigate the interaction of service level and shelf life agreement and its impact on the supply chain performance and efficiency.

5 - The Value of Real Time Yield Information in Multi-stage Inventory Systems

Marcus Dettenbach, University of Cologne, Albertus Magnus Platz, Cologne, Germany, marcus.dettenbach@uni-koeln.de, Ulrich Thonemann

We consider the number of defective units in an order to be random. The information on the number of defective units is available at any time. This setting is compared to a setting in which the yield is observable upon arrival of an order. We solve a dynamic program for both settings. We develop close-to-optimal heuristics with short run times and conduct various numerical experiments and identify dependencies for the value of real time yield information. An extension considers fixed order cost.

■ WB61

Hilton- Golden Gate 5

Organization Theory 2

Contributed Session

Chair: Jay Lee, California State Univ Sacramento, 6000 J St, Tahoe Hall 2079, Sacramento, CA, 95819, United States of America, jlee@csus.edu

1 - The Relationship between Career Growth and Job Performance

Hui Yang, University of Science and Technology of China, School of Management, HeFei, China, nyanghui@163.com

This paper establishes a model to interpret the relationship between career growth and job performance, empirically analyzes the impact mechanism of employees' career growth on job performance. we using correlation analysis and regression analysis methods, revealing the professional growth of job performance of paths and processes. The study found that career goals progress within the organization and professional capacity development for job performance have certain influence.

2 - Global ICT (Information, Communication & Technology) Firm's International Strategy and Performance

Jay Lee, California State Univ Sacramento, 6000 J St, Tahoe Hall 2079, Sacramento, CA, 95819, United States of America, jlee@csus.edu

This study examines the different alliance activities of major global ICT (Information, Communication & Technology) firms as they pursue an international expansion strategy in a highly competitive business environment. As in many other industries, global strategic alliances have been increasingly popular among global ICT firms all over the world. Two network characteristics - geographical scope and frequency of strategic alliances among global ICT firms - are to look at in this study.

3 - A Network-Based Approach to Organizational Learning

Mark Avnet, Assistant Professor, Texas A&M University, 4075 Emerging Technologies Building, 3131 TAMU, College Station, TX, 77843-3131, United States of America, avnet@tamu.edu

An analytical approach for measuring organizational learning is presented. Using survey data of respondents' knowledge and views about a given situation or problem, networks of shared mental models in an organization are constructed at several points in time. Structural comparisons of these networks are used to quantify learning in the organization. The approach is tested by relating organizational learning to metrics of safety performance in a major oil and gas company.

4 - The Role of Leaders in Responding to Uncertainty: Evidence from China's Largest Real Estate Company

Xiaofeng Zhang, School of Management, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an, Xi'an, China, xiaofeng.zh@mail.xjtu.edu.cn

Our constructing grounded theory study develops a conceptual model of leader dealing with uncertainty in China. We find that leaders search and grasp opportunity, follow policy and competition changes to respond to environmental uncertainty; promote organization evolution and mobilize resources for crisis management in the case of organizational uncertainty; consolidate position power and construct leader authority, accumulate experience and take external learning as to individual uncertainty.

■ WB62

Hilton- Plaza A

Applied Probability 2

Contributed Session

Chair: George Mytalas, NJIT, 257 86 Brooklyn, New York, United States of America, mytalas@njit.edu

1 - Multivariate Run Test for Detecting Non-Randomness in Process Control Charts

Young H. Chun, Professor of Decision Science, Louisiana State University, E. J. Ourso College of Business, 2219 Business Education Complex, Baton Rouge, LA, 70803, United States of America, prof@drchun.net

In a sequence of observations, a run is defined as a maximal subsequence of like observations. We propose a run test that checks a randomness hypothesis for a multi-valued data sequence. The randomness is tested based on the number of runs and the length of the longest run in a sequence of observations with multiple classes. The run tests can be applied to many practical situations, including the non-parametric test for statistical process control.

2 - An Efficient Decomposition Algorithm for Superquantile Regression

Dharmashankar Subramanian, IBM Research, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, dharmash@us.ibm.com, Pavithra Harsha, Ramesh Natarajan

A regression technique known as Superquantile regression, proposed by Rockafellar, Royset and Miranda 2013, is a method to estimate superquantile, well known as conditional value at risk, of a random variable that depends on covariates. The proposed linear program to estimate the coefficients of the regression fails to scale even for reasonably small instances. We present an efficient decomposition method to solve this problem even for very large instances with computational results.

3 - Optimal Call Center Forecasting and Staffing under Arrival Rate Uncertainty

Sihan Ding, PhD, Center for Mathematics and Computer Science, Science Park 123, Amsterdam, 1098 XG, Netherlands, S.Ding@cwi.nl, Ger Koole

We formulate the staffing problem in call centers as a new-vendor type problem, where the costs are the staffing costs. We show that under such a cost structure and the arrival rate uncertainty, the optimal staffing should occur according to a quantile of the distributional forecast, rather than the mean. It is also shown that the sum of quantile errors is asymptotically the optimal error measurement in call center forecasting. The results are validated numerically.

4 - Stochastic Enumeration for Counting SAW

Ad Ridder, Vrije University, de Boelelaan 1105, Amsterdam, 1081HV, Netherlands, ad.ridder@vu.nl, Slava Vaisman

In this talk we will consider counting the number of self-avoiding walks of length n on the 2D integer lattice. This is a so-called #P-complete counting problem. We will give a brief introduction to this complexity class and then present several randomized approximation schemes for estimating the number, including numerical results. Furthermore, we discuss the correspondence to efficient simulation algorithms for estimating rare event probabilities.

5 - An M/G/1 Queue System Subject to Disasters and Server Breakdowns

George Mytalas, NJIT, 257 86 Brooklyn, New York, United States of America, mytalas@njit.edu

We consider a M/G/1 queueing system subject to disasters and server breakdowns under N-policy. The server is turned off as soon as the system empties. When the queue length reaches or exceeds a value N (threshold), the server is turned on and begins to serve the customers. During the repair period arriving batches of customers accumulate in the queue without receiving service. Besides, the server has an exponential lifetime in addition to the catastrophe process.

■ WB63

Hilton- Plaza B

Dynamic Programming/ Control 2

Contributed Session

Chair: Kun Zhao, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32608, United States of America, zhaokunzk@ufl.edu

1 - Dynamic Repairman Assignment in a Layered Queuing Network with Correlated Queues

Sandjai Bhulai, VU University Amsterdam, Department of Mathematics, De Boelelaan 1081a, Amsterdam, 1081 HV, Netherlands, s.bhulai@vu.nl, Jan-Pieter Dorsman, Maria Vlasiou

We study a machine-repair model in which the machines make products themselves. Due to correlations of the machine downtimes, the queue lengths of the products are correlated. We study how the repairman should allocate its repair capacity dynamically, so as to minimize the expected total number of waiting products. We derive several properties pertaining to the repairman's optimal strategy. We also obtain a near optimal policy that performs nearly as well over a wide range of parameter settings.

2 - Inspection Scheduling of Multi-unit Systems With Budget Constraint

Mahmood Pariazar, American Airlines, 4333 Amon Carter Blvd, Forth Worth, TX, United States of America, mppv6@mail.missouri.edu, Esra Sisikoglu Sir

Consider a multi-unit system such as a multi-machine production system in which each unit needs to be inspected/maintained under a limited budget. The budget constraint makes it infeasible to inspect each item according to its optimal inspection schedule. Group inspection policies become suboptimal as each item has its own degradation probability. We use dynamic programming to determine the optimal inspection schedule of multi-unit systems and use approximation for large scale problem instances.

3 - Dynamic Programming Based Inequalities for Multidimensional Knapsack Problems

Kun Zhao, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32608, United States of America, zhaokunzk@ufl.edu, Joseph Hartman

Forward dynamic programming for the multidimensional knapsack problem is used to generate inequalities for an equivalent integer programming formulation. We illustrate the effectiveness of the approach through experimental testing.

■ WB64

Parc- Cyril Magnin I

Methods for Staffing Nonstationary Queueing Systems

Sponsor: Applied Probability Society

Sponsored Session

Chair: Jamol Pender, Cornell University, 206 Rhodes Hall, Ithaca, NY, 14850, United States of America, jjp274@cornell.edu

1 - Optimal Allocation and Pricing of Servers under Uncertainty with Co-sourcing

Jeffrey Kharoufeh, Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, PA, 15261, United States of America, jkharouf@pitt.edu, David Abdul-Malak

We consider the problem of optimally allocating servers in a multi-server queueing system in which the arrival rate is uncertain, a quality-of-service constraint must be satisfied, and server co-sourcing is available. Additionally, we determine the co-sourcing contractor's profit-maximizing pricing strategy by formulating the problem within the framework of a Stackelberg competition.

2 - Sizing Heterogeneous Servers with Non-stationary Arrivals for Time-stability

Soongeol Kwon, Texas A&M University, College Station, TX, United States of America, soongeol.kwon@gmail.com, Natarajan Gautam

We consider a set of parallel servers that could be powered on or off, and when on run at different speeds. Requests of multiple classes arrive according to a piecewise constant non-homogeneous Poisson process. Our objective is to make multiple decisions including assignment of classes to servers, routing probability of requests to servers, number of servers to be powered on, and the speed of each server. The goal is to minimize power consumption subject to achieving time-stable performance.

3 - Refining Piecewise Stationary Approximation for a Markov-Regulated Fluid Queue

Bo Zhang, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, United States of America, bozhang@gatech.edu, Guodong Pang, Bert Zwart

We present a refinement of the Piecewise Stationary Approximation for the stationary distribution of a Markov-regulated fluid queue. The refinement is analytically justified. Its accuracy and utility are demonstrated.

4 - Staffing Nonstationary Queues using Transition Rates

Jamol Pender, Cornell University, 206 Rhodes Hall, Ithaca, NY, 14850, United States of America, jjp274@cornell.edu

In this talk, we will present a new way to approximate and stabilize various performance measures of Markovian Jackson networks using the transition rates and the Kolmogorov forward equations of the Markov process. We show that the transition rates of the Markov process provide valuable information for approximating and stabilizing the probability of delay, abandonment probabilities, and the effective abandonment rate of the Jackson network.

■ WB65

Parc- Cyril Magnin II

Large-scale Stochastic Systems and Resource Allocation

Sponsor: Applied Probability Society

Sponsored Session

Chair: Kuang Xu, MIT, 77 Massachusetts Ave., Cambridge, MA, United States of America, kuangxu@mit.edu

1 - Incentivized Optimal Advert Assignment via Utility Decomposition

Neil Walton, University of Amsterdam, Science Part 904, Amsterdam, Netherlands, n.s.walton@uva.nl, Frank Kelly, Peter Key

For a large-scale Ad-auction over an infinite space of random searches, we show that a maximum aggregate utility can be solved in separate optimizations conducted by the advertisement platform and advertisers. Here, the platform solves an assignment problem and, on a slower time scale, each advertiser submits a bid which matches its demand for click-throughs with supply. This simple mechanism can incentivize truthful bidding and has a unique Nash equilibrium, which implements our decomposition.

2 - Supply Reservation in an Inventory Model for Cloud Computing

TongHoon Suk, Graduate Student, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, tonghoons@gatech.edu, Aaron Yen, Ilyas Iyoob, Ton Dieker

Motivated by the marketplace in cloud computing, we study an inventory model with uncertain demand for a perishable good that can be supplied at different prices depending on the length of the contractual commitment as measured by a lock-in period. This gives a trade-off between risk of having to buy last-minute capacity for a high price and buying resources that end up unused. We describe a data-driven approach to analyze this trade-off and illustrate our technique on a representative data set.

3 - Achievable Performance of Blind Scheduling Policies in Heavy Traffic

Bart Kamphorst, CWI, P.O. Box 94079, Amsterdam, 1090 GB, Netherlands, b.kamphorst@cwi.nl, Nikhil Bansal, Bert Zwart

It is well-known that SRPT is an optimal scheduling policy for minimizing the average sojourn time in G/G/1 queues. In practice one often does not know individual job sizes and a blind policy is required. Scheduling literature has shown strong bounds on the performance of blind scheduling policies in deterministic environments when compared to SRPT. I will show how the strong bounds on blind policies in deterministic environments can be used to obtain bounds in heavy traffic stochastic settings.

4 - Throughput Optimal Policies in a Flexible Fork-join Network

Yuan Zhong, Columbia University, 500 West 120th Street, New York, NY, 10027, United States of America, yz2561@columbia.edu, Jean Walrand, Ramtin Pedarsani

We consider a flexible fork-join processing network, that models applications in healthcare, cloud computing, manufacturing, etc. Jobs are modeled as directed acyclic graphs of tasks with precedence constraints among them. Servers are flexible with overlapping capabilities. In this talk, we present several throughput optimal scheduling policies for this network, and discuss their complexity and performance properties. We complement our results with simulations.

■ WB66

Parc- Cyril Magnin III

Predictive Modeling and Control for Additive Manufacturing

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Avenue, Los Angeles, CA, 90089, United States of America, qiang.huang@usc.edu

1 - Shape Deviation Modeling and Compensation for Fused Deposition Modeling Processes

Andi Wang, HKUST, Academic Bldg 4223, HKUST, Hong Kong, Hong Kong - PRC, awangab@ust.hk, Suoyuan Song, Fugee Tsung, Qiang Huang

In this research we intend to increase the geometric accuracy for Fused Deposition Modeling (FDM) process, one of the mostly adopted additive manufacturing technologies. Based on the FDM mechanism, we analyze the process and attribute the dimensional inaccuracy to two significant error sources: extruder positioning error and processing error. We further derived a effective compensation plan through changing the product design. Experiments show the effectiveness of our method.

2 - Optimal Meniscus Planning in SL-related AM for Improvement of Surface Finish and Geometric Accuracy

Yayue Pan, Assistant Professor, University of Illinois at Chicago, 739 Valley Circle Dr., Apt.103, Saline, United States of America, pyy2010@gmail.com

Surface quality is a big challenge in Additive Manufacturing (AM) processes.A meniscus method has been verified for surface finish improvement.Yet without proper settings, the geometric accuracy may have no improvement or even be worse.In this paper,different manufacturing process parameters in the SL-related AM systems were examined.Systematic models for surface quality control through meniscus deposition and process characterizations were developed and verified by experiments.

3 - Unified Predictive Modeling and Compensation Approach for 3D Printed Products

Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Avenue, Los Angeles, CA, 90089, United States of America, qiang.huang@usc.edu, Sobambo Sosina, Tirthankar Dasgupta, Hadis Nouri, Kai Xu, Yong Chen

Built upon our previous optimal compensation study of 3D printed products, this work aims at an unified modeling approach to predict the quality of both cylinder and polygon shapes. Experimental investigation of polygon shapes indicates the promise of predicting and compensating a wide class of products built through 3D printing technology

■ WB67

Parc- Balboa

Data Fusion in Manufacturing Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall,, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

1 - Approximate Likelihood Inference for Multistream Count Data Monitnoring

Devashish Das, PhD Candidate, University of Wisconsin, Madis, Department of Industrial Engineering, 1513 University Avenue, Madison, Wi, 53706, United States of America, ddas3@wisc.edu, Shiyu Zhou

In this paper we use a Poisson-Multivariate Normal density to model multistream count data. An approximate likelihood ratio test for this model is proposed, which significantly reduces the computational cost of multi-dimensional integrals involved in the likelihood function. These approximate likelihood tests were found to be effective in detecting changes to the in-control distribution. The proposed framework is compared with existing approaches as well as on a real data case study.

2 - Within-cycle Profile Monitoring and Fault Diagnosis using Multichannel Signals

Weihong Guo, Ph.D. Candidate, University of Michigan - Ann Arbor, 2860 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48105, United States of America, graceguo@umich.edu, Judy Jin, S. Jack Hu

Existing research on cyclic profile monitoring has been focusing on between-cycle detection at the end of part completion based on the entire cycle of signals. Extending from the authors' previous research on within-cycle profile monitoring for real-time defect prevention, this research develops a monitoring and diagnosis methodology to address the challenges and opportunities brought by multichannel signals for making monitoring decisions and fault diagnosis.

3 - Multiple Sensor Data Fusion in Degradation Modeling under Different Operation Conditions

Hao Yan, PhD Student, Georgia Institute of Technology, 755 Ferst Dr, NW, Atlanta, GA, 30332, United States of America, yanhao@gatech.edu, Kaibo Liu

System monitoring with multiple sensors in different operation conditions brings challenge to data fusion in degradation modeling. Thus, a data level fusion methodology is proposed to integrate data from multiple sensors in multiple operation conditions for accurate prediction of the remaining lifetime. The effectiveness of proposed method is demonstrated in the case study, which involves a degradation dataset of an aircraft in six different operation conditions.

4 - Dynamic Quality Models Considering Equipment Degradation in Manufacturing Systems

Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall,, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Xinwei Deng

The reliability of manufacturing equipment plays an important role for product quality assurance. In this paper, we focus on modeling the effects of the equipment degradation to product quality. A novel dynamic model is proposed to characterize the varying effects of process variables to quality due to equipment degradation. We use both simulations and a real data set from crystal growth manufacturing to show the advantage of the proposed model.

■ WB68

Parc- Davidson

Initialization Bias and Related Problems

Sponsor: Simulation

Sponsored Session

Chair: K. Preston White, Professor, University of Virginia, 151 Engineer's Way, P.O. Box 400747, Charlottesville, VA, United States of America, kpw8h@virginia.edu

Co-Chair: Winfried Grassmann, Professor, University of Saskatchewan, Dept. of Computer Science, 110 Science Place, Saskatoon, SK, S7N 5C0, Canada, grassman@cs.usask.ca

1 - MSER Algorithms for the Initial Transient Problem

Raghu Pasupathy, Associate Professor, Purdue University, Dept. of Statistics, West Lafayette, United States of America, pasupath@vt.edu, Bruce Schmeiser

The problem of the initial transient asks how large an initial segment of a time series should be deleted before constructing the estimator of the steady state mean. The MSER family of algorithms is a popular method to address this problem; MSER's efficacy, however, is still unclear and has been the subject of ongoing debate. In this talk, we will attempt to further clarify the computational and theoretical performance of MSER. We also present two new MSER variations that have shown promise.

2 - On the Initial Transient Problem for Reflected Brownian Motion

Rob Wang, Ph.D. Student, Stanford University, 314M Huang Engineering Center, Department of MS&E, Stanford, CA, 94305, United States of America, robjwang@stanford.edu, Peter Glynn

We discuss the convergence to equilibrium of one-dimensional reflected Brownian motion (RBM) and related initial transient formulae. These results provide new insights into the initial transient problem for queueing systems in heavy traffic, for which RBM is an effective approximation.

3 - Choosing a Good Starting State in Discrete Event Simulation

Winfried Grassmann, Professor, University of Saskatchewan, Dept. of Computer Science, 110 Science Place, Saskatoon, SK, S7N 5C0, Canada, grassman@cs.usask.ca

When estimating expectations by simulation, two criteria should be used to find a good starting state: the closeness of the expectation provided by the starting state, and the drift, a concept to be discussed. Good starting states make warm-up periods redundant.

■ WB69

Parc- Fillmore

Decision Making for Holistic Sustainability Assessment

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Gokhan Egilmez, Assistant Professor, North Dakota State University, Industrial & Manufacturing Engineering, NDSU Dept. 2485, PO Box 6050, Fargo, ND, 58108, United States of America, gokhanegilmez@gmail.com

1 - Forecasting Crude Oil Prices using Machine Learning Methods

Erkam Guresen, Ph.D.Student, Turkish Military Academy, Devlet Mah., Ankara, Turkey, erkamguresen@gmail.com, Gulgun Kayakutlu

Oil price becomes an increasingly essential topic of concern to all kind of decision makers from small investors to government policy makers. In this study monthly Brent Crude Oil Prices from January 1980 to June 2013 are used. ARIMA,Exponential Smoothing, Regression, Radial Bases Function Network, Support Vector Machine, and Multi-Layer Perceptron (MLP) models are developed using SPSS software. Three additional MLP models are constructed using dynamic algorithms CA02V01, CA03V01 and CA03V02.

2 - Energy and Carbon Footprints of Alternative Vehicle Options: Inclusion of State-specific Variations

Nuri Onat, PhD Candidate, University of Central Florida, 4000 Central Florida Blvd, Orlando, United States of America, nconat@knights.ucf.edu, Omer Tatari, Murat Kucukvar

Temporal and spatial variations are quite influential when deciding which vehicle option is a better choice in terms of energy and carbon footprints. We compared electric, plug-in hybrid electric, and hybrid electric vehicles across 51 states considering state-specific electricity generation mix and driving patterns. Life cycle methodology is utilized to quantify impacts of the vehicles. This study highlights how temporal and spatial variations affect the vehicle preference at state level.

3 - Ranking Sustainability Performance of the US and Canada Metropoles: An IF-MCDM Approach

Serkan Gumus, Assistant Professor, Turkish Military Academy, Bakanliklar, Ankara, 06654, Turkey, sgumus@kho.edu.tr, Gokhan Egilmez, Murat Kucukvar

Environmental sustainability performance assessment of 27 U.S. and Canada metropoles is focused. Firstly, collecting the data and contacting experts from academia, U.S. government agencies and industry. Secondly, experts are evaluated their sustainability performance. Thirdly, IF-MCDM model is applied considering expert judgements. In the final step, the sustainability scores, rankings, results analysis and discussions, and statistical highlights about the research findings are provided.

4 - Energy-Water Nexus of Electric Vehicle Technologies in United States

Murat Kucukvar, Assistant Professor, Istanbul Sehir University, Kusbakisi Cad. No:27, Uskudar, Istanbul, 34666, Turkey, muratkucukvar@sehir.edu.tr, Nuri Onat

According to the recent statistics, we are running out of time" to take actions towards achieving sustainable vehicle transportation in the U.S. This research aims to provide new insights into the potential water consumption and withdrawals resulting from an increased use of electric vehicles in the 51 states. Four vehicles types including ICEV, HEV, PHEV, and BEV will be analyzed. Stochastic process-based life cycle assessment model will be developed to conduct well-to-wheel" analysis.

5 - Life Cycle Based Environmental Impact Intensity Assessment of National Freight Logistics

Yong Park, Ph.D. Student, North Dakota State University, Fargo, ND, 58108, United States of America, Yong.Park@my.ndsu.edu

In this study, the U.S. manufacturing and transportation industries' nexus will be addressed from life cycle perspective. The main objective of this study is to determine the environmental impact intensity scores of four transportation modes. To achieve this goal, Economic Input-Output Life-Cycle Assessment (EIO-LCA) model will be used to quantify the life cycle inventory and ton-kilometer shipment characteristics for intensity assessment purposes.

6 - Eco-efficiency Analysis of Manufacturing and Transportation Nexus in the U.S. with PCA

Gokhan Egilmez, Assistant Professor, North Dakota State University, Industrial & Manufacturing Engineering, NDSU Dept. 2485, PO Box 6050, Fargo, ND, 58108, United States of America, Gokhan.Egilmez@ndsu.edu

The relationship between the U.S. manufacturing and transportation industries is studied from a life cycle perspective. The main aim is to quantify the life cycle impacts of U.S. manufacturing in the transportation industry and perform eco-efficiency analysis. To achieve this goal, a combined application of Economic Input-Output Life-Cycle Assessment (EIO-LCA) and Principal Component Analysis (PCA) is performed.

■ WB70

Parc- Hearst

Economics (Game Theory)

Contributed Session

Chair: Rachel Chen, University of California at Davis, 3208 Gallagher Hall, Davis, CA, 95691, United States of America, rachen@ucdavis.edu

1 - Three Equilibriums of Benefit-Seeking Behavior of Consuming Weak Regenerative Resource

Shaorong Sun, professor, University of Shanghai for Science and Technology, 516 Jungong Road Shanghai 200093 CHINA, School of Management, Shanghai, 200093, China, 438878648@qq.com, Yannan Zhang

Equilibrium curve and model of common weak regenerative resource under benefit-seeking behavior are deduced based on regeneration speed model of resource and consumption model of benefit-seeking behavior. Different equilibrium points of individual irrationality, individual rationality and collective rationality are deduced. Relationships of these points are analyzed. The number of members influents the profit of benefit-seeking behavior.

2 - Free Samples, Advertisement, and Targeting Strategies

Shiming Deng, Professor, Huazhong University of Science and Technology, 1037 Luo Yu Rd, Wuhan, China, smdeng@hust.edu.cn, Lingli Wu

Customers may be uncertain about the value of a product before having any experience on it. To reduce this uncertainty, companies may offer free samples to customer evaluation. We develop models to study the effectiveness of free samples for the cases they are offered alone or jointly with other ads. Furthermore, if selective marketing are possible, we develop algorithms for choosing customers who should receive samples and/or ads. Our research provides interesting managerial insights.

3 - Opaque Distribution Channels for Competing Service Providers: Posted Price vs. NYOP Mechanisms

Rachel Chen, University of California at Davis, 3208 Gallagher Hall, Davis, CA, 95691, United States of America, rachen@ucdavis.edu, Esther Gal-Or, Paolo Roma

Opaque selling has been widely adopted by service providers to sell off leftover capacity under stochastic demand. We study the impact of different selling mechanisms, Posted Price (PP) vs. Name-Your-Own-Price (NYOP), of an opaque reseller on competing service providers. We find that providers prefer that the opaque reseller uses a posted price instead of a bidding model. Our findings are consistent with the recent trend towards more published price sales for opaque products.

4 - Principal-Agent Framework for a Revenue Generating Unit

Shuo Zeng, University of Arizona, McClelland Hall 430, 1130 East Helen Street, Tucson, AZ, 85721, United States of America, shuozeng@email.arizona.edu, Moshe Dror, Moshe Shaked

We examine the contractual relationship between a principal (revenue generating unit) and an agent (service provider) in a Markovian setting with a risk neutral principal and a risk averse agent. We identify conditions for the existence of a contract and describe the terms for a Pareto-optimal contract. For risk averse agent we adopt a novel risk representation and show that both the principal and the agent are worse off in relation to risk aversion.

■ WB71

Parc - Lombard

Auctions/ Mechanism Design 1

Contributed Session

Chair: Shivam Gupta, UT Dallas, 800 W Campbell Rd, Richardson, TX, United States of America, sxg104920@utdallas.edu

1 - Wheat Auction with Spot Market Competing
Ruoran Chen, Department of Industrial Engineering, Tsinghua University, 519A, Shunde Building, Tsinghua, Beijing, China, crr11@mails.tsinghua.edu.cn, Simin Huang

Chinese governments frequently hold auctions to sell their wheat reservation inventories. In those auctions, wheat of unknown quality is auctioned off to bidders who have private valuations on the wheat. Meanwhile, auction sellers compete with spot wheat market, and spot wheat has better quality which is accessible to all. We use auction theory to analyze the interaction between wheat auction and spot trading. We find this interaction leads to low allocation efficiency.

2 - Re-incentivizing Discovery: Mechanisms for Partial-Progress Sharing in Research
Siddhartha Banerjee, Postdoc, Stanford University, 475 Via Ortega, Stanford, Ca, 94305, United States of America, sidb@stanford.edu, Ashish Goel, Anilesh Krishnaswamy

Partial-progress sharing (PPS) – where a researcher shares information immediately on making a breakthrough - is essential for an efficient research ecosystem. However there is evidence that existing rewards in research discourage PPS. We study the problem of incentivizing information-sharing in research under a stylized model. Under very general conditions, we give conditions to ensure PPS is incentive-compatible for all agents, and suggest mechanisms for real-world settings.

3 - On Virtually Efficient and Optimal Mechanisms in Procurement
Shivam Gupta, UT Dallas, 800 W Campbell Rd, Richardson, United States of America, sxg104920@utdallas.edu, Milind Dawande, Ganesh Janakiraman, Wei Chen

In multi-unit procurement under single-dimensional private information, we show the following: (1) A virtually-efficient mechanism is optimal iff the production costs of the suppliers are linear in their private types. (2) A virtual" VCG mechanism is optimal if the revenue function of the buyer is linear in the total amount procured, the production costs of the suppliers are linear both in their quantity and types, and the feasibility constraints governing allocations define a polymatroid.

■ WB72

Parc- Stockton

Data Analytics for Healthcare Applications

Sponsor: Data Mining

Sponsored Session

Chair: Talayeh Razzaghi, Postdoctoral Research Fellow, School of Computing, Clemson University, Clemson, SC, 29634, United States of America, trazzag@clemson.edu

1 - Applied Partial Least Square Correlation Analysis to Brain Activity Pattern Identification
Yilling He, University of Central Florida, he.yiling2046@gmail.com

Previous studies have demonstrated that sleep deprivation will change human brain activity pattern during certain tasks. Sleep deprivation may impact the activity pattern in various ways during different tasks. By applying the partial least square correlation analysis, we will combine behavior data and fMRI data of subjects with regular restfullness and sleep deprivation, in order to identify the differences of brain activity pattern between these two groups of subjects.

2 - Causal Interaction of Neural Networks in Sleep-deprived Brain
Muyuan Li, Ph.D Candidate, GRA, University of Central Florida, University of Central Florida, P.O. Box 1, Orlando, FL, 32816, United States of America, muyuanli2009@gmail.com

Sleep deprivation is common in modern work environment due to increasing social and occupational demand. While its impact on performance impairment is well studied, the patterns of neural connectivity still largely remain unknown. The objective of this study is using granger causality analysis to reveal the inference interactions in sleep-deprived brain networks.

3 - Are Emergency Departments Becoming the New Outpatient Units?
Sara Nourazari, PhD Candidate, Northeastern University, 360 Huntington Ave, Boston, MA, 02115, United States of America, s.nourazari@neu.edu, James Benneyan, Rifat Sipahi, Daniel Hoch

Delayed care access in outpatient settings may result not only in poor health outcomes and patient satisfaction but also contribute to non-urgent emergency department visits. This work investigates correlations between poor access to several neuro-specialties and the relative risk of scheduled or intended appointments balking or reneging into ED visits.

4 - Adaptive Borderline Cluster Based Oversampling Method to Balance Imbalanced Datasets
Iman Nekooeimehr, Presenter, University of South Florida, 14304 Wedgewood court Apt201, Tampa, Fl, 33613, United States of America, nekooeimehr@mail.usf.edu, Susana Lai-Yuen

In reality, many of the datasets are imbalanced which means different classes have different number of observations. This makes the classifiers fail to classify the minority classes correctly. We have proposed an adaptive borderline cluster based oversampling method which synthetically generates new minority instances to balance the dataset.

■ WB73

Parc- Mission I

Multilevel Optimization Problems in Energy II

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Sauleh Siddiqui, Johns Hopkins University, Baltimore, MD, United States of America, United States of America

1 - The Influence of the Panama Canal on Global Gas Trade
Seksun Moryade, smoryade@umd.edu, Steven A. Gabriel

The Panama Canal expansion will provide the route with shorter distances, reducing the voyage by 7,000 nautical miles to Japan from the Gulf of Mexico. Applying the World Gas Model from the University of Maryland, this paper investigates the potential effects of varying Panama Canal tolls on the LNG markets via six scenarios of possible Panama Canal tariffs. Results are compared and examined with the focus on prices, LNG flows, and supply displacement.

2 - Two-Level, Mixed-Integer Programming Models for Energy Conservation Measures
Bill Champion, Director of Asset Management Consulting/Quality Assurance Manager of EMG, Cockeysville, MD, United States of America, bchampion@emgcorp.com, Steven A. Gabriel

Energy Conservation Measure selection is made difficult given real-world constraints, limited resources to implement savings retrofits, various suppliers in the market and project financing alternatives. The most common method of implementation planning is suboptimal. This presentation demonstrates how two-level mixed integer programming is used to optimize the selection of energy conservation measures.

3 - Joint Participation in Electric Power and Gas Markets: A MPEC Approach
Pablo Duenas, PhD, Comillas Pontifical University, Calle Alberto Aguilera 23, Madrid, Spain, pablo.duenas@iit.upcomillas.es, Sonja Wogrin

Climate change, renewable integration and abundant unconventional gas resources have boosted the utilization of gas for electricity generation. Generation companies with gas-fired power plants submit their hourly offers to organized electricity markets and make use of gas system infrastructure by nominating their planned utilized capacity on a daily basis. A MPEC problem has been developed to considering the temporal mismatch effects. Results are compared with the single level model.

4 - Joint Operational Model for Smartgrid with Community Microgrids under Carbon Emissions Control
Felipe Feijoo, University of South Florida, 4202 E. Fowler Ave, ENB118, Tampa, United States of America, felipefeijoo@mail.usf.edu, Tapas Das

This research presents a model for obtaining optimal operational strategies for microgrids subject to optimal dispatch of electricity by the smartgrid via a bi-level mixed integer programming model. A designed experiment using the results from the bi-level model and a Pareto analysis are used to provide policy design guidelines for microgrids.

■ WB74

Parc- Mission II

Robust and Stochastic Modeling in Power System Operations and Planning

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Antonio J. Conejo, Professor, The Ohio State University, 286 Baker Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, conejonavarro.1@osu.edu

Co-Chair: Ramteen Sioshansi, Assistant Professor, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, sioshansi.1@osu.edu

1 - Robust Optimization of the Self-scheduling and Market Involvement for an Electricity Producer

Ricardo Lima, Laboratorio Nacional de Energia e Geologia, Estrada do Paco do Lumiar, 22, Lisboa, 1649-038, Portugal, ricardo.lima@lneg.pt, Augusto Novais, Antonio J. Conejo

This presentation addresses the optimization of the self-scheduling, forward contracting, and pool involvement of an electricity producer operating a system that combines thermal, hydro and wind sources, and uses a two stage adaptive robust optimization approach. The wind power production and the electricity pool prices are considered to be uncertain. The solution algorithms, computational performance, scheduling results, and the impact of risk management in the results are discussed.

2 - Robust Transmission Expansion Planning

Carlos Ruiz, Universidad Carlos III de Madrid, Avda. de la Universidad, 30, Leganes, 28911, Spain, caruizm@est-econ.uc3m.es, Antonio J. Conejo

We address the problem of transmission expansion planning in an electric energy system with different sources of uncertainty. An adaptive robust optimization model, formulated as a mixed-integer three-level problem, is used to derive the investment decisions that minimize the system's costs by anticipating the worst case realization of the uncertainty. The model is efficiently solved by using a cutting plane algorithm. A realistic case study is used to illustrate the proposed technique.

3 - Toward Fully Renewable Electric Energy Systems

Ruth Dominguez, Universidad de Castilla - La Mancha, Avenida Carlos III s/n, Toledo, Spain, Ruth.Dominguez@uclm.es, Antonio J. Conejo, Miguel Carrion

Global warming and fossil-fuel depletion motivate the increasing presence of renewable sources in power systems. We present an investment model that allows planning the transition from a thermal-dominated system to a renewable-dominated design. The objective is to minimize expected investment and operating costs. The model relies on stochastic programming and allows decisions in both generation and transmission facilities. This model has been tested on a real-world system.

4 - Integration of Plug-In Electric Vehicles in Fully-Renewable Power Systems

Miguel Carrion, Universidad de Castilla - La Mancha, Avenida Carlos III s/n, Toledo, Spain, Miguel.Carrion@uclm.es, Rafael Zarate-Mi-ano

During the last years, the usage of plug-in electric vehicles (PEVs) has been strongly promoted around the world. In this context, we analyze the impact of incorporating a large number of PEVs in a fully-renewable power system. The PEVs demand is modeled considering several charging profiles and different coordination schemes between the Independent System Operator and PEVs. The proposed model is tested in a case study based on the Iberian Peninsula Power System.

5 - Concepts and Practice using Stochastic Programs for Determining Reserve Requirements

Robert Entriken, Principal Technical Leader, EPRI, 3420 Hillview Avenue, Palo Alto, CA, 94304, United States of America, rentrike@epri.com, Russ Philbrick, Edward Lo, Larsen Plano, Aidan Tuohy, Garret LaBove, Eamonn Lannoye

We describe how to appropriately determine reserve reserve requirements. A model is designed to illuminate potential procurement issues for Load Following Up (LFU) reserve products, in both deterministic and stochastic problem formulations, and to show how to leverage modern power system optimization tools to automatically select resources that address deliverability issues in an economically efficient manner. Practical experience, gained from an operational model of the WECC, is also shared.

■ WB75

Parc- Mission III

Queuing Models

Contributed Session

Chair: Rowan Wang, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, wang1075@umn.edu

1 - Individual Performance Analysis of a Discrete-time Queue Fed by a Group of DAR(1) Traffic Sources

Daniel Miao, Associate Professor, National Taiwan University of Science and Technology, 43, Keelung Road, Sec. 4, Taipei, 106, Taiwan - ROC, miao@mail.ntust.edu.tw, Xenos Lin

We study how the individual performance measures seen by a constituent traffic source are affected by other interfering sources when they are superposed into a deterministic queue. With each source modeled by a DAR(1) process, the mean and variance of the individual waiting time are derived in closed form and a recursive structure in its higher moments is established. Numerical examples are given to demonstrate the crucial role played by the autocorrelation structure among these traffic sources.

2 - Service Systems with Appointment-Driven Arrivals, Non-Punctual Customers, and No-Shows

Rowan Wang, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, wang1075@umn.edu, Oualid Jouini, Saif Benjaafar

We consider service systems where a finite number of customers arrive over time. The arrival of customers is driven by appointments. However, customers are not necessarily punctual. Customers may also not show up altogether. Customers are not homogeneous in their punctuality, show-up probabilities, and time between previous and subsequent appointments. We develop an exact analytical approach to obtain various performance measures of interest.

3 - M/ G/ Infinity with Exponentially Distributed Setup Times

Babak Haji, University of Southern California, 2553 Dearborn dr, Los Angeles, CA, 90068, United States of America, bhaji@usc.edu, Sheldon Ross

We consider an M/G/infinity model with exponentially distributed setup times. Arrivals result in an idle server setting a setup. Upon completing a setup, a server begins serving a waiting customer. Upon completing a service, with probability p the server becomes eligible to serve a waiting customer. We show, in steady state, that the number of busy servers has a Poisson distribution and is independent of the number of servers in setup.

4 - Service Systems with Uncertain Quality and Anecdote Reasoning Customers

Hang Ren, University College London, Dept of Management Science & Innovation, Gower Street, London, WC1E 6BT, United Kingdom, hang.ren.13@ucl.ac.uk, Tingliang Huang

We study service systems with random service quality and boundedly rational customers who estimate their own valuation of service quality from word of mouth. We analyze customers' equilibrium joining behavior and the influence on the firm's profit. We find that the revenue-maximizing price is increasing in the customers' rationality level when the expected service quality is high enough, and the maximized revenue is unimodal in the customers' rationality level.

5 - Between Little's Formula and Bullwhip Effect

Xiaoyue Jiang, Tulane University, Department of Computer Science, Baton Rouge, United States of America, xjiang@tulane.edu

Effort is made to bring a deterministic queuing method, Network Calculus (NetCal), back to convex analysis framework. By further interpreting the fundamental results via the notion of variability, the Bullwhip Effect (BWE) in the supply-chain field arises naturally, so does a NetCal counterpart of the Little's formula in queuing. The former reveals an additivity structure between variabilities of supply and demand, and the latter connects the worst case scenarios of two QoS metrics.

■ WB76

Parc- Embarcadero

Analytics in Bioinformatics and Healthcare

Sponsor: The Practice Track

Sponsored Session

Chair: Young Woong Park, Northwestern University, 2145 Sheridan Rd, Evanston, IL, 60208, United States of America, ywpark@u.northwestern.edu

1 - Septic Shock Prediction for Patients with Missing Data

Joyce C. Ho, The University of Texas at Austin, 1 University Station, C0803, Austin, TX, 78701, United States of America, joyceho@utexas.edu, Cheng Lee, Joydeep Ghosh

Septic shock is a common and fatal condition. However, early prediction of patients at risk for septic shock is difficult due to the wide range of potential indicators, where missing data is a known issue. We investigate how different imputation selection criteria and methods can overcome the missing data problem. Our models, which use imputation methods in conjunction with predictive model, provide a generalized approach for predicting septic shock.

2 - Algorithm for Regression Subset Selection on a Network

Diego Klabjan, Professor of Industrial Engineering and Management Sciences Director of Master of Science in Analytics Program, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, d-klabjan@northwestern.edu, Sung Won Han, Judy Hua Zhong, Young Woong Park

We study a regression subset selection problem on a network, motivated from gene network inference. The problem is to build a regression model for each attribute by treating it as the response variable and the remaining attributes as explanatory variables, while preserving the acyclic structure of the selected variables. We solve the problem based on Lagrangian relaxation containing LASSO and maximum acyclic subgraph as sub-problems. A computational study is provided.

3 - The Role of the Microbiome in Women's Health

Paul Brooks, VCU, PO Box 843083, Richmond, United States of America, jpbrooks@vcu.edu, Greg Buck VMC

Next-generation sequencing technology facilitates conducting a DNA census of the microbiome, including the bacteria that reside in different body habitats. In this talk, we discuss the analysis of 16S metagenomic data generated from over 4,000 samples from female subjects. We observe differences in microbiome profiles based on diagnosis and demographic variables.

4 - Models for Predicting Objective Function Weights in Prostate Cancer IMRT

Justin J. Boutilier, University of Toronto, 5 King's College Road, Toronto, On, M5S 3G8, Canada, j.boutilier@mail.utoronto.ca, Timothy C. Y. Chan, Taewoo Lee, Tim Craig, Michael B. Sharpe

We demonstrate the clinical applicability of three machine learning models that predict optimization objective function weights from patient geometry for intensity-modulated radiation therapy of prostate cancer. Our weight prediction methodologies can produce clinical quality treatment plans by simultaneously predicting multiple weights and capturing trade-offs associated with sparing multiple OARs near a prostate tumor.

■ WB77

Parc- Market Street

Joint Session Analytics/SpORts: Baseball Analytics

Sponsor: Analytics & SpORts

Sponsored Session

Chair: Sean Barnes, Assistant Professor, University of Maryland, 4352 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu

1 - Minor League Scout Scheduling

Oguzhan Ozlu, Georgia Institute of Technology, School of Ind & Sys Engineering, 765 Ferst Drive, NW, Atlanta, GA, 30318, United States of America, a.o.ozlu@gmail.com, Joel Sokol

An MLB team needs to schedule which scouts should see each of thousands of minor league games over six months, subject to business constraints on travel, baseball-related needs, time off, etc., while minimizing the overall transportation and lodging costs. We will describe different layers of the problem and present exact integer optimization and heuristic approaches to obtain 'good' schedules. We will also outline the strategies for schedule recovery and handling uncertainties.

2 - Armchair Baseball Manager: Exploring Baseball Strategies

Marina Polyashuk, Associate Professor of Mathematics, Northeastern Illinois University, 5500 N. St. Louis Ave., Chicago, IL, 60625, United States of America, m-polyashuk@neiu.edu

This presentation is focused on solving the problem of devising an optimal lineup for a given baseball game. The problem is decomposed into two parts: one, selecting a starting assignment of position players and two, choosing a batting order for a given set of starters. Proposed solutions are based on multiple criteria methods, graph theory, and statistical analyses.

3 - The Connection between Flexible Production Networks and Baseball Roster Construction

Douglas Fearing, The University of Texas at Austin, 2110 Speedway, Stop B6500, Austin, TX, United States of America, doug.fearing@mccombs.utexas.edu, Timothy C. Y. Chan

Drawing from the theory of production flexibility in manufacturing networks, we provide the first optimization-based analysis of the value of positional flexibility (the ability of a player to play multiple positions) for a major league baseball team in the presence of injury risk. Using publicly available data on baseball player performance, we derive novel baseball-related insights that can be generalized to the manufacturing context.

4 - Great Expectations: An Analysis of Major League Baseball Free Agent Performance

Sean Barnes, Assistant Professor, University of Maryland, 4352 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu, Margrét Bjarnadöttir

We analyze MLB player data to characterize whether players meet the expectations set by free agent contracts. We develop two models using machine learning techniques: one based on market valuation and one based on future performance. We show that our second model more consistently matches previous performance with future value.

■ WB78

Parc- Mason

Analytic Hierachy Process

Contributed Session

Chair: Orrin Cooper, University of Memphis, 332 Fogelman, Memphis, United States of America, olcooper@memphis.edu

1 - Sensitivity Analysis for Analytic Network Models

Magda Gabriela Sava, PhD Student, Joseph M. Katz Graduate School of Business, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, 15260, United States of America, mgsava@katz.pitt.edu, Luis Vargas, Jerrold May

We propose an extension of the sensitivity and stability analysis for analytic network models previously developed. We study simple ANP models to understand how preference regions are created, and characterize their boundaries as the complexity of the network increases. We use optimization methods to find the most suitable boundaries between the preference regions and define the appropriate stability regions.

2 - Using Linking Pin Comparisons as Cluster Comparison Pivots

Orrin Cooper, University of Memphis, 332 Fogelman, Memphis, United States of America, olcooper@memphis.edu

The AHP pairwise comparison process is an innovative method that relies on our innate ability to make relative comparisons between objects. In practice, the differences between objects being compared should not normally exceed Saaty's 1-9 scale. Herein Linking Pin comparisons are used to make the comparisons to obtain the criteria cluster weights. This approach allows cluster weightings to exceed the 1-9 scale without using a new scale and to reduce the cognitive burden on the decision maker.

3 - Determining Customers' Selection Criteria: Comparison of Turkish Airline Companies

Ozay Ozaydin, Assistant Professor, Dogus University, Zeamet S. No:21 Acibadem, Istanbul, 34722, Turkey, oozaydin@dogus.edu.tr, Mine Isik, Emel Aktas

Airlines must dynamically adapt a number of competitive strategies in order to survive in the market and also expand their share. Criteria that customers use for selecting an airline are investigated, and a brief comparison of the local airlines' performances. AHP is used as a decision support system framework, combining numerical data such as fleet size, accident history, on-time performance with personal perception of decision makers to include all possible aspects of an airline success.

4 - Work Load Analysis by AHP

Baris Carikci, TUBITAK, Upriselite Sitesi A1 Blok No:67 Kartal /, Kartal / Istanbul, 34403, Turkey, baris.carikci@tubitak.gov.tr

Work Load Analysis is a tool to evaluate the necessary work force for the organization. Especially it is a must after the organizational restructuring and process oriented improvements. Without such an application, the organizations might be running with adequate or inadequate work force, which eventually leads the inefficiency and unmotivated labor force. In our case, we used AHP, which focuses on the business processes, to evaluate the work force needs.

■ WB79

Parc- Powell I

Joint Session DAS/MAS: Game Theory, Decision Analysis, and Homeland Security, Part II

Sponsor: Decision Analysis & Military Applications Society

Sponsored Session

Chair: Jun Zhuang, University at Buffalo, 317 Bell Hall, Buffalo, NY, 14260, United States of America, jzhuang@buffalo.edu

1 - Modeling Insurer-homeowner Interactions in Managing Natural Disaster Risk

Xiaojun Shan, Postdoctoral Research Associate, CEEEP at Rutgers University, 33 Livingston Ave, New Brunswick, NJ, 08901, United States of America, xiaojun.shan@ejb.rutgers.edu, Jamie Kruse, Yohannes Kesete, Yang Gao, Rachel Davidson, Jiazhen Peng, Linda Nozick

The system for managing natural disaster risk is problematic. Homeowners are often uninsured or underinsured while insurers often do not want to insure against these losses, which can cause an high chance of insolvency. To design an improved system for the different perspectives of the stakeholders, we develop a novel modeling framework integrating state-of-the-art hurricane loss and stochastic optimization models for decision supports to both the homeowners and insurer with governance.

2 - A Game-theoretic Model for Risk Sharing between Public and Private Sectors against Extreme Risks

Yang Zhang, Assistant Professor, Tsinghua University, Dept. of Industrial Engineering, Beijing, China, yangzhanguser@mail.tsinghua.edu.cn, Chen Wang

Public-private insurance programs can provide financial protection against catastrophic risks. We propose a sequential game with three parties, the government, an insurer, and potential policy holders, to investigate how the government can involve insurers to provide the service, while limiting their profits to avoid compromising the social welfare. We consider both natural and terrorism threats, assuming natural hazards to have considerably less ambiguity than terrorism risks.

3 - Public-private Partnerships in Disaster Management: Engaging with Multiple Private Sectors

Peiqiu Guan, Ph.D. Candidate, University at Buffalo, SUNY, 338 Bell Hall,, Department of ISE, Buffalo, NY, 14226, United States of America, peiqiugu@buffalo.edu, Jun Zhuang

Public sector would partner with multiple private sectors in different stages of disaster management to meet various needs. This research uses game-theoretical modeling, Monte Carlo Analytical Hierarchy Process, and expert opinions to study how to form optimal partnerships between the public section and multiple private sectors.

4 - Asymmetrically Prescriptive/Descriptive Game Theory with EU and PT Decision Makers

Philip Leclerc, Doctoral Student, Virginia Commonwealth University, 1501 Abelway Drive, Midlothian, VA, 23114, United States of America, philip.leclerc@gmail.com, Jason Merrick

Game theory assumes Expected Utility Theory preferences, but Prospect theory (PT) is presently the leading descriptive theory of choice under uncertainty. We study equilibria involving the full PT model for risk, and examine the impact of PT preferences on, e.g., existence and computational complexity. We develop examples illustrating that 1) each PT equilibrium may differ from the others and from NE, 2) PT equilibria may fail to exist, and 3) PT preferences can improve player welfare.

5 - Interdependent Network Performance Measures and Characteristics

Allison Reilly, Post-doctoral Researcher, Johns Hopkins University, 3400 N Charles Street, 303 Ames Hall, Baltimore, MD, 21210, United States of America, acr@jhu.edu, Andrew Samuel, Seth Guikema

Regulators are particularly concerned with predicting interdependent infrastructure system performance after a hazardous event given the threat of systemic disruption. In this work, we broaden the understanding by examining how competing network objectives impact investments and performance. We expand upon game-theoretic models of interdependent networks to ultimately aid decision-makers in setting effective regulatory strategies for encouraging efficient investments and improved performance.

■ WB80

Parc- Powell II

Infrastructure Modeling for Improved Decision Making

Sponsor: Decision Analysis

Sponsored Session

Chair: Kash Barker, Assistant Professor, University of Oklahoma, 202 W Boyd St, Rm. 124, Norman, OK, 73019, United States of America, kashbarker@ou.edu

1 - Infrastructure Risk Management: Prediction and Decision-Making

Seth Guikema, Assistant Professor, Johns Hopkins University, 313 Ames Hall, Department of Geog & Env. Engineering, Baltimore, MD, 21218, United States of America, sguikema@jhu.edu

Infrastructure in the US is aging, suffers from a lack of funding, and is subject to a number of significant natural hazards. At the same time, it is critical for societal functioning and security. Risk-based management of infrastructure is critical. This talk presents predictive risk models for infrastructure and shows how they can be used to support infrastructure management decision-making and investment. Examples from the electric power and potable water sectors are used.

2 - Improving the Computational Efficiency of the Interdependent Network Design Problem MIP Model

Andres Gonzalez, Rice University, 6100 Main St., MS-318, Houston, TX, 77005, United States of America, andres.gonzalez@rice.edu, Leonardo Duenas-Osorio, Andrés L. Medaglia, Mauricio Sanchez-Silva

The Interdependent Network Design Problem (INDP) focuses on finding optimal recovery strategies for a set of damaged interdependent infrastructure systems. In this work, we present an application of a Benders/Danzig-Wolfe decomposition hybrid algorithm to enhance the computational efficiency of the INDP MIP model. Hence, the presented hybrid algorithm enables the INDP model to study large and realistic infrastructure networks, thus contributing to resilience quantification.

3 - Resilience-Based Decision Making for Infrastructure Networks

Kash Barker, Assistant Professor, University of Oklahoma, 202 W Boyd St, Rm. 124, Norman, OK, 73019, United States of America, kashbarker@ou.edu, Charles Nicholson

We model network resilience as a function of vulnerability, the extent of impact after a disruption, and recoverability, the length of time required for restoration. We offer an optimization formulation to allocate resources to these two aspects of resilience, and test several heuristics for reducing the size of the network to reduce computational requirements.

4 - Resilience-Based Freight Transportation Infrastructure Network Design

Mohamad Darayi, PhD. Student, University of Oklahoma, 202 W Boyd St, Rm. 124, Norman, OK, 73019, United States of America, mdarayi@ou.edu, Kash Barker

Improving freight transportation infrastructure network design (i) by the addition of capacitated links/nodes or (ii) by increasing the capacity of current network components are explored as options to strengthen the functionality of the network and its effect on the multiple industries relying upon it. Considering different disruption scenarios, this research addresses a network completion decision making problem with respect to the network resilience, as well as multi-industry impacts.

■ WB81

Parc- Divisadero

Analytics and Energy

Sponsor: Data Mining

Sponsored Session

Chair: Theodore Trafalis, Professor, School of Industrial and Systems Engineering, University of Oklahoma, 202 W. Boyd St., Room 124, Norman, OK, 73019, United States of America, ttrafalis@ou.edu

1 - A Heuristic Algorithm to Solve the Single-facility LRP on RMS with Energy System Applications

Emre Tokgoz, Quinnipiac University, 275 Mount Carmel Ave., Hamden, CT, 06518, United States of America, emre.tokgoz-1@ou.edu, Samir Alwazzi, Theodore Trafalis

Solving LRP on Riemannian Manifold Surface (RMS) is a more realistic approach than using Euclidean surfaces because of the curved structure of the pathways on Earth with changing local RMS curvatures. In this work, we introduce a new LRP to be solved on RMS and find a heuristic algorithmic solution to this LRP. In particular, we formulate the LRP for a single facility on RMS. Applications in energy systems will be discussed in this talk.

2 - Kernel-based Regression in Natural Gas Storage Valuation

Alexander Malyscheff, malyscheff@gmail.com, Theodore Trafalis

The valuation of natural gas storage contracts has recently received significant attention in the energy management community. Least-Squares Monte Carlo (LSMC) represents one approach to value such contracts. We apply kernel-based machine learning techniques to derive the regression function required in the LSMC method.

3 - Securities Analysis of Selected Energy Companies Based on Data Mining and Machine Learning Approach

Zhen Zhang, Reserach Assistant, SCIPP, Norman, OK, United States of America, zhenzhang0217@gmail.com, Theodore Trafalis

Authors of this paper evaluate successful/failed energy moguls and aspiring new energy companies through quantitative and qualitative analysis facilitated by data mining and machine learning techniques. Quantitatively, it displays statistical superiority/inferiority based on a company's capitalization, earnings, dividends, assets, liabilities and operational data; Qualitatively, we focus on the industry, the general market, the role, the management, the prospect and the competitive advantage.

■ WB82

Parc- Haight

Multicriteria Decision Making 2

Contributed Session

Chair: Roman Slowinski, Professor, Poznan University of Technology, Pl. Marii Sklodowskiej-Curie 5, Poznan, 60-965, Poland, roman.slowinski@cs.put.poznan.pl

1 - Preference-driven Cone Contraction for Multiobjective Optimization

Roman Slowinski, Professor, Poznan University of Technology, Pl. Marii Sklodowskiej-Curie 5, Poznan, 60-965, Poland, roman.slowinski@cs.put.poznan.pl, Milosz Kadzinski

We present an interactive procedure for multiobjective optimization which involves robust ordinal regression in contraction of the preference cone in the objective space. The decision maker (DM) specifies pairwise comparisons of some non-dominated solutions from a current sample. The cone originating in a reference point is formed by all directions of isoquants of the achievement scalarizing functions compatible with the pairwise comparisons of solutions provided by the DM.

2 - MCDM and PROMETHEE Preference Functions for Crop Variety Selection

Jay Parsons, Optimal Ag Consulting, Inc., 3226 Ledgestone Ct., Fort Collins, CO, 80528, United States of America, jay.parsons@OptimalAg.com

Wheat varieties are typically evaluated for eleven different traits in addition yield data from test plots. The PROMETHEE methodology of multi-criteria decision making is a nice fit for this type of decision problem. In this paper presentation, I propose preference functions for the twelve criteria to be evaluated when selecting a wheat variety. Furthermore, I propose a software tool for integrating this information into a multi-criteria decision support system.

3 - The Robustness Space Pareto Set Reduction Problem

Daniel Jornada, Research Engineer Associate, Texas A&M University, 3367 TAMU, College Station, TX, 77843, United States of America, djornada@tamu.edu, V. Jorge Leon

We present a mathematical programming framework for identifying a subset of robust solutions from a given Pareto set arising from a multi-objective problem. The efficient set is mapped onto a 2-dimensional space, termed robustness space, representing model and solutions robustness with respect to uncertainties in prescribed solution values. We present theoretical properties, examples contrasting with existing Pareto set reduction approaches, and an approach for multi-objective linear programs.

4 - Bi-Objective Tabu Search for The Fleet Size and Mix Onshore Workover Rigs Scheduling Problem

Werner Soares, UFRN, UFRN - Centro de Tecnologia, Av. Sen. Salgado Filho s/n, Natal, Brazil, werner_soares@hotmail.com, Dario Aloise, Ana Paula Costa

Services on oil wells in onshore fields are performed by expensive workover rigs. A good choice of fleet size and mix and scheduling of such equipment is necessary. However, in literature, the quantities are considered fixed, a priori, and the rigs considered homogeneous. In this work, a Tabu Search heuristics is developed for obtaining a Pareto set of bi-objective solutions for a more robust version of this problem.

■ WB83

Parc- Sutro

Data Mining 2

Contributed Session

Chair: Chaojiang Wu, Assistant Professor, Drexel University, 3141 Chestnut Street, Philadelphia, Pe, 19104, United States of America, cw578@drexel.edu

1 - Tree Based Ensemble Methods in Travel Time Prediction

Yanru Zhang, University of Maryland, University of Maryland, Dept. of Civil & Environmental Eng., college park, MD, 20740, United States of America, yrzhang@umd.edu, Ali Haghani

Ensemble based algorithms have reached a celebrity status in solving prediction problems in recent years. Within them, tree based ensemble methods are successful ones that providing interpretable results, that are able to handle different types of predictor variables, and can fit complex nonlinear relationship. In this paper, we applied a gradient boosting regression tree method to analyze and model freeway travel time to improve the prediction accuracy and model interpretability.

2 - Using Global and Local Patterns for Improving Vehicle Trajectory Prediction

William Groves, University of Minnesota, 200 Union St SE Ste 4-192, Minneapolis, Mi, 55455, United States of America, groves@cs.umn.edu, Ernesto Nunes, Maria Gini

Location data collected from taxis contains a wealth of information about daily patterns of road use. We propose a framework for prediction of in-progress vehicle trajectories using eigen-based and Markov-based methods to leverage both general and highly localized patterns. We learn the road network and travel patterns directly from a large corpus of data (10,000 taxis observed for one week in a major city) to generate short-term predictions that correspond directly to the real-world situation.

3 - Evaluation of Airlines' Web Site Via Text Mining

Feyza Gürbüz, Erciyes ‹niversites, Erciyes Universitesi Müh. Fak. Endüstri, Kayseri, 38039, Turkey, feyza@erciyes.edu.tr, Esra Kahya-Ozyirmidokuz

The websites of airlines has a critical effect on customers. These websites use a lot of data which are unstructured. In this study the web text mining (TM) approach is performed on international airlines' web site data to extract knowledge from them. TM is used to extract the keywords based on the weight calculation of Term-Frequency Inverse-Document-Frequency and uses similarity analysis and support vector machine algorithms to cluster the airline websites.

4 - Dimension Reduction in Quantile Regression

Chaojiang Wu, Assistant Professor, Drexel University, 3141 Chestnut Street, Philadelphia, Pe, 19104, United States of America, cw578@drexel.edu, Yan Yu

To overcome the curse of dimensionality yet retain model flexibility, we propose two dimension reduction methods for modeling conditional quantiles: partially linear single-index models and partially linear additive models. The unknown univariate functions are estimated by penalized splines. Both simulations and real applications show encouraging results of the proposed estimators.

5 - Reacting in Real-time to New Malware Infections Committing Online Advertising Fraud

Jason Shaw, Senior Data Scientist, Integral Ad Science, 37 E 18th St, Fl 7, New York, NY, 10035, United States of America, jshaw@integralads.com, Kiril Tsemekhman

Most online advertising fraud is carried out by botnets built through malware. Immediate detection of newly infected machines is critical to fully protecting advertisers, but many techniques depend on algorithms which do not allow online classification of users as clean or infected. Using locality-sensitive hashing as the basis of a recommender system, we continuously incorporate a stream of tens of thousands of ads per second. With up-to-date data, new infections can be identified in minutes.

Wednesday, 12:45pm - 2:15pm

■ WC02

Hilton- Golden Gate 7

Risk, Incentives and Cooperation in Technology Management

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Niyazi Taneri, SUTD, 20 Dover Drive, Singapore, Singapore, niyazitaneri@sutd.edu.sg

1 - Cost-reducing Innovation and the Role of Patent Intermediaries

Shantanu Bhattacharya, Visiting Associate Professor of Operations Management, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, Shantanu.bhattacharya@insead.edu, Sameer Hasija, Anupam Agrawal

Patent intermediaries are non-practicing entities in the innovation domain. We analyze the competition between two identical incumbents and a PI for external cost-reducing innovations. We show PIs always win IP rights for incremental innovations, and for radical innovations with significant efficiency advantages and low uncertainty about the degree of innovation.

2 - How (and When) to Encourage Cooperation in Project Portfolios

Fabian Sting, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, fsting@rsm.nl, Yaozhong Wu, Pascale Crama

Inspired by an innovative real-life practice, we model a project portfolio system that shapes cooperative behavior. Help is at the core of this system in which employees may mutually ask for help, while management facilitates the exchange of help. We find that the company should take a nuanced approach to help. It is striking that asymmetric resource engagement emerges as an optimal approach: cooperative behavior may lead the company to induce different efforts even for symmetrical projects.

3 - Supplier Involvement in Component Development: Commitment versus Flexibility

Timofey Shalpegin, HEC Paris, 1 Rue de la Libération, Jouy en Josas, France, timofey.shalpegin@hec.edu, Zhixi Wan, Svenja Sommer

Manufacturers involve suppliers to develop prototypes of innovative component designs. A common practice is to set a target cost for each component design. Manufacturer can commit to a set of pre-determined cost targets or flexibly change the cost target of a design. We show that the flexible target cost scheme create benefits at the cost of provoking the supplier's strategic behavior. We examine the manufacturer's preference between the two types of target cost schemes.

■ WC04

Hilton- Continental 1

Service Operations Design and Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Sameer Hasija, Assistant Professor of Technology and Operations Management, INSEAD, 1 Ayer Rajah Avenue, Singapore, Si, 138676, Singapore, Sameer.Hasija@insead.edu

1 - Avoiding Expiration of Medical Inventory for Emergency Response

Quan Zhou, University of Auckland, Room 6121, OGGB, 12 Grafton Road, Auckland City, Auckland, 1010, New Zealand, q.zhou@auckland.ac.nz, Tava Olsen

Even with a long shelf life, medical supplies in the national reserve for large-scale emergencies are at risk of expiration. We consider the perishability of long-life reserve supplies, and propose to rotate them to hospitals' operational use. We derive the optimal policies for the rotation decision in combination with the hospital's ordering decision. We obtain intuitively appealing results with some surprising properties, which could provide implications for rotation operations.

2 - Contracting in Medical Equipment Maintenance Services: an Empirical Investigation

Tian Chan, PhD, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, TianHeong.CHAN@insead.edu, Francis de Vericourt, Omar Besbes

Fixed-fee and pay-per-service contracts are two forms of maintenance service plans that structure payment between operators and service providers. Using data from 712 medical scanners, we empirically compare their effects on service outcomes. We exploit a warranty period to isolate incentive effects from adverse selection, finding (1) a pay-per-service contract leads to relatively higher reliability and lower costs, and (2) the effects are driven by both operator and service provider.

3 - Optimal Design of Co-Productive Services: Interaction and Work Allocation

Guillaume Roels, UCLA, 110 Westwood Plaza, B511, Los Angeles, CA, 90066, United States of America, guillaume.roels@anderson.ucla.edu

In this paper, we develop an analytical model of joint production between a service provider and a customer and characterize how a service firm should design its co-productive system. Our analysis gives rise to a service-process framework with three archetypes of co-productive services: collaborative services, service factories, and self-services. We discuss the implications of our results for service process reengineering.

■ WC05

Hilton- Continental 2

Collaboration and Information in Supply Chains

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu

1 - Retailer's Forecast Capability Information and Demand Forecast Sharing in Supply Chains

Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Lakshmi Nittala

Does it help to know how good the retailer is at forecasting for sharing retailer's demand forecast information with the manufacturer? We demonstrate that it can actually hurt the forecast sharing between the retailer and the manufacturer.

2 - Online Retailer Competition with a Referral Service

Kihoon Kim, Korea University Business School, Anam-Dong, Seongbuk-Gu, Seoul, Korea, Republic of, kihoonk@gmail.com

We investigate whether two competing online retailers can be better off by adopting a referral service. When they adopt the referral service, a referral-offering online retailer faces a trade-off between generating additional revenues from referral fees and the risk of exposing its loyal consumers to the price of its referred online retailer. Our main result is that when the market shares of both retailers do not differ significantly, the referral service is likely to be adopted.

3 - Engage the Wisdom of Crowds: Structural Analysis of Dynamic User Contributions in Online Innovation

Wei Chen, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA, 92093, United States of America, Wei.Chen@rady.ucsd.edu, Xiahua (Anny) Wei, Kevin Zhu

What engages users and keeps them active? This paper studies the dynamics of user contributions in an innovation community where contributions are analogous to public goods. We use a hidden Markov model to characterize the fluctuation of user contributions with two latent motivation states (active vs. inactive) and their effects on the level of participation. We find that reputational motivations and reciprocity are effective in turning inactive users into active users, and keeping them engaged.

■ WC06

Hilton- Continental 3

Service Business Models

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, United States of America, jguajardo@haas.berkeley.edu

Co-Chair: Pnina Feldman, UC Berkeley, Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu

1 - Patient Portals in Primary Care: Impacts on Patient Health and Physician Productivity

Hessam Bavafa, Assissant Professor, Wisconsin School of Business, 975 University Ave, Madison, WI, 53706, United States of America, bavafa@wharton.upenn.edu, Christian Terwiesch, Lorin Hitt

Interest in innovative health care delivery models has increased due to measures such as the Affordable Care Act, which is designed to expand insurance coverage and contain health care costs. One innovation that has been forwarded as a low-cost alternative to office visits is e-visits," or secure messaging via patient portals. We evaluate the effect of e-visit adoption on patient health and physician productivity using a six-year panel dataset from a primary care provider in the United States.

2 - Pricing Reservations with Strategic Customers

Kate Ashley, UC Berkeley, Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, 94720, United States of America, kate_ashley@haas.berkeley.edu, Pnina Feldman

Many firms offer reservations for future service, which exposes them to costly no-shows. At the time reservations are offered, customers do not know their exact valuations for service, and may vary in their probabilities of showing up. This paper analyzes three different reservation pricing schemes that address the no-show problem, characterizes optimal prices and revenues under each scheme, and discusses managerial implications.

3 - Tournaments for Service Delivery

Karan Girotra, Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, karan.girotra@insead.edu, Konstantinos Stouras, Serguei Netessine

We consider contests in service delivery environments such as virtual call centers, i.e. call centers with an on-demand geographically dispersed workforce. We identify tournament design modes that trade-off tournament participation, quality of service and delivery costs.

■ WC07

Hilton- Continental 4

Supply Chain Management V

Contributed Session

Chair: Olov Isaksson, EPFL, Station 5, Lausanne, Switzerland, olov.isaksson@epfl.ch

1 - The Role of Supply Chain Complexity: An Investigation of the Thousands of Villages" Supply Network

Guanyi Lu, Assistant Professor, Oregon State University, 200 Bexell Hall, Corvallis, OR, 97331, United States of America, guanyi.lu@oregonstate.edu, Xitong Guo

Supply chain complexity has been conceptualized through the number of suppliers, the degree of differentiation among these suppliers, and the level of interrelationships among the suppliers. Our study of a large supply network suggests that two additional factors,interactions among buyers and presence of powerful third party, would also affect supply chain complexity and supply chain performance.

2 - Orders and Reciprocity in the Technology Supply Chain

Heejong Lim, PhD Student, Purdue University, 403 W. State Street, West Lafayette, IN, 47907, United States of America, limh@purdue.edu, Ananth Iyer

Motivated by the semiconductor and the LCD industry, we incorporate the reciprocal game in a dyadic (buyer-supplier) supply channel. In our model, the buyer's anticipated reciprocal behavior influences the seller's order so as to protect the seller during the oversupply period. We provide an analysis under different level of reciprocity following accepted economic models in order to explore the impact on order size and channel coordination. Insights from practice are then provided.

3 - Bullwhip Effect and Demand Uncertainty on Firms' Cost Behavior

Shilei Yang, Professor, Southwestern University of Finance and Economics, Guang Hua Chun #55, Chengdu, 610074, China, syang@swufe.edu.cn, Jing Zhu

The research is an interface study between cost accounting and supply chain management. Using the Compustat data, we find that firms with greater bullwhip effect tend to have a more flexible cost structure, but higher demand uncertainty is more likely associated with a rigid cost structure with an exception for firms in the retailing sector. In particular, firms with lower firm-level bullwhip ratio are usually more capable to withstand the stress on cost structure caused by demand uncertainty.

4 - Knowledge Spillovers in the Supply Chain: Evidence from the High Tech Sectors

Olov Isaksson, EPFL, Station 5, Lausanne, Switzerland, olov.isaksson@epfl.ch, Markus Simeth, Ralf W. Seifert

We explore knowledge spillovers in the supply chain and empirically show that buyer innovation has a strong positive impact on supplier innovation. We find that the duration of the buyer-supplier relationship positively moderates this effect, but that tie strength has a negative moderating role. The technological proximity of the two firms, however, is not found to have a significant effect on spillovers.

■ WC08

Hilton- Continental 5

Models of Human Dynamics in Social Data

Cluster: Social Media Analytics

Invited Session

Chair: Tauhid Zaman, MIT Sloan School of Management, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, zlisto@mit.edu

1 - A Billion Social Networks: What Each of Our Networks Says About Us

Lars Backstrom, Facebook, 750 N Shoreline Blvd #68, Mountain View, CA, 94043, United States of America, lars@fb.com

At Facebook, over a billion people engage with their friends each month. All this activity gives us a unique opportunity to understand real social networks. In microcosm, we can watch as new friendships turn into relationships, then engagements and finally marriages, observing effects on the rest of the network. Zooming out, we can observe the small world effect on a significant fraction of the whole world. Studying human relationships is now possible on a scale never previously imagined.

2 - The Structure and Evolution of Communities on Twitter

Gabor Szabo, Staff Data Scientist, Twitter, 1355 Market St, Suite 900, San Francisco, CA, 94103, United States of America, gabor@twitter.com, Satanjeev Banerjee

Social media services oftentimes facilitate the creation of connections among the users, based on shared interests or real-life relationships. As determined by their local network structure, most users are only linked to a very small fraction of the entire user base. In this paper we identify these dense subgraphs of the Twitter follower network as communities through a scalable algorithm, and describe their self-similar structure and temporal evolution.

3 - Tweet Time: Optimizing the Timing of Content in Twitter

Sina Modaresi, Graduate Research Assistant, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, sim23@pitt.edu, Tauhid Zaman, Juan Pablo Vielma

In online social networks, such as Twitter, users generate content for which they wish to maximize engagement by other users. We show how one can select the time the content is posted in Twitter in order to maximize its engagement. We present a model of user behavior which combines temporal and network aspects of Twitter. Our model is fairly general and can extend to other social networks, but we focus on Twitter because the data is readily available.

4 - Twitter as a Sensor Network: Detecting Change-points in Social Signals

Arash Delijani, MIT, 404A Broadway, Cambridge, MA, 02139, United States of America, arashd@mit.edu, Tauhid Zaman

We study the problem of detecting trending events in Twitter. We model this as a change-point detection problem, and use the Cumulative Sum (CUSUM) algorithm, which is optimal for this task. We test different models of user behavior on a large amount of historical data, and use them along with CUSUM, to detect trending events and evaluate our performance on events with known starting times. We also provide theoretical bounds for the detection delay of CUSUM for various models of user behavior.

■ WC09

Hilton- Continental 6

E-Business/ Commerce 1

Contributed Session

Chair: ShiKui Wu, Assistant Professor, University of Windsor, 401 Sunset Ave., OB-413, Windsor, ON, N9B 3P4, Canada, skwu@uwindsor.ca

1 - Modelling Pricing Strategies for Internet Domain Names
Claudia Loebbecke, University of Cologne, Pohligstr. 1, Koeln, Germany, claudia.loebbecke@uni-koeln.de, Thies Lindenthal

Interested in buyers' and sellers' pricing strategies for Internet domain names, we develop and empirically test a hedonic model for domain prices. We find differences in the implicit prices for selected domain attributes across different types of buyers, but no evidence of sellers being able to discriminate between the different buyer types.

2 - The Effect of Motivations on Mobile Coupon Sharing in Social Network Sites
Qing Tang, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, China, tangqing0825@gmail.com, Shan Liu

This study aims to examine the possible influence of SNS users' intrinsic and extrinsic motivations on m-coupon sharing and how users' coupon proneness affects sharing intention. Considering the act of sharing m-coupon is special case of viral marketing, we investigated four potential motivations: sense of self-worth and socializing from intrinsic motivations, economic reward and reciprocity from extrinsic motivations.

3 - The Role of E-commerce in Cross-border Transportation: An Integrative View
ShiKui Wu, Assistant Professor, University of Windsor, 401 Sunset Ave., OB-413, Windsor, ON, N9B 3P4, Canada, skwu@uwindsor.ca

This study investigates the role of e-commerce in a cross-border context at two levels: business-to-business and business-to-consumer. It examines the synergies between offline and online channels in key business operations, and investigates bidirectional and dynamic effects of e-commerce on transportation operations. Using case studies and simulations this study provides insights and guidelines for e-commerce practice in cross-border transportation.

4 - Goal-driven Analysis of Social Influencers
Roman Vaculin, Research Staff Member, IBM Research, 1101 Kitchawan Rd, Yorktown Heights, NY, 10598, United States of America, vaculin@us.ibm.com, Yosi Mass, Indrajit Bhattacharya, Jonathan Herzig

Definition and identification of social influencers largely depend on the purpose and context in which influencers are used. Given different goals, such as maximizing marketing campaign audience, maintaining brand awareness, spreading a credible message, or maximizing speed of message spread, different metrics achieve good results. In this work we present results of our experiments and demonstrate effectiveness of various traditional influence metrics with respect to given goals.

5 - Joint Optimization of Order Sourcing Assignment and Parcel Delivery for Online Supermarket with a Multi-warehouse System
Xiangpei Hu, Dalian University of Technology, Linggong Road,Ganjingzi District, Dalian, China, drhxp@dlut.edu.cn, Minfang Huang, Yuankai Zhang

For online supermarket with multi-warehouse system and two-stage distribution network, we develop a model for joint optimization of order sourcing assignment and parcel delivery, which can be regarded as the solution of a special kind of Location-Routing Problem. The model determines the assignment of order items to each warehouse and optimal delivery schemes to customers.

■ WC10

Hilton- Continental 7

Supply Chain/Green I

Contributed Session

Chair: Vincent Slaugh, PhD Candidate, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, vslaugh@cmu.edu

1 - Rental Inventory Management with Usage-Based Loss
Vincent Slaugh, PhD Candidate, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, vslaugh@cmu.edu, Bahar Biller, Sridhar Tayur

We study the operation of a discrete-time stochastic rental system over a single selling season in which rental units may be purchased or damaged by customers. We provide structural results related to the expected profit function and the optimal policy for allocating rental units to meet customer demand. In an industrial use case motivated by a high-fashion dress rental business, we show significant value to accounting for inventory loss and using the optimal inventory allocation policy.

2 - Product Remanufacturing in China's Projector Market
Huanming Li, Mitsubishi Electric Air-Conditioning & Visual Informations Systems (Shanghai) Ltd, No.300 East Nanjing Road, Shanghai, Sh, 200001, China, huanming.li@mlc-cn.com, Yi Liao

The whole market size for projectors in exhibition has a dramatic rise in China? However, one of the most important projector market's features is "declining price". This case study addresses on how to implement collection and remanufacturing of used products to improve environmental performance as well as profits?

3 - Energy Efficiency Contracting in Supply Chains
Ali Shantia, HEC Paris, 1, Rue de la liberation, Jouy-en-Josas, 78350, France, ali.shantia@hec.edu, Sam Aflaki, Andrea Masini

Increasing energy efficiency (EE) diminishes production costs of upstream suppliers while mitigating their environmental footprint. This study analyses the effects of bargaining power of a downstream retailer and EE technology uncertainty on adoption of energy efficiency technologies by a single manufacturer. Analyzing and comparing multiple contracting arrangements currently practiced in the industry, we study how energy service companies can affect supply chain coordination for EE.

4 - A Green Logistics Framework for Integrated Production-Distribution under Uncertainty
Aly Megahed, Research Staff Member, IBM Research - Almaden, 650 Harry Road - Office D3-428, San Jose, CA, 95120, United States of America, aly.megahed@us.ibm.com, Nagham El-Berishy, Bernd Scholz-Reiter

We present a mathematical modelling framework for integrated production-distribution of a real-world problem in the batch process industry in which we incorporate the green aspect of carbon emissions under uncertainty. The emissions are modeled as a function of the realized velocities at different distribution routes. We show how such integration could achieve significant cost savings. We also illustrate the impact of environmental regulations that governments impose on total supply chain costs.

■ WC11

Hilton- Continental 8

Supply Chain, Risk Management III

Contributed Session

Chair: Bo Li, PhD Student, Texas A&M University, 4217 TAMU, 320M Wehner, College Station, TX, 77840, United States of America, bli@mays.tamu.edu

1 - Contagion Risks in Supply Chains
Alireza Azimian, PhD Student, WLU, Unit 103, 55 Hickory Street E, Waterloo, ON, n2j3j5, Canada, azim9110@mylaurier.ca, Hamid Noori, Kevin Hendricks

While most of the papers in the context of Supply Chain Risk Management have addressed the threats associated with customers and suppliers, risks posed by rivals have received little to no attention in the supply chain literature. This research fills this gap by exploring how adverse consequences of incidents happened for a focal firm's supply chain may spread to its industry rivals; and what factors may contribute to significance of such contagion effect.

2 - Supply Chain Risk Mitigation using Information Sharing
Ek Peng Chew, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, 117576, Singapore, isecep@nus.edu.sg, Loo Hay Lee, Yi Tao

We study the impact of information sharing in a supply chain which consists of one retailer and two suppliers, among which each individual player has profit maximization as his primary objective. Using the game theory, we show that under some situations, prisoner dilemma phenomenon will exist. Hence some incentive schemes need to be implemented in order to incentivize the players in sharing the information.

3 - Supply-Chain Management under Conditional Value-at-Risk
Bo Li, PhD Student, Texas A&M University, 4217 TAMU, 320M Wehner, College Station, TX, 77840, United States of America, bli@mays.tamu.edu, Antonio Arreola-Risa

We consider a single item production-inventory system with stochastic demand and production, where inventory is controlled by a base-stock policy and unfilled demands are back-ordered. The relevant costs are inventory holding and back-ordering, which can be significant for high-value products. We propose Conditional Value-at-Risk (CVaR) as the decision criterion. We find the optimal base-stock level that minimizes CVaR for various model formulations and analyze the optimal solutions obtained.

4 - Characteristics of Risk Contagion along an Industrial Chain: Empirical Evidences from Shipbuilding

John Liu, Professor, City U of HK, Tat Chee Ave, Kowloon, Hong Kong - PRC, johnliu@cityu.edu.hk, Hui Bu, Yingfeng Wang

In this paper, we study empirical characteristics of risk contagion through an industrial chain, in the context of national shipbuilding-shipping industries, where risk contagion is referred to serially interrelated volatility triggered by uncertain events such as the global financial crisis of 2008. We develop DCC-GARCH models to estimate the conditional standard deviations and dynamic correlations of these time series.

5 - An Agriculture Feed Processing Supply Chain Modeling

Fesseha Gebremikael, Graduate Student, North Dakota State University, 253 University Village, Fargo, ND, 58102, United States of America, fesseha.gebremikael@my.ndsu.edu, Iddrisu Awudu, Khalid Bachkar

Risk management considering an agricultural firm that produces and sells transformed products. We consider a firm that has peanuts and corn as inputs. The supply chain consists of purchasing corn and peanuts, storage, transformation of the two inputs into the desired outputs, and shipping the outputs to customer destinations. A deterministic model is developed and further stochastic model is proposed. This case study is solved by using the AHP. The results indicate a good balance with buying and selling of the inputs in a hedging/risk management situation which is involves rationing.

■ WC12

Hilton- Continental 9

Supply Chain Optimization I

Contributed Session

Chair: Guoqing Zhang, Professor, University of Windsor, 401 Sunset Avenue, Windsor, Canada, gzhang@uwindsor.ca

1 - Multi-item Dual-Channel Supply Coordination for Online Shopping

Guoqing Zhang, Professor, University of Windsor, 401 Sunset Avenue, Windsor, Canada, gzhang@uwindsor.ca

We consider an e-business retailer who has a dual-channel supply network with a fulfilling center and multi-supplier for different items. The retailer can deliver the products from either the fulfilling center or the manufacturer who produces the product, depending on the geographic location of the customers and product availability. The problem is to determine the optimal order quantities in both retailer's fulfilling center and the supplier's warehouse with considering the space limitation.

2 - On the Multiple-machine Tardiness-minimization Problem with Nested Sequencing and Shared Resources

Yijun Wang, Rutgers University, 1 Washington Park, Newark, NJ, 07029, United States of America, yijun@pegasus.rutgers.edu, Lei Lei, Kangbok Lee

We consider the multiple-machine scheduling problem where a) the processing of a subset jobs involves external contracted manufacturers; and b) the starting time of internal processing depends on the availability of a shared resource. The objective is to minimize the total weighted tardiness. We define this problem as a MIP model and introduce two polynomial-time solvable cases. Examples with real data are presented.

3 - Modeling the Biofuel Supply Chain System from Dedicated Energy Crop under Uncertainty

Yuanzhe Li, PhD Student, Department of Civil and Environmental Engineering, University of California, Davis, University of California Davis, One Shields Avenue, Davis, CA, 95616, United States of America, rgli@ucdavis.edu, Yueyue Fan, Nathan Parker, Quinn Hart

A stochastic program is developed to model a complex biofuel production system using dedicated energy crop as feedstocks. By integrating agricultural land allocation and poplar adoption decisions and considering uncertainties in poplar yield, we aim to finding the optimal strategies for maximum system profit. Statistical approximation and decomposition methods are used to solve the stochastic mixed-integer programming model.

4 - A Computational Study for Common Network Design in Multi-commodity Supply Chains

Ting Wu, Nanjing University, No more22,Hankou Road, Nanjing, China, tingwu@nju.edu.cn

In this paper, we study a supply chain network design problem which consists of one external supplier, a set of potential distribution centers, and a set of retailers, each of which is faced with uncertain demands for multiple commodities.The goal is to minimize the system-wide cost. We propose a general nonlinear integer programming model for the problem and present a cutting plane approach to solve it.Computational results show that the proposed algorithm is efficiently.

5 - A Bi-level Stochastic Programming Model for Supply Chain Network Design with Assembly Line Balancing

Nima Hamta, PhD Candidate, University at Buffalo, SUNY, 437 Bell Hall, Department of ISE, University at Buffalo, SUNY, Amherst, NY, 14260, United States of America, nimahamt@buffalo.edu, Sara Behdad, Mohsen Akbarpour Shirazi, S.M.T. Fatemi Ghomi

The purpose of this paper is to integrate the strategic and tactical decisions in the supply chain network design (SCND) under demand uncertainty. The new bi-level stochastic programming model developed in this paper considers the SCND problem as a strategic decision in the upper-level model, while addressing the assembly line balancing as a tactical decision in the lower-level model. In addition, a scenario-based heuristic method is proposed to solve the developed model.

■ WC14

Imperial B

Supply Chain/Decision Analysis

Contributed Session

Chair: Gang Xie, Associate Professor, Academy of Mathematics and Systems Science, Chinese Academy of Sciences (CAS), 55 Zhongguancun East Road, Haidian Distr, Beijing, Ch, 100190, China, gxie@amss.ac.cn

1 - Combined Qualitative and Quantitative Analysis of the Thai Silk Industry

Natawat Jatuphatwarodom, University of Portsmouth, Flat 88, Fellows Court, Weymouth Terrace, London, E2 8LN, United Kingdom, natawat.jatuphatwarodom@port.ac.uk

This research is aimed at developing logistic and supply chain models that support policy decisions of the Thai Silk manufacturers' key decision makers. The constraints that restrict the expansion of the Silk industry are analysed. Supplier selection and Inventory management models were selected to be focal studies. Operational Research models (AHP/DEA/GP) were applied within the case studies.

2 - Emission-dependent Production and Policy Implications Considering Government Subsidies

Yu Jiao Zhu, University of Science and Technology of China, School of Management, Hefei, China, yujiaozh@mail.ustc.edu.cn

Based on the newsvendor model, this paper studies the impacts of government subsidies policy on emission-dependent manufacturer's decision-makings, and discusses the right way for the manufacturer to obtain emission permits. The analysis shows that after pushing the subsidy policy, the optimal production quantity of the emission-dependent manufacturer decreases.

3 - Optimal Outsourcing Strategies when Capacity is Limited

Salar Ghamat, PhD Student, Richard Ivey Business School, 1255 Western Road, London, ON, N6G 0N1, Canada, sghamat@ivey.ca, Xinghao Yan, Hubert Pun

Many Original Equipment Manufacturer (OEM) outsource some of their products' components to third-party suppliers. Some of these suppliers are competitive component manufacturers (CCM) that produce substitutable products. We consider a model where OEM has two potential suppliers: an independent supplier and a capacitated CCM. We take a game theoretic approach to find OEM's optimal outsourcing strategy. We show that, CCM may decrease its own output to satisfy the component demand of the OEM.

■ WC15

Hilton- Exec. Boardroom

Semiconductor Industry

Contributed Session

Chair: Mehmet Candas, Sr. Manager - IT Global Operations | Supply Chain, AMD, 7171 Southwest Pkwy., Austin, TX, 78735, United States of America, mfcandas@gmail.com

1 - Semiconductor Manufacturing Planning: Challenges and Solution Approaches

Mehmet Candas, Sr. Manager - IT Global Operations | Supply Chain, AMD, 7171 Southwest Pkwy., Austin, TX, 78735, United States of America, mfcandas@gmail.com, Enes Bilgin

Supply chain manufacturing planning involves many challenges, due to complexity and stochasticity of the manufacturing process, coupled with the sophisticated co-production, down-grading, and re-claiming activities. We will present our approach to handle these challenges while developing a decision support system for AMD's supply chain.

2 - Semiconductor Supply Chain Production Planning under Uncertainty

Jon Lowe, Graduate Research Assistant, Clemson University, 103 Freeman Hall, Clemson, SC, 29631, United States of America, jjlowe@clemson.edu, Scott Mason

Due to the high risk of obsolescence due to rapid technology changes, semiconductor manufacturers are reluctant to maintain large amounts of inventory in their supply chains. However, some inventory is needed to meet forecasted demand on time. We present a master planning stochastic program for the semiconductor supply chain and demonstrate the model's ability to schedule production under uncertain yield, lead time, and demand parameters using an industrial data set.

3 - Buyer Strategies to Maintain Suppliers in Development-Intensive Supply Chains

Mericcan Usta, Stanford University, 475 Via Ortega Ste 245, Stanford, CA, 94305, United States of America, usta@stanford.edu, Warren H. Hausman, Feryal Erhun

In industries including semiconductor and defense, the prominent buyer has to simultaneously maintain a supplier base and attain ambitious R&D goals. In collaboration with Intel, we propose several strategies through game-theoretic models. Those are: egalitarian value allocation in the face of relationship decline, commitment to develop non-focal suppliers against increased supplier asymmetry, and commitment to competitive price targets to achieve synergistic benefits of supplier collaboration.

■ WC16

Hilton- Franciscan A

Empirical Studies in Revenue Management and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu

Co-Chair: Necati Tereyagoglu, Assistant Professor of Operations Management, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Necati.Tereyagoglu@scheller.gatech.edu

1 - Multisupplier Contact in the U.S. Ketchup Industry

Necati Tereyagoglu, Assistant Professor of Operations Management, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Necati.Tereyagoglu@scheller.gatech.edu, O. Cem Ozturk

We examine empirically the effects of multisupplier and multimarket contact on pricing decisions of retailers in the U.S. ketchup industry. We find that prices are higher in markets served by retailers with extensive contacts in others markets. Moreover, we show that prices are higher when retailers use the same suppliers.

2 - Identifying Competitors in Markets with Fixed Product Offerings

Marcelo Olivares, Assoc. Professor, Columbia University, Broadway 3027, New York, NY, United States of America, molivares@columbia.edu, Roger Lederman, Garrett van Ryzin

We develop a novel methodology to identify competitors in markets where spatial location is an important factor of differentiation. In these markets, competition is determined by the preferences of different customer segments, which we identify using variation in observable attributes that determine the size of the distinct customer segments. We apply our methodology in the hotel travel industry, where the characterization of key competitors is used in practice to benchmark hotel performance.

3 - Who Are My Competitors: Drivers of Hotel Online Competition

Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu, Serguei Netessine, Sergei Koulayev

Hotel managers who used to identify competition set by looking across the street, are now faced with extensive competition as availability and price information are made nearly transparent online. What (and who) drives hotel competition in the new era? Using consumer click-stream data from two major online travel intermediaries, we develop a model to describe how different types of consumers search and how do these distinct search patterns influence hotel online competition.

■ WC17

Hilton- Franciscan B

Design and Control of Service Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Serhan Ziya, Associate Professor, University of North Carolina at Chapel Hill, NC. ziya@unc.edu

1 - Routing Based on Service Rates to Incentivize Strategic Servers in Many-Server Systems

Sherwin Doroudi, Tepper School of Business; Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, sdoroudi@andrew.cmu.edu, Ragavendran Gopalakrishnan, Amy Ward, Adam Wierman

Traditionally, research focusing on the design of routing policies for service systems has modeled servers as having fixed, possibly heterogeneous service rates. However, service systems are often staffed by people. Then, the rate a server chooses to work is impacted by the system's routing policy. We analyze the impact of "strategic servers" on system performance in many-server systems using a novel technique of differentiating the balance equations of the underlying heterogeneous M/M/N system.

2 - Tandem Queues with Reneging

Jianfu Wang, Assistant Professor, Nanyang Business School, Block S3, 50 Nanyang Avenue, Singapore, 639798, Singapore, jianfu.wang.ntu@gmail.com, Hossein Abouee Mehrizi, Oded Berman, Opher Baron

This paper considers a two-station tandem queueing system with reneging. We develop a new technique to solve two dimensional Markov chains. We use this technique to derive the distribution of number of customers in each station. This technique can be applied to many different settings for different service level measures. We employ the method to solve a system design problem and investigate the effect of cross-trained servers.

3 - Dynamic Multi-class Kidney Allocation

Valery Pavlov, University of Auckland Business School, Private Bag 92019, Auckland, 1142, New Zealand, v.pavlov@auckland.ac.nz, Ali Vahabzadeh

In the US alone, every year several thousand people die while waiting for a kidney transplant but, at the same time, thousands of suitable donor organs are eventually discarded. Our model is aiming to provide insights about possible measures, in-line with the current policies, to reduce the waste.

4 - The Effect of Random Waits on Customer Queue Joining and Reneging Behavior: A Laboratory Experiment

Zeynep Aksin, Koc University, Sariyer, Istanbul, Turkey, ZAKSIN@ku.edu.tr, Busra Gencer, Evrim Gunes, Ozge Pala

In many service settings, customers encounter queues and have to decide between joining, balking and reneging. This study investigates customers' queue joining and reneging behaviors via a laboratory experiment in which participants experience several observable queues with different characteristics in terms of queue length (long/short) and service times (deterministic/random)and decide to join, balk or renege. We analyze the effects of random service times on joining and reneging behavior.

■ WC18

Hilton- Franciscan C

Big Data Analytics and Predictive Modeling in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Yingying Kang, Principal Operations Research Consultant, Sabre Holdings Inc., 3150 Sabre Drive, Southlake, TX, 76092, United States of America, Yingying.Kang@sabre.com

1 - A StaticModel in Single-leg Flight Airline Revenue Management

Behrooz Pourghannad, Ph.D. Student, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48104, United States of America, behrooz@umich.edu, J.B.G. Frenk, Semih O. Sezer

We present a static single-leg airline revenue management. Requests for fare classes arrive according to independent non-homogeneous Poisson processes where cancellation and no-shows are considered. The objective is to find an optimal closing time(s) which maximizes the expected net revenue. We consider the time-dependence of the demand. Compared to dynamic continuous time models, mostly exponential time-to-cancellations, our model can be applied with arbitrary distributions for cancellations.

2 - Shaping Demand to Match Anticipated Supply
Sifeng Lin, Graduate Student, the Graduate Program of Operations Research and Industrial Engineering, the University of Texas at Austin, Austin, TX, 78712, United States of America, sifenglin@utexas.edu, Anant Balakrishnan, Yusen Xia

Firms can use dynamic pricing strategies to match anticipated demand with supply. In this paper, we develop an economic model to address these short-run demand shaping decisions for vertically differentiated products. The manufacturer must decide what prices to set for high quality and low quality products to judiciously and dynamically segment the market so as to maximize total profits. We identify properties of the optimal price and sales trajectories and the benefit of dynamic pricing.

3 - Revenue Management for Off-street Parking Lots
Manuel A. Bollvar, Universidad de Los Andes, Cra 1 Este No 19A - 40, Edificio Mario Laserna, Bogot·, Colombia, ma.bolivar643@uniandes.edu.co, Andrés L. Medaglia, Carlos Felipe Valencia, Raha Akhavan Tabatab, Carlos Felipe Ruiz

Off-street parking lots rely on the fact that customers' needs differ from one another, encouraging the use of distinctive fares (i.e., per time-fraction and subscription) to increase the revenue. We propose a methodology to forecast demand and obtain near-optimal subscription-selling policies for new parking lots based on historical data from existing lots for a parking company in Bogot· while considering the decision makers' preferences in avoiding customer rejection.

■ WC19

Hilton- Franciscan D

Retail Operations

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Shengqi Ye, Indiana University at Bloomington, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, shye@indiana.edu

1 - The Operational Value of Social Media Information
Ruomeng Cui, Assistant Professor, Kelly School of Business, Bloomington, IN, 47405, United States of America, cuir@indiana.edu, Antonio Moreno-Garcia, Dennis Zhang, Santiago Gallino

We empirically explore how social media information helps sales forecasting. Using (1) daily sales data from an online apparel startup company that primarily advertises on Facebook, and (2) publicly available Facebook posts and the users' comments and likes data, we find a statistically significant improvement in sales forecast accuracy. We analyze the underlying mechanism—the attention effect and the word-of-mouth effect. We quantify the operational value of social media information.

2 - Campaign Earlier or Later? Sponsored Search Advertising when Customers Re-click
Shengqi Ye, Indiana University at Bloomington, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, shye@indiana.edu, Shanshan Hu, Goker Aydin

Customers might click a retailer's link and check its product multiple times before making purchasing decisions. Noting this behavior, we investigate the retailer's optimal advertising policy when selling seasonal products over a predetermined horizon. We show that the retailer may want to advertise aggressively early in the selling season.

3 - Learning Consumer Tastes from Dynamic Assortments: A Nonparametric Bayesian Model
Dorothee Honhon, Assistant Professor, University of Texas at Dallas, Naveen Jindal School of Management, Dallas, TX, 75080, United States of America, Dorothee.Honhon@utdallas.edu, Canan Ulu

We study assortment decisions of a firm learning about consumer tastes. Each period, the firm offers an assortment to maximize expected total profits given its subjective beliefs on consumer tastes. Consumers choose a product that maximizes their utility and the firm updates its beliefs after having observed sales. We develop a nonparametric Bayesian learning model using Polya tree priors. We develop upper bounds on the firm's profit and study various heuristic policies.

4 - Optimal Merchandise Testing with Limited Inventory
Zhe Wang, UNC Chapel Hill, CB 3490, Chapel Hill, NC, 27599-3490, United States of America, zhe_wang@unc.edu, Adam Mersereau, Li Chen

We consider a retailer allocating a limited inventory among its stores for a "merchandise test" to learn about demand prior to a main selling season. The key tradeoff is between spreading inventory among many stores to get more sales observations versus consolidating inventory in a few stores to avoid stockouts and demand censoring. We characterize optimal policies with identical and non-identical stores and with and without sales timing information.

■ WC20

Hilton- Yosemite A

Homeland Security Applications II

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Paul Kantor, Professor, Rutgers/CCICADA, 4 Huntington St, New Brunswick, NJ, 08901, United States of America, paul.kantor@rutgers.edu

1 - Dynamic Modeling for Arctic Resource Allocation
Richard Garrett, Ph.D. Student, Rensselaer Polytechnic Institute, 539 Congress Street, Troy, NY, 12180, United States of America, garrer3@rpi.edu, Thomas Sharkey, Martha Grabowski, William Wallace

Interest in energy prospects has increased the potential for an oil spill incident in the Alaskan Arctic. A dynamic network expansion problem with stochastic scenario considerations is proposed to assess oil spill response resource allocation policies. The focus is on addressing task lists required for all potential spills to improve the objective of weighted task completion times. Stochastic programming solution methods are employed, and observations and performance results are discussed.

2 - Aviation Resource Optimization Model for the USCG
Christie Nelson, CCICADA, Rutgers University, 4th Floor, CoRE Bldg, 96 Frelinghuysen Road, Piscataway, NJ, 08854-8018, United States of America, christie.l.nelson.phd@gmail.com, James Wojtowicz, Paul Kantor, Thomas Rader, Chad Conrad, Endre Boros, Fred Roberts, Brian Ricks, Kevin Hanson, Brian Nakamura, Curtis McGinity

A model was created for the USCG to maximize aircraft fleet operational performance subject to budgetary constraints or to minimize fleet operational costs subject to performance targets. The model determines optimal deployment assignments, operational levels and aircraft allocation among USCG Air Stations for current infrastructure. It can also demonstrate potential efficiencies of proposed infrastructural changes and can be generalized for different types of aircraft and performance.

3 - Comparing Patron Screening Procedures at Professional Sports Stadiums
Brian Ricks, CCICADA, Rutgers University, 96 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, bcr50@scarletmail.rutgers.edu, Robert DeMarco, Brian Nakamura, Paul Kantor, Christie Nelson, Fred Roberts, Alisa Matlin, Cindy Hui, Holly Powell, Brian Thompson, Michael Tobia

Security officials balance difficult tradeoffs when choosing between patron screening methods. Together with NFL security personnel, we developed a novel patron screening model to contrast popular screening techniques, including walk-through magnetometers, wandings, and patdowns. We validated our model using ticket scan data and expert experience. The results helped guide the stadium in its future screen practices. Our approach is flexible enough to inform security personnel at any venue.

■ WC21

Hilton- Union Sq 1

Maintenance Problems in Transportation and Routing

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Jinwoo Lee, University of California, Berkeley, Berkeley, CA, United States of Americajinwoolee@berkeley.edu

1 - Long Term Freight Network Planning for Northern Australia using Incremental Network Flow
Leorey Marquez, Research Scientist, CSIRO, Private Bag 10, Clayton South, 3169, Australia, leorey.marquez@csiro.au, Melanie Ayre, Asef Nazari, Simon Dunstall, Andreas Ernst

Mining, agricultural and other commercial operations often require the transport of large quantities of materials between remote locations in Australia. This talk looks at the problem of deciding on investments to upgrade transportation infrastructure to meet expected future demand. The talk will present a model using a multi-period incremental network flow design, describe a matheuristic approach for solving the problem and present results demonstrating the effectiveness of the approach.

2 - Dynamic Discrete Network Design Problem – Application to Road Maintenance Planning
Pirmin Fontaine, Technische Universitat München, Arcisstrafle 21, Munich, 80331, Germany, pirmin.fontaine@tum.de, Stefan Minner

The deterioration of streets decreases the quality of road networks. Therefore, streets need to be maintained from time to time. We introduce a bilevel formulation by extending the Discrete Network Design Problem over several periods. This model is solved by a terminated Benders Decomposition approach. A numerical study shows the efficiency of this method and the quality of heuristical solutions without reaching convergence.

3 - Joint Optimization of Various Pavement Management Actions with Non-Markovian Deterioration
Jinwoo Lee, University of California, Berkeley, Berkeley, CA, United States of Americajinwoolee@berkeley.edu, Samer Madanat

We present dynamic programming solutions for the joint optimization of pavement maintenance, resurfacing and reconstruction activities. The majority of the literature does not consider reconstruction in optimization. We show that this leads to suboptimal policies. We use a non-Markovian pavement deterioration model, which is more realistic than the memoryless models.

■ WC22

Hilton- Union Sq 2

Organizational Behavior and Ethics

Sponsor: Organization Science

Sponsored Session

Chair: Emily Block, Assistant Professor of Management, University of Notre Dame, Notre Dame IN 46556, United States of America, esblock@gmail.com

1- Returns to Structural Complementarity: Roles in Entrepreneurial Teams
Brandy Aven

Abstract is not available at this time.

■ WC23

Hilton- Union Sq 3

Topics in Freight Transportation and Logistics

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Peng Sun, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, psun@duke.edu

1 - A Deterministic Network Model for Global Thermal Coal Optimization
Ashly Arigoni, Colorado School of Mines, Golden, CO, UniteD States of America, aarigoni@mymail.mines.edu

Our objective is to minimize the cost to ship thermal coal from supply regions to fill demand while respecting import and export port capacities, ship size constraints, and coal specification requirements. The global thermal coal model allows demand nodes to incorporate different coal qualities from different sources to observe minimum heat content and maximum sulfur and ash content, as well as fulfill demand requirements, all while maintaining the overall goal of minimizing total cost.

2 - An Options-Based Pricing Scheme for a Highway Reservation System on Truck-only Lanes
Chiungryeol Lee, Purdue University, 550 Stadium Mall Drive, West Lafayette IN 47907, United States of America, lee1210@purdue.edu, Srinivas Peeta

This study explores an options-based pricing scheme for a highway reservation system for truck-only lanes that guarantees a threshold speed level. The risk for highway operators in failing to meet the promised speed is considered in the pricing process. Numerical experiments illustrate that the proposed approach can help improve reliability in the freight industry while reducing traffic congestion in the highway system.

3 - Train Dispatching Problem under Exact Travel Time Estimation
Maged Dessouky, University of Southern California, 3715 McClintock Ave, Los Angeles, CA, United States of America, luncefu@usc.edu, Maged Dessouky

We consider the problem of dispatching trains through the railway network. Different speed limits are applied to different track segments and junctions. Travel time is obtained by accounting for the train's dynamics. This is a complex problem since the travel time on an edge depends on the entering velocity and exiting velocity. Therefore Dijkstra's algorithm doesn't guarantee optimality. We explore other heuristics and simulation is conducted to compare the proposed algorithms with Dijkstra's algorithm.

4 - Time-Dependent Pickup and Delivery TSP with Time Windows, Profits and Transfers
Peng Sun, TU/e, Pav E 17, Eindhoven 5600MB, Netherlands, P.Sun@tue.nl, Said Dabia, Tom Van Woensel

This problem is defined on a graph containing both transfers nodes and requests vertices where it is not necessary to visit all of them. Moreover, it also captures road congestion by considering time-dependent travel times. The problem consists of determining a tour that simultaneously optimize the collected profits and the total route duration. Thus, we present a time-dependent labeling algorithm to tackle this problem. The new dominance criteria is also introduced.

5 - Multi-commodity vs. Single-commodity Routing
Claudia Archetti, University of Brescia, C.da S.Chiara 50, Brescia 25122, Italy, claudia.archetti@unibs, Ann M. Campbell, M. Grazia Speranza

We study a routing problem where multiple commodities are requested by customers. We analyze the impact on transportation cost from using vehicles dedicated to a single commodity compared with using flexible vehicles capable of carrying any set of commodities. If multiple vehicles can be used, we examine when deliveries of individual commodities can be split and when they may not be split. We use worst-case and computational analysis to compare these different models.

■ WC24

Hilton- Union Sq 4

Transportation, Intelligent Systems II

Contributed Session

Chair: Qing Chuan Ye, PhD Candidate, Erasmus University Rotterdam, P.O. Box 1738, H8 Tinbergen Institute, room H7-26, Rotterdam, 3000DR, Netherlands, ye@ese.eur.nl

1 - Performance Observation in Privacy Ensured Connected Vehicle Environment using Vehicle Trajectories
Shayan Khoshmagham, University of Arizona, 1127 E. James E. Rogers, Tucson, AZ, 85721, United States of America, shkhoshmagham@email.arizona.edu, Larry Head, Mehdi Zamanipour, Yiheng Feng

This paper introduces an approach to observe the performance measures of a multi-modal transportation system in a connected vehicles environment. An Extended Tardiness Function (ETF) is deployed to guarantee that dynamic mobility applications ensure privacy. The primary purpose is to estimate performance from observations while not inferring vehicle identification.

2 - Signal Phase Allocation Algorithm in a Connected Vehicle Environment
Yiheng Feng, University of Arizona, 1127 E. James E. Rogers, Tucson, AZ, 85721, United States of America, yihengfeng@email.arizona.edu, Larry Head, Shayan Khoshmagham, Mehdi Zamanipour

A traffic signal phase allocation algorithm based on dynamic programming is proposed to optimize the signal timing in a connected vehicle (CV) environment. The algorithm considers a hierarchical structure with barriers on the upper level and phases on the lower level. Because of the low market penetration rate of CV, data from CV are processed to estimate location and speed of unequipped vehicles. Results show the proposed model has similar performance to well-tuned actuate signal control.

3 - Correcting Count-biases at Freeway Loop Detectors Based on Information from Probe Vehicles

Kwangho Kim, Postdoctoral Researcher, Institute of Transportation Studies, University of California, Berkeley, 416F McLaughlin Hall, UC Berkeley, Berkeley, 94720, United States of America, khkim@berkeley.edu

This paper proposes a new method to correct systematic biases in vehicle counts measured at freeway loop detectors by exploiting the conservation-of-vehicles principle. The proposed method is designed to compensate total count-biases, accumulated during a period, over each intervening time interval in proportion to a time-dependent correction factor, which is periodically adjusted by means of traffic information from probe vehicles. Outcomes from testing the proposed method turn out promising.

4 - An Asset Light Solution for Inter Terminal Transport at the Port of Rotterdam with Fairness

Qing Chuan Ye, PhD Candidate, Erasmus University Rotterdam, P.O. Box 1738, H8 Tinbergen Institute, room H7-26, Rotterdam, 3000DR, Netherlands, ye@ese.eur.nl, Yingqian Zhang, Rommert Dekker

Following the expansion of the Port of Rotterdam with Maasvlakte 2,there will be an increase in inter terminal transport.To accommodate this,we seek to take advantage of excess capacity of already available trucks in a so-called asset light solution by auctioning tasks to trucking companies.In order to avoid peak hours and maintain competition among companies,we do not want to have a mere optimal allocation in terms of costs,but in terms of fairness as well,which poses an interesting trade-off.

■ WC25

Hilton- Union Sq 5

Transportation, Operations I

Contributed Session

Chair: Bilge Atasoy, Postdoctoral Associate, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, batasoy@mit.edu

1 - Determining Hazardous Distractions for Teenage Drivers

Ali Mohammadhashemi, University of Tennessee-Knoxville, 1209 Clinch Avenue, Knoxville, TN, 37916, United States of America, amohamm7@utk.edu, Seyed Ahmad Niknam, Rapinder Sawhney, Robert Mee

In this research, the teenage drivers (16-19 years old) are driving in a simulation lab and the distractions are done by drivers and the severity of these distractions and their impacts on velocity, lane position , headway distance and safe headway distance is analysed. Finally the most dangerous distractions are identified and the reason why they are more important from other distractions is discussed.

2 - Regulating the Incoming Passenger Flow in Subway Systems during Emergency Situations

Qing Ye, Southwest Jiaotong University, 111 Erhuan Road Beiyiduan, Chengdu, China, qing.yeswjtu@gmail.com, Satish Ukkusuri, Qiyuan Peng

To mitigate the congestion problem in subway system during emergency situations, a control scheme for the incoming passenger flow is necessary and widely applied. In this research, a dynamic control scheme for the incoming passenger flow is proposed. A bi-level model and a sensitivity analysis-based algorithm are provided to regulate the incoming passenger flow. The effectiveness of the proposed approach has been demonstrated with a case study of Beijing subway.

3 - Optimizing the Menu of Travel Options for a Flexible Mobility on Demand System

Bilge Atasoy, Postdoctoral Associate, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, batasoy@mit.edu, Nathanael Cox, Moshe Ben-Akiva, Takuro Ikeda

We introduce a flexible mobility on demand system that provides a menu of options to passengers with the services of mini-bus, shared-taxi and taxi. For each request, a list of options is offered through an optimization framework. First, a myopic model is considered that optimizes the decisions for the current request. A set of experimental results is obtained for a network in Tokyo. Then, an extended model is studied that accounts for future demand in order to improve the quality of decisions.

4 - Stochastic ERU Allocation under Impacts of Secondary Incidents

Hyoshin Park, UMD, College Park, College Park, MD, United States of America, hyoshin0724@gmail.com

An optimal deployment of ERU depends on an incident rate and total delay as main indicators. Secondary-incident-induced delay can be estimated based on the reduced capacity considering primary and secondary incidents.The objective of the problem is to make location-allocation decisions in a way that the sum of the first-stage costs and the expected value of the second-stage costs are minimal.

5 - A Mixed Fleet Sizing Problem with the Green Alternative Fuel Vehicles

Ismail Capar, Texas A&M University, Industrial Distribution Program, College Station, United States of America, capar@tamu.edu, Mesut Yavuz

This research investigates a fleet sizing problem for an operation where a driver provides service to a number of customers at their sites. The operator would like to determine the optimal fleet mix consisting of alternative fuel vehicles (AFVs) with limited driving range and refueling capabilities and internal combustion vehicles without such limitations. We analyze the problem under a stochastic environment and evaluate the impact of route splitting and intraday refueling strategies for AFVs.

■ WC26

Hilton- Union Sq 6

Vehicle Routing III

Contributed Session

Chair: Gu Pang, Newcastle University Business School, 5 Barrack Road, Newcastle upon Tyne, United Kingdom, gu.pang@ncl.ac.uk

1 - Multiple Visits Model for Ready Mixed Concrete Delivery

David Rey, The University of New South Wales, UNSW, Sydney, 2052, Australia, d.rey@unsw.edu.au, Mojtaba Maghrebi, Travis Waller

Unlike most vehicle routing formulations, the delivery of Ready Mixed Concrete (RMC) often requires that a customer be visited multiple times in a given time period. Therefore conventional vehicle routing approaches cannot be simply adapted to RMC delivery and new models are required to account for such routing patterns. We introduce a mathematical programming model for the RMC delivery problem that is able to account for multiple customer visits through integer variables.

2 - Inventory Routing and the Optimal Levels of Postponement

Gu Pang, Newcastle University Business School, 5 Barrack Road, Newcastle upon Tyne, United Kingdom, gu.pang@ncl.ac.uk, Luc Muyldermans

We study Inventory-Routing Problems (IRPs). Our aim is to determine the parameter-dependent 'optimal' level of postponement (or accumulation times) when both routing and inventory holding costs are minimised. We carry out the computational experiments by applying the Continuous Approximation models. Our results reveal the 'optimal' accumulation times are dependent on client demand rates, client locations, client service requirements, and service regions.

3 - An Column-Generation Approach to the Public Transit Routing and Network Design Problem

Ran Zhang, University of South Florida, 4202 E Fowler Ave, Tampa, FL, 33620, United States of America, ranzhang@mail.usf.edu

The paper aims to rerouting the passenger paths in an existing public transit network with large passenger flow in China, in order to minimize the total costs of both passengers and operator. A new multi-commodity flow model is proposed and the bus lines can be generated dynamically. A Column Generation algorithm is introduced to solve this problem more efficiently.

4 - Value of Spatial Decision Support in Operations Research

Avijit Sarkar, Associate Professor, University of Redlands, 1200 E. Colton Avenue, Redlands, CA, 92373, United States of America, avijit_sarkar@redlands.edu, Hindupur Ramakrishna

Spatial decision support systems combine operations research (OR) and geotechnology to obtain elegant, efficient solutions for complex problems in routing, location, supply chain and logistics optimization. We provide taxonomy of spatial decision support in OR with focus on the value added by integrating OR with geotechnology in a unified framework.

5 - Branch and Price for the Vehicle Routing Problem with Time Windows and Driving Regulations

Said Dabia, TU/e, Pav F 19, Eindhoven, Ne, 5600MB, Netherlands, s.dabia@tue.nl, Emrah Demir, Maryam SteadieSeifi, Nico Dellaert, Tom Van Woensel

In this presentation, we show an exact algorithm for the vehicle routing problem with time windows considering drivers working and driving hours regulations. The exact algorithm is based on branch and price. The master problem is a standard set partitioning that can be solved by means of column generation. We show how we can handle working and driving hours regulations in the pricing problem of the column generation.

■ WC27

Hilton- Union Sq 7

Logistics 3

Contributed Session

Chair: Marcus Ang, Assistant Professor (Education), Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, marcusang@smu.edu.sg

1 - Truck Dispatch Optimization on a Large-Scale Logistics Network
Bo Zhang, Staff Researcher, IBM Research - China, Diamond Building 19-A, ZGC Software Park, Beijing, China, bozbo@cn.ibm.com, Yue Tong, Xin Shi, Hongbo Li

Timelessness of service is among the most important competencies of a logistics service provider nowadays. In our research, we propose a new method to optimize truck dispatching plan that reduces the freight transit times on a logistics network. Numerical experiments are conducted on real-world sized sample networks, the results of which demonstrate the effectiveness and efficiency of our method. Managerial insights are drawn for practitioners in transportation industry.

2 - Green Purchasing: A Mathematical Programming Perspective
Xin Ma, PhD Candidate, Hong Kong Polytechnic University, EF403, Hung Hom, Kowloon, Hong Kong - PRC, maxinstu@gmail.com, Ping JI, Cheng-hu Yang

Game processes between suppliers and manufacturers are presented by using a mathematical programming model. This model not only focuses on the issue of green supplier selection, but also solves the lot sizing issue based on capabilities of selected suppliers. Environmental factors are integrated into the model to study green purchasing.

3 - A Distribution Center where Robots" Pick Orders
Nima Zaerpour, Assistant Professor, VU University Amsterdam, De Boelelaan 1105, Rotterdam, 1081 HV, Netherlands, nzaerpour@rsm.nl

We consider a distribution center, which uses mobile-robotic fulfillment system eliminating walking. In such a system, the robots pick up an entire storage pod and bring it to a pick station, from where the products on the pod are distributed over customer bins. We study the retrieval sequencing and location assignment of storage pods leading to minimum robot's travel time. We propose a simple heuristic, which can substantially reduce the retrieval time.

4 - Optimizing Storage-Class Formation in Unit-Load Warehouses
Marcus Ang, Assistant Professor (Education), Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, marcusang@smu.edu.sg, Yun Fong Lim

We propose a new approach to form optimal storage classes for a unit-load warehouse. Under this approach, we determine the frequency of visits to each storage location based on a linear programming model that considers the warehouse's layout and the arrivals and mean demands of products. We use this frequency of visits to evaluate the "attractiveness" of each storage location. We compare our frequency-based class formation method with a cost-based method and a grid-based method.

■ WC28

Hilton- Union Sq 8

Measuring and Managing Delay through Trajectory Analysis

Sponsor: Aviation Applications

Sponsored Session

Chair: Heng Chen, Isenberg School of Management, University of Massachusetts, Amherst, MA, 01003, United States of America, heng@som.umass.edu

1 - Design and Analysis of a Large-Scale Database for Assessing Weather Impact on Passenger Aviation
Brian Lemay, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor MI 48109-2117, United States of America, blemay@umich.edu, Amy Cohn, Ji Wang

To better understand the system-based and propagating impacts of weather-based disruptions, we have developed a large scale database of roughly 70 million flight records and 50 million weather records. We present insights from the design of this database and preliminary analysis.

2 - Optimal Airline Actions during Collaborative Trajectory Options Programs
John-Paul Clarke, Associate Professor, Georgia Institute of Technology, 270 Ferst Drive, Atlanta, GA, 30332, United States of America, johnpaul@gatech.edu, Tim Niznik, Billy Wang, Balaji Nagarajan, Bosung Kim

Collaborative Trajectory Options Programs are designed to reduce en route congestion by rationing capacity. Optimal airline actions during CTOPs are determined via a two-stage algorithm. In stage one, the optimal set of trajectory options to submit is determined given available capacity, FAA rules, and possible actions by other airlines. In stage two, flights are optimally re-assigned to the slots obtained in stage one. Numerical results indicate significant reductions in operations costs.

3 - Optimal Metering Point Locations for Optimized Profile Descent Operations at Airports
Heng Chen, Isenberg School of Management, University of Massachusetts, Amherst, MA, 01003, United States of America, heng@som.umass.edu, Senay Solak

We consider Optimized Profile Descent (OPD) implementations at airports, and develop models to increase potential savings through optimal metering policies, which include identification of the number and locations for metering points. We present an algorithmic framework based on a stochastic dynamic program and a nonlinear stochastic integer program to identify best metering point configurations, and present some numerical results based on actual traffic information at a major U.S. airport.

4 - Vertical Trajectory Optimization to Minimize the Environmental Impact of Terminal Area Operations
Sang Gyun Park, Georgia Institute of Technology, 270 Ferst Drive, Atlanta, GA, 30332, United States of America, sanggyun.park@gatech.edu, John-Paul Clarke

En route descent from a point along the cruise segment to a metering fix at a lower altitude is optimized in the presence of altitude dependent winds. The optimal control problem is formulated with both mixed and pure state inequality constraints for flight envelope protection and passenger comfort, and timing constraints at meter fixes for capacity constraints. The vertical area navigation mode sequence that minimizes the environmental impact is derived from the optimal solution.

■ WC29

Hilton- Union Sq 9

Manufacturing 3

Contributed Session

Chair: Paolo Letizia, Assistant Professor of Operations Management, Rotterdam School of Management/Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, letizia@rsm.nl

1 - Two Types of Learning Effects on Maintenance Activities
Hakan Tarakci, Assistant Professor, University of North Texas, Box 305249, Denton, 76203, United States of America, hakan.tarakci@unt.edu

In this paper, we study a manufacturing system which is prone to failure. We consider two types of maintenance activities: Preventive (PM) and Corrective (CM). We assume that the repetitive nature of PM enables learning to occur and subsequent PMs take less time and cost less. In addition, the system is also able to learn from its failures in such a fashion that the number of failures in a previous cycle decreases the failure rate in the next cycle.

2 - On the Economic Lot-Size Scheduling and Pricing for Multiple Products
Alireza Kabirian, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH, 44106, United States of America, akabirian@csun.edu

In this paper, the economic production quantity problem for multiple products on a single-machine system is extended. It is assumed that annual demands of the products are functions of prices set by manufacturer. This extension considers an objective function comprised of sales revenues, inventory and setup costs as well as the costs of production. Non-linear programming methods are investigated for solving the models obtained.

3 - Achieving Zero Accident Facility
Mohammad Ali Asudegi, RA, University of Tennessee, 301 Woodlawn Pike Apt C6, Knoxville, TN, 37920, United States of America, aliasudegi@gmail.com, Rapinder Sawhney

Achieving Zero Accident approach has been the focus of many manufacturing companies for a while. The ultimate goal of this study is to develop a structure for a medium size manufacturing company to become a Zero Accident facility using statistical methods. Implementing the proposed guideline is found to be beneficial in preventing incidents in the workplaces.

4 - Quality Control in an Export Processing System
Paolo Letizia, Assistant Professor of Operations Management, Rotterdam School of Management/Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, letizia@rsm.nl, Long Gao

Export-processing is offshored production from developed countries. The majority of procurement contracts that are adopted for export-processing are flexible and do not specify product quality. Through contract theory we show that flexible contracts are preferred by the manufacturer when the product quality cannot be effectively communicated between the parties.

■ WC30

Hilton- Union Sq 10

Operations Management/Marketing Interface III

Contributed Session

Chair: Abhishek Shinde, Doctoral Student, Indian Institute of Management Calcutta, India, Room No C 203 Lake View Hostel, IIM Calcutta, Joka, DH Road, Kolkata, Wb, 700104, India, abhishekjs11@iimcal.ac.in

1 - Cash Conversion Cycle Consideration in Resource Constrained Supply Chain
Abhishek Shinde, Doctoral Student, Indian Institute of Management Calcutta, India, Room No C 203 Lake View Hostel, IIM Calcutta, Joka, DH Road, Kolkata, Wb, 700104, India, abhishekjs11@iimcal.ac.in, Nishant Kumar Verma

Often in marketing 'cash-to-cash-cycle' - ability of an organization to handle operating capital and meet operating expenses-is ignored, which can ultimately result in series of payment crisis and question the survivability of the organization . In our research paper we have discussed the importance of 'cash-to-cash-cycle' consideration in cash strapped channel partner and developed a model to prioritize the products to optimize cash-to-cash-cycle period.

2 - Channel Strategy Considering Store Brand Introduction: The Robinson-Patman Act Actually Helps
Yannan Jin, School of Management, Fudan University, No. 670, Guoshun Road, Yangpu District, Shanghai, China, jinyannan61@gmail.com, Xiaole Wu, Qiying Hu

Motivated by the prevalent phenomenon of store brand entry in the retailing market, this paper studies a manufacturer's channel strategy taking into account retailers' potential store brand introduction under two scenarios: in the presence and absence of the Robinson-Patman Act. The impacts of three factors on firms' decisions are investigated: the store brand base demand, the competition between national brand and store brand, and the cross-store national brand competition.

3 - Production and Sales Management for Successive Generations of New Products under Supply Constraints
Ashkan Negahban, PhD Student, Auburn University, 3301 Shelby Center, Auburn, AL, 36849, United States of America, anegahban@auburn.edu, Jeffrey Smith

Various real-world case studies show that an incorrect production and sales plan for the launch of a new product can lead to huge financial losses for companies. In this work, we study how a firm should manage its production and inventory before launching a new generation of a new product into the market. We use optimal control theory to establish the optimal sales policy and derive closed-form expressions for the demand and sales dynamics of the second generation of the product.

4 - Optimal Inventory and Demand Management through Dynamic Bundling and Pricing
Sang Jo Kim, PhD Candidate, MIT-Zaragoza International Logistics Program, Calle Bari 55, Edificio Nayade 5, Zaragoza, 50197, Spain, sjkim@zlc.edu.es, Youyi Feng

We investigate an optimal decision-making for a manufacturer that makes and sells two distinguishable products. To maximize its revenue, the firm often bundles products for stimulating sales. Optimal joint decisions on inventory replenishment, bundling/unbundling and pricing of the products show certain effective structures and draw significant managerial insights.

5 - Should Marketing Care About Supply Chain Management? On the Moderating Role of SCM on Advertising
Kristoph Ullrich, Ph.D. Candidate Supply Chain and Operations Management, Kuehne Logistics University - The KLU, Grofler Grasbrook 17, Hamburg, HH, 20457, Germany, kristoph.ullrich@the-klu.org, Sandra Transchel

Based on COMPUSTAT data we empirically investigate the impact of supply chain management capabilities on the association between advertise spending and stock returns. To capture the implications of complex feedback loops we employ vector autoregressive models and reveal (among other things) that the effect of advertise spending on abnormal stock returns depends on supply chain competencies.

■ WC31

Hilton- Union Sq 11

Incorporated Models in Business Processes Optimization

Sponsor: Service Science

Sponsored Session

Chair: Tulia Plumettaz, Xerox Corporation, 800 Phillips Rd, Bldg 128-257F, Webster, 14580, United States of America, Tulia.Plumettaz@xerox.com

1 - Planning Inventories in a Multi-Echelon On-line Retail Fulfillment System
Juan Li, Research Scientist, Xerox Corporation, 800 Phillips Road, Webster, NY, 14580, United States of America, Juan.Li@xerox.com, John Muckstadt

When designing and operating an order fulfillment system for an on-line retailer, many factors must be taken into account. We present a model and a computationally tractable method for planning procurements and allocating stock among warehouses. Our model is based on taking advantage of the length of time between when a customer places an order and when it must be fulfilled. We will demonstrate the effect of the percentage of demand that must be filled immediately on the total system inventories.

2 - A Multidisciplinary Approach to Model Child Support Services Business Processes
Bo Hu, Research Scientist, Xerox Corporation, 128/29E, 800 Phillips Road, Webster, NY, 14580, United States of America, bo.hu@xerox.com, Bryan Dolan, Patricia Wall, Maryann Fuhrmann, Kirk Ocke, Yasmine Charif

A multidisciplinary team of ethnographic researchers, business process modelers and data analysts was formed to study the processes and practices of several Child Support Services departments across the U.S. We will describe our methodology for collecting data and modeling key work processes. We will also discuss our recommendations for improving workflow, including new opportunities to increase stipulated child support orders and compliance.

3 - Optimization Models in Advertising: Paid Search
Aya Wallwater, PhD Candidate, Columbia University, Rm. 329, School of Engineering, 500 West 120th Street, New York, NY, 10027, United States of America, aw2589@columbia.edu

Modern advertising is heavily based on digital media. It consists with different marketing channel and typically the channel that drives the most traffic to a vendor's website is called Paid or Sponsored Search. Paid search is auction-based method to place online advertisements on webpages that shows results from search engine queries. Motivated by the importance of paid search within a digital campaign we will describe an optimal decision process to determine the daily bids on search keywords.

4 - Instability of Sharing Systems in the Presence of Retransmissions
Evangelia Skiani, PhD Candidate, Columbia University, New York, NY, es3009@columbia.edu, Predrag Jelenkovic

Retransmissions represent a primary failure recovery mechanism on all layers of communication network architecture. Similarly, fair sharing, e.g. Processor Sharing (PS), is a widely accepted approach to resource allocation among multiple users. Recent work has shown that retransmissions in failure-prone systems can lead to heavy-tailed delays. Here, we discover that PS-based scheduling induces complete instability in the presence of retransmissions regardless of the job size or the traffic load.

■ WC32

Hilton- Union Sq 12

Supply Chain, Game Theory & Combinatorial Auctions

Contributed Session

Chair: Ahmet Camci, Yasar University, Universite Caddesi, No:35-37, Agacli Yol, Izmir, 35100, Turkey, ahmet.camci@yasar.edu.tr

1 - On Group-Buying Pricing in B2B Systems
Wenxi Gu, PhD candidate, The Chinese University of Hong Kong, Dept of Systems Engineering, CUHK, Shatin, N.T., Hong Kong, Hong Kong - PRC, wxgu@se.cuhk.edu.hk, Xiaoqiang Cai

We explore the feasibility of group-buying pricing for a monopolist supplier who sells a single product to multiple independent Newsvendor-type retailers. The problem is analyzed as a Stackelberg game in which the supplier acts as the leader by announcing its pricing scheme first and the retailers act as followers by choosing their order quantities accordingly. We argue that group-buying pricing, if designed properly, can be a win-win solution for B2B systems.

2 - The Role of Transaction-specific Investment and Switching Costs in Customer Involvement

Yi Li, Xi'an Jiaotong University, School of Management, Xianning West Road No.28, Xi'an, 710049, China, yiyifirst@foxmail.com, Taiwen Feng, Gang Li

First, the empirical study demonstrates that trust and commitment have positive effects on customer involvement. Second, trust would indirectly impact on commitment through transaction-specific investment. Moreover, switching costs play widely distinct roles in different stages of customer relationship. Switching costs negatively moderate the relationship between trust and customer involvement, while positively moderate the relation of commitment to customer involvement.

3 - Solving the Wine Bottling Plant Lot-sizing Problem under Uncertainty and using Postponement

Sergio Maturana, Professor, Pontificia Universidad Catölica de Chile, Industrial and Systems Engineering Dept, Santiago, Chile, smaturan@ing.puc.cl, Mauricio Varas

Planning the wine bottling and labeling operations is difficult, especially if labeling postponement is allowed. We present a MIP model for lot sizing multiple production lines with decoupled bottling and labeling stages. This capacitated lot sizing model with set-up times was tested on a rolling horizon framework with error-prone demand forecasts against a benchmark model. We developed lagrangian decomposition and fix-and-relax heuristics using commercial solvers. The results are presented.

4 - Robust Optimization Model for Scheduling the Bottling Line of a Large Winery

Alejandro Mac Cawley, Assitant Profesor, Pontificia Universidad Catolica de Chile, Vicuna Mackenna 4860, Santiago, Chile, amac@uc.cl

We present a model that produces solutions for the wine bottling lot sizing and scheduling problem with sequence dependent setup times, in an adequate time-frame, which can be implemented by large wineries. The model incorporates particular aspects of the problem such as: major/minor setups, sequence dependent setup times, crewing limitations and finally, sanitation and traceability constraints. We introduce a robust schedule approach and we implemented an effective decomposition algorithm.

■ WC33

Hilton- Union Sq 13

New Product Development 2

Contributed Session

Chair: Debasish Mallick, Associate Professor, University of St. Thomas, 1000 La Salle Avenue #SCH 435, Minneapolis, MN, 55403, United States of America, dnmallick@stthomas.edu

1 - A SA-based Approach for the Feedback-length Minimization Problem

Weihao Huang, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an, China, h.w.h.1989@stu.xjtu.edu.cn, Yanjun Qian, Jun Lin

Finding an appropriate sequence of many interrelated activities becomes a key issue. One important objective of scheduling is to find an activity sequence with minimum total feedback length. This study first proposes two rules for reducing total feedback lengths. Then we combine these two rules with simulated annealing (SA) to provide a heuristic algorithm.

2 - A Framework Based on Quasi-Jackson Network for Evaluating the Complex Collaborative Design

Wen Su, Tsinghua University, Department of Industrial Engineering, Tsinghua University, Beijing, China, suw12@mails.tsinghua.edu.cn, Li Zheng

This paper presents a queueing network model to evaluate complex collaborative design (CCD) performance. The network based on quasi-Jackson theorem considers multiple design teams, stochastic task duration, rework and some other characteristics of design process. Using this model, we are able to analyze throughput, iteration times, and time delay of CCD. Some numerical examples are used to illustrate the proposed framework.

3 - Identifying SMEs-Oriented Technology using Patent Bibliographic Information

Keeeun Lee, Dongguk university-Seoul, E440, 26, Pil-dong 3-ga, Chung-gu, Seoul, Korea, Republic of, kelee@dongguk.edu, Byungun Yoon, Daeun Go, Inchae Park

This research aims to propose a systematic method that identifies SMEs-oriented technology in win-win innovation on the SMEs and Large firms. These technology fields are identified by factors, such as a difference in technology cycle time, applying a Hidden markov model based approach and value chains regarding technology. For this, patent bibliographic data is collected and then, considering innovation factors, technologies are matched to each firm type: large and small-sized enterprises.

4 - Spare Parts Demand under Fleet Expansion with Uncertain Product Customization

Tongdan Jin, Associate Professor, Texas State University, 601 University Drive, San Marcos, TX, 78666, United States of America, tj17@txstate.edu

Prior studies on after-sales service often assume the demand for spare parts is stationary. We analyze a spares inventory system confronted with a non-stationary demand process due to a growing installed base upon the new product introduction. The spare parts forecasting becomes more involved when the configuration of shipped products randomly changes. We synthesize renewal theory with computational analytics to tackle this challenging, yet quite realistic issue.

■ WC34

Hilton- Union Sq 14

Performance Measurement 1

Contributed Session

Chair: Ekaterina Koromyslova, Assistant Professor, South Dakota State University, Box 2223, Solberg Hall 206, Brookings, SD, 57007, United States of America, Ekaterina.Koromyslova@sdstate.edu

1 - De-Risking Business Decisions through Experimentation

Callyn Giese, Marketing Coordinator, Applied Predictive Technologies, 901 North Stuart Street, Suite 1000, Arlington, VA, 22203, United States of America, cgiese@predictiveTechnologies.com

APT is the world's largest purely cloud-based predictive analytics software company. APT's Test & Learn software is revolutionizing the way Global 2000 companies harness their Big Data to accurately measure the profit impact of advertising, marketing, pricing, merchandising, operations and capital initiatives, tailoring investments in these areas to maximize ROI.

2 - An Empirical Examination: Leadership and Dynamic Capabilities Influence on Performance

Zhe Yu Zhang, University of Science and Technology of China, School of Management, Hefei, China, zhufeng@mail.ustc.edu.cn

The article elaborates the process influence mechanism of firm performance output and sum up the regularity, which based on the two perspectives of dynamic capabilities and leadership. Though factorial analysis and structural equation modeling test the relationship among leadership, dynamic capabilities and firm performance; multiple group structural equation modeling verify life cycle and dynamic environment have controlling and moderating effects between these path relationships.

3 - Applied Activity-Based Budgeting Model for a University Department within Decentralized Budgeting

Ekaterina Koromyslova, Assistant Professor, South Dakota State University, Box 2223, Solberg Hall 206, Brookings, SD, 57007, United States of America, Ekaterina.Koromyslova@sdstate.edu, Gary Hatfield

Nowadays, universities strive to remain cost effective in the face of increasing expenses and diminishing support. An applied activity-based budgeting and cost management model for budgeting, strategic planning, and operational analytics allows administrators to be better informed about the effectiveness of the department's business activities while decreasing time and effort in transition towards a new decentralized budgeting and cost management system.

4 - Predictive Cost Analysis Model for Buildings: A Decision-Making Tool

Basima Abdulrahman, Graduate Assistant, Auburn University, 238 Harbet Engineering Center, Auburn University, Auburn, AL, 36849, United States of America, haa0003@auburn.edu, Haitham Eletrabi

The bills of quantities of the construction materials and the related budget have been a major headache for Civil Engineers for a long time. In this paper, we offer an innovative and simple technique for civil engineers and house owners to accurately estimate the construction costs. The proposed model use specific demographics and design related factors to calculate a detailed bill of quantities and construction budget that streamlines the decision making process in the construction industry.

5 - A Game Theoretical Approach to Modeling Energy Consumption with Consumer Preference

Guangyang Xu, University of Louisville, 2727 Riedling Dr Apt 7, Louisville, KY, 40206, United States of America, guangyang.xu@louisville.edu, Lihui Bai, Qipeng Zheng

We propose a new game theoretical equilibrium model to analyze residential users' electricity consumption behavior in smart grid where energy usage and price data are exchanged between users and utilities via advanced communication. Consideration is given to users' possible preference on convenience over cost-saving under the real-time pricing in smart grid, and each user is assumed to have a preferred time window for using a particular appliance.

■ WC35

Hilton- Union Sq 15

Fire and Emergency Medical Services

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Laura McLay, Associate Professor, University of Wisconsin-Madison, 1513 University Ave, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - A Stochastic Approach for Modeling Wildfire Propagation

Mohammad Hajian, Northeastern University, Dept. of Mechanical and Industrial Eng., Northeastern University, Boston, MA, 02115, United States of America, mhajian@coe.neu.edu, Peter Kubat, Emanuel Melachrinoudis

Wildfires can have significant economic and social impact. Predicting the fire propagation enables fighting the fire effectively and in a timely manner. In this research, a stochastic approach for modeling surface wildfire propagation is presented. Two different methodologies are developed to (a) find the probability distribution of the fire arrival time to a point of interest and (b) find the fire forefront stochastic contours.

2 - Allocation Models for Competition among Ambulance Services

Lavanya Marla, University of Illinois at Urbana- Champaign, Champaign, IL, United States of Americalavanyam@illinois.edu, Praveen Tumuluri

We consider a setting where multiple ambulance services compete to serve a population. Such settings have been observed in emerging economies where 911-type services are just being set up, which compete with existing ad-hoc services; as well as in cities like New York, where multiple EMS services exist. We demonstrate the opportunity costs occurring due to competition, and discuss game-theoretic models for better ambulance utilization. We conclude with results from a real-world case study.

3 - Spatial Analysis of Cardiac Arrests

Derya Demirtas, University of Toronto, 5 King's College Rd., Toronto, On, M5S 3G9, Canada, demirtas@mie.utoronto.ca, Roy H. Kwon, Timothy C. Y. Chan

Sudden cardiac arrest is a major public health problem. In this talk, we discuss statistical approaches such as intra-class correlation and kernel density estimation to analyze the stability of cardiac arrests in time and space, and estimate a spatial distribution of cardiac arrests. The resulting risk map provides insights on resource allocation decisions such as identifying the most appropriate areas for community CPR training or determining the placement of AEDs.

4 - A Budgeted Maximal Covering Problem for Reducing Cyber-security Vulnerabilities

Kaiyue Zheng, University of Wisconsin-Madison, Madison, Wi, 53706, United States of America, kzheng23@wisc.edu, Laura McLay

This talk will discuss a cyber-security planning application for securing global information technology (IT) supply chain from the myriad of cyber-security risks and vulnerabilities that exist. We propose a budgeted maximal covering problem for selecting cyber-security mitigations and will introduce integer programming models and greedy approximation algorithms for identifying optimal and near-optimal solutions.

■ WC36

Hilton- Union Sq 16

Humanitarian Operations in a Response Supply Chain

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Aruna Apte, Associate Professor, Naval Postgraduate School, 555 Dyer Road, Monterey, CA, 93940, United States of America, auapte@nps.edu

1 - Model of Supply Chain Vulnerability for Fresh Produce

Cameron MacKenzie, Assistant Professor, Naval Postgraduate School, 699 Dyer Rd., Bldg 234, Monterey, CA, 93940, United States of America, camacken@nps.edu, Aruna Apte

Fresh produce supply chains are highly vulnerable to contamination. Factors that influence the vulnerability of these supply chains include the perishability of the product, the supply chain structure, possible exposure to contamination, the ability to trace the source of contamination within the supply chain, and communication. We model these factors to explore how the interplay of these factors impacts vulnerability.

2 - Decision Model for Planning of Pilot Training Supply Chain

Uday Apte, Professor, Naval Postgraduate School, GSBPP, 555 Dyer Road, Monterey, CA, 93943, United States of America, umapte@nps.edu, John Khawam, Murat Mise

The pilot training process in the U.S. Department of Defense is structurally similar to a physical supply chain; each step serves as the supplier of partially trained pilots to the next step. By combining a LP model, a Markovian forecast and a new performance metric, we develop a decision model that balances cost with readiness in planning for pilot training supply Chain. We illustrate the proposed decision model using the training supply chain for F-16 pilots.

3 - The Self-sufficient Marine Problem

Aruna Apte, Associate Professor, Naval Postgraduate School, 555 Dyer Road, Monterey, CA, 93940, United States of America, auapte@nps.edu, Jay Simon, Eva Regnier

Marines engage in a wide variety of expeditionary operations, and must function without logistical support for long stretches of time. They face many constraints, including the amount they can physically carry, mission requirements, resources needed for sustainment, and the extent to which resources can be shared. In this work, we develop an optimization model for the self-sufficient Marine problem and examine the impacts of reducing the needed amounts of certain resources.

4 - Avoiding Tropical Cyclones in Automated Naval Logistics Planning

Walt DeGrange, CDR, Naval Postgraduate School, wcdegran@nps.edu, Steven Lantz, Eva Regnier

The US Navy's Combat Logistics Force (CLF) provides at-sea resupply to US and allied vessels throughout the world. The CLF scheduling system anticipates demand and schedules 45 days in advance to meet demand. Tropical cyclones (TCs) frequently disrupt these plans, requiring diversions, and inefficient steaming speeds. We evaluate the impact of using TC forecasts in operational planning, and the best lead time and geographic extent of severe weather to use in optimizing CLF operational planning.

■ WC39

Hilton- Union Sq 19

Operations Research Methods for Cancer Care

Sponsor: Health Applications

Sponsored Session

Chair: Christine Barnett, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, United States of America, clbarnet@umich.edu

1 - Developing Optimal Biomarker-Based Screening Policies using Reinforcement Learning

Christine Barnett, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, United States of America, clbarnet@umich.edu, Scott Tomlins, Todd Morgan, James Montie, John Wei, Brian Denton

Recent advances in the development of new biomarker tests, which physicians use for the early detection of cancer, have the potential to improve patient survival by catching cancer at an early stage. Q-learning methods were used to develop optimal screening policies, in terms of patient outcomes, for new prostate cancer biomarker tests. Numerical results based on a large clinical dataset will be used to draw insights about optimal screening policies.

2 - Health and Economic Outcomes of Alternative Follow-up Strategies in Lung Cancer Screening

Ayca Erdogan, University of Southern California, Los Angeles, CA, United States of Americaserdogan@usc.edu

USPSTF recently recommended that heavy-smokers between ages 55 and 80 to be screened annually with CT for lung cancer early detection. However, there are no guidelines on decisions to be made following a positive screening exam. Previous guidelines on nodule follow-up strategies were made before the screening recommendations, thus, need to be renewed. Using a validated micro-simulation model, we aim to analyze the impact of different follow-up strategies on health and economic outcomes.

3 - Individualized Decision Analysis for Prostate Cancer Treatments in the Genomic Era

Jennifer Mason, Assistant Professor, University of Virginia, 1300 Jefferson Park Avenue, Charlottesville, VA, 22908, United States of America, jem4yb@virginia.edu, Timothy Showalter

We present a decision analysis model to evaluate the effectiveness of a genomic classifier of risk of cancer progression as a determinant of decisions for post-prostatectomy prostate cancer treatments, compared to decisions in the absence of the genomic test. We use Monte Carlo simulation to estimate life years, quality-adjusted life years, and 5 and 10 year estimates of cancer progression outcomes for a cohort of patients using individual genomics-based cancer progression risk estimates.

4 - Optimizing Public Health Spending for Cancer Screening with a Focus on Health Outcomes

David Cornejo, North Carolina State University, Raleigh, NC, United States of America, dacornej@ncsu.edu, Maria Mayorga, Kristen Hassmiller Lich

For colorectal cancer and other chronic diseases, health outcomes may be improved through improved screening behavior. Health officials need to choose how to allocate limited public health budget to interventions that change individuals' choice to screen. We develop methods to optimize the allocation of a fixed public health budget across individuals' life course. This allocation accounts for the time-varying dynamics of disease as represented by a simulation model of colorectal cancer.

■ WC40

Hilton- Union Sq 20

New Models of Health Care Delivery: Reengineering for Efficient, Effective Care

Sponsor: Health Applications

Sponsored Session

Chair: David Hopkins, Senior Advisor, Pacific Business Group on Health, 575 Market St., Suite 600, San Francisco, CA, 94105, United States of America, dhopkins@pbgh.org

Co-Chair: Feryal Erhun, Stanford University, CERC, Stanford, CA, United States of America, ferhun@stanford.edu

1 - Transforming Ambulatory Surgical Care: Triple-R Model

Feryal Erhun, Stanford University, CERC, Stanford, CA, United States of America, ferhun@stanford.edu, Kimberly Brayton, Maziyar Kalani, Christine Nguyen

We present our Triple-R ambulatory surgical care model, which is designed to lower costs associated with ambulatory surgery in the United States, a sector experiencing one of the fastest growth rates and accounting for 8% of the 2.3 Trillion in domestic healthcare spending. We outline the current challenges that contribute to excessive spending, suggest our solutions to those challenges, and report our cost impact projections of these solutions.

2 - Reducing Wait Times for New Patient Chemotherapy Consults

Martin Puterman, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, martin.puterman@sauder.ubc.ca, Scott Tyldesley, Emma Liu, Claire Ma, Leah Weber, Antoine Sauré, Marianne Taylor

We describe our study of the impact of scheduling rules and oncologist capacity on wait times for new patient consults. We show that in a highly capacitated system scheduling rules have little impact on service levels. In view of this, we determine the number of additional new patient consults needed by specialty to achieve target service levels. Furthermore, we describe models for investigating the impact of new patient consults on downstream oncologist workload and panel size.

3 - Surgical Care in United States vs. India

Dhruv Kazi, UCSF. University of California, San Francisco, CA, United States of Americakazi@ucsf.edu

Coronary Artery Bypass Grafting (CABG) is believed to cost the most efficient U.S. hospitals about $30,000 to produce. The same operation reportedly costs Narayana Hospital in India under $2,000. In this talk, we discuss the underlying reasons of this cost difference. We also share how learnings from India can be used to develop new surgical care models to decrease U.S. health spending and improve surgical outcomes.

■ WC41

Hilton- Union Sq 21

Supply Chain Management IV

Contributed Session

Chair: Kurt Masten, PhD Candidate, Drexel University, Gerri C Lebow Hall, 3220 Market Street, Philadelphia, PA, 19104, United States of America, kam478@drexel.edu

1 - Exploration versus Exploitation of Trust: Strategic Behavior in Cooperative Relationships

Maryam Razeghian Jahromi, Doctoral Assistant, EPFL, EPFL CDM MTEI OES, ODY 4 16 (Odyssea) Station 5, Lausanne, 1015, Switzerland, maryam.razeghianjahromi@epfl.ch, Thomas Weber

This paper sheds light on the dynamics of trust in repeated bilateral interactions. At each time period, a decision maker learns about the cooperative behavior of a business partner and decides whether or not to continue the relationship based on her updated beliefs about the counterparty's objectives. We analyze how the duration of the relationship changes when the business partner anticipates and strategically distorts the informational consequences of his actions.

2 - Supply Chain Coordination under Asymmetric Information and Demand Updates

James Cao, University of Saskatchewan, 215 209 Willis Crescent, Saskatoon, SK, S7T0L8, Canada, cao@edwards.usask.ca

We explore the role of forecast updating in a supply chain with asymmetric demand information. A supplier sells to a downstream retailer who benefits from demand updates each period. Although the supplier is higher up on the supply chain and therefore unable to observe demand in each period, it is possible for the supplier to infer the state of demand through the retailer's ordering activity. We show that it is in the best interests of the retailer to not share her information.

3 - An Inventory-Production System Subject to Production Constraints and Variable Target Inventory

Mohammadreza Parsanejad, PhD Candidate, Keio University, Department of Administration Engineering, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, Kanagawa, Yokohama, 223-8522, Japan, parsanejad2011@gmail.com, Hiroaki Matsukawa

In Inventory and Order Based Production Control System (IOBPCS) there is no limitation for manufacturing line to produce items while in the real world there are production constraints. The extended version of IOBPCS subject to production constraints with fixed target inventory has been analyzed in recent years. In this paper we aim to analyze the nonlinear IOBPCS which is called NIOBPCS with production constraints for variable target inventory levels.

4 - The Value of Dual-sourcing in a Supply Chain

Isik Bicer, Mr., University of Lausanne, Quartier UNIL-Dorigny, Batiment Anthropole, Lausanne, 1015, Switzerland, isik.bicer@unil.ch, Suzanne De Treville, Valerie Chavez

We consider a dual-sourcing model where a buyer purchases its products from two different suppliers. We apply extreme-value theory and analyze the effects of tail behavior of demand distribution on the optimal sourcing policy. Combining product-flexibility and dual-sourcing models, we develop a framework that shows effective sourcing strategies for different product characteristics.

5 - The Case for 3rd Party Supply Chain Coordination

Kurt Masten, PhD Candidate, Drexel University, Gerri C Lebow Hall, 3220 Market Street, Philadelphia, PA, 19104, United States of America, kam478@drexel.edu, Seung-Lae Kim

Supply chain coordination (SCC) has been an area of intense interest from multiple perspectives. Some focus on coordination mechanisms while others explore methodology and experience. Little research has attempted to bridge these separate streams of research in a meaningful way. A proposal is made to use an independent and neutral third party to address the low application rates of the many techniques available in the literature. A model is developed and payment options explored.

■ WC42

Hilton- Union Sq 22

HSEA - III - Undergraduate Student Research Presentation

Sponsor: Health Applications

Sponsored Session

Chair: Andy Banerjee, Texas A&M University, 3131 TAMUS, College Station, TX, 77843, United States of America, banerjee@tamu.edu

1 - HSEA undergraduate Student Research Presentation

Andy Banerjee, Texas A&M University, 3131 TAMUS, College Station, TX, 77843, United States of America, banerjee@tamu.edu

This session provides a forum for undergraduates and masters student to present the results of their applied research in healthcare applications of operations research and management science. The focus is on problem definition and scoping, data analysis, modeling, and ñ where appropriate ñ lessons learned from piloted implementations.

■ WC43

Hilton- Union Sq 23

Constraint Programming

Sponsor: Computing Society

Sponsored Session

Chair: Willem-Jan van Hoeve, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, vanhoeve@andrew.cmu.edu

1 - Scheduling Home Health Care with Separating Benders Cuts in Decision Diagrams

John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, United States of America, jh38@andrew.cmu.edu, Andre Augusto Cire

We schedule home health care delivery with a logic-based Benders method in which the master problem is a decision diagram and the subproblem is a constraint programming problem. Benders cuts are implemented with a novel separation algorithm for the decision diagram.

2 - Insights into Parallelism with Intensive Knowledge Sharing

Horst Samulowitz, IBM Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, samulowitz@us.ibm.com, Ashish Sabharwal

Novel search space splitting techniques have recently been successfully exploited in parallelizing Constraint Programming and MIP solvers. We use universal hashing to extend existing approaches to a generalized setting. We show that such static splitting approaches are not as effective when intensively sharing knowledge. Finally, there exists a surprising tradeoff between communication cost for knowledge sharing across nodes and cost incurred by the computational load per node.

3 - A CP-Based Branch-and-Price-and-Cut Approach for Operating Room Planning and Scheduling

Louis-Martin Rousseau, Professor, CIRRELT - Polytechnique Montréal, CP 6079 Succ Centre-Ville, Montréal, QC, H3C 3A7, Canada, Louis-Martin.rousseau@polymtl.ca, Seyed Hossein Hashemi Doulabi, Gilles Pesant

We study integrated planning and scheduling of operating rooms. The problem is formulated as a mathematical programming model and a branch-and-price-and-cut algorithm is developed based on a constraint programming model to solve the subproblem. Some dominance rules and a fast infeasibility checking criterion based on a multidimensional knapsack problem are also developed which effectively improve the efficiency of the constraint programming model.

4 - Integrating CP, MIP and Decision Diagrams for the Time-Dependent TSP

Joris Kinable, KU Leuven, Gebroeders de Smetstraat 1, Gent, 9000, Belgium, joris.kinable@kuleuven.be, Andre Cire, Willem-Jan van Hoeve

The Time-Dependent Traveling Salesman Problem (TD-TSP), is a generalization of the well-known TSP where the travel times between cities are dependent on the order or time the cities are visited. This work presents an integrated solution procedure for the TD-TSP, thereby unifying Constraint Programming (CP), Mixed Integer Programming (MIP) and Decision Diagrams into a single framework. Experimental results indicate significant performance improvements over dedicated MIP or CP approaches.

■ WC44

Hilton- Union Sq 24

IT in Healthcare and Education

Sponsor: Information Systems

Sponsored Session

Chair: Rohit Aggarwal, Assistant Professor, University of Utah, 221 B Connor Road, Salt Lake City, UT, 84113, United States of America, Rohit.Aggarwal@business.utah.edu

1 - What Drives Quality Academic Exchanges in the Online Classroom?

Aravinda Garimella, PhD Student, University of Washington, 350 Mackenzie Hall, Seattle, WA, 98105, United States of America, aravinda@uw.edu, Ming Fan

The pedagogical benefits of academic dialogue amongst students have long been acknowledged in the collaborative learning literature. With the advent of massive open online courses (MOOCs), there has been debate on whether MOOCs can achieve deep and meaningful interaction as effectively as brick-and-mortar classrooms do. We empirically investigate the mechanics of academic exchange between students learning mathematics via micro-lectures on one of the pioneer websites in the K-12 MOOC space.

2 - Adverse Drug Effects and Drug Effectiveness: Mining Social Media to Predict Perceived Effectiveness

Michael Lee, Doctoral student, University of Utah, 1182 West 200 North, Unit #b415, Centerville, UT, 84014, United States of America, michael.lee@business.utah.edu, Olivia Sheng

Each year, Adverse Drug Events (ADEs) cause thousands of fatalities and billions of dollars costs. Research suggests that patient education is key. The most accessible way for patients to get drug and ADE information is social media / online drug review sites. Social media can provide insights to patients' perceptions of ADEs and drug effectiveness. This research evaluates patients' perceptions of drug effectiveness using text mining, and sentiment analysis techniques of social media posts.

3 - Investments-adjusted Cost Sensitive Learning for Medical Decision Making

Yuanyuan Gao, Doctoral student, University of Utah, 131 South 1000 East, Apt 18, Salt Lake City, UT, 84102, United States of America, yuanyuan.gao@business.utah.edu, Xiao Fang, Paul Hu

This study designed an Investment adjusted cost sensitive learning (IACSL) method to reduce the total misclassification costs. We tested our method empirically on the weaning problem. The weaning has been proven to be a very challenging problem in ICU intensive care.Our results demonstrated that integrated with appropriate investments and reasonable reduction in costs, IACSL could achieve a better classification solution with lower costs.

■ WC45

Hilton- Union Sq 25

Behavioral Operations 1

Contributed Session

Chair: Jeannette Brosig-Koch, Universitat Duisburg-Essen, Universitatsstrafle 12, Essen, 45117, Germany, jeannette.brosig-koch@ibes.uni-due.de

1 - Promises and Social Distance in Buyer-Determined Procurement Auctions

Timo Heinrich, Universitat Duisburg-Essen, Forsthausweg 2, Duisburg, 47057, Germany, timo.heinrich@ibes.uni-due.de, Jeannette Brosig-Koch

This study explores the effects of communication and its interaction with reputation information in buyer-determined procurement auctions with moral hazard. The results of our laboratory experiment demonstrate that ñ in contrast to reputation information ñ communication only slightly increases market efficiency. Buyers' choice of a bidder is influenced by both, reputation information and communication. In the field we find a choice pattern that is consistent with our lab data.

2 - Running Behavioral Operations Experiments in Online Labor Markets

Yong Won Seo, Associate Professor, Chung-Ang University, 84 Heukseok-Ro, Dongjak-Gu, Seoul, Korea, Republic of, seoyw@cau.ac.kr, Yun Shin Lee

Online labor markets provide an ideal platform for conducting behavioral experiments because experimental results can be produced more quickly, cheaply, and easily. We review recent research about online labor markets and demonstrate the validity of online experiments in the field of behavioral operations. To this end, we replicate the seminal newsvendor experiment using Amazon's Mechanical Turk (MTurk) and show that online subjects on MTurk behave similarly to subjects in physical laboratories.

3 - Cognition versus Computational Power in High-volume Store Replenishment Decisions

Antti Tenhiala, IE Business School, Calle de Maria de Molina 12, 5, Madrid, 28006, Spain, antti.tenhiala@ie.edu, Shivom Aggarwal

Using longitudinal data from a multi-site implementation of automatic store replenishment (ASR) software in a retail supply chain, this study investigates the factors that explain the performance effects of human decisions to deviate from the recommendations of the ASR software. For practitioners, the results show when to restrain and when to encourage deviations. For the theory, the results elaborate the relative strengths and weaknesses of cognition and computational power in decision making.

4 - An Experimental Study of Posted Prices

Seungbeom Kim, University of Southern California, 950 South Flower Street #706, Los angeles, CA, 90015, United States of America, seungbek@usc.edu, Sriram Dasu

We use laboratory experiments to gain insights into how customers make purchase decisions. We find that the quantal response model provides a more accurate description of customers' decisions. If decision making is consistent with our experimental findings, then pricing models that are based on the assumption that customers are rational expected utility maximizers can result in significant loss in profitability. We also study how customers learn in these types of settings.

■ WC46

Hilton- Lombard

Advances in Theory and Computation of Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Kiavash Kianfar, Texas A&M University, College Station, TX, United States of America, kianfar@iemail.tamu.edu

1 - Power Grid Visualization by Means of Optimization

Mingyang Di, Northwestern University, 2145 Sheridan Road, C210, Evanston, IL, 60208, United States of America, mingyangdi2012@u.northwestern.edu, Diego Klabjan, Esa Rantanen

The operators in electric power system control centers play a crucial role in ensuring the integrity of the nation's electric grid. Thus, the task to optimize the layout of visual elements on the display interface is of vital importance. To this end, algorithms using several optimization techniques are proposed to make the interface less cluttered subject to human perceptual and cognitive capabilities. We report our findings based on a real-world power grid in US.

2 - A Few Strong Knapsack Facets

Sangho Shim, Research Associate, Kellogg School of Management, 2001 Sheridan Road, Suite 548, Evanston, IL, 60208, United States of America, shim@kellogg.northwestern.edu, Sunil Chopra, Wenwei Cao

We perform the worst case analysis for the knapsack facets with coefficients equal to multiples of 1/k. The worst case analysis shows that a few facets of small k are strongest and facets of larger k are weaker. We define the 1/k-facets up to k equal to 4.

3 - Continuous n-mixing: A Unified Framework for Lot-sizing, Facility Location & Network Design Problems

Manish Bansal, Ph.D. Candidate, Department of Industrial and Systems Engineering, Texas A&M University, 3131 TAMU, Texas A&M University, College Station, TX, 77843-3131, United States of America, bansal@tamu.edu, Kiavash Kianfar

We present facets of continuous n-mixing set with(out) bounded integer variables which we then utilize to develop new valid inequalities for multi-module lot-sizing, facility location, and network design problems. This research generalizes several existing concepts in cutting plane theory along with various well-known families of cuts for the aforementioned problems. We also present our computational results which show that our cuts (applied using our separation algorithm) are very effective.

4 - Improving the Tractability of a Nuclear Waste Disposal Optimization Problem

Benjamin Johnson, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, bebjohns@mines.edu, Alexandra M. Newman, Jeffrey King

We formulate an integer program that determines a methodical way to dispose of nuclear waste within a repository, using Yucca Mountain as a case study. We exploit the underlying network structure of the problem, address symmetry concerns, and eliminate unnecessary variables to expedite solutions for the objective: minimize the total weighted heat load of all 3x3 waste packages. We present results for this objective and extensions for two other objectives to reduce heat load hot spots.

■ WC47

Hilton- Mason A

Stochastic Optimization in a Data-Driven Context

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Ruiwei Jiang, University of Arizona, Engineering Building 310, University of Arizona, Tucson, AZ, 85721, United States of America, ruiweijiang@email.arizona.edu

1 - Robust SAA

Nathan Kallus, MIT, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu, Dimitris Bertsimas, Vishal Gupta

We propose a tractable methodology for data-driven optimization, which enjoys strong asymptotic as well as finite-sample performance guarantees. The key to this is new theory that links sample average approximation of stochastic optimization, distributionally robust optimization, and statistical hypothesis testing. This also characterizes the asymptotic and finite-sample guarantees of existing data-driven procedures. We demonstrate numerically that our approach outperforms existing approaches.

2 - Distributionally Robust Discrete Optimization with Entropic Value-at-Risk

Daniel Zhuoyu Long, The Chinese University of Hong Kong, The CUHK, Hong Kong, Hong Kong - PRC, zylong@se.cuhk.edu.hk, Jin Qi

We study the discrete optimization problem under the distributionally robust framework. We optimize the Entropic Value-at-Risk, which is a coherent risk measure and is also known as Bernstein approximation for the chance constraint. We propose an efficient approximation algorithm to resolve the problem via solving a sequence of nominal problems. The computational results show that the number of nominal problems required to be solved is small under various distributional information sets.

3 - A Practically Efficient Framework for Distributional Robust Linear Optimization

Melvyn Sim, Professor, National University of Singapore, Singapore, Singapore, melvynsim@nus.edu.sg, Dimitris Bertsimas, Melin Zhang

We developed a modular framework to obtain exact and approximate solutions to a class of linear optimization problems with recourse with the goal to minimize the worst-case expected objective over a probability distributions or ambiguity set. We propose an approach to lift the original ambiguity set to an extended one by introducing additional auxiliary random variables.

4 - Risk-averse Two-Stage Stochastic Program with Distributional Ambiguity

Ruiwei Jiang, University of Arizona, Engineering Building 310, University of Arizona, Tucson, AZ, 85721, United States of America, ruiweijiang@email.arizona.edu, Yongpei Guan

We develop a risk-averse two-stage stochastic program (RTSP) taking into account the distributional ambiguity. We derive an equivalent reformulation for RTSP that applies to both discrete and continuous distributions. Also, the reformulation reflects its linkage with a full spectrum of coherent risk measures under varying data availability.

■ WC48

Hilton- Mason B

Optimization, Stochastic 1

Contributed Session

Chair: Majid Taghavi, McMaster University, 1280 Main St. W, Hamilton, L8S 4L8, Canada, taghavm@mcmaster.ca

1 - Optimal Policy for Attracting FDI: Investment Cost Subsidy versus Tax Rate Reduction

Yuan Tian, Ryukoku University, 67 Tsukamoto-cho, Fukakusa, Fushimi-ku, Kyoto, Japan, tian@econ.ryukoku.ac.jp

We examine two policies for a host government to attract FDI: investment cost subsidy and tax rate reduction. Taking into consideration the strategic interaction between foreign firms and the host government through value functions, we demonstrate that there exists a critical level of the growth rate (or volatility) of the profits: when the growth rate (or volatility) of the profits is lower than the critical level, investment cost subsidy is optimal; otherwise, tax rate reduction is optimal.

2 - A Stochastic Programming Approach to Satellite Ground Station Placement

Aaron Hoskins, Graduate Student, Mississippi State University, Industrial & Systems Engineering, Starkville, MS, United States of America, abh318@msstate.edu

Ground stations are needed for satellites to be able to download data. If the satellite's mission is to collect data after a natural disaster, then the optimal ground station location(s) will not be known before the disaster occurs. A stochastic programming approach is applied to find the optimal ground station placement when the ground stations must be built before the disaster site is known.

3 - Resolving MDP Problems with Misspecified Transition Matrices

Hao Jiang, University of Illinois at Urbana-Champaign, 117 TB 104 S. Mathews Ave., Urbana, United States of America, jiang23@illinois.edu, Uday Shanbhag

We consider a Markov decision process with no knowledge of the transition matrix. Our goal is to obtain the optimal value function and policy while simultaneously learning the misspecified transition matrix. Learning-enhanced value and policy iteration schemes are shown to be convergent. Finite-time error statements and preliminary comparisons are provided with Q-learning.

4 - Single Resource Stochastic Capacity Expansion with Multiple Sources of Capacity

Majid Taghavi, McMaster University, 1280 Main St. W, Hamilton, L8S 4L8, Canada, taghavm@mcmaster.ca, Kai Huang

We consider the multi-period single resource stochastic capacity expansion problem with spot market and permanent capacity available to the decision maker. The problem is modeled as a multi-stage stochastic integer program. We show the totally unimodularity property of the model and develop polynomial-time primal and dual algorithms to solve it.

■ WC49

Hilton- Powell A

3Rs of Networks: Restoration, Risk, and Replenishment

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Sarah Nurre, Assistant Professor, Graduate School of Engineering & Management, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Sarah.Nurre@afit.edu

Co-Chair: Brian Lunday, Assistant Professor, Graduate School of Engineering & Management, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, brian.lunday@afit.edu

1 - Applying Ranking and Selection Procedures to Mitigation for Improved Infrastructure Restoration

Emily Heath, Rennselaer Polytechnic Institute, Department of Mathematical Sciences, Troy, NY, United States of America, heathe@rpi.edu, Thomas Sharkey, John Mitchell

We seek to determine for a network the single arc mitigation plan that contributes the most to the expected restoration of the network over different damage scenarios using ranking and selection (R&S) procedures. We find that R&S procedures are competitive with standard statistical tests in terms of the level of confidence achieved and often reduce the required computational effort. Current and future research examines how these methods can be scaled for multiple-arc plans.

2 - Risk-based Decision Support for Mass Casualty Incident Response

Behrooz Kamali, PhD Candidate, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA, 24061, United States of America, kamali@vt.edu, Douglas Bish

In this research, we systematically coordinate the response to a mass-casualty incident using optimization. Using our optimization models, we analyze the structure of the optimal response. We then structure the model to allow large problems to be solved in an operational timescale. The solutions we develop are response plans that reduce casualty risk by effectively using regional resources (e.g., emergency vehicles and hospitals) to transport and treat casualties.

3 - Information-Sharing in Interdependent Network Restoration

Thomas Sharkey, Assistant Professor, Rensselaer Polytechnic Institute, 110 8th Street CII 5108, Troy, NY, 12180, United States of America, sharkt@rpi.edu, Burak Cavdaroglu, Huy Nguyen, Jon Holman, John Mitchell, William Wallace

We consider the problem of restoring multiple disrupted infrastructure networks after an extreme event. Each network has its own restoration resources that will repair damage done to its components in order to bring services back online. This work analyzes the loss in restoration effectiveness resulting from decentralized restoration efforts across networks and how information-sharing can reduce this loss. Computational results based on realistic damage scenarios to networks are presented.

4 - The Aircraft Network Routing Problem with Aerial Refueling Requirements

Brian Lunday, Assistant Professor, Graduate School of Engineering & Management, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, brian.lunday@afit.edu, Sarah Nurre, Tanya Kannon, Raymond Hill

We present three formulations to solve the aircraft routing problem with aerial refueling: two MINLPs and an MILP. We discuss the formulations' equivalence using transformations to the underlying network structure and/or a separation of routing decisions via their temporal sequence, as well as the formulations' relative sizes, and we analyze their performance in solving a battery of tests instances representing combinations of network size and frequency of aerial refueling point availability.

■ WC50

Hilton- Powell B

Optimization, Integer 3

Contributed Session

Chair: Marco Luebbecke, Professor, RWTH Aachen University, Operations Research, Kackertstrafle 7, Aachen, 52072, Germany, marco.luebbecke@rwth-aachen.de

1 - A New Metric for Parental Selection in Plant Breeding

Ye Han, Iowa State University, 235 Sinclair Ave, Unit 211, Ames, IA, 50014, United States of America, yeh@iastate.edu, William D. Beavis, John N Cameron, Lizhi Wang

With the application of operations research, we developed a new metric, parental breeding value (PBV), based on application of conditional probability distribution and integer programming to help to solve the parental selection problem to accelerate the process of plant breeding and save resources at the same time. From the results of simulations, the PBV metric is demonstrated to shorten the plant breeding process and decrease the resources costs.

2 - Multi Objective Branch and Bound Algorithm

Ozgu Turgut, OR Scientist, Wayne State Uni., 1230 Wisteria Drive Apt 321, A321, Ann Arbor, MI, 48104, United States of America, ozgu.turgut@gmail.com, Alper Murat

This algorithm can be used in order to obtain full Pareto front as well as a representative set generation algorithm for multi-objective integer optimization type of problems(MOIP). Branching is performed on solution points on objective space. Standard concepts of B&B has been investigated and explained within the multi objective optimization context such as fathoming, node selection, heuristics, as well as MOIP specific concepts like filtering, non-domination probability, parallel running.

3 - Separation of Generic Cutting Planes in Branch-and-Price using a Basis

Marco Luebbecke, Professor, RWTH Aachen University, Operations Research, Kackertstrafle 7, Aachen, 52072, Germany, marco.luebbecke@rwth-aachen.de, Jonas Witt

Dantzig-Wolfe reformulation on an integer program may lead to stronger relaxations. A fractional solution to the reformulated program translates to the original program, but usually does not constitute a basic solution. This hinders us from separating cutting planes like Gomory mixed integer cuts which rely on a basis. We check what the literature offers for this defect and propose remedies. We give computational experience with our implementation, which is the first of this kind.

4 - Bilevel Optimization for Capacity Expansion with Rational Markets
Pablo Garcia-Herreros, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, pgarciah@andrew.cmu.edu, Pratik Misra, Erdem Arslan, Sanjay Mehta, Ignacio E. Grossmann

Capacity expansion is usually formulated without considering the influence of markets or the role of providers. We formulate the problem as a mixed-integer bilevel LP that models the rational behavior of markets. The upper level maximizes profit by establishing the expansion plan; the lower level is an LP that minimizes total market cost. A single-level reformulation is obtained using strong duality of the lower level LP. An example from the industrial gas industry is used for illustration.

■ WC51

Hilton- Sutter A

Game Theory 1

Contributed Session

Chair: Vyacheslav V. Kalashnikov, Associate Professor, Dr., Tecnologico de Monterrey (ITESM), Campus Monterrey, 2501 Av, Eugenio Garza Sada South, Monterrey, NL, 64849, Mexico, slavkamx@gmail.com

1 - Co-development of Tests for New Drugs with Risk Averse and Risk Seeking Agents
Jianbo Qian, Ivey, Western University, London, Canada, jqian42@uwo.ca

We study optimal contract structures between a pharmaceutical company and a companion diagnostics company to co-develop a new test. We use a principal/agent framework, where the pharmaceutical company is the principal and invest in the development, and the companion diagnostics company is the agent and supplies effort. We use a general form for the utility function to investigate the cases risk-neutral/averse/seeking agents.

2 - Strategic Behavior in Limited Price Auctions
Xiaodong Zhang, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, xzhangas@ust.hk, Qi Qi, Zhou Chen

Vickrey auction has been a favourite among market makers for its simplicity and truthfulness. There are, however, other considerations in various markets that change the requirements. We discuss fairness and equilibrium in those markets beyond the simple setting of an auction.

3 - Dual-licensing Strategy for Software Companies
Ying Liu, Xi'an Jiaotong University, No. 28, Xianning Road, Beiling District, Xi'an, China, liuyingleyna@stu.xjtu.edu.cn, Xiuwu Liao

Open source software brings new business models while posing a great threat to commercial software. To leverage innovation benefits from community and make profits at the same time, some companies adopt dual-licensing strategy which means software is licensed under both open source and commercial license. When the software is used for profit, users have to pay for the commercial license; otherwise they don't. The paper studies when it's profitable to adopt this strategy and how to employ it.

4 - Consistent Conjectures in Oligopoly are Optimal Cournot-Nash Strategies in the Upper Level Game
Vyacheslav V. Kalashnikov, Associate Professor, Dr., Tecnologico de Monterrey (ITESM), Campus Monterrey, 2501 Av, Eugenio Garza Sada South, Monterrey, NL, 64849, Mexico, slavkamx@gmail.com, Vladimir A. Bulavsky, Nataliya I. Kalashnykova

Properties of consistent conjectural variations equilibrium developed for oligopolistic markets of a single commodity are examined. In general, consistent conjectures are distinct from those of Cournot-Nash. Now define an upper level game with the same agents as in the original oligopoly but with the conjectures playing the role of the agents' strategies. Then the consistent conjectures of the lower level (original) game provide for the Cournot-Nash optimal strategies for the upper level game.

■ WC52

Hilton- Sutter B

Optimization, Linear Programming 1

Contributed Session

Chair: Davood Shamsi, Stanford University, 469 Ruthven Ave, Apt B, Palo Alto, CA, 94301, United States of America, davood@stanford.edu

1 - A Parametric Programming Approach to Consensus Clustering Gene Expression Profile Data
Victoria Ellison, Ph.D. Student, North Carolina State University, 2500 Stinson Drive, Raleigh, NC, 27695, United States of America, vmelliso@ncsu.edu, Yahya Fathi, Amy Langville

A new method of consensus clustering is proposed and applied to gene expression analysis. Resembling hierarchical clustering methods and based on parametric linear programming and sensitivity analysis, the approach offers a method for discovering clustering results of different cluster sizes. It also provides a metric of closeness between objects and clusters. A new algorithm is also proposed to more efficiently solve problems parametric programming problems with redundant constraints.

2 - Online Resource Allocation in Display Advertising
Davood Shamsi, Stanford University, 469 Ruthven Ave, Apt B, Palo Alto, CA, 94301, United States of America, davood@stanford.edu, Yinyu Ye

We study online impression allocation in display advertising using a real data set. At the first step, allocation algorithm is guided by the estimated dual prices. Next, we propose a risk minimization framework for updating dual prices on the fly. As impressions arrive, they are allocated to advertisers such that a risk measure is minimized. Using a real data set with 700 advertisers and millions of impressions, we show enforcing an exponential penalty function results in a higher revenue.

3 - The Unit Commitment Model for Power Interruption Contracts
Lakshmi Palaparambil Dinesh, Graduate Assitant, The University of Cincinnati, 2925 Campus Green Dr, Cincinnati, OH, 45221, United States of America, lakshmi603@gmail.com, Jeffrey Camm

The term unit commitment implies which generating units within an electric power plant should be operational during a particular time period. One of the costs involved in power generation and distribution is the cost the supplier will have to incur by signing up for an interruption contract with the customers. The model aims to understand when the power interruption contacts should be executed by the supplier and how they could lead to overall cost minimization.

4 - Production Scheduling Considering Energy Consumption
Mostafa Ghafoorivarzaneh, Student, University of Tennessee - Department of Industrial and Systems Eng., 610 Sutherland View Way, Apt# 735, Knoxville, Te, 37919, United States of America, mghafoor@utk.edu, Rapinder Sawhney

A considerable part in production cost is energy cost, but in most of production scheduling optimizations this part has been disregarded. In this study in addition to traditional scheduling terms, the following energy parts have been considered: Energy consumption for producing each item, Energy consumption for start-up, Idle energy consumption, Energy consumption for changing setup between production types. The cost has been minimized considering hourly fluctuations of electricity cost.

5 - Optimizing Boat Hull and Deck Mold Storage Scheduling with Linear Programming Based on the Production
Tron Dareing, Student, University of Tennessee - Department of Industrial and Systems Eng., 512 John D. Tickle Building, 851 Neyland Drive, Knoxville, Te, 37996, United States of America, tdareing@utk.edu, Rapinder Sawhney, Mostafa Ghafoorivarzaneh

This research has been done on linking the production schedule with hull and deck mold storing using bi-level optimization. In this case, there was a limited amount of space to store boat molds inside. Outside storage will result in more damages and more frequent repair times. In order to decrease the non-value added time of the maintenance and transportation, a linear model was developed which synced the mold storage with the production schedule.

■ WC53

Hilton- Taylor A

Finance

Contributed Session

Chair: Sandeep Juneja, Professor, Tata Institute of Fundamental Research, HB Road, Colaba, Mumbai, 400005, India, juneja@tifr.res.in

1 - Financial Market Risk over a Period of Time and its Indicator
Chunhui Xu, Professor, Chiba Institute of Technology, Tsudanuma 2-17-1, Narashino, 275-0016, Japan, joh.haruki@gmail.com

Risk indicators for financial market risk had been focused on the risk at a certain future time spot, the risk over a period of time has not been reflected. This talk will introduce our study aiming at filling this gap. I will introduce the notion of period value at risk(PVaR), which was proposed for measuring the risk during a period of time, and the methods we proposed for computing PVaR of an investment.

2 - Multi Armed Bandit Sampling in Nested Portfolio Risk Measurement
Sandeep Juneja, Professor, Tata Institute of Fundamental Research, HB Road, Colaba, Mumbai, 400005, India, juneja@tifr.res.in, Ankush Agarwal, Nahum Shimkin

We consider estimating probability that portfolio loss exceeds a large threshold within a time horizon when the portfolio comprises of diverse financial securities and its value at any state-time is a conditional expectation that needs simulation estimation. We develop a multi armed bandit based sampling method to determine whether at any time loss exceeds specified threshold. For this we also develop computation lower bounds and show that proposed method matches them up to the first order.

3 - Nonparametric Models for Predicting Credit Default Swap Prices: Empirical Study
Youngdoo Son, Dept. of Industrial Eng./Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, 151-744, Korea, Republic of, hand02@snu.ac.kr, Jaewook Lee, HyeongMin Byun

In this study, we investigate the out-of-sample prediction performance of non-parametric machine learning models for credit default swap (CDS) prices. The comparisons were performed on the real market CDS prices including the period of global financial crisis. Also to verify the statistical performance of various models, we compared the statistical differences between the compared methods and tested the predictive performance of several time step ahead forecasting of time series.

4 - Discrete-Event Simulation of Financial Market Dynamics
Vitali Volovoi, Independent Contractor, 505 Birchington Close, Alpharetta, GA, 30022, United States of America, vitali@volovoi.com

Quality of the financial markets is analyzed by means of discrete-event simulations. Model construction and visualization is performed using a new framework, Abridged Petri Nets (APNs). The focus of the presented models is on understanding the underlying market dynamics and on the relationship among the various market quality measures. In particular, impacts of various types of traders on the market liquidity and the market's resilience to external shocks are investigated.

■ WC54

Hilton- Taylor B

Financial Regulation and Risk Management

Sponsor: Financial Services Section

Sponsored Session

Chair: Xianhua Peng, Assistant Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, maxhpeng@ust.hk

1 - Network Effects on Risk and Asset Prices
John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Jing Wu

The structure of firm connections has direct effects on their exposure to systematic risk. This talk will present a model of this form of risk propagation in supply chain networks and show how this impacts asset prices.

2 - Rank Dependent Utility and Risk Taking in Complete Markets
Xuedong He, Assistant Professor, Columbia University, 316 Mudd, 500 W. 120th street, New York, NY, 10027, United States of America, xh2140@columbia.edu, Xunyu Zhou, Roy Kouwenberg

We analyze the portfolio choice problem of investors who maximize rank dependent utility in a single-period complete market. We propose a new notion of less risk taking: choosing optimal terminal wealth that pays off more in bad states and less in good states of the economy. We prove that investors with a less risk averse preference relation in general choose more risky terminal wealth, receiving a risk premium in return for accepting conditional-zero-mean noise (more risk).

3 - Risk Analysis and Hedging of Parisian Options
Kyoung-Kuk Kim, Associate Professor, Korean Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Industrial and Systems Engineering,KAIST, Daejeon, Ch, 305-701, Korea, Republic of, catenoid@kaist.ac.kr, Dong-Young Lim

A Parisian option is an option such that a specified amount of time below/above a barrier is a trigger. We study its greeks via Laplace transform and conduct risk analysis, showing that theta is important to understand the behaviors of Parisian options and how it can make dynamic hedging fail. Instead, we propose a quasi-static hedging strategy by decomposing the option into other derivatives that are statically hedged. Numerical comparisons of dynamic and static hedging are reported.

4 - On the Measurement of Economic Tail Risk
Xianhua Peng, Assistant Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, maxhpeng@ust.hk

We show that the only tail risk measure that satisfies a set of economic axioms proposed by Schmeidler (Econometrica, 1989) and the statistical property of elicitability (i.e. there exists an objective function such that minimizing the expected objective function yields the risk measure; see Gneiting (J. Amer. Stat. Assoc., 2011)) is median shortfall, the median of tail loss distribution. Elicitability is important for backtesting. We also extend the result to incorporate multiple scenarios.

■ WC55

Hilton- Van Ness

Global Optimization in Graphs/Networks

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Sergiy Butenko, Texas A&M University, 4037 ETB, TAMU-3131, College Station, TX, 77843, United States of America, butenko@tamu.edu

1 - A Global Optimization Approach for the Maximum Quasi-clique Problem
Zhuqi Miao, PhD Student, Oklahoma State University, 322 Engineering North, Oklahoma State Un, Stillwater, OK, 74078, United States of America, zhuqi.miao@okstate.edu, Baski Balasundaram, Eduardo Pasiliao

The maximum quasi-clique problem (MQCP) can be formulated as a {0,1}-program with a linear objective function and a single quadratic constraint. Motivated by the MQCP, this research investigates Lagrangian based upper-bound, and embeds this upper-bound in a branch-and-bound algorithm for the MQCP. The effectiveness of this approach is studied by solving the MQCP on DIMACS benchmark instances.

2 - Optimization Approach for Analysis of Neuronal Connectivity Network
Alla Kammerdiner, Assistant Professor, New Mexico State University, PO Box 30001, MSC 4230, Las Cruces, NM, 88003, United States of America, alla@nmsu.edu

We present a new approach for analyzing integrity of white matter in the brain. First the network model is constructed from a diffusion tensor image by single linkage clustering to signify the integrity of fiber bundles. The nodes into specified regions of interests denote the sink and source nodes of our model. By solving the maximum flow problem, the maximum flow is obtained for a given image. Finally, the solutions are used in image comparisons. Our approach is illustrated on simulated data.

3 - Metaheuristic Framework for Detecting Robust Cliques in Networks Subject to Uncertain Edge Failures
Oleksandra Yezerska, Texas A&M University, College Station, TX, United States of America, yaleksa@tamu.edu, Sergiy Butenko, Vladimir Boginski

We develop and compare several heuristic approaches for detecting robust cliques in graphs subject to uncertain edge failures. A clique is robust if it satisfies certain risk requirements modeled using the CVaR concept. The proposed heuristics employ techniques borrowed from the well-known tabu search and GRASP metaheuristics.

■ WC57

Hilton- Golden Gate 1

Academic Projects and Cases Using Real-world Data and Scenarios to Prepare Students for the Workforce

Sponsor: INFORM-ED

Sponsored Session

Chair: Wendy Swenson-Roth, Associate Professor, Georgia State University, 6230 Forest Park Dr, Signal Mountain, TN, 37377, United States of America, wroth@gsu.edu

1 - Industry and Academia Partner to Provide Real-World Data and Issues to Learn Complex Systems Design

Michael Ogle, Assistant Professor and Undergraduate Director, UNC Charlotte, 9201 University City Blvd., CARC 220, Charlotte, NC, 28223, United States of America, Mike.Ogle@uncc.edu

An industry trade association and its college-industry council organization have partnered for twenty years to offer an annual design competition focused on real-world data and marketplace challenges, creating an intensive five-week design experience. This session focuses on how that industry-university collaboration is structured and how it can provide a model for other industries to partner with academia to grow the next generation of educated customers and solution providers.

2 - Teaching Sustainability from an Optimization and Analytics Perspective

Iddrisu Awudu, NDSU, 26 University Village, Fargo, ND, United States of America, Iddrisu.Awudu@my.ndsu.edu

This paper presents a discussion on teaching sustainability by considering optimization and analytics methods. A decision for corporate social responsibility is made by combining a stochastic optimization model using Sample Average Approximation (SAA) algorithm and principal component analysis. A case study is presented based on an ethanol plant in the mid-west.

3 - Mathematical Modeling to Reduce Waste of Compounded Sterile Products in Hospital Pharmacies

Vera Tilson, Simon School, University of Rochester, Rochester, NY, United States of Americavera.tilson@simon.rochester.edu, Greg Dobson

In recent years, many U.S. hospitals embarked on lean" projects to reduce waste. Thoughtful analysis of the data captured by operational systems allows the modeling of many potential process options. Such models permit the evaluation of likely waste reductions and financial savings before actual process changes are made. We present an operations management case based on a student project.

4 - Methods of using the Internet and Laptops in the Classroom with the Goal of Improving Student's Preparation for the Workforce

Wendy Swenson-Roth, Associate Professor, Georgia State University, 6230 Forest Park Dr, Signal Mountain, TN, 37377, United States of America, wroth@gsu.edu

The information students will need and the problems they will receive when they enter the workforce are different from what they are exposed to in many courses. Students receive a substantial amount of course Information through lectures and textbooks. In addition, problems often come with a well-organized data set and a clearly defined problem. Methods are presented to help prepare students to transition from homework problems, where the data and model are clearly laid out, to an end of the semester group project where students are responsible for the entire Decision Making Process.

■ WC58

Hilton- Golden Gate 2

Scheduling IV

Contributed Session

Chair: Cong Zhao, University of Wisconsin Madison, 1513 University Ave, Room 3235, Madison, WI, 53706, United States of America, czhao27@wisc.edu

1 - Analysis of Multi-product Manufacturing Systems with Setup States

Cong Zhao, University of Wisconsin Madison, 1513 University Ave, Room 3235, Madison, WI, 53706, United States of America, czhao27@wisc.edu, Jingshan Li, Ningjian Huang

An analytic model for manufacturing systems with unreliable machines, finite buffers and setup states is developed. Solutions for two-machine are derived and aggregation procedure for longer lines are proposed. Extensive simulation shows this method has high accuracy. This provides a quantitative tool to study the impact of flexibility of manufacturing operations and derive managerial insights.

2 - Scheduling: Agreement Graph vs Resource Constraints

Mourad Boudhar, USTHB University, BP 32, El-Alia, Algiers, Algeria, mboudhar@yahoo.fr, Mohamed Bendraouche, Ammar Oulamara

We consider two problems. The first is scheduling with agreements (SWA) that consists in scheduling jobs non-preemptively on identical machines in a minimum time, subject to constraints that only some specific jobs can be scheduled concurrently. These constraints are represented by a graph. We definitely close the complexity status of SWA on 2 machines with 2 fixed processing times. The second problem is the resource-constrained scheduling. We deduce new complexity results for the latter.

3 - A Subcubic Algorithm to Propagate the Energy Reasoning for the Cumulative Constraint

Nicolas Bonifas, École Polytechnique & IBM, Route de Saclay, Palaiseau, 91128, France, nicolas.bonifas@polytechnique.edu

In the field of constraint-based scheduling, we present an algorithm to propagate the energy reasoning of Lopez in subcubic time, compared to the cubic time needed for the original algorithm. This is a result of great practical significance since energy reasoning is stronger than both timetabling and edge-finding to propagate the cumulative constraint. This new result is based on new properties of the energy reasoning and on new data structures.

4 - Particle Swarm Optimization for Scheduling Flexible Flow Line

Parastoo Amiri, Clemson University, 250 Elm St. # 423, Clemson, SC, 29631, United States of America, pamiri@clemson.edu, Mary Elizabeth Kurz

Previous research on scheduling flexible flow lines (FFL) to minimize makespan has utilized approaches such as branch and bound, integer programming, or heuristics. Particle swarm optimization (PSO) is a population-based metaheuristic method which finds a solution based on the analogy of sharing useful information among individuals. The effectiveness of a discrete PSO in FFL scheduling is compared to genetic algorithms. Methods to avoid premature convergence are evaluated.

■ WC59

Hilton- Golden Gate 3

Operations Management

Contributed Session

Chair: Maria Emilia Camargo, Professor, University of Santa Cruz do Sul, Av. João Machado Soares, 3199, Santa Maria, Brazil, kamargo@terra.com.br

1 - Role of Communication in a Collaborative Supply Chain: An Empirical Analysis

Qingyu Zhang, Professor, Shenzhen University, College of Management, Shenzhen, China, q.yu.zhang@gmail.com, Mei Cao

The objective of the study is to explore the mediating role of communications in the relationships among collectivism, goal congruence, and process efficiency in a supply chain. Data was collected through a Web survey of U.S. manufacturing firms. The results and implications are discussed.

2 - Optimality of Base Stock List Price Policy for Dynamic and Nonstationary Inventory-Pricing Control

Sirong Luo, Associate Professor, Shanghai University of Finance and Economics, School of Statistics and Managment, Guoding Road 777, Yan, Shanghai, 200433, China, luo.sirong@mail.shufe.edu.cn

We study a dynamic inventory-pricing control problem. Demand are two parameter nonlinear, nonstationary and nonadditive model. Using a decision variable transformation approach, we show that the BSLP policy is optimal and the optimality conditions depend only on the location and scale parameters of demand as functions of price. Our results complement the existing results for both backorder and lost sale models in this area.

3 - Applying Cuscore Statistic to Process Control

Maria Emilia Camargo, Professor, University of Santa Cruz do Sul, Av. João Machado Soares, 3199, Santa Maria, Brazil, kamargo@terra.com.br, Suzana Russo, Ivonne Maria Gassen, Marcia Adriana de Oliveira Cerezer

This paper present the study about the statistics CuScore, using the real data (Textile Industry Oeste Ltda in the State of Santa Catarina, Brazil) to investigate the behaviour this statistics in decteting the changes in the process. Also present the comparation between the statistics CuScore with the technics of Exponentially Weighted Moving Average (EWMA). The combination of the ajustament system (EPC) with to monitoring system (SPC) showed best results than only the ajustament system.

4 - Data-Driven Modeling to Improve Elementary School External Resource Acquisition

Samantha Meyer, Graduate Student, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, samanthameyer2011@u.northwestern.edu

Using interview and survey data we collected from nine urban elementary schools, we develop a series of optimization models to improve school resource acquisition. We explore trade-offs across multiple resource dimensions (knowledge, human, and financial resources) and objectives (equity, effectiveness, and efficiency). Lastly, we discuss implications of this study for organizations that wish to strategically form external partnerships to improve access to scarce resources.

■ WC60

Hilton- Golden Gate 4

Inventory Management VII

Contributed Session

Chair: Kemal Gursoy, Instructor, Rutgers University, 100 Rockafeller Road, Room 5146, Dept. of MSIS, Piscataway, NJ, 08854, United States of America, kgursoy@rci.rutgers.edu

1 - Optimal Procurement: Case of a Cost Conscious Manufacturer

Kemal Gursoy, Instructor, Rutgers University, 100 Rockafeller Road, Room 5146, Dept. of MSIS, Piscataway, NJ, 08854, United States of America, kgursoy@rci.rutgers.edu, Melike Baykal-Gursoy, Sicong Hou

We consider a manufacturer who uses an expensive raw material to produce products for a stable market. The raw material price is subject to unknown market conditions, and thus it is random and may not be stationary. There are opportunities to make profitable spot purchases, or making long term purchasing commitments. The objective of procurement policy is to minimize mainly the purchasing cost and secondarily the inventory holding costs. We also present a case study.

2 - The Profit and Pricing Effect of Item-level Inventory Management

Fang Fang, Associate Professor, California State University at San Marcos, 333 S Twin Oaks Valley Rd, San Marcos, CA, 92127, United States of America, fangfang@csusm.edu, Xiaohui Xu

This research studies the strategic decisions when online retailers are able to dynamically track item-level inventories. The decision is on whether to release the inventory level to the consumers, especially when the inventory is low; and how the prices can be dynamically adjusted to improve profitability. Our preliminary results show that the online retailers shall be able to improve profits by adopting a contingency inventory-revealing plan when inventory drops to a certain threshold.

3 - The Stochastic Lot Sizing Problem with Remanufacturing

Onur A. Kilic, Hacettepe University, Institute of Population Studies, Ankara, Turkey, onuralp@hacettepe.edu.tr, Huseyin Tunc, S. Armagan Tarim

We study the stochastic lot sizing problem with remanufacturing under customer service level constraints. The problem is a stochastic extension of the classical lot sizing problem where demand can be met via two alternative sources: manufacturing new products and remanufacturing returned products. It is known that even the deterministic version of this problem is NP-hard. We propose a mixed integer programming based heuristic for the problem building on the static-dynamic uncertainty strategy.

4 - Multi-period Inventory Management with Bounds on Cumulative Commitment and Demand Forecast

Na Zhang, Student, Huazhong University of Science and Technology, School of Management, Wuhan, Hubei, 430074, China, m201373374@hust.edu.cn, Zhe Yin, Fei Lv

We propose a retailer's inventory replenishment policy to cooperate with a supplier in a periodic review. The retailer shares an advanced replenishment plan based on demand forecast with the supplier and commits total order quantity of several periods within range of a lower and upper percentage of the planned quantity. Using a year sales data from a retail chain store in China, we examine the effects of this policy on retailer's inventory turnover performance by the method of simulation.

5 - Fixed-Interval Order-up-to Policies for Serial Systems

Guangyu Wan, PhD candidate, Nanyang Business School, NBS PhD Office, Block S3-01B-73, Nanyang Technological University, Singapore, 639798, Singapore, wang0699@e.ntu.edu.sg, Qinan Wang

This paper studies an echelon fixed-interval order-up-to policy for a serial system, in which related cost are evaluated continuously. We provide:(1) a simple recursive approach to evaluate the exact system cost;(2) a complete characterization of an optimal ordering policy by equating the marginal echelon inventory related cost to the inventory holding cost at the upstream stage. An optimal ordering policy for a given replenishment schedule can be identified by a simple bottom-up procedure.

■ WC61

Hilton- Golden Gate 5

Military Application 2

Contributed Session

Chair: Ramzi Mirshak, Defence R&D Canada, 101 Colonel By Drive, Ottawa, ON, Canada, ramzi.mirshak@drdc-rddc.gc.ca

1 - Multi-objective Crew and Fleet Scheduling using an GA/IP Hybrid

Ramzi Mirshak, Defence R&D Canada, 101 Colonel By Drive, Ottawa, ON, Canada, ramzi.mirshak@drdc-rddc.gc.ca, Matt Smart

We present a problem that involves scheduling fleets and crews that are dispatched from two bases and must fulfill three distinct mission sets. We optimize crew and fleet objective functions through a hybrid GA/IP, where aspects of the fleet maintenance profile are pre-allocated in the GA. This approach permits us to estimate the Pareto front for the multi-objective problem of optimizing fleet maintenance and minimizing the crew-swaps between assets while meeting the mission sets.

2 - Mitigation Methods and Techniques for Enhancing Sonar Operational Confidence

Mark Gammon, Defence Scientist, Defence R&D Canada - Atlantic, 9 Grove Street, Dartmouth, NS, B2Y 3Z7, Canada, mark.gammon@drdc-rddc.gc.ca

There are numerous challenges to effectively model sonar performance given variability in ocean acoustic parameters. It is well recognized by the operational community that it is challenging to accurately predict the performance of a sonar system. Numerous initiatives are required to harmoniously provide a level of confidence to operators for sonar prediction. Simulation tools that are being utilized include the NATO Multi-Static Tactical Planning Aid and the Environmental Modelling Manager.

3 - A Continuous-Time Model for Airlift Scheduling at the United States Transportation Command

Allison Chang, Technical Staff, MIT Lincoln Laboratory, 244 Wood Street, Lexington, MA, 02420, United States of America, aachang@mit.edu

USTRANSCOM is responsible for providing the Department of Defense with global mobility. Current research efforts to assign resources to requirements typically discretize time into intervals. This type of model scales with the granularity of the time horizon, and thus becomes prohibitively large. We introduce a continuous-time scheduling model that removes the dependence of the model size on how finely the horizon is divided. We demonstrate the performance of this model on several test datasets.

4 - Time-Dependent Portfolio of Systems Optimization using GAs with Gradient-Directed Mutations

Stephen Henry, Senior Member Technical Staff, Sandia National Labs, 1515 Eubank Ave, Albuquerque, NM, 87123, United States of America, smhenry@sandia.gov, John Eddy, Mark Smith

Long-range business or military planning often requires portfolio optimization of integer system counts over many time periods. Genetic Algorithms (GAs) are an attractive approach due to their ability to optimize over multiple non-linear objectives. However, random GA mutations have difficulty with the inherent coordination in year-to-year investment levels. This work uses objective function gradients to direct mutations in a coordinated fashion, giving impressive speedups over zeroth-order GAs.

■ WC62

Hilton- Plaza A

Homeland Security

Contributed Session

Chair: Daniel Faissol, Group Leader, Lawrence Livermore National Laboratory, 7000 East Ave., Livermore, CA, 94550, United States of America, faissol1@llnl.gov

1 - Modeling, Simulation and Optimization to Guide Radiological and Nuclear Searches

Daniel Faissol, Group Leader, Lawrence Livermore National Laboratory, 7000 East Ave., Livermore, CA, 94550, United States of America, faissol1@llnl.gov, Richard Wheeler, Thomas Edmunds, Claudio Santiago

We present a prototype modeling, simulation, and optimization tool to support operational planning of radiological or nuclear search missions in an urban environment. The tool includes a 3-dimensional simulation model of an urban scene to estimate the expected background radiation and attenuation of the radiation through building walls. We then solve a non-linear optimization problem and demonstrate that optimized searches can perform 3-30 better than unguided strategies.

2 - DDDAMS-based System for Surveillance and Crowd Control via UAVs and UGVs

Amirreza M. Khaleghi, Research Assistant, University of Arizona, 1127 James E. Rogers Way, Tucson, AZ, 85721, United States of America, amirreza@email.arizona.edu, Dong Xu, Mingyang Li, Jyh-Ming Lien, Sara Minaeian, Yifei Yuan, Christopher Vo, Arsalan Mousavian, Jian Liu, Young-Jun Son

A dynamic data driven adaptive multi-scale simulation (DDDAMS) based planning and control framework is presented for surveillance and crowd control via teams of UAVs and UGVs. Various issues are discussed such as enabling algorithms (detection, tracking, motion planning), control architectures, and team formation/coordination policies. An agent-based hardware-in-the-loop simulation testbed is constructed, where the modeling fidelity can be adjusted according to the observations and performance.

3 - Quantifying Difficulty in Transporting Illicit Radiological and Nuclear Materials

Samrat Chatterjee, Pacific Northwest National Laboratory, 902 Battelle Blvd, Richland, WA, 99354, United States of America, samrat.chatterjee@pnnl.gov, Robert Brigantic, Casey Perkins

Varying levels of information may be available to an analyst for the quantification of illicit radiological and nuclear transport difficulty along a path. In this study, the characterization of difficulty is explored using ordinal rankings, probability distributions, and intervals. A systems-approach is then adopted to investigate the propagation of difficulty.

4 - Modeling the National Oceanic and Atmospheric Administration's (NOAA) Observing Portfolio

David Helms, National Oceanic and Atmospheric Administration (NOAA), 1335 East West Hwy, Silver Spring, MD, 20910, United States of America, David.helms@noaa.gov

Since 2005, NOAA has developed a large-scale portfolio analysis (PA) model to support investment decisions across its complex mission-space and portfolio of 100+ observing systems (e.g. satellites, ships, aircraft, and surface-based). The model is very large and detailed, employs advanced data elicitation and modeling capabilities; and informs NOAA's investment decisions. It is also a PA proving ground for other federal agencies involved in planning and conducting national earth observations.

■ WC63

Hilton- Plaza B

Decision Analysis 3

Contributed Session

Chair: Shital Thekdi, Assistant Professor, University of Richmond, 1 Gateway Rd., Richmond, VA, 23103, United States of America, sthekdi@richmond.edu

1 - Scenario-Based Input-Output Inoperability Modeling for Risk Management of Port Disruptions

Shital Thekdi, Assistant Professor, University of Richmond, 1 Gateway Rd., Richmond, VA, 23103, United States of America, sthekdi@richmond.edu, Joost Santos

Disruptions to maritime port operations have potential to propagate economic losses across supply chains. Risk management should anticipate the impact of disruptions and guide protective investments. This presentation will: (1) Describe a scenario-based interdependency model to identify sectors vulnerable to disruptions, and (2) Prioritize risk management policy investments. The methods will be demonstrated on a United States port responsible for handling $36.1 billion of cargo annually.

2 - Enhanced Techno-economic Analysis for Advanced Biofuel Production

Qi Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50010, United States of America, qili@iastate.edu, Guiping Hu

We will increase the complexity of the traditional techno-economic analysis of commercial biorefinery by considering the practical logistic settings and constraints. At the same time, new uncertainty analysis such as Monte-Carlo simulation and regression analysis could be performed to test the uncertainty in technical data (e.g., reactor performance, product yields), facility size, and capital costs.

3 - Understanding the Channels of Contagion: A Game between Borrower and Lender Countries

Jonathan Welburn, PhD Student, University of Wisconsin - Madison, 1513 University Ave, 3237 Mechanical Engineering Building, Madison, WI, 53706, United States of America, welburn@wisc.edu, Vicki Bier, Kjell Hausken

The process by which crises spread across countries and regions, known as contagion, causes risk to economic stability. We use a multi-agent model of borrower and lender countries to capture the transmission of shocks through trade and debt channels of contagion by strategic interaction. We also explore the possibility of common-cause shocks that lead to crises without propagation. Simulation and sensitivity analysis explain how negative events in trade and debt can lead to a crisis.

4 - Decision-Making under Uncertainty: A Decision-Analytic Typology of Emotion, Logic and Dynamics

Ursula Ott, Associate Professor, Loughborough University, School of Business and Economics, Ashby Road, Loughborough, LE11 3TU, United Kingdom, U.F.Ott@lboro.ac.uk

We use a decision-analytic mechanism to show the impact of emotion, logic and dynamics for managerial players. In a complex globalized world, managers have adapted to their organizations and have learnt to make decisions in an uncertain environment. The dynamics of their behavior is driven by emotion, logic and dynamics. We show the paths of decision-making from three angles and come up with a typology of ELD for managerial decision-making.

5 - How to Use Regression Correctly

Syed Shahabuddin, Professor, Central Michigan University, Smith 203C, Mt Pleasant, MI, 48858, United States of America, shaha1s@cmich.edu

Forecasting is a critical tool for making sound futuristic decisions. Forecasters can use timeseries or regression to forecast. Using a method, one must follow the required rules of the method to make an accurate forecast. Some forecasters do not know the rules, ignore the rules, or implement them partially. Thus, most forecasts are inaccurate. My paper discusses the required rules associated with regression and shows the consequences of ignoring, violating, or partially implementing them.

■ WC64

Parc- Cyril Magnin I

Probability Theory and Combinatorial Optimization

Sponsor: Applied Probability Society

Sponsored Session

Chair: Alessandro Arlotto, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, alessandro.arlotto@duke.edu

1 - When Exactly is Long Chain Optimal?

Antoine Desir, PhD Candidate, Columbia University, New York, NY, United States of America, ad2918@columbia.edu, Yehua Wei, Vineet Goyal, Jiawei Zhang

The long chain process flexibility design has been an important concept in the design of flexible sparse configurations. We show that in a system with n supply and n demand nodes, long chain is optimal among the class of connected networks with at most 2n arcs. Our proof is based on a combinatorial analysis of the structure of augmenting paths and maximum flow in directed graphs. Surprisingly, the result does not hold for disconnected networks and we present a counterexample.

2 - Incorporating Correlation in Rounding LP Relaxations

Arash Asadpour, New York University, 44 W 4th St, New York NY aasadpou@stern.nyu.edu

We investigate linear optimization problems in the presence of combinatorial structures. We show how one can incorporate appropriate concentration inequalities in order to round the solution of the LP relaxation of the problem.

3 - Online Stochastic Bin Packing

Varun Gupta, Assistant Professor, University of Chicago, 5807 S Woodlawn Avenue, Chicago, IL, 60637, United States of America, varun.gupta@chicagobooth.edu, Ana Radovanovic

In one-dimensional online stochastic bin packing, n items with sizes sampled i.i.d. from an unknown distribution arrive as a stream and must be packed on arrival to minimize the number of non-empty bins. We present the first truly distribution-agnostic bin packing heuristic that achieves additive O(sqrt(n)) waste compared to OPT for all discrete distributions. We also present results on stochastic online bin packing with item departures for which are heuristic extends as-is.

4 - Beardwood-Halton-Hammersley Theorem for Stationary Ergodic Sequences: A Counterexample

J. Michael Steele, University of Pennsylvania, Philadelphia, PA, United States of America, steele@wharton.upenn.edu, Alessandro Arlotto

We construct a stationary ergodic process { X_1, X_2, X_3, ... } such that each X_t, has the uniform distribution on the unit square and the length of the shortest path through { X_1, X_2, ...,X_n } is not asymptotic to a constant times the square root of n. In other words, we show that the Beardwood-Halton-Hammersley theorem does not extend from the case of independent uniformly distributed random variables to the case of stationary ergodic sequences with the uniform stationary distribution.

■ WC65

Parc- Cyril Magnin II

Optimal Control in Queueing Networks

Sponsor: Applied Probability Society

Sponsored Session

Chair: Jim Dai, Cornell University, 226 Rhodes Hall, Cornell University, 136 Hoy Road, Ithaca, NY, 14853, United States of America, jd694@cornell.edu

Co-Chair: Shuangchi He, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, heshuangchi@nus.edu.sg

1 - Diffusion Approximation for Multidimensional Reflecting Processes via their Stationary Equations

Masakiyo Miyazawa, Professor, Tokyo University of Science, Yamazaki 2641, Noda, 278-8510, Japan, miyazawa@is.noda.tus.ac.jp

We consider diffusion approximations of the stationary distributions of multidimensional reflecting processes. Such a diffusion limit is usually studied through a scaling limit of processes. We here directly consider a limit of stationary equations. This may not guarantee the weak convergence of the stationary distributions. Nevertheless, it will be useful when charcateristics are obtainable from the stationary equations and when a process limit is hard to get. We present such examples.

2 - Optimal Stock Allocation for Production-Inventory Systems with Multiple Impatient Customer Classes

Yasar Levent Kocaga, Assistant Professor of Operations Management, Yeshiva University, Belfer Hall 403/A, 2495 Amsterdam Avenue, New York, NY, 10033, United States of America, kocaga@yu.edu, Yen-Ming Lee

We address the production and inventory control of a make-to-stock system with multiple impatient customer classes. We assume Poisson demand and exponential production times. Demand not satisfied immediately is backordered; but waits only up to an exponentially distributed amount of time, and is cancelled if not satisfied within this time. We show that the threshold inventory rationing policy is still optimal under certain conditions including a requirement on the order of abandonment rates.

3 - Staffing Service Systems with Unknown Arrival Rates Restricted by Partial Distributional Information

Ying Chen, The University of Texas at Austin, 1 University Station, Austin, TX, 78712, United States of America, lesleycy@utexas.edu, John Hasenbein

We study the staffing level minimization problem in a large-scale queueing system with a QoS constraint on the probability that a customer waits in a queue. We consider an Erlang-C model where the arrival rates follow an uncertain discrete distribution with partial information. We explore two cases: in the first one, the constraint has to be satisfied by every possible distribution, while in the second case, the constraint is enforced only on the overall delay probability.

4 - Routing and Scheduling in a Gurvich Network

Arda Sisbot, Graduate Research Assistant, University of Texas at Austin, Department of Mechanical Engineering, Austin, TX, 78712-1063, United States of America, arda@utexas.edu, John Hasenbein

We focus on a two-class parallel queueing network with a flexible server having a faster rate of service for the class with higher holding cost. Under Poisson arrivals, our model jointly considers incoming job routing and flexible server assignment to one of the classes. Through the associated fluid model we determine a near-optimal discrete policy. The asymptotic behavior of the policy is then analyzed. Numerical experiments are performed to assess the performance of the proposed policy.

■ WC66

Parc- Cyril Magnin III

Sensor-based System Informatics and Control

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

Co-Chair: Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall,, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

1 - Evaluating the Microstructure of A206 Metal Matrix Nanocomposites using Ultrasonic Attenuation

Jianguo Wu, University of Wisconsin-Madison, 1513 University Ave, Industrial and Systems Engineering, Madison, WI, 53706, United States of America, wu45@wisc.edu, Shiyu Zhou, Xiaochun Li

A206-Al2O3 MMNCs are promising high performance materials with potential applications in various industries. The Al2O3 nanoparticles dispersed using ultrasonic cavitation technique can enhance the nucleation of intermetallic phases and reduce grain sizes.This paper investigated the relationship between the ultrasonic attenuation and the microstructures. The results provide useful guidelines on the developmemt of the new quality inspection technique for A206-Al2O3 nanocomposites.

2 - Estimating Length of Nanorods using Dynamic Light Scattering Data

Xin Li, Florida State University, 2525 Pottsdamer Street, Tallahassee, FL, United States of America, xl12d@my.fsu.edu, Chiwoo Park

We present a new approach for estimating length distribution of nanorods with dynamic light scattering (DLS) data. The conventional approach uses the CONTIN procedure and it involves numerical inverse Laplace transform which has some numerical issues and is computationally expensive. Our method avoids the numerical inversion by reformulating the problem into a regression setting with physics-based basis functions. Our method outperforms the CONTIN in terms of accuracy and computation.

3 - Joint Modeling of Quantitative and Qualitative Responses in Additive Manufacturing

Hongyue Sun, Virginia Tech, Virginia Polytechnic Institute and State, University, 112 Durham Hall,, Blacksburg, VA, 24061, United States of America, hongyue@vt.edu, Prahalad Rao, Ran Jin, Xinwei Deng, Zhenyu Kong

This paper focuses on modeling the product quality in a fused deposition modeling (FDM) additive manufacturing process. During such a process, both quantitative and qualitative (QQ) types of responses are used to quantify the product quality. The in situ process variables are also included in the QQ model to predict the QQ responses with functional predictors. Both numerical simulations and experimental studies are conducted to evaluate the modeling performance.

4 - Weighted-Likelihood Based Control Chart for Monitoring Censored Weibull Lifetimes

Chi Zhang, PhD Candidate, HKUST, Room 4223, Academic Building, HKUST,, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, czhangaf@ust.hk, Fugee Tsung

Lifetime experiments are widely seen in modern industrial/medical applications. And process monitoring for lifetime observations has received increasing attention in recent years. This work applies the recent developed weighted likelihood scheme to monitor lifetime data. The proposed control chart is not only able to present desirable In Control (IC) performance, but also robust under various scenarios. Numerical simulations have demonstrated the effectiveness of our method.

5 - Heterogeneous Recurrence Monitoring and Control of Nonlinear Stochastic Processes

Yun Chen, USF, 14219 Les Palms Circle, Apt. 101, Tampa, FL, 33613, United States of America, yunchen@mail.usf.edu, Hui Yang

Process monitoring of dynamic transitions in complex systems is more concerned with heterogeneous recurrence variations. However, little has been done to investigate heterogeneous recurrence variations and link with process monitoring. This paper presents a novel approach of heterogeneous recurrence analysis of nonlinear stochastic processes. Experimental results show that this research provides an effective scheme for monitoring and control of nonlinear dynamic transitions of complex systems.

■ WC67

Parc- Balboa

Data Fusion for Process Monitoring and Diagnosis

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, WI, United States of America, kliu8@wisc.edu

1 - Imbalanced Classification by Hidden Structure Learning

Yang Zhao, PhD Student, City University of Hong Kong, 83 Tat Chee Ave, Kowloon, Hong Kong - PRC, yangzhao9-c@my.cityu.edu.hk, Kwok Leung Tsui, Abhishek Shrivastava

We propose a decomposition based approach to two-class imbalanced classification problem. This approach works by first decomposing the majority class using an unsupervised learning algorithm. The base classifier is then constructed on each sub-problem. The ensemble is tuned to increase the sensitivity towards the minority class. We also provide a metric for estimating the stability of the decomposition. We demonstrate the performance of the proposed approach through various real datasets.

2 - Phasor Measurement Uncertainty Quantification in Voltage Stability Analysis

Jianhui Wang, Decision and Information Sciences Division/Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221, Argoone, IL, 60439, United States of America, jianhui.wang@anl.gov, Chen Chen

We present an uncertainty quantification method for phasor measurement units (PMUs) in voltage stability assessment. The effect of local phasor measurement uncertainty on the bus impedance and the Thevenin equivalent impedance used for voltage stability analysis is quantified analytically.

3 - Online Steady-State Detection using Sequential Monte Carlo Methods

Yuxing Hou, University of Iowa, Ames, IA, United States of America, yuxing-hou@uiowa.edu, Yong Chen

We propose an efficient on-line steady-state detection algorithm using a multiple change-point model and sequential Monte Carlo methods. The proposed algorithm is a Rao-Blackwellized version of the particle filter change-point detection algorithm.

4 - An Automatic Nonlinear Profile Monitoring Method using RP in Progressive Stamping Processes

Xi Zhang, Assistant Professor, Peking University, Haidian, Beijing, China, xi.zhang@pku.edu.cn, Kaibo Liu, Cheng Zhou

This research proposed a nonlinear profile monitoring method by using the recurrence plot for monitoring the progressive stamping processes. We investigated the relationship between the faulty patterns in RP and the changes in nonlinear profiles due to missing parts. A parameter learning algorithm was developed to determine the critical parameters involved in RP, and the selected features from RP were embedded into the support vector machine to identify those faulty process conditions.

■ WC68

Parc- Davidson

Simulation Applications of Supply Chain and Reverse Logistics

Sponsor: Simulation

Sponsored Session

Chair: Suman Niranjan, Assistant Professor for Operations Management, Savannah State University, 209 Jordan Bldg,COBA, 219 College St, Savannah, GA, 31404, United States of America, niranjans@savannahstate.edu

1 - Capacity Management in a Pre-Admission Testing Center

Sal Agnihothri, Professor, Binghamton University, SUNY, School of Management, Binghamton, NY, 13902-6000, United States of America, agni@binghamton.edu, Anu Banerjee

A Pre-Admission Testing Center (PATC) is a hospital unit to gather important patient information and perform procedure-specific tests to get the patients ready for surgery in the Operating Room (OR) on the surgery date. We consider a PATC where patients can either walk-in or schedule an appointment in advance to get the service. In this talk, we explain the efforts to determine the bottleneck and increase capacity to reduce patient waiting time. We analyze the system using a simulation model.

2 - A Simulation Approach to Modeling Lumpiness in Spare Parts Demands

Frank Ciarallo, Associate Professor, Wright State University, 3640 Col Glenn Hwy, Dayton, OH, 45435, United States of America, frank.ciarallo@wright.edu, Albert Lowas

Demand for spare parts in many supply chains has been characterized as lumpy: having the characteristic of high quantity variability as well as high timing variability. Using a simulation-based methodology, this talk explores the underlying characteristics that drive lumpy demand for spare parts from fleets of aircraft. These findings demonstrate that a significant portion of variability that has historically been considered random can be accounted for by deterministic patterns.

3 - A Simulation Analysis of Collection and Processing of End-of-Life Garments

Kai Huang, Dr., McMaster University, 1280 Main St. W, Hamilton, ON, L8S 4L8, Canada, khuang@mcmaster.ca, Suman Niranjan

We analyze a collection and sorting process of end-of-life garments, which can be re-manufactured or recycled. The supply of the garments and the demand for re-manufactured items are stochastic and price-sensitive. We develop a discrete-event simulation to determine the near-optimal acquisition price of garments and selling prices of re-manufactured items.

4 - Optimal Queue Length Based Server Sharing Decisions in Field Services

Suman Niranjan, Assistant Professor for Operations Management, Savannah State University, 209 Jordan Bldg,COBA,Savannah State Univ, 3219 College St, Savannah, GA, 31404, United States of America, niranjans@savannahstate.edu, Sal Agnihothri

We consider a field service system with equipment located in a geographic area. The area is divided into two territories, each with a single server who provides onsite service. The objective of this paper is to investigate the conditions for server sharing between the two service territories. In particular, we use simulation to explore the impact of additional travel time and server utilization on server sharing decisions between two territories.

■ WC69

Parc- Fillmore

Expert Elicitation, Climate, and Energy Technologies

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Max Henrion, CEO, Lumina Decision Systems, 26010 Highland Way, Los Gatos, Ca, 95033, United States of America, henrion@lumina.com

1 - An Elicitation of Expert Assessments of Current and Future Li-ion Battery Costs and Designs for EVs

Apurba Sakti, Massachusetts Institute of Technology, Cambridge, MA, United States of America, sakti@mit.edu

In this elicitation, battery manufacturers, car OEMs, and consultants assessed Li-ion battery cost and design developments for a PHEV10, a PHEV40, a BEV100 as well as for specific designs similar to the Ford C-Max Energi and the Nissan Leaf in 2013 and 2018.

2 - Consumer Cost Effectiveness of CO2 Mitigation Policies in Restructured Electricity Markets

Jared Moore, PhD Candidate, Carnegie Mellon University, 5620 Hempstead Rd., #10, Pittsburgh, PA, 15217, United States of America, jaredmoo@andrew.cmu.edu, Jay Apt

We examine the cost to consumers per tonne of carbon offset of a carbon price and renewable portfolio standards in the restructured markets of PJM, ERCOT, and MISO. We find consumers' costs are strongly dependent on the price of natural gas and on the characteristics of the generators in the dispatch stack. We find that both policies have consequences in capacity markets and that the RPS can only be more cost effective if existing capacity supply remains adequate and gas prices increase.

3 - The Value of Integrated Production Planning in Aluminum Recycling

Jiyoun Chang, Student, MIT, 77 Massachusetts Ave., E38-435, Cambridge, MA, 02139, United States of America, jiyoun@mit.edu, Elsa Olivetti, Randolph Kirchain

Recycling low-quality scrap and byproducts is of great interest in the aluminum industry due to its economic and environmental benefit but requires two stage processing. This work includes developing models for two-stage blending operations to maximize incorporation of secondary raw materials. The analysis quantifies the opportunities associated with integrated production planning given a complex operational environment including variation in demand and raw materials availability.

■ WC70

Parc- Hearst

Economics- Policy

Contributed Session

Chair: Lorena Berumen, Head of Academic Area in Operations Management, Universidad Panamericana, Augusto Rodin 498, Ciudad de México, Mexico, laberumen@up.edu.mx

1 - understanding the Effects of Policy Designs for the Future of the US Light-duty Vehicle Fleet

Alan Jenn, PhD, Carnegie Mellon University, 3621 Childs Street, Pittsburgh, PA, 15213, United States of America, ajenn@andrew.cmu.edu, Ines Azevedo

We assess the effects of vehicle policies on the design/composition of the US fleet. We incorporate consumer demand by measuring responsiveness to changes in vehicle attributes by calibrating a logit model to sales of vehicles. We maximize the profits of manufacturers in an iterative NLP, by changing design decisions of vehicles sold (fuel economy and vehicle prices). We find that manufacturers face higher incremental costs and have dynamic pricing strategies in the presence of policies.

2 - Do Government R&D Subsidies Serve as a Signal for External Investors? Evidence from China

Yanhui Gao, Xi'an Hi-tech Development Zone, 1 Jinye Road, Xi'an, China, yhgaoxjtu@aliyun.com

Using the data on China's high-tech industry during the period 1998-2008, we find that government subsidies have positive effect on external finance and it is more significant in non-state owned sectors and the areas with worse external market conditions. The results are very important for alleviating financial constraints of non-state owned industries and improving the efficiency of allocation of capital.

3 - Encouraging Long-Shot Investments: Regulatory Options for Orphan Drug Development

Anjali Nursimulu, Visiting Risk Fellow, International Risk Governance Council, EPFL IRGC CM 1516, CP 99, Lausanne, 1015, Switzerland, anjali.nursimulu@irgc.org, Thomas Weber

By granting market exclusivity for new orphan drugs a regulator can promote research on treatments for rare diseases. For given effectiveness thresholds and terms of exclusivity, as well as the structure of the disease spectrum and the various expected payoffs for successful drugs, firms can enter an R&D race head-on or diversify their efforts. In a game-theoretic setting, we identify regulatory policies that maximize welfare by both encouraging R&D investments and realizing treatment benefits.

4 - Impact of Insecurity on the Manufacturing Sector, Panel Data Model: Mexican Case

Lorena Berumen, Head of Academic Area in Operations Management, Universidad Panamericana, Augusto Rodin 498, Ciudad de México, Mexico, laberumen@up.edu.mx, Margarita Hurtado, Jen ai de la Cruz, Gilberto Gonzalez

Insecurity adversely affect economic development, particularly economic performance of enterprises and hinders the formation of value chains. In this work the impact of violence in Mexico on manufacturing activity was measured from a panel data model, which includes information from manufacturing of Mexico between 2007 and 2011. It was found that the main factors limiting the development of the manufacturing industry are insecurity conditions.

■ WC71

Parc - Lombard

Auctions/ Mechanism Design 2

Contributed Session

Chair: Christina Lee, Massachusetts Institute of Technology, 216 Harvard St, Apt #1, Cambridge, MA, 02139, United States of America, celee@mit.edu

1 - Strategic Outsourcing under Dynamic Information Asymmetry

Long Gao, University of California, School of Business Administration, Riverside, CA, United States of America, long.gao@ucr.edu, Elodie Adida

We study a procurement problem where the supplier's private capability is dynamically evolving. The buyer commits to a long-term contract for profit-maximizing. We show that the optimal contract spreads out the needed distortions over time to limit information rents. The contract is asymptotically efficient and easy to implement.

2 - Heuristic Algorithms to Solve the Course Allocation Problem

Hoda Atef Yekta, PhD Candidate, University of Connecticut, School of Business, 2100 Hillside Road Unit 1041, Storrs, CT, 06269, United States of America, Hoda.AtefYekta@business.uconn.edu, Robert Day

This research formulates the course allocation problem as a multi-objective mathematical model considering both efficiency and measures of fairness. Results of four proposed heuristic algorithms are compared with existing mechanisms and we show that our new algorithms can improve both efficiency and fairness of the results.

3 - Modeling of Emergency Cooperation of Urban Extreme Storm Floods Based on Strong Reciprocity

Liu Gaofeng, Hohai University, No.200, North Jinling Road, Xinbei Distr, Changzhou, 213022, China, gaofengliu@hhu.edu.cn, Huimin Wang

Strong reciprocity theory is applied into emergency management of Urban extreme storm floods, and a model of emergency cooperation mechanisms is set up,which is performed in Jingdezhen city.The results show that the government strong reciprocity helps to promote emergency cooperation. Besides, rewards and punishment, strong ability of acquiring and processing information, extensive publicity and education can all improve emergency cooperation efficiency and effectiveness.

■ WC72

Parc- Stockton

Energy VI

Contributed Session

Chair: Thomas Yeung, Associate Professor, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, BP20722, Nantes, 44000, France, thomas.yeung@emn.fr

1 - Optimizing Maintenance & Operation Policies for Offshore Wind Farms with Stochastic Wind Conditions

Thomas Yeung, Associate Professor, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, BP20722, Nantes, 44000, France, thomas.yeung@emn.fr, Bruno Castanier, Canan Pehlivan

Offshore wind power is an emerging source of sustainable energy via wind turbine farms located in bodies of water off coasts. They present maintenance challenges due to their harsh environment and accessibility issues. We propose a Markov decision process to determine the optimal subset of wind turbines to maintain as well as the braking speed to reduce deterioration while considering short and long term stochastic wind conditions. A numerical example and analysis is presented.

2 - Multi-criteria Decision Support for Transmission and Generation Expansion Planning in Power Systems

Valentin Bertsch, Karlsruhe Institute of Technology (KIT), Hertzstr. 16, Karlsruhe, 76187, Germany, Viktor Slednev, Wolf Fichtner

The energy sector continues to undergo substantial structural changes. Currently, the expansion of renewable energy sources and the decentralisation of energy supply lead to new players entering the market who pursue different objectives and have different preferences. Thus, multiple, conflicting targets need to be considered. As a result, decision processes grow more complex at all levels. We therefore propose an approach combining multi-criteria decision analysis and energy systems modelling.

3 - On the Use of Fritz-John Optimality Conditions to Represent Optimal Power Flow Solutions

Katia Almeida, Professor, Universidade Federal de Santa Catarina, Dep. de Engenharia Elétrica, UFSC, Florianöpolis, 88040-900, Brazil, katia@labspot.ufsc.br

Computer programs that solve the optimal power flow (OPF) problem are important tools for the analysis of electric power systems. They should provide the system optimal operating point for a variety of network topologies and consumption levels. Depending on the scenario being analyzed, OPF solutions are close to non regular points of the constraint set. This work investigates the use of normalized Fritz-John optimality conditions, together with interior point methods, to solve the OPF problem.

4 - Corrective Switching with AC Feasibility

Paula Lipka, UC Berkeley, 450 Sutardja Dai Hall, 2594 Hearst Ave, Berkeley, CA, United States of America, plipka@berkeley.edu, Richard O'Neill, Shmuel Oren

Corrective switching can be used to correct a voltage violation or line overload problem caused by a line or generator contingency. Here, we examine using corrective switching with a sequential linear program that approximates the alternating-current optimal power flow problem to quickly solve for a feasible switching sequence that minimizes load shed.

5 - California Assembly Bill 2514 Energy Storage Purchase Requirements: An Innovation-Diffusion Approach

Mohammed Osman, Dept. of Technology & Society, Stony Brook University, 16 Hessian Ct., Centereach, NE, 11720, United States of America, mohammed.osman@stonybrook.edu

California Assembly Bill 2514 is a first-in-the-nation policy requiring that utilities purchase energy storage technology. AB 2514 implements a buying schedule for grid scale electricity storage on the three largest California utilities by RPS 33% by 2020 deadline. It mandates 1,325 MW of storage capacity or ~2% of projected peak 2020 summer demand to be added to the grid. We look at the policy's assumptions, expectations, and critical response from utilities using Innovation-Diffusion theory.

■ WC73

Parc- Mission I

Optimization for Distributed Power Systems

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Chen Chen, Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221, Argonne, IL, 60439, United States of America, morningchen@anl.gov

1 - Enhancing Demand Bidding in Electricity Markets

Hamed Mohsenian-Rad, University of California at Riverside, 900 University Ave, Riverside, CA, United States of America, hamed@ee.ucr.edu

A brief analysis of existing electricity market data suggests that demand side market participation is not as efficient as supply side market participation. This can affect price competitiveness and potentially create concerns about market power and supplier collusion. Accordingly, in this talk, we examine different methods to exploit flexible loads and other resources to enhance demand biding in deregulating electricity markets.

2 - A Mixed-integer Nonlinear Program for the Optimal Design and Dispatch of Remote Hybrid Power Systems

Mike Scioletti, PhD Student, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, mikescio@gmail.com, Alexandra M. Newman

We present a design and dispatch strategy for the integration of renewable energies, specifically solar photovoltaic cells combined with battery storage and diesel generators at Forward Operating Bases (FOBs). This problem is a non-convex, mixed-integer nonlinear programming (MINLP) problem. Given the difficulties associated with solving large, non-convex MINLPs to global optimality, we present convex underestimation and linearization techniques to bound and solve the problem.

3 - Demand Charge Reduction with Battery Energy Storage System

Fang Chen, Lehigh University, 200 West Packer Ave, Bethlehem, PA, 18015, United States of America, fac210@lehigh.edu, Lawrence V. Snyder

In an electricity network, large power consumers are charged for their peak demand. A battery energy storage systems (BESS) may be employed to perform peak shaving tasks in order to reduce the demand charge. We introduce two optimization algorithms to properly dispatch battery power assuming demand is stochastic. We then develop a real time planning algorithm, where the load forecast is obtained from a real time predictor. Simulation results show that the system can achieve substantial saving.

4 - Design and Control Decision Model for Distributed Green Energy Generation

Alireza Ghalebani, PhD Student in Industrial Engineering, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, alireza@mail.usf.edu, Tapas Das

We studied optimal design and control strategy customized for distributed green energy generation systems. A MIP decision model is developed for regions with net-metering policy and time varying price of electricity. It considers inputs such as characteristics of the power system components, micro-grid's demand pattern, reliability requirement, system maintenance, local incentives and regulations, and weather data.

■ WC74

Parc- Mission II

Modelings in Electricity Markets for Policy Insights

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Xiaojun Shan, Postdoctoral Research Associate, CEEEP at Rutgers University, 33 Livingston Ave, New Brunswick, NJ, 08901, United States of America, xiaojun.shan@ejb.rutgers.edu

1 - Energy Technology Allocation for Distributed Energy Resources: A Strategic Technology-Policy Model

Sreekanth Mallikarjun, Stony Brook University, Department of Technology and Society, Stony Brook, NE, United States of America, sreekanth.mallikarjun@stonybrook.edu, Herbert Lewis

We present a two-stage multi-objective strategic technology-policy framework. The first stage utilizes a production possibility frontier model to evaluate the performance of each energy technology based on economic, technical, and environmental objectives. The second stage incorporates factor efficiencies from the first stage, energy capacity limitations, dispatchability, and renewable energy penetration, and energy end-use demands into a bottleneck multi-criteria decision model.

2 - Grid Planning using Multistage Stochastic Programming: Benefits of Additional Decision Stages

Saamrat Kasina, Johns Hopkins University, Baltimore, MD, United States of America, bkasina1@jhu.edu, Pearl Donohoo-Vallett, Ben Hobbs

Planning models must accurately capture market forces, incentives, and planning time-lines while giving planners the maximum flexibility possible. We analyze how the number of times the operator is allowed to delay or modify investment decisions or exercise options i.e., the number of decision stages affects the timing and location of generation and transmission decisions, and expected system cost. Numerical test cases are used to quantify this effect.

3 - Game-theoretic Model for Electric Distribution Reliability from a Multiple Stakeholder Perspective

Frank Felder, Research Associate Professor, CEEEP at Rutgers University, 33 Livingston Ave, New Brunswick, NJ, United States of America, ffelder@rutgers.edu, David Coit, Xiaojun Shan

We build and solve two games where either factory or utility decides first on whether to buy Combined heat power plant or harden. We also study government intervention (eg, mandating utility not to harden its distribution and factory to buy a Combined Heat Power with blackstart capability). We illustrate with notional data and show that under some conditions, investing in a Combined Heat Power Plant with blackstart capability could be optimal while the utility does not harden its distribution.

■ WC75

Parc- Mission III

Simulation I

Contributed Session

Chair: Kaan Kuzu, University of Wisconsin-Milwaukee, 3202 N. Maryland Ave, Milwaukee, WI, 53201, United States of America, kuzu@uwm.edu

1 - Comparison of Perceptions and Behavior in Ticket and Physical Queues

Kaan Kuzu, University of Wisconsin-Milwaukee, 3202 N. Maryland Ave, Milwaukee, WI, 53201, United States of America, kuzu@uwm.edu

We designed an empirical study to obtain insights into participant perceptions of and behavior within different queuing arrangements. We specifically focused on the decision making process before and during waits in ticket and physical queue arrangements, and examined how participants adjust their willingness to wait. Using the empirical study results, we tested the impact of changes in customers' willingness to wait on system performance measures.

2 - Internal versus External Complexity: How Organizations React

Bizhan Jamshidnezhad, Lecturer, APIC, 55 Regent St., Chippendale, Sydney, NS, 2008, Australia, bizhan@apicollege.edu.au

This paper investigates the effects of environmental complexity on organizational performance by means of computational modeling. The results of the model show counter-intuitively that the complexity of environmental requirements has positive effects on performance. Also, the results demonstrate that the internal complexity is detrimental to the organizational performance. As regards learning memory, it is seen that shorter memory cycles as defined in this work improve organizational learning.

3 - A Simulation Approach to Airline Maintenance Cost
Massoud Bazargan, Professor, Embry Riddle Aeronautical University, College of Business, 600 S. Clyde - Morris Blvd., Daytona Beach, FL, 32114, United States of America, bazargam@erau.edu

In the past few years airlines in the United States have been using third party companies to do their maintenance operations. This study introduces a simulation approach to help airlines decide if they need to conduct maintenance of their aircraft in-house or outsourced purely from financial aspects. The simulation models incorporate the exciting fleet of an airline and attempt to determine the costs associated with each strategy.

4 - A System for Teaching Simulation to College Students
Ingolf Stahl, Professor Emeritus, Stockholm School of Economics, Box 6501, Stockholm, SE 11383, Sweden, ingolf.stahl@hhs.se

The paper discusses what system is most suitable to use in a one-semester course in simulation in which the focus is on modeling of business decisions and having the students do a simulation project of value in a company. Less than twenty class room hours can be spent on teaching the software. The paper is based on the experience from teaching over ten thousand business students during three decades.

■ WC76

Parc- Embarcadero

Multi-Channel Attribution Modeling

Sponsor: The Practice Track

Sponsored Session

Chair: George Roumeliotis, Senior Data Scientist, Intuit, 2623 Marine Way, Mountain View, CA, 94043, United States of America, George_Roumeliotis@intuit.com

1 - B2B Marketing Multi-touch Attribution/close Loop of Attribution and Contribution
May Xu, LinkedIn, 2029 Stierlin Court, Mountain View, CA, 94043, United States of America, mxu@linkedin.com, Neethi Thomas

Attribution is a process that links marketing activities with an outcome and to determine which activities receive credit for a sale which ensures proper budget allocation for ROI. A weighting technique (based on effectiveness of each campaign and recency) is discussed. In addition, we will discuss how to close the loop of marketing attribution and contribution, the two distinctive questions facing CMOs.

2 - Marketing Attribution on the Front Line
Kevin Potcner, Principal, Exsilon Analytics, 149A Hartford Street, Sasn Francisco, CA, 94114, United States of America, kevin.potcner@exsilondata.com

Implementing a marketing attribution initiative is complex and met with myriad challenges. The effort requires alignment from teams within and outside the organization, each bringing differing expectations, needs, and biases. Influencing marketing leaders to provide the models" with an important seat-at-the-table begins long before the models are built. The presenter will outline specific steps that the project team can take to facilitate important buy-in, support, and credibility.

3 - Current State of Attribution Modeling
George Roumeliotis, Senior Data Scientist, Intuit, 2623 Marine Way, Mountain View, CA, 94043, United States of America, George_Roumeliotis@intuit.com

This talk will review the state-of-the-art of attribution modeling, comparing the performance of various methodologies on a real-world data set.

4 - Digital Attribution is Only a Down Payment
John Wallace, DataSong, 234 Front St, San Francisco, United States of America, jwallace@datasong.com

Most attribution exercises begin with a focus on understanding the effects of digital marketing. Yet for most large advertisers, digital spend is only a fraction of their overall budget, and as difficult as it is for some marketers to accept, there are other, outside factors that explain why their customers buy. Attribution models need to incorporate a variety of non-marketing data such as loyalty program information, service events, and product reviews.

■ WC77

Parc- Market Street

Theory and Applications of Analytics and Big Data

Sponsor: Analytics

Sponsored Session

Chair: Felipe Aros-Vera, Rensselaer Polytechnic Institute, 110 8th St, Troy, NY, 12180, United States of America, arosvm@rpi.edu

1 - A Survey on the Big Data Analytics and its Applications
Amir Gandomi, Ryerson University, 350 Victoria Street, Toronto, ON, M5B 2K3, Canada, agandomi@ryerson.ca, Murtaza Haider

This study establishes a definition for the term "big data". Big data analytics is discussed as one of the two sub-processes of extracting insights from big data. Specifically, a literature review is presented on text analytics, audio analytics, video analytics, social media analytics and predictive analytics.

2 - Surveying Predictive Models for Diabetes Disease Complications
Saeed Piri, PhD Student, Oklahoma State University, IEM department, 322 Engineering North, Stillwater, OK, 74078, United States of America, saeed.piri@okstate.edu, Tieming Liu

One of the most important applications of analytics is in healthcare. Diabetes is a chronic illness requiring continuous care with multifactorial risk reduction strategies beyond glycemic control. Diabetes has several complications including heart disease, neuropathy, nephropathy, etc. In this study we try to survey predictive models that predict the diabetes complications ahead of time and as result patients can apply intervention strategies to stop or even reverse the progress of the disease.

3 - Hawkes Point Processes as a Big Data Analytics Tool for Social Media Management
Amir Hassan Zadeh, PhD Student, Oklahoma State University, Spears School of Business, Stillwater, OK, 74078, United States of America, amir.zadeh@okstate.edu, Ramesh Sharda

Online social networks (OSNs) generate a huge volume of content and clickstream data over time as a result of continuous social interactions between users. Because these interactions are not fully observable, the mining of such social streams is more challenging than traditional data streams. Point processes as a promising approach can be used to unravel latent network structure of OSNs and particularly understand human interactions and collective behavior within the social networks.

■ WC78

Parc- Mason

Decision Support Systems 1

Contributed Session

Chair: Dilek Onkal, Bilkent University, Faculty of Business Administration, Ankara, 06800, Turkey, dilekon@gmail.com

1 - Does Acceptance of Forecast Advice Depend on Scenario Optimism?
Dilek Onkal, Bilkent University, Faculty of Business Administration, Ankara, 06800, Turkey, dilekon@gmail.com, K.Zeynep Sayim, M.Sinan Gonul

Scenarios constitute effective tools for information sharing by depicting alternative storylines of possible futures.Recent research suggests that decision makers effectively utilize optimistic/pessimistic scenarios as channels of forecasting advice.However, the scenarios used in these studies are not only optimistic/pessimistic in tone and content, but are also labeled as such.Current work focuses on exploring whether the effects of scenarios originate from their content or from framing.

2 - Risk-informed Regulatory Compliance Enforcement Model for Technical Systems and Products
Lency Mulamootil, Decision Analysis Advisor, Technical Standards and Safety Authority, 3300 Bloor Street West, Toronto, ON, M8X 2X4, Canada, lmulamootil@tssa.org, Srikanth Mangalam, Arun Veeramany, David Witt, Rene Karavas

A typical mandate of regulatory authorities that have oversight of public safety is to identify non-compliances with regulated systems and products. A key parameter in this critical process is the determination of a permissible time duration within which a non-compliance must be rectified. This paper proposes a risk-informed decision process to assign a time duration for a given regulatory non-compliance and describes how it can be adapted and implemented for a given regulated sector.

3 - A Context Representation Model for Real-time Vehicle Routing in the Distribution of Product Oil

Lijun Sun, Dalian University of Technology, Linggong Road, Ganjingzi District, Dalian, China, slj@dlut.edu.cn, Xiangpei Hu

In China, the urban distribution of product oil is realized by multi-compartment vehicles of several types. Moreover, the types of sources of urban demands vary greatly, including gas stations and some third-industry companies. Constructing a mathematical model for real-time vehicle routing cannot totally reflect and solve this complicated distribution problem, a context representation model is presented to complement it.

4 - Appraising Investments in Integrated and Interdependent Complex Systems: The Case of Smart Cities

Sebastian Maier, Imperial College London, Skempton Building - South Kensington Cam, London, SW7 2AZ, United Kingdom, s.maier13@imperial.ac.uk, John Polak, David Gann, Aruna Sivakumar

Cities require massive capital investment in new infrastructures and services. However, traditional methods of investment appraisal are widely considered as inadequate. To overcome their limitations, this research presents a new appraisal framework that aims at valuing smart city investments while taking into account multiple interdependencies among different investments and the major uncertainties inherent in the investments' underlying technologies, thus supporting long term strategic planning.

■ WC79

Parc- Powell I

OR Models in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Victor Richmond Jose, Georgetown University, McDonough School of Business, 544 Hariri Building, Washington, DC, 20057, United States of America, vrj2@georgetown.edu

1 - When to Issue an Offer and What Deadline to Set When Both Parties Have Outside Options

Sasa Zorc, PhD Student, INSEAD, Ayer Rajah Avenue 1, Singapore, 138676, Singapore, sasa.zorc@insead.edu, Ilia Tsetlin

We model a finite-horizon setting where two agents could make a deal but also are searching for other alternatives. Key decision variables are time to make an offer and the deadline. We explore different settings and show, in particular, that a) issuing all offers as exploding offers is the dominant strategy and b) revealing information about your own search improves equilibrium outcomes for all agents.

2 - Impact of Bayesian Learning and Externality on Strategic Investment

Wenxin Xu, University of Illinois, Chicago, IL, United States of America, wxu9@illinois.edu, Dharma Kwon, Anupam Agrawal, Suresh Muthulingam

We investigate the impact of the interplay between learning effects and externalities on competitive investments with uncertain returns. Our model reduces to a war of attrition under certain conditions, and the interplay between externality and learning has counter- intuitive effects on investment strategies and payoffs.

3 - Inequity-averse Optimization in Operational Research

Ozlem Karsu, Bilkent University, Bilkent, Ankara, Turkey, ozlemkarsu@yahoo.co.uk, Alec Morton

In this paper we review the operational research (OR) literature on inequity-averse optimisation. We discuss two equity related concerns, namely equitability and balance, which are distinguished based on whether anonymity holds. We review applications involving these concerns and discuss alternative ways to incorporate such concerns into OR models. We discuss the pros and cons of different approaches and provide some future research directions.

4 - Expert Elicitation for Production Planning: Theory and Implementation

Saurabh Bansal, The Pennsylvania State University, Business Building, University Park, PA, United States of America, sub32@psu.edu, Genaro Gutierrez

We first present some new results for the determination of probability distributions from subjectively elicited limited information from an expert, and then discuss the application of results at a large firm for a $800 million decision. The technical development specifically allows for incorporating expert's biases and inconsistencies during the deduction of distribution parameters.

■ WC80

Parc- Powell II

Joint Session DAS/ENRE: Energy Infrastructure: Decisions and Models

Sponsor: Decision Analysis & Energy Natural Resources and the Environment

Sponsored Session

Chair: Seth Guikema, Assistant Professor, Johns Hopkins University, 313 Ames Hall, Department of Geog & Env. Engineering, Baltimore, MD, 21218, United States of America, sguikema@jhu.edu

1 - Robust Portfolio Planning of Offshore Wind Farms

Alexana Cranmer, University of Massachusetts, 120B Marston, 160 Governors Drive, Amherst, MA, 01002, United States of America, acranmer@umass.edu, Erin Baker

We apply a spatial version of robust portfolio analysis to wind siting, to help us better understand the value of each project in the context of the full portfolio of projects. Wind farm sites are generally considered one at a time and current approaches do not account for any interactions between the qualities of the sites. Sites may interact with each other through wake effects, profit potential, and wildlife impacts.

2 - Long-Term Hurricane Impact on U.S. Power Systems

Andrea Staid, PhD Student, Johns Hopkins University, 313 Ames Hall, Department of Geog & Env. Engineering, Baltimore, MD, 21218, United States of America, astaid@gmail.com, Seth Guikema, Roshanak Nateghi, Steven Quiring, Michael Gao

Climate change may impact hurricane behavior. The electric power distribution system is particularly vulnerable to hurricane damage. Hurricanes may change in intensity, annual frequency, or geographical location. We simulate the hurricane impact to power systems under plausible climate scenarios. We assess the long-term impacts of hurricanes on U.S. power system infrastructure, and the results can be used to inform decisions regarding improvements in grid reliability, resilience, and robustness.

3 - Evaluating Risk Mitigation Investments in Coastal Power Systems that are Prone to Hurricane Impacts

Roshanak Nateghi, NSF SEES Postdoctoral Fellow, Johns Hopkins University, 313 Ames Hall, Department of Geog & Env. Engineering, Baltimore, MD, 21218, United States of America, roshanak.nateghi@gmail.com, Seth Guikema

The US power systems are repeatedly stressed by hurricanes. They cause widespread outages that lead to huge economic losses. Research shows that tree-trimming practices of utility companies are an important factor in the extent of hurricane damage. In this talk, we describe the results of our decision analysis model used to assess the costs and benefits associated with investing in vegetation management for power networks and discuss further studies needed to address this research question.

4 - Manipulation of Day-ahead Electricity Prices through Virtual Bidding in the U.S.

Chiara Lo Prete, Assistant Professor of Energy Economics, The Pennsylvania State University, John and Willie Leone Family Department, of Energy and Mineral Engineering, University Park PA 16802, United States of America, chiaraloprete@psu.edu, William Hogan

Enforcement actions of the Federal Energy Regulatory Commission in regard to allegations of price manipulation in electricity markets have recently been in the spotlight. We focus on one type of market manipulation strategy considered by FERC (placing unprofitable virtual bids to enhance the value of related FTR positions) and construct examples of equilibrium manipulation in the context of Kumar and Seppi (1992).

■ WC82

Parc- Haight

Data Mining 6

Contributed Session

Chair: Qi Zhang, Carnegie Mellon University, Department of Chemical Engineering, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, qz@andrew.cmu.edu

1 - Data-driven Construction of Convex Region Surrogate Models

Qi Zhang, Carnegie Mellon University, Department of Chemical Engineering, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, qz@andrew.cmu.edu, Ignacio E. Grossmann, Arul Sundaramoorthy, Jose M. Pinto

There is an increasing demand for process models that are sufficiently accurate as well as computationally efficient. In this work, we develop an algorithm for the

data-driven construction of a type of surrogate models that can be formulated as MILPs yet still provide good approximations of nonlinearities and nonconvexities. In the surrogate model, the feasible region is given by the union of polytopes and for each region, the objective function can be approximated by a linear function.

2 - Patent Pool Analysis in Bibliometrics
Hiroko Nakamura, The University of Tokyo, 7-3-1 Hongo, Bunkyoku, Tokyo, Japan, techhn@mail.ecc.u-tokyo.ac.jp, Yuya Kajikawa

Taking statistics and bibliometrics approach, we investigate charactoristcs of patents in the patent pools managed by Mpeg LA. While previous research compare patents in a patent pool and patents, which is not in a patent pool but applied by the same applicant and in the same IPC category, we compare patents in a patent pool with patents, which cited same patents.

3 - A Hybrid Generating Rules Method for Identifying Financial Distress
Ching-Hsue Cheng, Professor, National Yunlin University of Sci. & Tech., 123 University Road, Section 3,Douliou, Yunlin, Taiwan - ROC

This study employed six attribute selection methods to reduce high dimension data. After attribute selection, this study utilized rough set classifier to find the rules of financial distress. In verification, the TEJ dataset was employed as experimental data in Type I, Type II error, and accuracy criteria. The experimental results show that the logistic regression and chi- square attribute selection method combined with rough set classifier outperform the listing methods.

4 - Temporal Analysis of Origin-destination Matrices Estimation based on Passenger Cars Traffic Counts
Carlos Gonzalez-Calderon, Postdoctoral Research Associate, Rensselaer Polytechnic Institute, 110 8th St, JEC 4037, Troy, NY, 12180, United States of America, gonzac8@rpi.edu, Susana Restrepo Morantes, John Jairo Posada Henao, Catalina Osorio

This research introduces an entropy maximization demand model to estimate origin-destination matrices for passenger vehicles on the basis of traffic counts for different years. The performing of the formulation for the different time periods (2001-2008) is tested in the Medellin, Colombia network.

■ WC83

Parc- Sutro

Data Mining 3

Contributed Session

Chair: James Wilson, Department of Statistics and Operations Research, UNC Chapel Hill, Chapel Hill, NC, United States of America, jdwilson1212@gmail.com

1 - Extraction of Statistically Significant Communities in Multilayer Networks
James Wilson, Department of Statistics and Operations Research, UNC Chapel Hill, Chapel Hill, NC, United States of America, jdwilson1212@gmail.com

Community detection is an important problem in the study of complex networks. We consider community detection in the context of multilayer networks where the observed data is a collection of networks on the same vertex set. We propose and investigate a novel testing based community extraction procedure that identifies statistically significant community-layer pairs. We investigate the potential use of our method through analysis of a gene expression dataset from the cancer genome atlas.

2 - Feature Selection in Relational Data Mining
Michele Samorani, University of Alberta, Edmonton, AB, Canada samorani@ualberta.ca, Ivor Cribben

Traditional data mining and statistical techniques require a single table as input; by contrast, we tackle the problem of findings patterns in a relational database. This is possible by automatically exploring the database and generating new attributes using information from all tables. However, doing so results in a large set of attributes that may be correlated with one another. In this talk, we show the benefits of this approach and discuss how to select the most important features.

3 - Study on City-Production Integration of High-tech Industrial Park Based on Fuzzy AHP
Lin Su, PhD, Tongji University, School of Economic and Management, Siping Road, Yangpu District, Shanghai, China, yjshsl@163.com, Xia Wang, Bing Guo, Xin Zheng

City-production integration is fully interpreted but barely evaluated. In this paper, the building of Evaluation Index System comprehensively evaluates the degree of city-production integration of Shanghai High-tech industrial park by applying the fuzzy AHP to that case. We finally found certain factors actively promoting the integration of city-production and put forward policy recommendations.

4 - Longitudinal Service Repurchasing Models and Their Financial Effects
Yoko Norose, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, 305-8573, Japan, norose@aclab.esys.tsukuba.ac.jp, Yukihiko Okada, Yukie Sano, Yuji Takano

The purpose of this research is to build longitudinal service repurchasing models for estimating their long-term revenue contributions empirically. We identify remarkable step-up / step-down repurchasing behaviors based on 2.9 million purchasing records (about 1 million individuals) for the past 18 years of TAC school, a biggest educational service company in Japan.

5 - Temporal Skeletonization on Sequential Data: Patterns, Categorization, and Visualization
Chuanren Liu, PhD Student, Rutgers Business School, 1 Washington Street, Room 1003C, Newark, NJ, 07102, United States of America, chuanren.liu@rutgers.edu

We propose "temporal skeletonization" to proactively reduce the representation of sequences to uncover hidden temporal structures. The key idea is to summarize the temporal correlations in an undirected graph. Then, the embedding topology of the graph allows us to translate the rich temporal content into a metric space. This opens up new possibilities to explore, quantify, and visualize sequential data. Our approach can effectively discover critical buying paths from noisy customer event data.

Wednesday, 2:45pm - 4:15pm

■ WD01

Hilton- Golden Gate 6

MAS Tutorial Session. The State of Operations Research in the US Military: A 75th Anniversary Perspective

Sponsor: Military Applications Society

Sponsored Session

Chair: Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@knology.net

1 - The State of Operations Research in the US Military: A 75th Anniversary Perspective
Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@knology.net

This extended presentation offers perspectives on the past, present, and future of Operations Research in the US Department of Defense with emphasis on the Army. The need for a critical review is argued, and a framework for a comprehensive assessment is developed. Enduring principles are suggested, and new concepts are presented, including both strategic and transformational analytics.

■ WD02

Hilton- Golden Gate 7

Product Development and Process Development in Pharmaceutical Industry

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Zhili Tian, Assistant Professor, Florida International University, 11200 SW 8th Street, Miami, FL, 33199, United States of America, ztian@fiu.edu

1 - Production Planning Models for Biopharmaceutical Perfusion Production
Phil Kaminsky, Professor, University of California, Berkeley, IEOR Dept., 4141 Etcheverry Hall, Berkeley, Ca, 94720-1777, United States of America, kaminsky@ieor.berkeley.edu, Dan Bu

Perfusion production technologies are increasingly used in Biopharmaceutical production, and introduce a variety of scheduling and planning challenges. Motivated by these challenges, we introduce several novel lot-sizing and planning models, analyze these models, and develop heuristic approaches to solving them.

2 - Technology Investment on Improving Environmental Performance
Derek Wang, McGill University, Montreal, QC, Canada derek.wang@mcgill.ca, Shanling Li, Toshiyuki Sueyoshi

We investigate empirically the linkage between firms' environmental technology adoption decisions and firms' characteristics using data from U.S. companies in

2011-2013. This study shows the determinants that lead companies to invest in different types of technologies, and how the choice of technology affects the companies' market performance.

3 - Optimal Investment in Phase II and III New Drug Development
Zhili Tian, Assistant Professor, Florida International University, 11200 SW 8th Street, Miami, FL, 33199, United States of America, ztian@fiu.edu

Firms conduct Phase II and/or III drug trials by enrolling and treating thousands of patients. Finding these patients is expensive and time consuming, with uncertainty. We consider how firms should determine their investment policy. This must be done recognizing that there is also uncertainty in the outcome of a trial.

4 - Financing Drug Discovery for Orphan Diseases
David Fagnan, PhD Candidate, MIT, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, dfagnan@mit.edu, Andrew Lo, Roger Stein

Recently proposed 'megafund' financing methods for funding translational medicine require billions of dollars in capital to de-risk the drug discovery process enough to issue long-term bonds. We demonstrate that the same financing methods can be applied to orphan drug development but, because of the unique nature of orphan diseases and therapeutics (lower development costs, faster FDA approval times, and lower failure rates) the amount of capital needed to de-risk such portfolios is much lower.

■ WD03

Hilton- Golden Gate 7

Electronic Markets and Mechanisms

Sponsor: eBusiness

Sponsored Session

Chair: Yifan Dou, Assistant Professor, Beihang University, 37# Xueyuan Road, Haidian District, Beijing, China, dou@buaa.edu.cn

1 - Online Reputation and Pricing Strategies in E-markets
Min Xu, Harbin Institute of Technology, 92 Xidazhi street, School of Management,, Harbin, He, 150001, China, xuminivy@gmail.com, Wen Shi, Qiang Ye

This paper explores the relationship of sellers' online reputation and their pricing strategies in E-markets. Empirical results suggest that sellers' reputation has a positive impact on price. Meanwhile, the number of competitors will moderate the relationship between reputation and price. Generally, sellers with higher reputation will charge higher price, but their positive correlation will be weakened when there are more competitors in the E-markets.

2 - Dual-sourcing Auctions under Supply Risks
He Huang, School of Economics and Business Administration, Chongqing University, Chongqing, China, huanghecqu@gmail.com, Hongyan Xu

This paper examines unit-price dual-sourcing auctions when the buyer faces multiple suppliers with random yields and privately informed costs. We analyze and compare three widely used auction mechanisms: i) a generalized second-price (GSP) open auction; ii) a generalized first-price (GFP) sealed-bid auction with quantity commitments; and iii) a hybrid auction which selects two winners with an open-descending auction and then allocates quantities with a simplified version of ii).

■ WD04

Hilton- Continental 1

Topics in Supply Chain Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: S. Alex Yang, Assistant Professor, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, sayang@london.edu

1 - Inventory Pooling under Heavy-Tailed Demand
Mihalis Markakis, Assistant Professor, Universitat Pompeu Fabra, Ramon Trias Fargas, 25-27, Barcelona, Spain, mihalis.markakis@upf.edu, Kostas Bimpikis

We consider a single-period multi-location newsvendor model with independent demands. We show both analytically and numerically that the benefits to inventory pooling (in terms of both the inventory levels and the expected costs) in the presence of ``heavy-tailed" demand uncertainty are much more modest than what Eppen's celebrated result predicts (for the case of Normal distributions). We also discuss various extensions of these results.

2 - Financial Pooling in Supply Chain
Qu Qian, Assistant Professor, Shanghai University of Finance and Econo, School of International Business Adminis, 100 Wudong Road, Shanghai, China, qian.qu@mail.shufe.edu.cn, Ming Hu, S. Alex Yang

We show that one possible role trade credit plays is to pool the liquidity buffers between suppliers and retailers. Due to this pooling effect, even as the supplier's cost of capital is high, the retailer should still demand for trade credit. However, this role is not without costs. As an innovative financial scheme, supply chain finance increases the efficiency of this pooling effect, and as a result reduces the overall supply chain financing cost.

3 - The Impact of Supplier Competition on Supply Chain Responsiveness
Ruixue Guo, Stanford University, 63 Abrams Ct, Apt 313, Stanford, CA, 94305, United States of America, rguo@stanford.edu, Robert Swinney

We study a model with two types of suppliers "efficient and responsive" competing for the business of a single manufacturer. We find that competition between the suppliers reduces the advantage of responsive supplier, compared to a model exogenous procurement costs from the two suppliers. We also demonstrate how the manufacturer's power in establishing contract price affects its incentives to source from a responsive supplier.

4 - Integrative Management of Transfer Pricing and Global Sourcing Decision in a Multinational Firm
Vernon Hsu, Professor, The Chinese University of Hong Kong, Room 1502, Cheng Yu Tung Building,CUHK, Hong Kong, Hong Kong - PRC, vhsu@cuhk.edu.hk, Kaijie Zhu, Xiaopeng Zhang

We exam integrative management of a multinational firm's transfer pricing (TP) and global sourcing decisions to take advantage of different tax rates across subsidiaries and to maximize the firm's global after-tax profits. With various decision timelines (ex-ante and ex-post TP decisions) and structures (centralized and decentralized sourcing decisions), we characterize optimal TP and sourcing decisions in various scenarios. Several new and important managerial insights are derived.

■ WD05

Hilton- Continental 2

Multichannel Retailing

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Santiago Gallino, Tuck School of Business, 100 Tuck Hall, Hanover, NH, 03755, United States of America, santiago.gallino@tuck.dartmouth.edu

1 - The Drivers of Consumer Latency in Online Retailing
Vishal Gaur, Cornell University, Johnson School, Ithaca, NY, United States of America, vg77@cornell.edu, Nikolay Osadchiy

Consumer latency is the time from the first click by a customer on a website until the time to purchase. We develop an econometric model to assess the drivers of consumer latency using data from an online retailer.

2 - Channel Integration & Sales Concentration: Empirical Evidence
Ioannis Stamatopoulos, PhD Student, Northwestern University, 829 Foster St, Evanston, IL, 60201, United States of America, i-stamatopoulos@kellogg.northwestern.edu, Santiago Gallino, Antonio Moreno-Garcia

Competing for an increasingly demanding customer pool, retailers progressively integrate their B&M and Online channels. In this paper, using a proprietory dataset coming from the implementation of a Ship to Store (StS) capability of a large US housewares retailer, we find that StS causes a statistically and economically significant drop in sales concentration.

3 - Need for Speed: The Value of Delivery Lead-Time in Online Retailing
Jiaqi (Joseph) Xu, PhD Student, The Wharton School, University of Pennsylvania, 3730 Walnut Street, Suite 500, Phialdelphia, PA, 19104, United States of America, jiaqixu@wharton.upenn.edu, Marshall Fisher, Santiago Gallino

We explore the relationship between online retail sales and service quality in terms of delivery speed by analyzing a quasi-natural experiment from an apparel retailer. The retailer improved service quality for a subpopulation of its customers by opening a new distribution center (DC) in western US. We establish a causal link between delivery time reduction and sales, and show that sales was 3.88% higher in western US compared to eastern US after opening of the new DC.

4 - How Can I Help You? Improving Retail Store Execution through Online Learning

Santiago Gallino, Tuck School of Business, 100 Tuck Hall, Hanover, NH, 03755, United States of America, santiago.gallino@tuck.dartmouth.edu, Marshall Fisher, Serguei Netessine

Converting demand into sales in today's retail environment is not a trivial task. When retailers fail on their store execution, customers walking into the store will leave empty-handed or carrying fewer bags than they might have otherwise. But, is it true that more-engaged associates perform better? Is it the case that employees who became more knowledgeable about the products they are selling improve their sales performance? And if so, by how much?

■ WD06

Hilton- Continental 3

Humanitarian-Driven Inventory Management: Pre-positioning and Responses

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Fang Liu, Nanyang Technological University, 50 Nanyang Drive, Singapore, Singapore, Liu_Fang@ntu.edu.sg

Co-Chair: Yulan Wang, Asst Prof, Hong Kong Polytechnic University, Kowloon, Hong Kong, Hong Kong - PRC, yulan.wang@polyu.edu.hk

1 - A Stochastic Location-Routing Model for Prepositioning and Distributing Emergency Supplies

Xiaofeng Nie, Assistant Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, xiaofengnie@ntu.edu.sg, Yidong Zhang, Aakil Caunhye, Mingzhe Li

We model post-disaster situations as scenarios and propose a two-stage stochastic programming model to preposition and distribute emergency supplies. In the first stage, the model decides where to locate warehouses and how many quantities to stock for prepositioning purposes. In the second stage, the model decides how many quantities to transport to demand sites and the corresponding routing. Furthermore, the issue of equitability is taken into consideration when distributing emergency supplies.

2 - An Integrated Inventory Management Framework for Emergency Operations

Eren Ozguven, Assistant Professor, Florida State University, 2525 Pottsdamer Street, Tallahassee, FL, 32310, United States of America, eozguven@fsu.edu, Kaan Ozbay

This research describes the steps required to develop a novel and comprehensive framework for the development of a humanitarian emergency inventory management framework that enables the real-time tracking of emergency supplies/demands through the integration of emerging technologies such as Radio Frequency Identification Devices (RFID) for commodity tracking and logistics.

3 - Optimal Allocation of Resources Bases on Social Costs

Jose Holguin-Veras, William H. Hart Professor, RPI, 110 8th St JEC 4030, Troy, NY, United States of America, jhv@rpi.edu

This talk discusses the policy implications of allocating scarce resources under post-disaster conditions using the concept of social cost.

4 - Optimal Deployment of Emergency Supply Inventory with a Humanitarian Relief Objective

Yulan Wang, Asst Prof, Hong Kong Polytechnic University, Kowloon, Hong Kong, Hong Kong - PRC, yulan.wang@polyu.edu.hk, Fang Liu, Pengfei Guo

We consider the optimal pre-positioning of emergency supply inventory (ESI) that are used for recurring disasters with an objective of minimizing the total expected number of casualties. We derive the expected casualty number and develop two algorithms to find the optimal ESI allocation. We extend the problem to the scenario where the pre-positioned ESI may be partially destroyed, the transportation infrastructure may be destroyed, and the disaster may occur at more than one location.

■ WD07

Hilton- Continental 4

Supply Chain Management VII

Contributed Session

Chair: Sunantha Teyarachakul, Dr., MacEwan University, 10700-104 Avenue NW, Edmonton, AB, T5J 4S2, Canada, teyarachukals@macewan.ca

1 - Commodity Hedging in a Competitive Supply Chain

Ehsan Bolandifar, Assistant Professor, Chinese University of Hong Kong, 1 Chak Cheung Street, Cheng Yu Tung Bld. R 922, Hong Kong, Hong Kong - ROC, ehsan@baf.cuhk.edu.hk

We study optimal hedging policy in a competitive market where a retailer procures two substitutable commodities from two processors. We show that how market competition and commodity price correlation affect optimal hedging policies of the producers in a supply chain setting.

2 - Optimality of Operations and Marketing Coordination Mechanisms in a Two-level Supply Chain

Chirag Surti, Assitant Professor, UOIT, 2000 Simcoe Street North, Oshawa, ON, L1H7K4, Canada, chirag.surti@uoit.ca, Salma Karray

Research on supply chain coordination relies on the assumption that manufacturers incentivize the retailer by offering a single coordination mechanism. Most manufacturers offer multiple incentives to the retailer in order to coordinate the channel. This paper relaxes this central assumption and investigates the optimal mix of manufacturer's coordination mechanisms. The main finding suggests that the preference for the type(s) of coordination depends on the demand and marketing effort parameters.

3 - Financing the Capital-Constrained Newsvendor with Trade Credit in the Presence of Bankruptcy Cost

Shuang Xiao, Huazhong University of Science and Technology, Luoyu Road 1037, Hongshan District, Wuhan, China, 996719696@qq.com

We consider a two-level supply chain with a supplier and a capital-constrained retailer. The retailer is facing bankruptcy risks and failure of loan repayment leads to a costly bankruptcy. We model the interaction between the supplier and retailer as a Stackelberg game with the supplier as the leader, and try to find the best financing structure among the bank, supplier and retailer, from different perspectives.

■ WD08

Hilton- Continental 5

Supply Chain Management VII

Contributed Session

Chair: Jinfeng Yue, Professor at MTSU, Dean and Professor at SHUFE, Middle Tennessee State University (MTSU) and, Shanghai University of Finance and Econ, Murfreesboro, TN, 37132, United States of America, jinfeng.yue@mtsu.edu

1 - Optimal Inventory Policy and Disposition Decision for Supply Chain with Stochastic Returned Products

Sajjad Farahani, University of Wisconsin, Milwaukee, Industrial Engineering Department, Milwaukee, WI, 53211, United States of America, farahani@uwm.edu, Farshid Zandi

This paper consider an analytical queuing model for a two echelon supply chain; including inventory system and remanufacturing system with stochastic returns. High congestion of return product at remanufacturing facility causes considerable delays and consequently remarketing value losses for time-sensitive products and high-tech products with short life cycles. We propose a model for admission decision that decides about acceptance of return products and maximum capacity of inventory system.

2 - The Effects of Knowledge Management, Cooperative Norms and Joint-action on Supplier's Innovation

Zainab Al Balushi, Assistant Professor, Sultan Qaboos University, College of Economics PO BOX 20, Operations Mangement, AL Khoudh, 123, Oman, zainab.albalushi@gmail.com, Asma Al Zaidi

Inter-firm knowledge management enables effective utilization of competencies. This paper examines the effects of inter-firm knowledge absorptive capacity on supplier's innovation and how joint action between exchange partners fosters this outcome. Also it examines the moderating role of cooperative norms that exists in the exchange relation. Dynamic capability view was used as theoretical lens. A survey was conducted on manufacturing firms in the Arabian Gulf countries and analyzed using SEM

3 - Coordination Conditions in Supply Chain Contracts
Jinfeng Yue, Professor at MTSU, Dean and Professor at SHUFE, Middle Tennessee State University (MTSU) and, Shanghai University of Finance and Econ, Murfreesboro, TN, 37132, United States of America, jinfeng.yue@mtsu.edu

This research uses distribution free approach to study the coordination conditions in different supply chain contracts. It is shown that coordination is achievable for any supply chain contract if some general conditions can be satisfied. The managerial insights are discussed with recommended managerial approaches which provide practical solutions to coordinate supply chain by any preferred contract.

4 - Impact of Customization Postponement on Delivery Lead Time Agreement
Xiao Zhang, UT Dallas, 5657 Amesbury Dr, Apt 1402, Dallas, TX, 75206, United States of America, xiao.zhang@utdallas.edu, Ozalp Ozer, Holly Lutze

A manufacturer (M) produces a batch of common intermediate products, customizes into multiple end products, and delivers them to two retailers (Rs) with different cost parameters. Delivery lead times determine three parties' inventory levels and costs. M minimizes its cost by offering a portfolio of lead times and corresponding payments, from which Rs choose their best options. We derive the explicit form of the optimal lead time agreement. Customization postponement leads to faster delivery.

■ WD09

Hilton- Continental 6

E-Business/ Commerce 2

Contributed Session

Chair: Rajhans Mishra, Assistant Professor, Indian Institute of Management Indore, Faculty Block B First Floor, IIM Indore, Rau, Indore, 453331, India, rajhans111@gmail.com

1 - Web Analytics for Customer Profiling and Segmentation for e-Commerce using Sequential Information
Rajhans Mishra, Assistant Professor, Indian Institute of Management Indore, Faculty Block B First Floor, IIM Indore, Rau, Indore, 453331, India, rajhans111@gmail.com, Siddhartha Rastogi

Web analytics can be used to suggest right products to right customers at right time. It will help e-commerce organizations to increase the probability of purchase of products. We propose a scheme of customer profiling and segmentation using a web recommendation system, which considers sequential navigational information of users for the generation of recommendations.

2 - A Restaurant Recommendation System using Collaborative Filtering
Brian Piper, Data Scientist, Forio, 1159 Howard Street, San Francisco, CA, 94103, United States of America, bpiper@forio.com

A recommendation system with a web-based UI is demonstrated that allows users to explore items and their relationships. Strength of similarity among items is displayed as an interactive visualization. The visualization enables users to understand how recommendations are obtained and explore alternatives and select between different items. The approach is demonstrated using restaurant data provided by Yelp for Phoenix, AZ.

3 - The Power of the Like Button Social Media Effect on Internet Financing
Chao Ding, Assistant Professor, University of Hong Kong, School of Business, Pokfulam Rd, Hong Kong, Hong Kong - PRC, chaoding@hku.hk, Yang Duan, Yong Jin

Using data collected from Kickstarter and Facebook, this paper examines the power of the "like" button on Internet financing. Our empirical results show that the social media has a significantly positive impact. One more click of the Facebook "like" button leads to a 0.15% greater chance of success for Kickstater projects. Surprisingly, it has little influence on expediting the fundraising process. We also find the crowdfunding contributors have a stronger preference for technology projects.

4 - Understanding the Virtual Activities in an Online Game and their Impacts on Real Money Spending
Gwangjae Jung, Singapore Management University, 80 Stamford Road, Singapore, 178902, Singapore, gwangjaejung@smu.edu.sg, Youngsoo Kim

We examine the relationship between online activities and real money spending in an online game. We collected users' log data in an online game from February to August 2010. Our analyses show that virtual money and real money basically complement each other in playing an online game. Another interesting finding is that users can save real money by accomplishing a task with other users together. We also find the impacts of virtual activities vary depending on the purpose of real money spending.

■ WD11

Hilton- Continental 8

Supply Chain, Managing Disruptions I

Contributed Session

Chair: Amirhossein Khosrojerdi, University of Oklahoma, 1021 East Brooks St Apt F, Norman, Ok, 73071, United States of America, akhosrojerdi@ou.edu

1 - A Location-inventory Model under the Risk of Supply Disruptions with Facility Fortifications
Ehsan Jafari Shirazi, West Virginia University, Moprgantown, WV, United States of America, ejafaris@mix.wvu.edu, Wafik Iskander

The interest in reliable facility location models has recently been growing fast, triggered by recent high-profile disruptions. It has also been shown in the literature that failing to incorporate long term decisions on location and short term decisions on inventory may result in suboptimality (Daskin et al. 2002, Shen et al. 2003). In this study, a location-inventory model with facility fortifications for improving the reliability of facilities is proposed.

2 - Coordinated Selection of Supply Portfolio and Scheduling of Customer Orders under Major Disruptions
Tadeusz Sawik, Professor and Chair, AGH University of Science and Technology, Al. Mickiewicza 30, Krakow, Poland, ghsawik@cyf-kr.edu.pl

Coordinated supplier selection and customer order scheduling under major disruptions is studied for different sourcing strategies. The suppliers are located in different regions and the supplies are subject to local and regional disruptions. New MIP formulations are proposed to minimize expected worst-case cost or maximize expected worst-case customer service level.

3 - Supply Chain Disruption and Quality
Rebecca Clemons, Doctoral Candidate, Cleveland State University, Monte Ahuja College of Business, 1860 E. 18th Street, Cleveland, OH, 44115, United States of America, clemonsbec@gmail.com, Walter Rom, Susan A. Slotnick

A manufacturer has two suppliers. The old supplier experiences random disruption with acceptable quality. The new supplier is reliable with unacceptable quality. A simulation study examines the impact of policy decisions for a given level of disruption while considering cost of supplier development, appraisal, purchasing, holding and backorder costs.

4 - An Assessment of Disruption Mitigation Strategies: Inventory, Backup Suppliers and Supplier Protect
Masoud Kamalahmadi, Student, North Carolina A&T State University, 1601 E Market Street, Greensboro, NC, 27411, United States of America, Mkamalah@aggies.ncat.edu, Mahour Parast

The purpose of this paper is to develop an assessment to examine the impacts of three disruption mitigation strategies (Pre-positioning Inventory, Backup Suppliers, Suppliers Protection) on supplier selection and allocation. A two stage mixed integer programming model with three extensions are developed. Each model suggests contingency plans for each scenario and provides proper supplier selection and allocation to meet customer demand during disruptions in suppliers and/or regions.

5 - A Controllable Structural Network Design for a Resilient Supply Chain
Amirhossein Khosrojerdi, University of Oklahoma, 1021 East Brooks St Apt F, Norman, Ok, 73071, United States of America, akhosrojerdi@ou.edu, Janet Allen, Krishnaiya Thulasiraman, Farrokh Mistree

A method is proposed for designing expandable supply chains that are resilient to natural or human induced extreme events. The proposed method is based on designing controllable structures for supply chains when locating control nodes in the network structure brings flexible restoration plans. Our focus is also on the development of efficient restoration strategies that aid the supply chain in recovering from a disruption, thereby limiting the impact on its customers.

■ WD12

Hilton- Continental 9

Supply Chain Optimization II

Contributed Session

Chair: Jian Zhang, Postdoc Fellow, McGill University, Frank Dawson Adams Building, Room 110, 3450 University Street, Montreal, QC, H3A0E8, Canada, jian.zhang9@mail.mcgill.ca

1 - Mining Supply Chain Planning with Dynamic Recovery Rate and Market Uncertainty

Jian Zhang, Postdoc Fellow, McGill University, Frank Dawson Adams Building, Room 110, 3450 University Street, Montreal, QC, H3A0E8, Canada, jian.zhang9@mail.mcgill.ca, Roussos Dimitrakopoulos

A mining complex's strategic and tactical plans for production and transportation are optimized using a stochastic mixed-integer-nonlinear program in consideration of both contracted customers and the spot market. A heuristic is developed to deal with the complexity caused by the dynamic recovery rate in each processing plant. The proposed model and heuristic can be employed before signing a long-period sales contract to reduce risk due to the resource and market uncertainties.

2 - The Two-Phase Stochastic Lotsizing Problem with Optimal Timing of Additional Review

Dina Smirnov, Technion - Israel Institute of Technology, Faculty of Industrial Engineering, Haifa, 32000, Israel, kadina7@gmail.com, Yale T. Herer

We study a single-location problem with Poisson demand and a finite planning horizon. Additional inventory review and production are allowed during the period. The additional review timing is a decision variable whose value is selected before the sales period starts. We use analytical tools to develop algorithms for finding the optimal initial production quantity, the optimal timing of the additional review, and the optimal decision at the time of the additional review.

3 - The Impact of Information Visibility on Supply Chain Coordination in a Food Industry

Wenbo Zhang, Xi'an Jiaotong University, No. 28 at Xianning West Road, Xi'an, China, wenbozhang@stu.xjtu.edu.cn

With various food safety crisis worldwide especially in China recently, supply chains involved have attracted much closer attentions than food manufacturers. Information visibility(IV) is believed a most effective safety practice. We study a food supply chain consisting of one supplier and one manufacturer. IV is derived from both players, and the market demand is price and IV sensitive. Models and examples are used to illustrate how IV influence the supply chain coordination strategies.

■ WD14

Imperial B

Retail Management I

Contributed Session

Chair: Ameera Ibrahim, University of Massachusetts Amherst, Isenberg School Of Management, 121 Presidents Drive, Amherst, MA, 01003, United States of America, ameera@som.umass.edu

1 - Assortment Planning in the Presence of Variety Seeking

Yanzhi David Li, Department of Manament Science, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong, Hong Kong, Hong Kong - PRC, yanzhili@cityu.edu.hk, Di Xu, Zhaowei Miao, Huiqiang Mao

This paper explores the optimal assortment planning when the customers have the variety seeking preference, i.e., the utility of a customer is decreased for the product purchased on the previous purchase occasion. Through myopic and strategic planning, we show how the assortment planning under this context can be different.

2 - New Science of Retail - Digitized Offline Store Case Study

Shin Woong Sung, PhD Candidate, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, sw.sung@kaist.ac.kr, Juyeong Lee, Young Jae Jang

We introduce the concept of the digital offline store that utilizes various advanced digital technologies to sense the customer behaviors in selecting and buying products in the store. The case study conducted with the biggest sports outdoor brand in Korea is introduced to illustrate the concept and to show how the concept is applied to the actual distribution and inventory management.

3 - Distribution Center Design to Support Business Processes Involved in the Management of Retail Store

Germ·n Klee Rebolledo, Universidad de La Frontera- MGSIC Programm, Ir˙n 01830, Temuco, Chile, german.klee.r@gmail.com, Jaime Bustos

A model of joint procurement processes and delivery to showroom, enabling substantial improvements in commercial operation and sales targets of the company is presented. Sales targets in retail management materialize through selling products to achieve the highest volume, margin and frequency in order to ensure profitability, while promoting sustainability. Linking procurement processes, offices and shop supplies give the starting point for a successful sales process.

4 - A Multi-category Assortment Packing Problem under Cross-Selling and Cannibalization Effects

Ameera Ibrahim, University of Massachusetts Amherst, Isenberg School Of Management, 121 Presidents Drive, Amherst, MA, 01003, United States of America, ameera@som.umass.edu, Ahmed Ghoniem, Bacel Maddah

We examine the problem of optimizing the release times of substitutable and complementary products that belong to different categories over a multi-period horizon. Products have a longevity over which their attractiveness decays (e.g., electronics or fashion products), while being positively or negatively impacted by the specific mix of products that have been introduced. Using a 0-1 fractional program with an attraction demand model, we discuss managerial insights from our computational study.

■ WD15

Hilton- Exec. Boardroom

Procurement and Purchasing Management 1

Contributed Session

Chair: Vahid Ganji, University of tennessee, 511A John D. Tickle Engineering Building, 851 Neyland Drive, Knoxville, TN, 37996-2315, United States of America, vganjili@utk.edu

1 - Combined Method for Buyer-Supplier Negotiations – Qualitative and Quantitative Data

Vahid Ganji, University of Tennessee, 511A John D. Tickle Engineering Building, 851 Neyland Drive, Knoxville, TN, 37996-2315, United States of America, vganjili@utk.edu, John E. Bell, Rapinder Sawhney

To model buyer-supplier negotiations and identify effective negotiation strategies in changing business conditions, an integrated model using fuzzy AHP, fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and inverse DEA (data envelopment analysis) methods is proposed. The model handles multi-inputs (values offered by buyer) and multi-outputs (values offered by suppliers) and both quantitative and qualitative data forms.

2 - Integrated Spot and Auction Procurement of Wheat Millers

Wenhao Li, Tsinghua University, Room 408, Apartment #14, Tsinghua University, Beijing, 100084, China, wenhaoli111@gmail.com, Ruoran Chen, Simin Huang

This paper analyzes the optimal procurement and production of wheat millers with two procurement options—spot and auction. The objective is to satisfy demand and quality requirements at minimum costs under spot price and auction uncertainty. Compared with the current sequential decision making, our proposed model significantly increases expected profit. Moreover, it effectively hedges procurement risks. This paper elucidates for the first time the value of auction for wheat millers.

3 - Procurement Negotiation with Two-sided Private Information

Cheng Qian, University of Sydney, 11/115 Garden Street, Maroubra, NS, 2035, Australia, c.qian@econ.usyd.edu.au

We consider a procurement negotiation process where a buyer and a supplier negotiate on price and quality under two-sided uncertainty. The buyer has private information on valuation, and the supplier has private cost information. We characterize the equilibrium outcome and analyse the amount of information each player should reveal.

4 - Supply Contract Competition: The Role of Subcontracting and Single-Sourcing Commitment

Lusheng Shao, University of Sydney, 91 Darlington Road, Sydney, Australia, l.shao@econ.usyd.edu.au

We consider a situation where two suppliers compete for a buyer's purchase business. Two procurement mechanisms are studied: Splitting Mechanism where the suppliers each bid a supply function which maps quantities to payments and the buyer may split her order; Commitment Mechanism where the buyer commits to sole-source before bidding and the winning supplier can subcontract with the losing supplier after bidding. We characterize equilibrium for each mechanism and make a comparison between them.

5 - Joint Emergency Procurement under Supply Disruptions and Price Competition

Sobhan Asian, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798, Singapore, sobhan1@e.ntu.edu.sg, Xiaofeng Nie

We study two competing retailers who differ in their market bases, each basically sourcing from its main supplier that is subject to disruptions. To cope with supply risk, the retailers use a common emergency source, which is perfectly reliable but more expensive. The retailers' equilibrium solutions are obtained under different emergency strategies, separate buying (SB) and joint procurement (JP). We show that the higher the main sources' disruption risks, the higher the attractiveness of JP.

■ WD16

Hilton- Franciscan A

Joint Session RMP/BOM: New Results on Strategic Consumer Behavior in RM

Sponsor: Revenue Management & Pricing & Behavioral Operations Management

Sponsored Session

Chair: Anton Ovchinnikov, Assistant Professor, University of Virginia, 100 Darden Blvd, Charlottesville, VA, United States of America, AOvchinnikov@darden.virginia.edu

1 - Experimental Studies on Purchasing Scarce Products under Dynamic Pricing

Vincent Mak, Cambridge Judge Business School, University of Cambridge, Trumpington Street, Cambridge, CB2 1AG, United Kingdom, v.mak@jbs.cam.ac.uk, Jiaojie Han, Eyran Gisches, Amnon Rapoport

We experimentally tested a two-period dynamic pricing model in which a firm sells a good under exogenous inventory constraints to a market of buyers. In one experiment, human buyers purchased from an automated seller; in another, both seller and buyers were human subjects. Equilibrium predictions assuming fully strategic buyers largely accounted for aggregate behavior in both experiments, but there were also nuanced deviations from equilibrium that had profit and pricing implications.

2 - Strategic Consumers, Myopic Retailers

Anton Ovchinnikov, Assistant Professor, University of Virginia, 100 Darden Blvd, Charlottesville, VA, United States of America, AOvchinnikov@darden.virginia.edu, Mirko Kremer, Benny Mantin

We investigate the behavior of retailers who sell a fixed inventory of products over a two period horizon (main selling season followed by a markdown period) to a mixture of myopic and strategic consumers. We present a stylized model and an experimental study. Our main result is that retailers exhibit a significant degree of myopia when facing consumers who are strategic. We quantify the degree of myopia and explore how it depends on various demand and supply factors.

3 - Behavioral Anomalies in Consumer Wait-or-Buy Decisions and Their Implications for Revenue Management

Nikolay Osadchiy, Assistant Professor, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30309, United States of America, nikolay.osadchiy@emory.edu, Manel Baucells, Anton Ovchinnikov

We propose a model that incorporates behavioral anomalies in consumer wait or buy decisions, and analytically solve the consumer wait-or-buy problem in a retail markdown setting. Through a behavioral study we estimate the model parameters and numerically show that accounting for the behavioral anomalies a firm would offer larger markdowns yet generate higher revenue compared to the current literature's predictions.

■ WD17

Hilton- Franciscan B

Customer Differentiation in Services

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Mojtaba Araghi, Rotman School of Management, University of Toronto, 105 St. George Street,, Toronto, ON, Canada, Mojtaba.Araghi08@Rotman.Utoronto.Ca

1 - Multi-period Lead Time and Stocking Decisions for a Dual-channel Retailer

Nevin Mutlu, PhD Candidate, Virginia Tech, 607 Clay St. Apt 10., Blacksburg, VA, 24060, United States of America, nmutlu@vt.edu, Ebru Bish, Erick Wikum

As traditional brick-and-mortar retailers expand their sales channels to online, mobile, and catalog orders, the consumer adoption rates of these emerging channels is increasing as a function of time. The dynamic change of demand across channels has important implications for retailers' operational decisions. We develop a novel, dynamic demand model, and show that the retailers' optimal decisions in this dynamic environment differ significantly from those under static demand.

2 - Customer Acquisition and Service Quality for a Call Center with Time-Varying Demand Response

Mojtaba Araghi, Rotman School of Management, University of Toronto, 105 St. George Street,, Toronto, ON, Canada, Mojtaba.Araghi08@Rotman.Utoronto.Ca, Philipp Aféche, Opher Baron

This paper proposes and analyzes a novel call center model that accounts for customer lifetime value and the impact of service quality on customer acquisition and retention under time-varying demand response. We provide prescriptions on the optimal ad-hoc and periodic advertisement policies, along with the optimal staffing and priority plans for managing the call center operations.

3 - Threshold Policy for Call Centers with Time Dependent Arrival Rate

Benjamin Legros, Ecole Centrale Paris, Grande Voie des Vignes, Chatenay Malabry, France, belegros@laposte.net, Ger Koole, Oualid Jouini

In the context of multi-channel call centers with inbound calls and emails, we consider a threshold policy on the reservation of agents for the inbound calls. The optimization problem consists of maximizing the throughput of emails under a constraint on the waiting time of calls. We propose an efficient adaptive threshold policy). This scheduling policy is evaluated both in the stationary and the non-stationary case.

4 - Staffing Shift Planning for a Hospital Call Center with Inbound and Outbound Calls Blending

Yanli Zhao, Wayne State University, 630 Merrick St Apt 810, Detroit, Mi, 48202, United States of America, ee0086@wayne.edu, Susan Yu, Kai Yang

This research considers the staffing shift planning for a hospital call center with a single kind of inbound calls and multiple kinds of outbound calls. A mathematical programming model is developed with the objective of minimizing the labor cost, by deciding the shift setting and workload allocation. The service level and staffing utilization are taken into consideration in the constraints. Numerical experiments based on actual operational data are included to show the optimization results.

■ WD18

Hilton- Franciscan C

New Topics in RM: Demand Learning, Strategic Consumers, and Behavioral Issues

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Bora Keskin, The University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, bora.keskin@chicagobooth.edu

1 - Price Differentiation: A Machine Learning Approach

David Simchi-Levi, Professor, MIT, 77 Massachusetts Ave, Room 1-171, Cambridge, MA, 02139, United States of America, dslevi@mit.edu, Clark Pixton, Zachary Owen

We propose the use of machine learning classifiers for the task of consumer segmentation for price discrimination. We quantify the effect of classification errors on expected revenue, and we develop lower bounds on the performance of

machine learning revenue management policies for worst-case demand functions. These bounds show that such policies can outperform single-price policies even with significant classification error. We also formulate price selection as a tractable integer program.

2 - Revenue Management using Thompson Sampling

David Simchi-Levi, Professor, MIT, 77 Massachusetts Ave, Room 1-171, Cambridge, MA, 02139, United States of America, dslevi@mit.edu, Kris Johnson, He Wang

We consider the dynamic pricing problem of a retailer facing limited inventory. The retailer has no prior assumption of demand and must learn expected demand for each price throughout the season. Thompson sampling is a randomized strategy that balances exploration to learn demand and exploitation to maximize revenue. We use Thompson sampling to develop a dynamic pricing strategy and compare the algorithm's revenue to the optimal revenue given known demand.

3 - Innovative Dynamic Pricing: The Potential Benefits of Early-Purchase Reward Programs

Mike Wei, Assistant Professor, University at Buffalo, 326 Jacobs Hall, Buffalo, NY, 14260, United States of America, mcwei@buffalo.edu, Yossi Aviv

To mitigate the negative influence of strategic consumer behavior, we use stylized scientific model to seek for the optimal form of a reward program that should be offered to strategic consumers if they made early purchase decisions. Such program is identified among all possible functional forms that specify a reward to consumers that is contingent of future markdowns and sales realizations. We will share our findings in this presentation.

4 - Consistency between Prospect Theory and the Newsvendor Pull-to-Center Effect

Bhavani Shanker Uppari, PhD Student, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, BhavaniShanker.UPPARI@insead.edu, Sameer Hasija

This paper revisits the role of Prospect Theory (PT) in explaining the newsvendor Pull-to-Center (PTC) effect. Our results contrast with the existing literature that uses zero profit as a reference point in the PT model. We use the extant literature to establish the saliency of the mean demand as a decision and show that, with the outcome associated with this decision as the reference point, PT cannot be ruled out as a potential explanation for the PTC effect.

■ WD19

Hilton- Franciscan D

Revenue Optimization in Retail and Services II

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Thunyarat Amornpetchkul, Lecturer, NIDA Business School, Boonchana-Autthakorn Bldg., 8th fl, 118 Seri-Thai Rd. Khlong Chan, Bangkapi, Bangkok, Thailand, thunyarat.a@nida.ac.th

1 - Pricing Strategy for Theater Seats with Various Quality Levels in the Movie Industry

Ling-Chieh Kung, Assistant Professor, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, Taipei, 10617, Taiwan - ROC, lckung@ntu.edu.tw, Chia-Yin Hsieh

Nowadays, seats in a cinema hall are typically charged the same price regardless of their locations. This uniform pricing strategy not only deviates from the common practice for most performance goods but also conflicts with the screening literature for revenue maximization. With a stylized model, we find that uniform pricing intensifies the competition among consumers, induce early purchase, and thus may be revenue-maximizing in several scenarios.

2 - Strategic Use of Uncertainty through Mystery Discounts

Thunyarat Amornpetchkul, Lecturer, NIDA Business School, Boonchana-Autthakorn Bldg., 8th fl, 118 Seri-Thai Rd. Khlong Chan, Bangkapi, Bangkok, Thailand, thunyarat.a@nida.ac.th

Recently, several retailers have experimented with offering mystery discount" where multiple discount levels are distributed among consumers. Under a mystery discount, consumers may discover the acquired discount prior to making purchase decisions, or at the point of purchase. Furthermore, consumers may or may not be informed about the actual distribution of different discount levels. This paper investigates how mystery discounts affect consumer purchase behavior and the seller's profitability.

3 - Effect of Cyclic Pricing on Inventory Costs

Yifan Feng, PhD Student, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, fengx233@umn.edu, Zizhuo Wang

We consider a monopolist selling a product to patient customers. Cyclic pricing policy has been shown to achieve optimal revenue in several studies. However, as price affects the demands, inventory costs are also changed when one uses a cyclic pricing policy. In this talk, we study the inventory cost of cyclic pricing policies compared to static ones. We identify two opposite effects ñ a pooling effect and a cost accumulation effect and give conditions under which each strategy has a lower cost.

4 - The Influence of Risk Preferences on Rebate Effectiveness

Ozgun Caliskan Demirag, Penn State Erie, 5101 Jordan Road Burke 259, Erie, PA, 16563, United States of America, ozc1@psu.edu

We study how the performance of rebate promotions is affected by the risk preferences of end customers and firms offering the rebates. Focusing on risk-averse and risk-neutral behaviors, we analyze the optimal values of production/order quantity, retail price, and rebate amount in a channel facing demand uncertainty and price sensitivity.

■ WD21

Hilton- Union Sq 1

Supply Chain and Transportation

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Zhaodong Wang, University of Illinois, Urbana, IL, United States of America, zwang137@illinois.edu

1 - Coordinated Inventory Replenishment and Outsourced Transportation Operations

Osman Alp, TED University, Endustri Muhendisligi Bolumu, TED Universitesi, Ankara, 06440, Turkey, osman.alp@tedu.edu.tr, Ulku Gurler, Nasuh Cagdas Buyukkaramikli

We consider a one-warehouse-N-retailer supply chain with stochastic demand. Inventory is managed in-house whereas transportation is outsourced to a 3PL provider. We develop operating characteristics under periodic and continuous joint replenishment policies. We identify settings where a periodic review policy is comparable to a continuous review one. We compare the overall performance of the outsourced transportation strategy under a contract to that of operating with in-house fleet of vehicles.

2 - Modeling the Petroleum Supply Chain under Disruption and Mitigation Strategies

Yasaman Kazemi, North Dakota State University, 1225 10th St, N, Apt 1, Fargo, ND, 58102, United States of America, yasaman.kazemi@ndsu.edu, Joseph Szmerekovsky

In this research, a three echelon supply chain model for the downstream petroleum industry is proposed to study the problem of facility failures due to a specific disruption and select appropriate mitigation and coping strategies to handle the effects of the disruptive event. A two stage stochastic mixed integer linear programming model (SMILP) is developed, and Geographic Information Systems (GIS) was used to locate facilities, obtain realistic transportation data, and to visualize the process.

3 - Bullwhip Effect in Supply Chains under Nonlinear Ordering Policies

Zhaodong Wang, University of Illinois, Urbana, IL, United States of America, zwang137@illinois.edu, Yanfeng Ouyang

This paper analyzes the bullwhip effect in multi-echelon supply chains under nonlinear ordering policies (such as base-stock policies). A describing-function approach is used to derive closed-form formulas to predict amplification of order fluctuations. The analytical results are verified by simulations and hold promise to explain empirical observations.

■ WD22

Hilton – Union Sq 2

Historical and Microfoundation of Strategy

Sponsor: Organization Science
Sponsored Session

Chair: Emily Block, Assistant Progessor of Management, University of Notre Dame, Notre Dame, IN, 46556, United States of America, esblock@gmail.com

1 - Frontiers of Strategy Research on Time Horizon, University of Connecticut
Greg, Reilly, Rebecca Ranucci, David Souder

Abstract is not available at this time.

2 - Moving Opportunism to the Back Seat: Bounded Rationality, Costly Conflict, and Hierarchical Forms
Libby Weber

Abstract is not available at this time.

3 - Do Accelerators Accelerate? A Study of Venture Accelerators as a Path to Success
Bemajmin Hallen, Chris Bingham, Susan Cohen

Abstract is not available at this time.

4 - The Well of the Past: The Historical Boundedness of Absorptive Capacity, University of Arizona
Eugene Paik

Most research on absorptive capacity suggests that more of it is universally better for organizations. Breaking from that tradition, this study examines that organizations' absorptive capacity can mislead them to avoid new technology despite its potential opportunities. I specifically argue that the adoption may be delayed when absorptive capacity is shaped by negative experience with prior, then-new technologies. I test this proposition by examining the record-labels' album releases in MP3 format as a function of the extent to which their earlier releases suffered from piracy.

5 - Spinning Off onto Shaky Ground: Executive Mobility in an Uncertain Task Environment, University of Texas at Austin
Y. Sekou Bermiss

Abstract is not available at this time.

■ WD23

Hilton- Union Sq 3

Traffic Management I

Contributed Session

Chair: Masoud Hamedi, Research Scientist, University of Maryland, Department of Civil & Environmental Eng, 1173 Glenn L. Martin Hall, College Park, MD, 20742, United States of America, masoud@umd.edu

1 - Dynamic Structural Learning of a Bayesian Network for Drivers' Behaviors
Sojung Kim, The University of Arizona, 1127 E. James E. Rogers Way Room 162, Tucson, AZ, United States of America, sojungkim@email.arizona.edu, Sung Joong Kim, Young-Jun Son

The goal of this work is to introduce a dynamic structural learning approach for a Bayesian network to represent evolution of drivers' reasoning behaviors at an intersection. The proposed approach considers three assumptions: 1) a limited memory of a driver, 2) partial observation of the road environment, and 3) non-stationary road environment. The proposed approach is demonstrated with real drivers' behavioral responses obtained from experiments conducted in a virtual reality driving simulator.

2 - A Pattern Recognition Approach for Measuring Performance of High Occupancy Vehicle Lanes
Masoud Hamedi, Research Scientist, University of Maryland, Department of Civil & Environmental Eng, 1173 Glenn L. Martin Hall, College Park, MD, 20742, United States of America, masoud@umd.edu, Ali Haghani, yanru zhang

Making more efficient use of existing road system through HOV lanes is a cost-effective solution to improve mobility.Continuous monitoring of the system performance is key to a success implementation. A framework for fusing traffic data from several sources to estimate key HOV indicators is introduced. Motivated by advancements in travel time measurement technologies, a pattern recognition algorithm for separating travel time on HOV and regular lanes collected by Bluetooth sensors is developed.

3 - A Traffic Signal Priority Control Model for Multi-Modal Users
Mehdi Zamanipour, Research Assistant, University of Arizona, 1127 E. James E. Rogers, Tucson, AZ, 85721, United States of America, zamanipour@email.arizona.edu, Yiheng Feng, Shayan Khoshmagham, Larry Head

The opportunity to manage multi-modal transportation systems has become possible with the advent of connected vehicle systems. We present a mathematical model to implement traffic signal control for multiple traffic modes based on an N-level importance hierarchy. The model allows decision makers to establish a priority policy for different modes.

4 - Dynamic Origin-Destination Demand Estimation for Congested Traffic Networks
Ala Alnawaiseh, Post Doctor, Southern Methodist University, 3101 Dyer St, Room 203, Dallas, TX, 75205, United States of America, aalnawai@smu.edu, Hossein Hashemi, Khaled Abdelghany

A methodology for time-dependent origin-destination demand estimation in congested urban transportation networks is presented. The methodology utilizes time-varying traffic density and flow observations to estimate a demand pattern that replicates the observed flow breakdown at bottleneck locations. The problem is formulated in the form of a linear mathematical program. The results of experiments that illustrate the performance of the new methodology are presented.

■ WD24

Hilton- Union Sq 4

Disaster and Emergency Management 1

Contributed Session

Chair: Reza Zanjirani Farahani, Kingston University London, KHBS 215, Kingston Business School, Kingston Hill, Kingston Upon Thames, United Kingdom, zanjiranireza@gmail.com

1 - A Study on the Arrangement Method of Relief Supplies in a Depot Immediately after a Disaster
Zhao Jie, Tokyo University of Marine Science and Technology, 2-1-6, Etchujima, Koto-ku, Tokyo, Japan, zhaojie6111@gmail.com, Kurokawa Hisayuki

Relief supplies were sent to the depot from all over the country soon after The Great East Japan Earthquake. However, the problem is that the many of relief supplies still have not reached the victim after the natural disaster occurred. One of the reasons of the cause was delayed sorting process of the material. Consequently, in this study, we report the result of the arrangement method of relief supplies in a depot by "operations research (OR)".

2 - Quantifying Resilience in Cyber-Physical Systems
Igor Linkov, Risk and Decision Science Focus Area Lead, US Army Corps of Engineers, 696 Virginia Rd, Concord, MA, 01742, United States of America, Igor.Linkov@usace.army.mil

Security in the face of increasingly pervasive and costly cyber attacks has prompted the call for enhanced resilience. We argue that resilience can be understood as a property of a networked system, and two approaches are discussed in which to develop resilience metrics: a MCDA matrix-based approach, and network science tools. The use of these approaches for strengthening system resilience and ensuring the continuity of the critical functions of cyber-physical systems will be discussed.

3 - An Empirical Analysis of Disaster Operations Management and a Research Agenda
Niratcha Grace Tungtisanont, PhD Student, Clemson University, 100 Sirrine Hall, Clemson, SC, 29634, United States of America, ntungti@g.clemson.edu, Aleda Roth, Yann Ferrand

We first motivate the need for a humanitarian operations agenda, describing the operations management gaps and future research directions. We then conceptualize humanitarian and disaster operations in multiple ways, including the four phases of the disaster cycle, a typology of natural disasters, the stakeholders in disaster management, and the magnitude, frequency, and time duration of disasters. Finally, we perform an econometrics analysis to study the losses resulting from natural disasters.

4 - Identifying Points of Supply Consolidation for Relief Provision using Uncongested Transport Links
Guven Ince, UMass Amherst, 990 N Pleasant St, Apt E14, Amherst, MA, 01002, United States of America, gince@som.umass.edu, Agha Iqbal Ali

We make use of optimization methodology to reveal the dependence of timely provision of relief to populations in rehabilitation sites on the selection of points of supply consolidation. The optimization framework is demonstrated for the provision of supplies to affected populations in the aftermath of a catastrophic earthquake in Istanbul.

5 - Rapid Flow Path Network Design: Properties and Two Exact Algorithms

Reza Zanjirani Farahani, Kingston University London, KHBS 215, Kingston Business School, Kingston Hill, Kingston Upon Thames, United Kingdom, zanjiranireza@gmail.com

I introduce rapid flow path network design problem (RFPNDP) which has applications such police patrolling and quick and temporary road network repair after disasters. RFPNDP makes decisions which are made rapidly as there is not sufficient time, generates many feasible solutions rather than only one optimal and consider handmade solutions as computer systems may have already been collapsed. We extract some properties of RFPNDP analytically and develop two algorithms to solve it in special cases.

■ WD25

Hilton- Union Sq 5

Transportation, Operations II

Contributed Session

Chair: Mesut Yavuz, University of Alabama at Tuscaloosa, Tuscaloosa, Tuscaloosa, AL, United States of America, myavuz@cba.ua.edu

1 - LNG Inventory Routing with Pickup Contracts and Origin-destination Clauses

Marielle Christiansen, Professor, Norwegian University of Science and Technology, Alfred Getz vei 3, Trondheim, Norway, marielle.christiansen@iot.ntnu.no, Sondre Thorvaldsen, Henrik Andersson, Kristian Emanuelsen

We consider an LNG supply chain problem where an energy actor is responsible for the routing and scheduling of LNG ships and the inventory management at the regasification terminals. At the liquefaction plants there exist purchase agreements with upstream suppliers containing issues regarding the total pickup volume, prices, loading regularity and origin-destination restrictions. Three models are developed and compared. Computational studies based on real-world instances show promising results.

2 - Balance vs. Efficiency Trade-off in Mixed-fleet Green Vehicle Routing

Mesut Yavuz, University of Alabama at Tuscaloosa, Tuscaloosa, Tuscaloosa, AL, United States of America, myavuz@cba.ua.edu, Ismail Capar

Minimization of total vehicle miles traveled (VMT) is commonly adopted as the objective function in vehicle routing. When a mixed-fleet consisting of gasoline or diesel and alternative-fuel vehicles is considered, a weighted VMT objective better represents efficiency. Balance among vehicle routes is measured in terms of total tardiness and maximum tardiness. In this talk we present trade-offs between efficiency and balance via a computational experiment in a mixed-fleet setting.

3 - Dynamic Traffic Control Interventions for Enhanced Mobility

SeyedBehzad Aghdashi, Post-Doc, ITRE, 803 Essex Forest Dr #, Cary, NC, 27518, United States of America, saghdas@ncsu.edu

This research is intended to develop efficient (optimized) methods that dynamically evaluate the current traffic system performance, propose interventions that can ameliorate the performance as needed, and implement and re-evaluate the effectiveness of the intervention. To enable real progress in this arena, the focus will be on active traffic management techniques and their application on freeway facilities.

4 - Parcel Distribution Timetabling Problem with Incomplete Hub Network

Omar Ben-Ayed, Professor, Qatar University, College of Business and Economics, PO Box 2713, Doha, 2713, Qatar, omar.benayed@qu.edu.qa, Salem Hamzaoui, Faiza Zalila, Belaid Aouni

Parcel distribution timetabling problem optimizes the movements of parcels in their journey from their pickup to their delivery. The minimization of the time spent in this journey is a common objective for this problem. We provide a comprehensive presentation of this problem that emphasizes its practical aspects. The proposed mixed integer program addresses the common case of incomplete hub network where the volume between two hubs is not large enough to justify the use of a dedicated transport.

■ WD26

Hilton- Union Sq 6

Vehicle Routing IV

Contributed Session

Chair: Mohammad Yousef Maknoon, Ecole Polytechnique Montreal, 2900 Boulevard Edouard-Montpetit, Montreal, Canada, mohammad-yousef.maknoon@polymtl.ca

1 - A Parallel Route Construction Algorithm for the Vehicle Routing Problem with Soft Time Windows

Sezgin Kaplan, Asst. Professor, Turkish Air Force Academy, Hava Harp Okulu, Yesilyurt, Istanbul, 34149, Turkey, skaplan@hho.edu.tr, Ahmet Herekoglu

A novel parallel route construction algorithm is developed for the vehicle routing problem with soft time windows (VRPSTW). The Apparent Tardiness Cost rule, which is a good composite dispatching rule for the parallel machine scheduling problem with total weighted tardiness, is adapted to the VRPSTW by considering the slack factors for the time windows. Computational results are compared with the alternative heuristic algorithms for the set of benchmark problems by Balakrishnan (1993).

2 - Vehicle Routing with Cross-dock Selection

Mohammad Yousef Maknoon, Ecole Polytechnique Montreal, 2900 Boulevard Edouard-Montpetit, Montreal, Canada, mohammad-yousef.maknoon@polymtl.ca, Gilbert Laporte, Pierre Baptiste

Vehicle routing problem with cross-dock selection is a variant of the vehicle routing problem containing spatial and load synchronization constraints by which products are transferred and processed via at least one cross-dock. In this presentation, we investigate this problem and demonstrate the challenges in finding the optimal solution. Finally, we represent a heuristic methodology to handle practical problems.

3 - Multiple Partial Dominance for the Elementary Shortest Path Problem with Resource Constraints

Troels Martin Range, Associate Professor, Department of Business and Economics, University of Southern Denmark, Campusvej 55, Odense, 5230, Denmark, tra@sam.sdu.dk

We present a new dominance criterion for dynamic programming used in the Elementary Shortest Path Problem with Resource Constraints. The criterion is based on the observation that a state can be partially dominated by another state and that we can combine the partial dominance of several states to fully dominate a given state. By using this criterion we can eliminate states earlier in the solution process which may be worthwhile, when the problems become difficult.

4 - A Study on Indian Rice and Wheat Food Supply Chain – Select Modeling Insights

Lohithaksha M Maiyar, Research Scholar, Indian Institute of Technology Kharagpur, Industrial and Systems Engineering Dept., IIT Kharagpur, Kharagpur, WB, 721302, India, lohit10.maiyar@gmail.com, Jitesh J Thakkar

Over the recent times the major global concern is to ensure food security to the growing population. In line with this concern, this paper discusses the issues and challenges faced in efficient supply of rice and wheat in Indian context with the help of a specific network diagram. Finally few mathematical models for the rice and wheat distribution system have been presented which can be taken as an input for further analyzing and improving the current state of Indian food distribution system.

5 - Minimum Cost Path Problem for Plug-in Hybrid Electric Vehicles

Okan Arslan, PhD Candidate, Bilkent University, Department of Industrial Engineering, Bilkent University, Ankara, 06800, Turkey, okan.arslan@bilkent.edu.tr, Baris Yildiz, Oya Karasan

We investigate the minimum-cost path problem for plug-in hybrid electric vehicles. The objective is to find a minimum-cost path between given departure and destination points in a transportation network and to determine the refueling and battery switching policies. We show that the problem is NP-complete and propose two solution techniques: a mixed integer quadratically constrained program and a dynamic programming based heuristic.

■ WD27

Hilton- Union Sq 7

Aviation

Contributed Session

Chair: Rodrigo Scarpel, Instituto Tecnológico de Aeronautica, Praca Marechal Eduardo Gomes, 50, ITA - IEM , sala 2311, São José dos Campos, SP, 12228900, Brazil, rodrigo@ita.br

Co-Chair: Alexander Yemelyanov, Professor, Georgia Southwestern State University, 800 GSW University Drive, Americus, GA, 31709, United States of America, alexander.yemelyanov@gsw.edu

1 - A Data Mining Approach for Early Identification of Potential Disruptive Scenarios

Rodrigo Scarpel, Instituto Tecnológico de Aeronautica, Praca Marechal Eduardo Gomes, 50, ITA - IEM , sala 2311, São José dos Campos, SP, 12228900, Brazil, rodrigo@ita.br

On disruption management, the philosophy of robust optimization is to generate an operational plan that is "good" for most scenarios and acceptable for the worst scenario. Thus, in oder to employ the robust optimization all potential disruptive scenarios must be specified. The objective of this work is to make use of a data mining approach for early identification of such disruptive scenarios for the São Paulo International Airport (Brazil).

2 - Global Air Jet Medical Network Design

Wei Chen, University of Pittsburgh, 241 Mevis Hall, Pittsburgh, PA, 15260, United States of America, raul.weichen@gmail.com, Jennifer Shang

Given current international health care demand unbalance situation and considering all air medical transport's characteristics, this research designs a global network structure for an air medical transport firm. The objective of the research is to maximize firm's global service coverage in a cost effective way.

3 - Optimization of Performance Shaping Factors Analysis in Safety Databases

Alexander Yemelyanov, Professor, Georgia Southwestern State University, 800 GSW University Drive, Americus, GA, 31709, United States of America, alexander.yemelyanov@gsw.edu, Alla Yemelyanov

The existing databases on accident/incident reports such as NTSB, NASA-ASRS, etc. are suitable mostly for statistical analysis of predetermined error categories rather than for the analysis of underlying causal factors. We present an error modeling method with classification algorithms and verbal decision analysis that allow to collect cognitive PSFs at the stage of accident investigation and provide further analysis of these data to determine repeated factors and error-provoking situations.

4 - Optimizing AMAN-SMAN-DMAN at Hamburg and Arlanda Airport

Carlo Mannino, Professor, SINTEF ICT, Forskningsveien 1, OSLO, Norway, carlo.mannino@sintef.no, Dag Kjenstad, Patrick Schittekat

Air Traffic Management controls movement of airplanes at airports, a complex task divided into Arrival, Surface and Departure Management problems. Airports handle them independently preventing good solutions to be found. We developed an integrated optimization approach that showed remarkable improvements compared to expert controllers for Hamburg airport. Embedded in an ATM system developed with SAAB and THALES, it will be officially validated by the Swedish air traffic control in October 2014.

■ WD28

Hilton- Union Sq 8

Data Mining and Optimization for Air Traffic Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Aude Marzuoli, Georgia Institute of Technology, 270 Ferst Drive, School of Aerospace, Atlanta, GA, 30332-0150, United States of America, amarzuoli3@gatech.edu

1 - Multimodal Impact Analysis of an Airside Catastrophic Event

Alexandre Bayen, University of California at Berkeley, Berkeley, CA, United States of America, bayen@berkeley.edu, Aude Marzuoli, Eric Feron, Emmanuel Boidot, Alexis Ucko, Mark Hansen, Paul van Erp

The present project aims at performing a data-driven analysis of multimodal (air, rail, road) transportation efficiency through the case study of a large-scale disruption in the San Francisco Bay Area. The study provides an overview of the impact of the disruption on the air side and the ground side, and highlights the coupling between transportation modes. This analysis stresses the importance of further data-driven research on interdependent infrastructure networks to improve their resilience.

2 - Regression Models of Aircraft Engine Fuel Burn and Emissions

Yashovardhan Chati, MIT, Boston, MA, United States of America yschati@mit.edu, Hamsa Balakrishnan

The Flight Data Recorder collects aircraft and engine parameters during the course of a flight. In this talk, we propose statistical models for different aircraft types that predict engine fuel flow rates, total fuel burn and emissions of various pollutant species, given observations of trajectory variables (such as position and speed). The results can be used to refine fuel burn and emissions inventories, in order to better reflect the impacts of actual aircraft operations.

3 - Airport Ground Delay Planning using Markov Decision Processes

Jonathan Cox, Stanford, 496 Lomita Mall, Stanford, CA, United States of America, joncox@stanford.edu, Mykel Kochenderfer

We present a solution to the single airport ground hold problem that outperforms existing solution techniques by a considerable margin. The approach uses Monte Carlo tree search to find an approximate solution to a Markov decision process model of the system dynamics. Performance is demonstrated by comparison to existing techniques using historical data from San Francisco International Airport.

4 - Message Clustering and Targeting for Throughput-Limited Communication

Joseph Rios, Research Aerospace Engineer, NASA, Ames Research Center, Mail Stop 210-15, Moffett Field, CA, 94035, United States of America, joseph.l.rios@nasa.gov, Avijit Mukherjee

In certain communication environments, efficient use of throughput is paramount. For example, sending messages via satellite wherein the cost is related to the target area of the broadcast and the message length, one needs to efficiently compose and bundle messages based on their payloads. We developed models for clustering multiple payloads with varying target locations that minimize the total broadcast cost. We demonstrate the utility of the model with an aviation application for Alaska.

■ WD29

Hilton- Union Sq 9

Operations Management/others

Contributed Session

Chair: Kai Luo, Kedge Business School, France, Toulon, France, kai.luo@kedgebs.com

1 - Tacit Knowledge Management Methods

Kai Luo, Kedge Business School, France, Toulon, France, kai.luo@kedgebs.com

In the knowledge economy, knowledge is the strategic resource for enhancing competitive advantage of organizations. This paper addresses two different strategies based on the distinction between tacit and explicit knowledge. We provide theoretical results for both linear and non-linear models. Managerial insights are also provided via numerical examples.

2 - Critical Influencing Factors and Paths of Leader's Global Mindset

Haixin Zhang, University of Science and Technology of China, Jin Zhai Road 96, Hefei, China, z_h_x606@139.com

Based on literature research and grounded theory, explore the deep-seated factors that affect the leader's global mindset.

3 - Inspection, Traceability and Recall Cost Sharing Contracts

Shengnan Sun, Southeast University, School of Economics and Management, Sipailou 2, Nanjing, 210096, China, sun.shengnan@seu.edu.cn, Xinping Wang

Traceability and inspection are different policy mechanisms for firms to improve food quality and safety with their supply chain. The two mechanisms are not independent in terms of their influence on firm behavior and food safety. In this paper, we discuss contractual agreements by which food product recall costs can be shared between a manufacture and a supplier to induce traceability improvement effort, and analyze the impact of inspection policy on contracts.

■ WD30

Hilton- Union Sq 10

Operations Management/Marketing Interface IV

Contributed Session

Chair: Changseung Yoo, UT Austin, 2110 Speedway Stop B6500, CBA 5.202, Austin, TX, 78712-1277, United States of America, Changseung.Yoo@phd.mccombs.utexas.edu

1 - On Pricing and Composition of Multiple Bundles offered in Multiple Market Segments

Juan-Carlos Ferrer, Associate Professor, P. Universidad Católica de Chile, Casilla 306 Correo 22 Santiago Chile, Santiago, Chile, jferrer@ing.puc.cl, Alejandro Cataldo

We study the problem facing a company that should determine the optimal composition and price for multiple bundles offering across multiple market segments, where it will compete with other bundles offered by the competition. We consider that competitors will not react in the short term, and we assume that consumers are rational (maximize their utility function). The problem is modeled as a mixed nonlinear program, and we propose heuristic methods to solve it.

2 - A Two-product Inventory System with a Probabilistic Good

Xiaoya Xu, University of Macau, Macau, Taipa, China, yb27003@umac.mo, QI FU, Zhaotong Lian

We investigate the impact of offering a probabilistic good in a single period two-item inventory planning system. The optimal inventory decisions for the two regular products are analyzed. This probabilistic selling strategy can help firms effectively pool the excess stocks to better match supply with demand and thus enhance profitability. We also explore the pricing decision of the probabilistic good using both additive and multiplicative demand functions when there is demand cannibalization.

3 - Price, Quality and Advertising Decisions Considering Reference Price Effects

Qinglong Gou, Associate Professor, University of Science and Technology of China, Jinzhai Road 96, Hefei, 230026, China, tslg@ustc.edu.cn, Zhimin Huang, Yanyan He

A change from the B2C e-commerce is that a consumer cannot observe a product's quality directly. Thus, an online consumer makes his decision mainly based on his own expectation, i.e., the reference quality. In this paper we incorporate reference effect into a firm's joint decision on quality, advertising and pricing under a dual channel framework. Our study provides a new perspective of investigating the influence of B2C e-commerce.

4 - Consumer Intention to Purchase Remanufactured Product: An Experimental Analysis of Product Knowledge

Yacan Wang, Beijing Jiaotong University, No.3 Shangyuan Road, Xizhimen Wai, Haidian District, Beijing, China, ycwang@bjtu.edu.cn, Benjamin Hazen

This paper develops a research model to describe consumers' intention to purchase remanufactured products. Using a 2x2x2 inter-group experiment, we examine how knowledge of remanufactured products in terms of cost, quality, and green benefits affects consumers' perception of both risk and value associated with purchasing remanufactured products, and how these perceptions subsequently affect consumers' purchase intentions.

5 - Competitive Pricing and Advertising in Dynamic Oligopoly Markets

Changseung Yoo, UT Austin, 2110 Speedway Stop B6500, CBA 5.202, Austin, TX, 78712-1277, United States of America, Changseung.Yoo@phd.mccombs.utexas.edu, Genaro Gutierrez

We analyze a multi-firms pricing and advertising model in a dynamic oligopoly market. We show that, under mild assumptions, the value functions of the firms in equilibrium exhibit strategic complementarities and that the equilibrium is increasing in brand awareness. To this end, we compare existing dynamic advertising models by designing a Kalman filter to estimate the models with actual market data, and show that there are many models that satisfy our assumptions. For those that violate our assumptions, we show that our choice of advertising models perform just as good as them.

■ WD31

Hilton- Union Sq 11

Innovation and Quality in Service Delivery

Sponsor: Service Science

Sponsored Session

Chair: Nilanjan Chattopadhyay, Dean Executive Education, Manipal University, Dubai International Academic City, Dubai, United Arab Emirates, nchattopadhyay@gmail.com

1 - An Investigation of Firm Performance and Country-of-Origin Effect in Adoption of Innovation

Jiyoon An, Texas Tech University, Rawls College of Business, Lubbock, TX, 79409, United States of America, jiyoon.an@ttu.edu

This paper examines the influence of a supplier firm's performance and country-of-origin effect on a buyer firm's willingness to adopt a supplier firm's product innovation. Specifically, a buyer firm's perceived importance of purchasing product and entrepreneurial orientation affect their willingness to accept a product innovation, which is moderated by a supplier firm's performance and country-of-origin effect from a network innovation perspective.

2 - Incentives for Quantitative and Qualitative Quality in Service Outsourcing Contracts

Zhi Ouyang, School of Management, Xi'an Jiaotong University, No. 28 at Xianning West Road of Xi'an, Xi'an, China, ouyangzhi1987@stu.xjtu.edu.cn

As to the poor service quality in outsourcing practice, we introduce qualitative quality into conventional outsourcing contacting. Based on the contract theory, we analyze the optimal quality for service outsourcing and investigate the reward and punishment mechanism for qualitative quality changes. We show optimal quantitative quality need to be modified to fit with feasible qualitative one; thus, service requirements with modified quality metrics can improve the outsourcing performance.

3 - Eco-labels and Their Contribution to Company Profit

Xu Yang, Assistant Professor, San Jose State University, Dept of Marketing and Decision Sciences, San Jose State University, San Jose, CA, United States of America, xu.yang@sjsu.edu, Amy Xia

In this research we study how an industry designs the eco-label to promote green products in the market. The research questions we address include: how to design the eco-labeling mechanism, does it bring any profit to pursue the eco-label, how to price the green product to stay profitable? The main contribution of the research is to prove the positive effect of eco-label to company profit.

4 - Shipping Cost Optimization for an E commerce Retail Company

Mrinalini Shah, Professor, Institute of Management Technology, Raj Nagar, Hapur Road, Ghaziabad, 201001, India, shahmrinalini@gmail.com, Nilanjan Chattopadhyay

An Indian online sports equipment retail company was facing huge loss due to fixed shipping charge of Rs 70 from its customers whereas courier companies were charging on the basis of volumetric weight. The challenge was 10,000+ products and 150+ cities as destination.The objectives was to decide the shipping charge from customers which should not exceed 15% of the price of the product and should be at least higher then what courier company charge to them while earning 7% overall profit margin.

5 - The Role of E-service Offerings, Customer Ratings, and Reviews in Enhancing Customer Demand

Xun Xu, PhD Candidate, Washington State University, Department of Finance and Management, Science, Washington State University, Pullman, WA, 99163, United States of America, xun.xu@email.wsu.edu, Charles Munson

Using the largest C2C online shopping website in China, we collected data for 200 online sellers for each of 40 products (8000 observations) pertaining to the sellers' respective customer ratings and reviews, relative popularity, history, price, and e-service offerings (e.g., fast shipping, refund opportunities, and purchase security). We examine the extent to which these activities and characteristics influence customer demand. Implications for online selling strategies are discussed.

6 - Strategic Balancing between Service Quality and Innovation: Evidence from Banking Industry

Nilanjan Chattopadhyay, Dean Executive Education, Manipal University, Dubai International Academic City, Dubai, United Arab Emirates, nchattopadhyay@gmail.com, Mrinalini Shah

Objective of this paper is to discuss the eternal problem faced by service providers while adopting a sustainable strategy to balance service quality and innovation, and therefore, cost. Analysis of data on multiple firms operating in different geographies lead to conclusion that fostering inter-functional collaboration can lead to service enhancement and quality through innovation.

■ WD32

Hilton- Union Sq 12

Supply Chain/Competition

Contributed Session

Chair: Dong Xu, Research Assistant, University of Arizona, 1127 E. James E. Rogers Way, Rm 111, Old Engr Bldg, Tucson, AZ, 85721, United States of America, dongxu@email.arizona.edu

1 - Is Online Channel a Counterstrategy to the Store Brand by the National Brand?

Xiaomeng Luo, PhD candidate, Department of Marketing, City University of Hong Kong, Rm 709, Hall 7, Student Residence, Kowloon, Hong Kong, Hong Kong - PRC, xiaomeng.sissi.luo@gmail.com, Jianbin Li, Ling Ge, Liwen Chen

We consider a supply chain with a national brand manufacturer distributing his products both through a retailer and an online channel. The retailer is also capable of introducing her own store brand. We use a two-stage game-theoretic model to capture the strategic interaction between the online channel and the store brand.

2 - Vertical Competiton in a Decentralized Supply Chain under Supply Uncertainty

Shaoxuan Liu, Associate Professor, Shanghai Jiao Tong University, ACEM, Shanghai, China, liusx@sjtu.edu.cn, Rick So, Fuqiang Zhang

We study a two-stage decentralized supply chain in which a manufacturer sells a product to a retailer who in turn sells the product to consumers.The supply process of the supply chain is uncertain and customer demand is determined by the retailer's endogenous sales effort decision. We study the impacts of supply uncertainty on the firms' optimal decisions, their profits and the supply chain efficiency.

3 - Pollution Control, Bilateral Duopoly, Double Marginalization, Dynamic Games

Fouad el Ouardighi, Professor, ESSEC Business School, Bp 105, Cergy Pontoise, 95021, France, elouardighi@essec.fr, Bowon Kim

The literature on pollution control has pointed out the improper internalization of pollution externalities in a horizontal setting (i.e., with two producers) involving no price competition. We design a bilateral duopolistic price competition differential game and compare whether supply chain coordination would be more efficient than horizontal coordination to reduce pollution.

4 - An Integrated Simulation and Game Theoretic Framework for Analysis of Supply Chain Competitions

Dong Xu, Research Assistant, University of Arizona, 1127 E. James E. Rogers Way, Rm 111, Old Engr Bldg, Tucson, AZ, 85721, United States of America, dongxu@email.arizona.edu, Young-Jun Son

An integrated simulation and game-theoretic approach is presented to study the multi-echelon, multi-period newsvendor competition. We will first discuss an innovative simulation-based game platform involving agent-based and systems dynamics modeling, which can be utilized in both the repeated matrix game and stochastic game settings. The game solving procedures are further developed, with the equilibrium existence, uniqueness, and algorithm convergence in the considered supply chain experiments.

■ WD33

Hilton- Union Sq 13

Research and Development

Contributed Session

Chair: Xiang He, University of Cambridge, Emmanuel College, Saint Andrews Street, Cambridge, CB2 3AP, United Kingdom, xh232@cam.ac.uk

Co-Chair: Mohammad Quasem, mohammadquasem@gmail.com

1 - Effect of R&D Diversification on Alliance Outcomes

Xiang He, University of Cambridge, Emmanuel College, Saint Andrews Street, Cambridge, CB2 3AP, United Kingdom, xh232@cam.ac.uk

We examine the effect of R&D alliance choices on innovation quality and innovation output. In particular, We find that a firms' existing R&D diversification is a strong moderating variable, in that it affects a firm's tendency to commit to any particular R&D alliance. We use a novel instrumental variable to remove endogeneities rising from partner selection.

2 - Best Practices using the CPLEX Python API

Ryan Kersh, Software Developer, IBM, 355 Goodpasture Island Rd., Eugene, OR, 97405, United States of America, rkersh@us.ibm.com

Python is a popular programming language that has been gaining traction in the scientific community. The CPLEX Python API allows users to access the CPLEX optimization engine from Python. When writing programs to solve LP problems using the CPLEX Python API there are several best practices which can prevent errors, improve performance, and enhance readability. Using real examples, a tour of the CPLEX Python API, and best practices for writing programs in this environment will be given.

3 - Integrated Pricing Strategies of Remanufactured Products with Replacement Purchase

Lei Jing, National University of Singapore, E1-07-26, Computing Lab, Kent Ridget 10, Singapore, 117576, Singapore, jinglei@nus.edu.sg, Boray Huang

For remanufacturing business in highly saturated markets, many product sales come from replacement purchase. Pricing strategies are usually adopted by remanufacturing companies to balance supply and demand. In this study, the joint decision of acquisition, trade-in and selling price is considered. It is shown that a remanufacturing firm should offer higher rebates to replacement customers when this customer segment has high return quality and high price sensitivity.

4 - The Influence of Dr. Deming's Philosophy in Quality Improvement

Mohammad Quasem, mohammadquasem@gmail.com

PDSA (plan-do-study-act cycle), also known as the Deming Wheel, is an important factor of processes and systems development, which are the keys to improving quality. This along with his famous 14 points is a critical element in organizational development, leading him to be granted the title as the father of quality improvement. Deming believed that defective products were produced due to the carelessness of management. Over the last 60 years Dr. Deming has been the most important contributor in improving quality. This study has shown how his philosophy of quality improvement has influenced nearly every field.

■ WD34

Hilton- Union Sq 14

Performance Measurement 2

Contributed Session

Chair: Arne S. Drud, ARKI Consulting & Development, Bagsvaerdvej 246A, Bagsvaerd, 2880, Denmark, adrud@arki.dk

1 - A Study on Connectivity-Electrical Conductivity Relationship of Carbon Nanotube Networks

Min-Yang Li, Florida State University/High-Performance Materials Institute, 2005 Levy Ave, Tallahassee, FL, 32310, United States of America, minyangli@gmail.com, Richard Liang, Andrew Moench, Brian Wiesner

Although experimental and theoretical studies have identified some factors that affect the electrical conductivity of CNT films, the effect of CNT network topology on the electrical conductivity remains unclear. We present an image analysis approach to extract the CNT network topology information directly from a scanning electron microscope (SEM) image of a CNT film, and use the result to study the relationship between the network topology and the electrical conductivity.

2 - Performance Impacts of Plant Level Production Improvement Programs

Markku Kuula, Professor, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, Finland, Markku.Kuula@aalto.fi, Katri Kauppi

With increased competition, manufacturing organizations are forced to launch new activities to develop their operations. The aim of this paper is to analyze how production improvement activities and product development efforts affect plants' performance. The analyses are made using data from the International Manufacturing Strategy Survey 6th edition. The data set consist of manufacturing five industry sectors and over 800 responses across 15 countries.

3 - From CONOPT3 to CONOPT4

Arne S. Drud, ARKI Consulting & Development, Bagsvaerdvej 246A, Bagsvaerd, 2880, Denmark, adrud@arki.dk

The presentation gives an overview over the major changes in CONOPT between version 3 and 4: Improved preprocessor; Separation between user model and various internal sub-models; Improved sub-algorithms with selection based on up-to-date model information; Stability improving basis selection. Emphasis is on reliability and large scale. Efficiency comparison of old vs. new version will be provided.

4 - Mining Process Metrics from Project Tracking Tools for Software Development Teams

Ryan Panos, Arizona State University, 3243 Guillermo Pl, Hayward, CA, 94542, United States of America, rpanos@asu.edu

I have pursued statistical relationships between policy choices and environmental factors in software development teams by mining time related data from project tracking tools. Ideally, these dependent and independent variables will also be correlated with indicators of productivity levels. In support of the movement to agile methodologies, we also are attempting to measure how agile a team might be relative to others and in contrast to traditional waterfall based teams.

5 - Contextual Managment in China's Local NGOs and Social Enterprises

Husheng Xu, University of Science and Technology of China, School of Public Affairs, Hefei, China, hsxu@mail.ustc.edu.cn, Liang Gao

NGOs and Social Enterprises management in China context are attracting increasing attention. Theory and practice of this field are creating social value to improve societal development. 54 and 47 non profit organizations and potential social enterprises were fully surveyed in 2011 and 2013. All these groups were local grass organizations from inner area of central China which acquire specific attention. With respect, China's unique contextual management characters were considered in this study.

■ WD35

Hilton- Union Sq 15

Dynamic and Stochastic Models in Emergency Response and Preparedness

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Sibel Salman, Associate Professor, Koc University, Rumelifeneri Yolu, Sariyer, Istanbul, Turkey, ssalman@ku.edu.tr

1 - Modeling for Pre-planning of Resources for Emergency Situations

Shaligram Pokharel, Professor, Qatar University, P.O. Box 2713, Doha, Qatar, shaligram@qu.edu.qa, Rojee Pradhananga, Fatih Mutlu, Jose Holguin-Veras

A two-stage stochastic resource allocation and distribution model is presented for prepositioning of resources to meet demand at an emergency (post-disaster stage) situation. Supply deficit in the post disaster stage is met with shipments from the suppliers. The problem is to obtain optimal resource allocations and choice of suppliers and distribution centers for pre and post disaster situation. Application of the model on a case study and analysis of cost and service trade-off are discussed. (This research is funded through Qatar/QNRF/NPRP Project: 5-200-5-027)

2 - A Heterogeneous Fleet of Vehicles for Automated Humanitarian Missions

Enes Bilgin, Advanced Micro Devices, 13509 Lamplight Village Ave, Austin, TX, 78727, United States of America, enes1988@gmail.com, David Escobar Sanabria, Pieter Mosterman, Kun Zhang, Justyna Zander

An automated emergency response system responds to dynamic and heterogeneous pick-up and delivery requests submitted in the aftermath of a disaster. Autonomous fixed wing aircraft is used for reconnaissance, autonomous trucks serve as depots and the requested items are delivered via autonomous quadcopters. The system aims to respond to high priority requests in minimum time, for which p-median and tabu search algorithms are utilized.

3 - Dynamic Vehicle Routing by Incorporating Social Data in Disaster Relief

Emre Kirac, PhD Candidate, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ekirac@uark.edu, Ashlea Milburn

Decision makers in disaster response community have faced challenges whether to take social data streams into consideration to identify needs in a shorter amount of time. However, needs identified through social media initially have not been verified. Confidence in requests changes with time based on verification inputs. A wide variety of decision policies are defined to represent a broad range of emergency manager preferences. These policies are compared across a variety of demand scenarios.

4 - Impact of Information Sharing on Relief Distribution During Disasters

Huguette Tran, University of North Texas, 1155 Union Circle, 311396, Denton, TX, 76203, United States of America, huguette.tran@unt.edu, Cigdem Kochan, David R. Nowicki

This study evaluates the impact of demand information sharing on relief distribution during a disaster. A mathematical model is developed to determine the optimal relief quantities when there is full and partial information sharing. The results show that full information sharing improves the accuracy of the relief quantities.

■ WD36

Hilton- Union Sq 16

Sports & Entertainment I

Contributed Session

Chair: Stephen Hill, Assistant Professor, UNC Wilmington, 601 South College Road, Wilmington, NC, 28403-5611, United States of America, hills@uncw.edu

1 - Building Perfect Tournament Brackets with Data Analytics

Christopher Hagmann, Purdue University, 480 Stadium Mall Dr., West Lafayette, IN. United States of America, chagmann@purdue.edu, Nan Kong

The NCAA men's basketball tournament highlights data analytics to the everyday person as they look for help building their brackets. In this talk, a k-Nearest Neighbors algorithm is proposed to compare new opponents to previously played teams. A distance between teams is calculated to determine the most similar teams and to weight the value of each win or loss to the teams. The value of k is determined from previous years and applied to 2014. Results are compared to other predictions for 2014.

2 - Down - Set - Punt? Evaluating a Late-Game Strategy in Canadian Football

Keith Willoughby, University of Saskatchewan, 25 Campus Drive, Saskatoon, SK, S7N 5A7, Canada, willoughby@edwards.usask.ca, Kent Kostuk

In several respects, Canadian football is unlike the American version of the sport. One particular difference involves kicking strategies. Canadian teams can earn a single point by punting the ball through the end zone. During the final moments of a tied game, a team may prefer punting for a single point rather than attempting a field goal. We build a decision analysis model for this scenario and use it to evaluate actual decisions made during a 2010 Canadian football game

3 - Learning to Dance: Conference Tournament Design for Maximum Financial Benefit

Stephen Hill, Assistant Professor, UNC Wilmington, 601 South College Road, Wilmington, NC, 28403-5611, United States of America, hills@uncw.edu

NCAA basketball conferences hold tournaments to determine their champions. The champions then receive automatic bids to the NCAA Tournament. For some conferences, the tournament champion is likely to be the conference's only participant in the NCAA Tournament. We analyze whether it is in a conference's financial interest to ensure that its best team receives the automatic bid. We discuss the implications that this analysis could have on the structuring of tournaments.

4 - Analyzing and Forecasting Attendance at FIFA Soccer World Cups

Ghaith Rabadi, Associate Professor, Engineering Management and Systems Engineering, 5115 Hampton Blvd, Old Dominion University, Norfolk, VA, 23529, United States of America, grabadi@odu.edu, Ahmed Ghoniem, Agha Iqbal Ali, Mohammed Al-Salem

Abstract: The FIFA World Cup is among the most popular international sport events. This paper analyzes historical data on attendance at FIFA World Cups over the last two decades. Key factors that influence attendance are identified and their relative importance is discussed. This analysis can be used within a forecasting framework to predict attendance at future events.

■ WC37

Hilton- Union Sq 17

Marketing 1

Contributed Session

Chair: Shaobo Li, University of Cincinnati, 2925 Campus Green Dr., Cincinnati, OH, 45221, United States of America, lishaobo413@gmail.com

1 - Product Strategy under Smartphone Competition

Siddhartha Sharma, Indian School of Business, AC 6121, Gachibowli, Hyderbad, AP, 500032, India, siddhartha_sharma@isb.edu, Amit Mehra

We observe an unusual phenomenon of Nexus 5 having a much lower price tag than other phones of comparable quality like iPhone 5S and Galaxy S4. Using a game-theoretic model, we show that the usual result of high quality-high price can be overturned in the case of smartphone competition. This happens because introduction of Nexus allows for increased revenue for Google since it does not share the ad and app revenue from Android phones as it has to do on the earnings from iPhones.

2 - Non-Monetary and Monetary Rewards for Product Review Contribution in a Connected Community

Xiaojing Dong, Santa Clara University, 500 El Camino Real, Lucas Hall, Marketing, Santa Clara, CA, 95053, United States of America, xdong1@scu.edu, Yacheng Sun

We empirically demonstrate that monetary reward can sometimes decrease product review contributions in a community. Using a HB model, we examine individual-level contributions before/after the introduction of monetary reward. We find that with the reward, consumers with more friends decreased their contributions by 90%; while those with fewer or no friends increased their contributions by 1400%. They suggest that there is a significant conflict between monetary rewards and non-monetary rewards.

3 - The Pricing Strategy of Multinational Enterprises

Mei-Wen Chao, Assistant Professor, Kao-Yuan University, No. 1821, Chung-Shan Rd, Lu-Chu district, Kaohsiung, Taiwan - ROC, t80149@cc.kyu.edu.tw

Multinational Enterprise (MNE) has been studied extensively across countries and companies. While the emerging globalization of market pressures MNEs to consolidate operations, price always remains a key point of international differentiation for most products. This paper consider the pricing strategy by taking into consideration of entry mode, product life cycle and outsourcing. Salient results and practical issues involved in this unique problem are discussed in detail in this paper.

4 - In Search of Models for Stock Return Forecasts

Shaobo Li, University of Cincinnati, 2925 Campus Green Dr., Cincinnati, OH, 45221, United States of America, lishaobo413@gmail.com, Yan Yu

We attempt to investigate forecastability of US stock market return by using a set of information. Given the high dynamicity of stock return, we propose to develop Bayesian Dynamic Linear Model (DLMs), which assumes model coefficients to be time-varying. Model Averaging technique is applied to improve the forecasting accuracy. We compare our developed DLMs model with previously established models in terms of out-of-sample R square.

5 - Causality and Time: A Longitudinal Model for the Impact of Digital Advertising

Daniel Hill, Senior Data Scientist, Integral Ad Science, 95 Morton St., Floor 8, New York, NY, 10014, United States of America, dhill@integralads.com, Gijs Joost Brouwer, Kiril Tsemekhman, Alan Hubbard

Ad networks target people who are inclined to buy the product being advertised. Do their ads cause users to convert or would they have converted regardless? Previous studies have applied the tools of causal analysis to address this question. However, their static models did not capture the dynamic interplay between user and advertiser. We developed a longitudinal event-driven causal framework for the analysis of ad campaigns. Our method generalizes to any intervention on online behavior.

■ WD38

Hilton- Union Sq 18

Health Care, Process 1

Contributed Session

Chair: Anu Banerjee, PhD Student, Binghamton University, SUNY, Vestal Parkway East, Binghamton, NY, 13902, United States of America, banerjee@binghamton.edu

1 - Correcting Systematic Errors in Clinical Laboratories

Chin Hon Tan, National University of Singapore, 1 Engineering Drive 2, Singapore, Singapore, isetch@nus.edu.sg

Analyzers in clinical laboratories are tested periodically to ensure that readings are within acceptable levels of accuracy. When a systematic error (e.g., contamination of reagent) occurs, readings may deviate significantly from their true values. Therefore, the laboratory should retest all affected patient samples. However, the onset of error is often unknown. We propose a Bayesian approach, which sequentially updates the distribution for the time of error, in tackling this problem.

2 - EHR and its Impact on Healthcare

Anu Banerjee, Ph.D. Student, Binghamton University, SUNY, Vestal Parkway East, Binghamton, NY, 13902, United States of America, banerjee@binghamton.edu, Sal Agnihothri

An Electronic Health Record (EHR) is a systematic collection of health information in digital format to capture a patient health status. It allows patient history to be viewed and shared across different healthcare settings. Implementing EHR system could reduce costs and increase quality of care. Recently the U.S. Govt. provided incentives to drive adoption of EHRs. The objective of this paper is to examine EHR and its impact on healthcare operations in general and patient health in particular.

3 - The Effect of Organizational Practices on Outcomes of Cardiothoracic Surgery

Jingyun Li, PhD Student, The University of Texas at Dallas, 7740 McCallum Blvd. Apt. 321, Dallas, TX, 75252, United States of America, jxl097620@utdallas.edu, Indranil Bardhan, Steve Ring

Coronary Bypass Artery Grafting (CABG) patients experience significant variations in healthcare outcomes after surgery. We study hospital- and surgeon-specific organizational practices related to cardiac surgeries on a large panel of CABG patients, using archival and survey data collected across 26 hospitals in North Texas, and their impact on patient outcomes.

4 - Process Issues of Patient Safety and Home Care for Healthcare Delivery Systems in Japan

Masato Takanokura, Kanagawa University, 3-27-1 Rokkakubashi, Kanagawa-ku, Yokohama, Japan, takanokura@kanagawa-u.ac.jp, Masaru Kawakami, Keiou Ishiguro, Tomokazu Muto, Seiko Taki, Tetsuo Yamada

Healthcare delivery systems in Japan should be improved urgently to enhance their quality of service and to reduce social security costs simultaneously. The consumption tax increased this spring in Japan to supplement the lack of social security costs. The aim of this study is to identify processes in healthcare delivery systems especially for patient safety and home care in hospitals and nursing homes in Japan. Possible alternative solutions are discussed under the constraints in Japan.

5 - Supply and Demand Alignment at Primary Care Facilities

Sina Faridimehr, Graduate Research Assistant, Wayne State University, Wayne State University, Detroit, MI, United States of America, fb1562@wayne.edu, Seung Yup Lee, Azade Tabaie, Alper Murat, Qingyu Yang, Ratna Babu Chinnam, Evrim Dalkiran, Hakimuddin Neemuchwala, Michael Lederle

We propose statistical models to improve timely access for patients while maintaining clinic capacity utilization in primary care facilities. The models leverage correlations between scheduling practice, panel size management, appointment slot grid design and access performance. Results from VA facilities are promising.

■ WD39

Hilton- Union Sq 19

Optimization in Radiation Therapy

Sponsor: Health Applications

Sponsored Session

Chair: Jagdish Ramakrishnan, Post-doctoral Scholar, University of Wisconsin-Madison, Wisconsin Institute for Discovery, Madison, WI, 53715, United States of America, jramakrishn2@wisc.edu

1 - Spatio-temporally Optimized Radiation Therapy

Minsun Kim, University of Washington, Radiation Oncology, Seattle, WA, 98195, United States of America, mk688@uw.edu, Fatemeh Saberian, Archis Ghate

Adaptive radiotherapy utilizes mid-treatment, anatomical images to re-evaluate tumor volume to modify treatment plans accordingly. We propose a stochastic control formalism framework for spatio-temporally optimized radiotherapy, where mid-treatment functional images provide clinicians with a chance to adapt the plan to biological changes of tumors in response to radiation. Potential benefits of spatio-temporal approach over current adaptive therapy will be demonstrated by numerical simulations.

2 - Optimization Problems in Proton Therapy Treatment Planning

Gino Lim, Department Chair, Hari and Anjali Agrawal Faculty Fellow, Associate Professor, University of Houston, E206 Engineering Building 2, Houston, TX, 77204, United States of America, ginolim@uh.edu, Wenhua Cao

Radiation therapy treatment planning for cancer patients provides many challenging optimization problems. Unlike conventional photon based radiation therapies, the new intensity modulated proton therapy (IMPT) is highly sensitive to uncertainties and its optimization involves very large data sets. Therefore, we will present uncertainty incorporated models and efficient solution algorithms for choosing IMPT treatment beam angles, selecting proton energy levels, and determining intensity profiles.

3 - Simultaneous Beam Sampling and Aperture Shape Optimization for SPORT

Masoud Zarepisheh, Stanford University, Department of Radiation Oncology, Stanford, CA, United States of America, masoudzp@stanford.edu, Ruijiang Li, Yinyu Ye, Lei Xing

We build a mathematical model whose decision variables are beam angles and aperture shapes. We solve the resulting large scale optimization problem by integrating three optimization techniques: column generation, the subgradient method, and pattern search. Column generation adds the most beneficial stations (aperture shapes, beam angles, and corresponding intensities) sequentially. Then, the subgradient method and pattern search improve the selected stations locally and globally.

4 - Biological Planning for High-dose Rate (HDR) Brachytherapy and Applications to Cervical Cancer

Eva Lee, Professor & Director, Georgia Institute of Technology, Ctr for OR in Medicine & Healthcare, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

This work is joint with Rush University. HDR treatment preserves organ functionalities. Major challenges involve determining the best seed type, their spatial configuration, and dwell time. PET imaging facilitates design of treatment that target at cancer cells. We present an advanced planning system to simultaneously optimize the radiation source while at the same time escalating dose to the PET-identified cancer pockets. Results for cervical cancer patients treated will be discussed.

■ WD40

Hilton- Union Sq 20

Center for Systems Engineering in Health

Sponsor: Health Applications

Sponsored Session

Chair: Sean Barnes, Assistant Professor, University of Maryland, 4352 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu

1 - A Multiobjective Optimization Technique for CRNA Staffing

Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N Charles St, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu, Robert Greenberg, Scott Levin, Claro Pio Roda

Staffing in hospital operating rooms (OR) require scheduling Certified Registered Nurse Anesthetists (CRNAs). Due to uncertainty in patient demand, creating an efficient schedule is not straightforward, and requires balancing surgical caseload, staff satisfaction, and costs. We present a multiobjective optimization technique that takes operating room patient flow data as input and creates a CRNA scheduling tool. As a case study, we implement this technique at the OR at Johns Hopkins Hospital.

2 - Outcomes-Based Emergency Department Triage

Scott Levin, Associate Professor, Johns Hopkins School of Medicine, 5801 Smith Ave, Baltimore, MD, 21209, United States of America, slevin33@jhmi.edu, Andrea Dugas, Matthew Toerper, Tom Kirsch

Our novel emergency department (ED) triage tool, HopScore, aims to support outcomes-based differentiation of patients addressing deficiencies in the current standard, Emergency Severity Index (ESI). The tool uses easily obtained patient demographic and clinical information commonly collected at triage to predict patients' risk for critical outcomes.

3 - PACER Surge Application

Matthew Toerper, Senior Software Engineer, Johns Hopkins University, 5801 Smith Avenue, Baltimore, MD, 21209, United States of America, mtoerper@jhu.edu, Gabe Kelen, Scott Levin, Lauren Sauer, Jamil Bayram, Christina Catlett

The National Center for the Study of Preparedness and Catastrophic Event Response (PACER) Surge application is a scalable, internet-based tool that allows hospital planners to simulate strategies in response to heightened population care needs during disasters. The tool determines the effects of these strategies on hospital surge capacity.

4 - Application of Supervised Machine Learning Methods to Predict Daily Hospital Discharges

Sean Barnes, Assistant Professor, University of Maryland, 4352 Van Munching Hall, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu, Eric Hamrock, Matthew Toerper, Sauleh Siddiqui, Scott Levin

We apply supervised machine learning methods to predict patients likely to be discharged each day in a single hospital unit. We compare the predictive performance for logistic regression, decision trees, and ensemble learning approaches, and compare these results to clinician predictions.

■ WD41

Hilton- Union Sq 21

Supply Chain Management VI

Contributed Session

Chair: Byeong-Yun Chang, Ajou University, San 5, Woncheon-dong, Yeongtong-gu, Suwon, Korea, Republic of, bychang@ajou.ac.kr

1 - The Impact of Supply Chain and Business Process Managements on Firm Performance

Byeong-Yun Chang, Ajou University, San 5, Woncheon-dong, Yeongtong-gu, Suwon, Korea, Republic of, bychang@ajou.ac.kr

This research is to develop an integrated framework of SCM and BPM and to test their joint impact on firms' competitive advantage as well as economic and operational performance. In doing so, this paper will be a pioneer for both researchers and practitioners by giving empirical evidence on how SCM and BPM are interrelated each other and how they contribute to firms' effort in building their competitiveness and economic achievement.

2 - Effects of Demand Information Sharing on Service Level in Supplier Collaboration

Ki-Seok Choi, Hankuk University of Foreign Studies, 81 Oedae-ro, Yongin, 449-791, Korea, Republic of, kchoi@hufs.ac.kr, Kyungsik Lee

Buyer and supplier can benefit from collaboration in which buyer shares customer demand information with supplier. Shared demand information helps supplier reduce backorders and improve service level. We analyze the impact supplier collaboration has on service level by focusing on how early demand information is shared.

3 - A Study of Factor and Measurement of Supply Chain Resilience on the Buyer's and Seller's Perspective

Xiaowei Ji, Huazhong University of Science & Technology, Luo Yu Road No. 1037, Wuhan, 730074, China, Jixw@hust.edu.cn

Through empirical research, we identify the elements of supply chain resilience, analyze their influence on the competitiveness of supply chain and the mechanism of this course.On this basis, we use empirical methods to analyze the measurement of an enterprise's supply chain resilience.

4 - Blood Distribution Game

Harshal Lowalekar, Assistant Professor, Indian Institute of Management Indore, Prabandh-Shikhar, Rau-Pithampur Road, Indore, MP, 453331, India, harshal@iimidr.ac.in, Raghu Santanam, Ajay Vinze

We present a business game which models the problem of blood distribution from a regional blood bank to hospital blood banks. The computer-based multi-player game demonstrates the effects of constrained supply and stochastic demand on the performance of various stakeholders in the supply-chain of perishables like blood.

5 - Outsourced Parts Clustering for Supplier Quality Assurance

Venkat Venkateswaran, Professor of Practice, Rensselaer Polytechnic Institute, Room 725, 275 Windsor Street, Hartford, CT, 06120, United States of America, venkav3@rpi.edu, Steven Webster, Daniel Dillon

A supplier for the aerospace industry may be responsible for several hundred complex parts of small runs each. The quality protocol at the contracting aerospace company requires that process capability for each part manufactured at the supplier be certified, audited and continually monitored. A natural way to attack this complexity is to group parts into clusters and treat them as blocks. We describe our special purpose clustering algorithm to accomplish this.

■ WD42

Hilton- Union Sq 22

HSEA -IV- Undergraduate Projects in Healthcare Engineering

Sponsor: Health Applications

Sponsored Session

Chair: Jose Zayas-Castro, University of South Florida, 4202 E. Fowler Ave., ENB 118, Tampa, FL, 33620-5350, United States of America, josezaya@usf.edu

1 - HSEA Healthcare Team Based Projects

Jose Zayas-Castro, University of South Florida, 4202 E. Fowler Ave., ENB 118, Tampa, FL, 33620-5350, United States of America, josezaya@usf.edu

The panelists will address the status and progress of the curricular developments and education of health systems engineering. They will share their views, address barriers, requirements and ideas for the path forward. The panelists will address questions from the audience.

■ WD43

Hilton- Union Sq 23

Network Flow Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Martin Takac, Lehigh University, 27 Memorial Drive West, Bethlehem, PA, United States of America, martin.taki@gmail.com

1 - Moment-Based Relaxations of Optimal Power Flow Problems
Daniel Molzahn, Dow Postdoctoral Fellow, University of Michigan, 1301 Beal Avenue, Room 4234A, Ann Arbor, MI, 48109, United States of America, dan.molzahn@gmail.com, Ian Hiskens

Optimal power flow (OPF) is the key problem in operating electric power systems. A hierarchy of moment-based" convex relaxations globally solves many non-convex OPF problems for which existing relaxations fail. Comparing the feasible spaces of the low-order relaxations illustrates the capabilities of the moment relaxations. Exploiting sparsity and selectively applying the higher-order relaxation enables global solution of larger problems.

2 - Elementary Estimators for High-Dimensional Statistical Models
Pradeep Ravikumar, University of Texas at Austin, 2317 Speedway, Stop D9500, Austin, TX, 78712, United States of America, pradeepr@cs.utexas.edu, Eunho Yang, Aurelie Lozano

State of the art statistical estimators of structurally constrained high-dimensional statistical models are based on solving regularized convex programs, which are typically non-smooth non-strongly convex programs. An ongoing but strong line of research has focused on developing efficient and scalable optimization methods to solve these programs. Here, we address this scaling issue at the source, and develop *closed-form statistical estimators*, that yet come with strong statistical guarantees.

■ WD44

Hilton- Union Sq 24

Strategy/Strategic Planning I

Contributed Session

Chair: Jiulin Teng, HEC Paris, 1 Rue de la Liberation, Dept of Strategy and Business Policy, Jouy-en-Josas, 78350, France, jiulin.teng@hec.edu

1 - Empirical Study on the Relationships between Manufacturing Strategy and Competitive Performance
James Ang, Associate Professor of Decision Sciences, National University of Singapore, Mochtar Riady Building, BIZ 1, 15 Kent Ridge Drive, Singapore, 119245, Singapore, bizangsk@nus.edu.sg, Tomoaki Shimada, Eugene Lim, Ser-Aik Quek

We conducted non-linear regression analysis on the relationships between manufacturing strategy and competitive performance using data from the High Performance Manufacturing Project. We showed that data on established and emerging manufacturing countries should not be mixed for the purpose of data analysis, and found different characteristics in established and emerging manufacturing countries.

2 - Analysis of Prefabricated Urban Housing Constructions on Freight Transport Systems
Panagiotis Angeloudis, Lecturer, Imperial College London, Department of Civil & Environmental Eng, South Kensington Campus, London, SW7 2AZ, United Kingdom, p.angeloudis@imperial.ac.uk, Bani Anvari, Washington Y. Ochieng

Prefabricated buildings have become the choice of many construction teams as they offer time, cost, quality and environmental benefits compared to traditional on-site construction. We have explored the effects of prefabricated urban constructions on freight transport systems and identified cost-efficient logistics strategies using genetic algorithm. Our results will be beneficial for the Construction Method Selection Model which advises to what extent building components should be prefabricated.

3 - Contractual Negotiation and Ex Ante Economizing
Jiulin Teng, HEC Paris, 1 rue de la Liberation, Dept of Strategy and Business Policy, Jouy-en-Josas, 78350, France, jiulin.teng@hec.edu

We enrich the study of contracts with the ex ante cost aspect. Using a bargaining theoretic model with strategic reaction, we provide a view of contractual negotiation as a means to economizing bargaining cost, information cost, and monitoring cost. We thereby extend the lens of contract beyond the dichotomy of ex ante incentive alignment and ex post economizing. Further, we show ex ante cost aspect is both theoretical and practical antecedents of ex post cost and ex ante incentive aspects.

4 - Myopia in Strategy Making: Evidence from a Laboratory Study
Daniella Laureiro-Martinez, Senior Fellow, ETH Zurich, Weinbergstrasse 56-58, Zurich, Pl, 8092, Switzerland, dlaureiro@ethz.ch, Stefano Brusoni, Maurizio Zollo, Amulya Tata

This study explains differences in decision making performance on the basis of the choice patterns implemented by individuals while playing a four armed bandit task. We develop a procedure to identify and cluster strategies. We observe the emergence of strategies which differ in terms of content, myopia and performance. Our results extend current research by operationalizing the concept of myopia, and showing that the different levels of myopia in choice strategies reliably predict performance.

5 - Alignment between Business Strategy and Operations: Implications for Managerial Decisions
Kalinga Jagoda, Associate Professor, Mount Royal University, 4825 Mount Royal Gate SW, Calgary, T3E 7N9, Canada, kjagoda@mtroyal.ca, Senevi Kiridena

The current research on operations strategy has almost exclusively focused on businesses operating in the manufacturing sector. Using the empirical data collected from more than 400 firms in the Canadian oil and gas industry, this paper examines the linkages between the alternative forms operations strategy and organizational performance.

■ WD45

Hilton- Union Sq 25

Behavioral Operations 2

Contributed Session

Chair: Nico Laya, University of Auckland Business School, Private Bag 92019, Auckland, 1142, New Zealand, nhio001@aucklanduni.ac.nz

1 - Using the Newsvendor Game as a New Research Environment for Behavioral OM and Marketing
Tong Wu, University of Rochester, 201 Conant Road, Apt B, Rochester, NY, 14623, United States of America, tong.wu@simon.rochester.edu, Abraham Seidmann

The newsvendor problem represents a fundamental question in supply chain management. There is a growing body of empirical research that points at the various cognitive biases that misdirect managers under uncertainty. In this talk, we will discuss the research and teaching role of a new experimental system called the Newsvendor game, and present some preliminary research results of those newsvendor games under the tournament competitive environment. Significantly gender difference is observed.

2 - Team Decision-making and Individual Learning in the Newsvendor Problem
Valery Pavlov, University of Auckland Business School, Private Bag 92019, Auckland, 1142, New Zealand, v.pavlov@auckland.ac.nz, Nico Laya

The study investigates group decision-making in the Newsvendor problem using a laboratory experiment. The key observations are (i) that flat teams (as opposed to hierarchical) promote better individual performance at the post-team stage, and (ii) exposure to working with an expert on team may not remove decision biases of non-experts but is likely to replace them with other biases.

3 - Behavioral Study of Supplier Switching Decision Making
Hyejeong Gwon, PhD Candidate, Korea University, 408 LG-Posco Hall, KUBS, 145 Anam-ro Seongbuk-ku, Seoul, Korea, Republic of, 11ku11@korea.ac.kr, Daeki Kim

According to psychological theories, humans use heuristics rather than logical thinking especially when the decision is complicated. The firm level's decision maker is a human being and the decision is usually associated with plenty of factors. This study proposes a behavioral model of supplier switching decision making. Regulatory focus theory is implied to reflect the effect of individual characteristics on decision making process.

4 - Imprecise Skill Level Affecting Dynamic Operator Assignment
Corey Kiassat, Assistant Professor of Industrial Engineering, Quinnipiac University, 275 Mt. Carmel Avenue, Hamden, CT, 06518, United States of America, corey.kiassat@quinnipiac.edu, Nima Safaei

Our novel methodology measures skill level in a dynamic operator assignment problem under an imprecise environment. Operator skill is assessed by an expert whose belief reflects environmental, personal, and social effects. Expert belief is characterized using Accuracy (skill level with highest degree of belief) and Confidence (the spread of belief degrees on skill levels around accuracy). Fuzzy logic's membership function is used to model confidence and accuracy as dimensions of expert knowledge

■ WD46

Hilton- Lombard

Complexity and Algorithmic Aspects in Linear and Nonlinear Optimization

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Amitabh Basu, Johns Hopkins University, 3400 N. Charles St., Baltimore, MD, 21231, United States of America, basu.amitabh@jhu.edu

1 - How Good Are Sparse Cutting-Planes?

Marco Molinaro, Georgia Tech, Ferst Drive, Atlanta, GA, United States of America, marco.molinaro@isye.gatech.edu, Qianyi Wang, Santanu Dey

Sparse cutting-planes are often the ones used in MIP solving. But how well do they approximate the IP hull? We abstract this question as the approximation of arbitrary polytopes (e.g. the IP hull) by sparse valid inequalities. We will discuss recent results, such as matching upper/lower bounds on the approximation error, and an analysis showing that for a class of hard packing IPs, sparse cutting-planes do not approximate the integer hull well.

2 - Recent Developments on the Oracle Complexity of Convex Optimization

Cristobal Guzman, Georgia Tech, 755 Ferst Drive NW, Atlanta, United States of America, cguzman@gatech.edu, Sebastian Pokutta, Gabor Braun, Arkadi Nemirovski

We study lower bounds for oracle-based algorithms in convex optimization. First, we prove new lower bounds for smooth optimization over non-Euclidean domains, deriving nearly-optimal lower bounds for ell^p balls, where $p\in[1,\infty]$. Second, we extend oracle complexity to the distributional setting, where the distribution of instances is part of the algorithm input. This model can be analyzed by information-theoretic arguments, unifying known lower bounds for the nonsmooth case.

3 - Reverse Split Rank

Alberto Del Pia, Assistant Professor, University of Wisconsin-Madison, Madison, WI, United States of America, delpia@wisc.edu, Michele Conforti, Marco Di Summa, Yuri Faenza

The reverse split rank" of an integral polyhedron P is defined as the supremum of the split ranks of all rational polyhedra whose integer hull is P. Already in R^3 there exist polyhedra with infinite reverse split rank. We give a geometric characterization of the integral polyhedra in R^n with infinite reverse split rank.

4 - Submodular Knapsack Polytope

Avinash Bhardwaj, University of California at Berkeley, 450/60 Sutardja Dai Hall, University of California Berkeley, Berkeley, CA, 94720-1758, United States of America, avinash.bhardwaj@berkeley.edu, Alper Atamturk

We define new inequalities for the level set of of an arbitrary submodular function. This work generalizes earlier studies on monotone submodular functions. Application to stochastic network design with correlations is provided.

■ WD47

Hilton- Mason A

Topics in Stochastic Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Yongpei Guan, University of Florida, Weil 413, Gainesville, FL, 32611, United States of America, guan@ise.ufl.edu

1 - Data-Driven Risk-Averse Two-Stage Stochastic Program

Chaoyue Zhao, University of Florida, Weil 413, Gainesville, FL, United States of Americacherryzhao09@ufl.edu, Yongpei Guan

In this project, we investigate the data-driven risk-averse two-stage stochastic program with a new class of probability metrics. We reformulate the problem as a traditional two-stage robust optimization problem for the discrete distribution case and develop a sampling approach for the continuous distribution case. We prove that the risk-averse problem converges to the risk-neutral problem with an exponential rate.

2 - A Stochastic Trust Region Algorithm for Mixed Logit and Latent Class Logit Type Problems

Anton Kleywegt, Georgia Institute of Technology, School of Industrial and Systems Enginee, Atlanta, GA, 30332-0205, United States of America, anton@isye.gatech.edu

We consider mixed logit and latent class logit type problems. We propose a trust region type algorithm that controls sampling from the set of observations as well as the sample size for each observation. We provide convergence results, and demonstrate the algorithm with numerical results for the estimation of mixed logit and latent class logit discrete choice models, using airline data.

3 - Two-stage Portfolio Optimization with Higher-order Conditional Measures of Risk

Sitki Gulten, Rutgers University, 1 Washington Park, Newark, NJ, 07102, United States of America, sgulten@business.rutgers.edu, Andrzej Ruszczynski

We describe a study of novel risk modeling and optimization techniques to daily portfolio management. First, we develop specialized methods for scenario generation and scenario tree construction. Second, we construct a two-stage stochastic program with conditional measures of risk, which is used to re-balance the portfolio on a rolling horizon basis, transaction costs included in the model. Third, we present an extensive simulation study with different risk measures on real world data.

4 - Recent Progress on Stochastic Unit Commitment Problems

Yongpei Guan, University of Florida, Weil 413, Gainesville, FL, 32611, United States of America, guan@ise.ufl.edu

In this talk, we review the research progress on recent studies for stochastic unit commitment problems. We discuss the motivation, algorithm developments, and computational experiment results.

■ WD48

Hilton- Mason B

Optimization, Stochastic 2

Contributed Session

Chair: Khatibi Arash, University of Illinois, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, khatibi2@illinois.edu

1 - A Two-stage Stochastic PDE-constrained Optimization Model for Control of Smart Mechanical Structures

Dmitry Chernikov, The University of Iowa, 418 Brown St. Apt 19, Iowa City, IA, 52245, United States of America, dmitry-chernikov@uiowa.edu, Pavlo Krokhmal, Olesya Zhupanska

We consider the problem of optimization of "smart", or "multifunctional" mechanical structures under uncertainty. In particular, a PDE-constrained optimization model for vibration control of a composite plate due to an impact load through an application of electromagnetic field is presented. To account for uncertainty in the impact load, a two-stage stochastic PDE-constrained programming problem is formulated. A solution method is presented, and the results of computational study are discussed.

2 - Doubly Stochastic Sequential Assignment Problem

Khatibi Arash, University of Illinois, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, khatibi2@illinois.edu, Golshid Baharian, Sheldon Jacobson

This paper introduces the Doubly Stochastic Sequential Assignment Problem (DSSAP), an extension of the Sequential Stochastic Assignment Problem where sequentially arriving tasks are assigned to workers with random success rates. The best secretary problem is used to find the optimal policy for the DSSAP with IID random success rates. An optimal assignment algorithm is presented that achieves the maximum total expected reward for the DSSAP with any given success rate distribution.

■ WD49

Hilton- Powell A

Network Analytics

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Sangho Shim, Research Associate, Kellogg School of Management, 2001 Sheridan Road, Suite 548, Evanston, IL, 60208, United States of America, shim@kellogg.northwestern.edu

1 - Steiner Tree Inequalities for Clustering Problems
Kangbok Lee, Assistant Professor, York College, CUNY, 94-20 Guy Brewer Bldv., Jamaica, NY, 11451, United States of America, klee5@york.cuny.edu, Sangho Shim, Sunil Chopra

Inequalities from node minimum Steiner trees are strong valid inequalities for constrained partition into connected components. They are added to Chopra-Rao system for the partition problem which is completely described in tree case by Lee, Chopra and Shim (2013) and speed up branch-and-cut for constrained tree partitioning into sub-trees.

2 - Tabu Search for Solving the Black-and-White Travelling Salesman Problem
Haitao Li, Associate Professor, College of Business Administration, 229 ESH, One University Blvd, St. Louis, MO, 63121-4400, United States of America, lihait@umsl.edu, Bahram Alidaee

The black-and-white traveling salesman problem (BWTSP) is an extension to the well-known TSP and has various applications in logistics and telecommunication networks design. We develop several tabu search (TS) heuristics for solving the BWTSP. Extensive computational experiment on both benchmark and randomly generated instances shows effectiveness and efficiency of our algorithms.

3 - New Heuristic Approaches for Parts Clustering and Layout Design
Mohammad Moshref-Javadi, Purdue University, 315 N. Grant St., Purdue University, West Lafayette, IN, 47907, United States of America, moshref@purdue.edu, Mark Lehto

This paper considers minimization of transportation in warehouses. To achieve this, parts which are more frequently ordered together are grouped together. Then family groups are located in the layout. In addition, interactions between parts in different groups are also taken into account. We used Principal Component Analysis to group parts into part families. Also, several heuristics were used to locate part families. The results indicate 40% reduction in transportation.

4 - Large Scale Mixed Integer Programming for Feature Selection
Younghoon Kim, PhD Student, Korea University, Anam-Dong, Seongbuk-Gu, Seoul 136-713, Seoul, Korea, Republic of, younghoon.kim11@gmail.com, Sangho Shim, Seoung Bum Kim

We propose a feature selection algorithm based on a large-scale mixed integer programming. The proposed method minimizes the least square error subject to the number of selected feature being equal to a constant integer specified by users. Consequently, the number of features selected can be equal to the constant value that users specified. We will present the formulation and algorithm to solve this model.

■ WD50

Hilton- Powell B

Optimization, Integer 4

Contributed Session

Chair: Kalpana Dahiya, Senior Assistant Professor, Panjab University, UIET, Chandigarh, 160014, India, kalpanas@pu.ac.in

1 - A Traveling Salesman Problem with Budget and Time Constraints
Elham Kookhahi, Wichita State University, Wichita, KS, 67220, United States of America, exkookhahi@wichita.edu, M Bayram Yildirim

In this paper, a mathematical model is presented for a travelling salesman problem in which a sub tour of a set of cities can be visited to maximize the number of customers that can be served with a limited budget and time. The problem is solved using a genetic algorithm and numerical results are presented.

2 - An Iterative Algorithm for Two-stage Time Minimization Assignment Problem
Kalpana Dahiya, Senior Assistant Professor, Panjab University, UIET, Chandigarh, 160014, India, kalpanas@pu.ac.in

An iterative algorithm has been proposed to solve a two-stage bottleneck assignment problem, in which jobs are performed in two-stages. The objective is to find that set of m agents performing the primary jobs in Stage-I for which the sum of the overall completion times of jobs in Stage-I and the corresponding optimal completion time of the secondary jobs in Stage-II by the remaining (n-m) agents is the minimum.

3 - Benders Decomposition for Coils Allocation and Shuffling Problem
Yuan Yuan, The Logistics Institute, Northeastern University of China, NO. 3-11, Wenhua Road, Heping District, Shenyang, China, yyuan.tli@gmail.com, Lixin Tang

We propose a hybrid approach combining Benders decomposition and cut generation to solve a coil allocation and shuffling problem. The problem is formulated as a 0-1 linear model. In the approach Benders decomposition acts as the main frame and employs cut generation to deal with its integer subproblem. Numerical experiments show the competitiveness of the approach.

4 - Optimization Models and Methods for University Course Timetabling
Antony Phillips, Department of Engineering Science, University of Auckland, Auckland, New Zealand, aphi038@aucklanduni.ac.nz, Cameron Walker, Matthias Ehrgott, David Ryan

University course timetabling is a large resource allocation problem, in which both times and rooms are determined for each class meeting. We present a novel approach for course timetabling based on mathematical optimisation. By decomposing the problem into a timetable generation, followed by a room assignment, integer programming becomes viable even for large practical problems. Computational results on data from the University of Auckland will be presented.

■ WD51

Hilton- Sutter A

Game Theory 2

Contributed Session

Chair: Nelson Uhan, Mathematics Department, United States Naval Academy, Chauvenet Hall, Annapolis, MD, 21402, United States of America, uhan@usna.edu

1 - Impacts of Human Behaviors' Diffusion in an Epidemic Model Based on Spatial Game
Songnian Zhao, PhD Candidate, Kansas State University, 1600 Hillcrest Drive APT 4, Manhattan, KS, 66502, United States of America, songnian@ksu.edu, Yan Kuang, David Ben-Arieh, Chih-Hang Wu

In this paper, a new behavior-based SIR model using spatial evolutionary game is constructed to predict the spread of infectious disease. Information transmission, contact structure and changes of human behaviors are emphasized in modeling the dynamics of infectious diseases,and people make decisions based on the information available to them during the game, by balancing their own benefits and costs. Equilibrium analysis and numerical simulation results will be shown in the end.

2 - The Strategic Effect of In-Store Medium under Product Line Competition
Haruki Kobayashi, Keio University, 3-14-1 Hiyoshi Kohokuku, Yokohama, Japan, 151e0423@gmail.com, Nobuo Matsubayashi

Manufacturer's competitive actions of enhancing their product lines result in increasing consumers' burden of selecting products. In particular, communicating to consumers about the product differences from the rival's products is a harder task for manufacturers. We consider a retailer's service model of in-store advertising, where the retailer neutrality provides product information to consumers for free, whereas he charges manufacturers. We explore the optimal tariff design for this service.

3 - A Game-theoretic Procedure for Bridge Construction Cost Allocation
Saurav Kumar Dubey, PhD Student-Department of Industrial and Systems Engineering, University of Tennessee at Knoxville, 1615 Laurel Avenue, Knoxville, TN, 37916, United States of America, skumardu@utk.edu, Dongju Lee, Alberto Garcia-Diaz

The proposed method integrates traffic capacity and load requirements to allocate bridge costs among vehicle classes, using two game-theoretic criteria known as Aumann-Shapley value and Shapley value, and an incremental allocation procedure.Players are defined as vehicle classes, axle load applications, or lanes.The gross-weight based incremental procedure determines marginal costs.

4 - Dynamic Allocations for Cooperative Games under Uncertainty with Risk-averse Players
Nelson Uhan, Mathematics Department, United States Naval Academy, Chauvenet Hall, Annapolis, MD, 21402, United States of America, uhan@usna.edu, Alejandro Toriello

We consider a class of cooperative games in which the costs of cooperation are uncertain and evolve over time, and the players are risk averse. These games generalize the classic linear production game, and as a result, model a variety of cooperative settings. We give sufficient conditions for the existence of an allocation in the strong sequential core - the set of allocations that distribute costs as they are incurred and are stable against coalitional defections at any point in time.

■ WD52

Hilton- Sutter B

Optimization, Linear Programming 2

Contributed Session

Chair: Gene Coffman, Technical Leader, Ford Motor Company, Manufacturing Development Center, 6100 Mercury Drive, Dearborn, MI, 48126, United States of America, gcoffman@ford.com

1 - The New Approach to Diet Problem

Fariborz Partovi, Professor, Drexel University, Gerri Lebow Hall. Room 726, 3220 Market Street, Philadelphia, PA, 19104, United States of America, Partovi@drexel.edu

Over the years many researchers have contributed to updating, extension, and new methodologies for solving the diet problem. However the problem with the classical models is based on lack of proper presentation of food preferences. For many people, especially when they are eating outside their home, the taste of the food may be as important as the nutrition values. In this paper we propose a new method for designing foods that are more desirable to customers and cost less to the producers.

2 - Fuzzification of the Special Simplex Method for the Transportation Problem

Gene Coffman, Technical Leader, Ford Motor Company, Manufacturing Development Center, 6100 Mercury Drive, Dearborn, MI, 48126, United States of America, gcoffman@ford.com, Stephany Coffman-Wolph

The framework for the fuzzification of algorithms can be applied to a wide variety of problems including the widely recognized transportation problem from the field of Linear Programming. This deterministic transportation problem algorithm will undergo the fuzzification process to become a fuzzy algorithm (i.e., fuzzified transportation problem). It will be demonstrated that an optimal solution to the original problem is contained within the alternative optima of the fuzzified problem.

3 - Polyhedral Results for 2-sided Stable Matchings and Ordinal Transportation

Pavlos Eirinakis, Athens University of Economics and Business, Patission 76, Athens, 10434, Greece, peir@aueb.gr, Ioannis Mourtos, Dimitrios Magos

We establish the dimension of the many-to-many stable matching (MM) polytope and its minimal equation system and facets. We utilize this analysis to provide a minimal description of the Stable Admissions (SA) polytope and the polyhedral correspondence of the known MM and SA constraints. Further, we derive an upper and a lower bound for the diameter of the Stable Marriage polytope. Finally, we provide an implicit linear representation for the ordinal transportation problem.

4 - Accounting for Risk and Pillar Recovery in MILP Room and Pillar Production Sequencing Models

Angelina Anani, Missouri University of Science and Technology, 407 E12th Street, Rolla, MO, 65401, United States of America, akakc2@mail.mst.edu, Kwame Awuah-Offei

The goal of this work is to formulate a mixed integer linear programming (MILP) model of room and pillar production sequencing that incorporates pillar recovery and project risks. The model maximizes the project's net present value and minimizing project risks while meeting all constraints.The model is solved with CPLEX using the MATLAB API. The model has been validated with a realistic mine sequencing problem. Future work will use branch-and-bound solution algorithms to solve this problem.

5 - Analytically Solving a Customer Scheduling Problem with Customer Mix Restrictions

Ridvan Gedik, Visiting Assistant Professor, Mississippi State University, 260 McCain Hall, Mississippi State, MS, 39762, United States of America, gedik@ise.msstate.edu, Chase Rainwater, Edwin Romeijn

This research examines the impact of incorporating long term customer mix preferences and operational capacity constraints on customer scheduling decisions in a facility. We propose an algorithm which generates efficient frontiers by utilizing the key concepts of post-optimality sensitivity analysis and parametric right hand side perturbation principles.

■ WD53

Hilton- Taylor A

Finance Theory and Empirics

Contributed Session

Chair: Fernando Moreira, Assistant Professor, University of Edinburgh, 29 Buccleuch Place, Edinburgh, United Kingdom, fernando.moreira@ed.ac.uk

1 - SEO Returns and the Japanese Law Reforms

Yasunori Katsurayama, Waseda University, 1-6-1 Nishi-Waseda, shinjuku-ku, Tokyo, Japan, yasunori@cf.socs.waseda.ac.jp, Keiji Abe

After 2000, book building became a familiar pricing tool for the SEO in the Japanese Market. The SEO price is determined in two weeks after the SEO announcement. Investors might be able to make profit by selling short the SEO shares in this period. As they can close their short position, after SEO, using SEO stock whose price was got cheaper by short selling. Closing of the short position using the SEO shares was prohibited in 2011. We report the CAR around the law reforms.

2 - Regulatory Capital Charges for Too-connected-to-fail Institutions: A Copula Approach

Fernando Moreira, Assistant Professor, University of Edinburgh, 29 Buccleuch Place, Edinburgh, United Kingdom, fernando.moreira@ed.ac.uk

We propose two copula-based approaches to support the calculation of regulatory capital concerning systemic risk. The main advantage of our methods over some traditional approaches is the possibility of capturing potential asymmetric and/or tail dependence across the performance of institutions. We illustrate the application of our models in the case of the largest UK financial institutions (in terms of assets) by using daily data from 2008 to 2012.

3 - Optimal Stopping Of A Credit Lending Process With Multiple Disorders

Xiaoxuan Zhang, JP Morgan, 277 Park Ave, New York, NY, 10172, United States of America, zhangxiaoxuan@live.com

We study an optimal stopping time problem that arises from the risk management of a credit lending process. The loss is driven by the borrower's credit status where multiple disorder is possible. The goal of the lender is to find a stopping strategy to maximize the expected profit, which are at risk of no payment recovery when the borrower defaults. We show that optimal stopping times forms a threshold type policy. Application in responsive energy load scheduling is also discussed.

4 - Market Adoption of Reverse Factoring

Matthew Reindorp, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, M.J.Reindorp@tue.nl, Nico Dellaert, Umberto Dello Iacono

Existing research on Supply Chain Finance (SCF) arrangements such as reverse factoring almost exclusively considers a static context, where market factors take fixed, known values. Our study links the direct benefits of reverse factoring to dynamic, interacting market factors: competition, interest rates, receivables volumes, and firms' working capital goals. We utilize System Dynamics to show that a comprehensive assessment of reverse factoring cannot neglect the evolutionary perspective.

5 - Binomial and Multinomial Tree Monte Carlo Methods for Pricing Options on Multiple Assets

Dirk Sierag, CWI, Science Park 123, Amsterdam, Netherlands, D.D.Sierag@cwi.nl, Bernard Hanzon

We propose an effective method for pricing multi-asset options by combining the efficiency of Monte Carlo simulation with the accuracy of multinomial trees. The latter are generalised from binomial trees in two directions: 1) the structure of the tree, from Pascal's triangle to Pascal's simplex; 2) the probability vector of the successor-nodes, this is a free parameter. We evaluate accurate multi-asset option prices by generating random probability vectors and corresponding multinomial trees.

■ WD54

Hilton- Taylor B

Modeling and Computations in Financial Engineering

Sponsor: Financial Services Section

Sponsored Session

Chair: Ning Cai, Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, ningcai@ust.hk

1 - Lifecycle Consumption and Investment with Illiquid Housing and Voluntary Retirement

Min Dai, National University of Singapore, Singapore, 117546, Singapore, matdm@nus.edu.sg, Hong Liu, Yingshan Chen

We consider the joint decisions of housing, stock investment, daily consumption, and voluntary retirement. We show that the investor is more aggressive in investing in both stock and house before retirement than after retirement. In the presence of shortsale constraints for stocks, our model can help explain the well known stock market nonparticipation puzzle. Furthermore our model predicts that stock investment, daily consumption rate and housing choice all jump at retirement date.

2 - The Pricing of European-type Options under Time-inhomogeneous Diffusion Processes

Yingda Song, National University of Singapore, Centre for Quantitative Finance, Block S16, 6 Science Drive 2, Singapore, 117546, Singapore, matsy@nus.edu.sg

This paper proposes a series expansion formula for European-type options under time-inhomogeneous diffusion processes. Its convergence is proved rigorously under some regularity conditions. Numerical results demonstrate that our series representation method is accurate and efficient.

3 - Optimal VWAP Tracking

Daniel Mitchell, Assistant Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, Singapore, dan.mitchell@utexas.edu, Jedrzej Bialkowski, Stathis Tompaidis

We consider the problem of finding a strategy that tracks the volume weighted average price (VWAP) of a stock, a key measure of execution quality for large orders used by institutional investors. We obtain the optimal, dynamic, VWAP tracking strategy in closed form in a model with general price and volume dynamics. We build a model of intraday volume using the Trade and Quote dataset to empirically test the strategy.

4 - Central Bank's Intervention of Interest Rates: An Impulse Control Approach

Haolin Feng, Assistant Professor, Lingnan College, Sun Yat-sen University, 135 Xin Gang Xi Road, Sun Yat-sen University, Guangzhou, 510275, China, fenghaol@mail.sysu.edu.cn, Daniel Mitchell, Kumar Muthuraman

We model the central bank's intervention of short rate as a stochastic control problem on a general class of processes. We consider fixed as well as variable intervention costs, and we develop an algorithm to numerically solve the resulted impulse control problem. We then study the effect of the intervention on longer term interest rate securities. The method developed here can be applied to a very wide range of impulse control problems beyond the realm of interest rate models.

■ WD55

Hilton- Van Ness

Chance, Inference and Robustness

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Leo Liberti, Research Staff Member, IBM Research, Yorktown Heights, NY, 10598, United States of America, leoliberti@gmail.com

1 - An Improved Lagrangian Relaxation Approach for Nonconvex Two-stage Stochastic Programs with Recourse

Paul Barton, Lammot du Pont Professor of Chemical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Ave, 66-470b, Cambridge, MA, 02139, United States of America, pib@mit.edu, Rohit Kannan

In this work, an improved Lagrangian relaxation approach, which dualizes the non-anticipativity constraints of only the continuous first-stage variables and solves the corresponding Lagrangian dual problems using nonconvex generalized Benders decomposition in a branch-and-bound framework, is proposed. An efficient implementation is outlined, and the effectiveness of the proposed decomposition approach is demonstrated through case studies.

2 - MINLP Problems in Inference of Chemical Reaction Networks

Emilio Carrizosa, Universidad de Sevilla, F. Matem·ticas, Avd. Reina Mercedes s/n, Sevilla, 41012, Spain, ecarrizosa@us.es, M Asuncion Jimenez-Cordero, Bogl·rka G Töth, Rafael Blanquero

We address the problem of finding the stoichiometric matrix and the reaction rates that best fit to the empirical concentrations given. The coefficients of the matrix are integer numbers, and the reaction rates are non negative continuous values, so the proposed optimization program is a MINLP with linear constraints, whose objective function is nonconvex and contains an ordinary differential equation term.

3 - Tight Relaxations of Non-Convex Quadratic Programs in Robust Sensitivity Analysis

Guanglin Xu, PhD Candidate, University of Iowa, S221 John Pappajohn Business Building, Iowa CIty, IA, 52242-1994, United States of America, guanglin-xu@uiowa.edu, Samuel Burer

Abstract: We study robust sensitivity analysis in LP problems where general perturbations in parameters including objective coefficients, right-hand sides, and constraint matrix entries are considered. This generality leads to non-convex quadratic programs (QPs) that are NP-hard in general. We investigate tight convex relaxations of these QPs and present preliminary computational results.

■ WD58

Hilton- Golden Gate 2

Scheduling V

Contributed Session

Chair: Hakan Gultekin, TOBB University of Economics and Technology, Sogutozu Cad. No:43, Sogutozu, Ankara, Turkey, hgultekin@etu.edu.tr

1 - Balancing Assembly Lines with Material Handling Robots

Hakan Gultekin, TOBB University of Economics and Technology, Sogutozu Cad. No:43, Sogutozu, Ankara, Turkey, hgultekin@etu.edu.tr, Burak Can Yildiz

An assembly line in which the loading/unloading of the machines and the material transportation are carried out by a single robot is considered. Each part requires a number of operations to be processed on the machines. The problem is to determine the assignment of the operations to the machines, and also to determine the sequence of robot moves that jointly minimize the cycle time. An integer programming formulation and a heuristic are developed. The effectiveness of the heuristic is tested.

2 - Significant Influential Factors in Flow Shop Research

Milton Smith, Professor, Texas Tech University, Dept. of Industrial Engineering, Mail Stop 3061, Lubbock, TX, 79409, United States of America, milton.smith@ttu.edu, Shrikant Panwalkar, Christos Koulamas

Flow shop sequencing research has been affected by several developments; no review of developments causing major impacts on research exists. NP theory, computing technology, optimizing and heuristic procedures are examined. We look at our discussion from a paper on lessons of flow shop scheduling research.

3 - Assignment and Sequencing of Multipass Assembly & Test Operations in Semiconductor Manufacturing

Zhufeng Gao, The University of Texas at Austin, 1 University Station C2200, Austin, TX, 78712-0292, United States of America, gaozhufeng@gmail.com, Jonathan Bard

We present a three-phase methodology for assigning and sequencing assembly and test operations for semiconductors. The facility in which these operations are performed is similar to a reentrant flow shop. The chips follow a specific route through the facility where each step in the route is referred to as a pass. In phase 1 lots are assigned to machines; in phase 2 they are sequenced; in phase 3 changeovers are performed. The methodology was tested using data provide by a leading manufacturer.

4 - Integrated Production and Distribution Scheduling for Fresh Agri-food Supply Chain in China

Mu Du, Dalian University of Technology, Institute of Systems Engineering, School of Management, Dalian, 116023, China, dumu.dlut@gmail.com, Xiangpei Hu, Nan Kong

Farm-to-home online retail is a fast-growing supply chain mode for fresh produce in China. Makespan, one of the most important metrics in such a make-to-order process, is highly sensitive to the production and distribution decisions. We introduce an integrated production and distribution scheduling model that minimizes the total make-span. We propose a heuristic method to solving the problem efficiently. We report a case study based on real-world business practice in China.

5 - Randomized On-line Algorithms for Throughput Maximization with Advance Informat

Ishwar Murthy, Professor, Indian Institute of Management Bangalore, Bannerghatta Road, Bangalore, 560076, India, ishwar@iimb.ernet.in, Sumit Sarkar

We consider the problem of equal length jobs that arrive at random. Further, the scheduler has advance knowledge of all jobs that will arrive over a finite horizon Ta, but no information beyond. We first present lower bounds on the competitive ratio of any randomized on-line algorithm as a function of Ta. We then present a randomized on-line algorithm that matches the lower bound.

■ WD63

Hilton- Plaza B

Decision Analysis 2

Contributed Session

Chair: Shweta Agarwal, PhD Student, London School of Economics, Houghton Street, London, WC2A 2AE, United Kingdom, s.agarwal@lse.ac.uk

1 - Sequential Exploration with Geological Dependencies and Uncertainty in Oil Prices

Babak Jafarizadeh, Statoil, Forusbeen 50, Stavanger, Ro, 4034, Norway, bajaf@statoil.com

Oil & gas prospects in vicinity are likely to share geologic features. Using these relationships, an optimal sequential drilling program can be devised. Because It takes up to a year to interpret the outcomes of a well, the variations in the forward curve may change the economics of the upcoming wells. We introduce a framework for evaluating sequential exploration strategies where prospects are geologically dependent and the uncertainty in prices is described as a meanñreverting process.

2 - Resolving Expected Utility Paradoxes with a Moving Target Partial Moments Model

Mark Schneider, University of Connecticut, 2100 Hillside Road #1041, Storrs, CT, 06269, United States of America, mark.schneider@business.uconn.edu, Robert Day, Robert Garfinkel

A model of skewness preference relative to an endogenous target is shown to explain the Allais paradoxes, favorite-longshot bias, and fourfold pattern of risk attitudes without requiring nonlinear probability transformations. The maximin payoff is shown to be a simple and natural specification for the target return in a choice set. An implication of the model is that the decision maker is risk-seeking toward upside risk and risk-averse to downside risk, relative to the target.

3 - Developing a Decision Support Tool for Evaluating Partnerships in Forest Products Value Chains

Mehdi Piltan, PhD Candidate, University of British Columbia, Department of Wood Science, Main Mall Univ, Vancouver, BC, V6T1Z4, Canada, mehdi.piltan@alumni.ubc.ca, Taraneh Sowlati

In this study we investigated the correlation between companies' characteristics and their partnering practices (types and drivers) in the context of forest product industry in Canada. Then we studied the factors contributing to the successful partnership using regression. In the second phase, we focused on one partnership to evaluate the success factors and the performance of the partnership using Analytical Network Process and Interpretive Structuring Modeling.

4 - Zero-Inflated Transformation Hazard Modeling for Corporate Bankruptcy Prediction

Shaonan Tian, Assistant Professor, San Jose State University, One Washington Square, San Jose, CA, 95192, United States of America, Aidong Ding, Yan Yu

A main challenge for modeling corporate bankruptcy prediction is the so-called "excess-zeros", that is, the number of defaults is extremely small comparing to the number of non-defaults. We propose to introduce a zero-inflated transformation hazard modeling to predict corporate default. In particular, we propose to build a mixture model framework with certain likelihood that a firm will almost surely stay at the non-bankruptcy state but otherwise follow the hazard-model framework.

■ WD64

Parc- Cyril Magnin I

Algorithms on Graphs and Trees

Sponsor: Applied Probability Society

Sponsored Session

Chair: Mariana Olvera, Columbia University, 500 W 120th Street, Suite 306, New York, NY, 10027, United States of America, molvera@ieor.columbia.edu

1 - Quick Detection of High-degree Entities in Large Directed Networks

Nelly Litvak, Associate Professor, University of Twente, PO Box 217, Enschede, 7500AE, Netherlands, N.Litvak@utwente.nl, Konstantin Avrachenkov, Liudmila Ostroumova

We suggest an efficient randomized algorithm for quick detection of high-degree entities in large online networks. Practical importance is attested by the many companies that maintain networks' statistics. Our algorithm significantly outperforms existing methods. For instance, we find the top-100 most followed users in Twitter with 92% precision using only one thousand API requests. We derive predictions for the algorithm's performance and show that its complexity is sublinear in network size.

2 - Stability of the Stochastic Matching Model

Pascal Moyal, Associate Professor, UTC, LMAC - Rue Roger Couttolenc, CS 60319, Compiégne, 60203, France, pascal.moyal@utc.fr, Jean Mairesse

We introduce what we call the 'stochastic matching model': items arrive one by one in a buffer and depart from it as soon as possible, by pairs. There is a finite set V of classes of items, and the allowed matchings by pairs depend on the classes, according to a matching graph on V. We investigate the stability of the underlying Markov chain. We show in particular that the model may be stable if and only if the matching graph is non-bipartite.

3 - Queues with Synchronization

Mariana Olvera, Columbia University, 500 W 120th Street, Suite 306, New York, NY, 10027, United States of America, molvera@ieor.columbia.edu

We study a queueing network with synchronization requirements such as those found in cloud computing implementations. When the number of servers is large, we show that the distribution of the waiting time of a job can be approximated by the solution to a branching stochastic fixed point equation. This solution can be analyzed via weighted branching processes.

4 - Ranking Algorithms on the Directed Configuration Model

Ningyuan Chen, Columbia University, 321 S. W. Mudd Building, 500 W. 120th Street, New York, NY, 100275811, United States of America, nc2462@columbia.edu

We study a family of generalized PageRank algorithms on the directed configuration model with prescribed degree distributions. We show that as the number of nodes in the graph goes to infinity, the rank of a randomly chosen node converges in distribution to the solution of a stochastic fixed point equation whose asymptotic behavior is explicit. The main tool in our analysis is a coupling of the graph with a weighted branching process whose growth is determined by the in-degree distribution.

■ WD65

Parc- Cyril Magnin II

Performance Evaluation and Optimal Policies

Sponsor: Applied Probability Society

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, ananth@engr.wisc.edu

1 - On the Inter-departure, Inter-start, and Cycle Time Distribution of Closed Queueing Networks

Svenja Lagershausen, Dr., Leibniz Universitaet Hannover, Koenigsworther Platz 1, Hannover, 30167, Germany, svenja.lagershausen@prod.uni-hannover.de, Baris Tan

We present a method to determine the exact inter-departure, inter-start and cycle time of closed queueing networks that can be modeled as Continuous-Time Markov Chains with finite state space. The method is based on extending the state space to determine the transitions that lead to a departure or an arrival of a part on a station using a first passage time analysis. We consider closed-loop production lines with phase-type service time distributions and finite buffers.

2 - Optimal Service Rate & Servers in Closed Finite Queueing Networks

James MacGregor Smith, Professor, University of Massachusetts, 874 North Pleasant Street, Amherst, MA, 01002, United States of America, jmsmith@ecs.umass.edu

Many manufacturing and service systems service rates & servers require care in determining their optimal values. Because of blocking in closed finite queueing systems, this service rate & server allocation issue is a challenging nonlinear optimization problem. A new decomposition method together with a nonlinear sequential quadratic optimization algorithm is demonstrated for solving this problem in series, merge, and split topologies.

3 - Optimal Purification Strategies Based on Quality-Yield Tradeoffs in Biomanufacturing Operations

Tugce Martagan, University of Wisconsin-Madison, Engineering Centers Building, Madison, WI, 53705, United States of America, martagan@wisc.edu, Ananth Krishnamurthy

We develop an infinite horizon Markov decision model to minimize costs of purification operations in biomanufacturing. The model considers quality-yield tradeoffs, and identifies the best equipment selection (chromatographic technique) and operating policy (pooling window) to minimize purification costs, and penalty costs for not meeting the demand or quality requirements.

4 - Score Based Anticipative Transfer Requests in the Intensive Care Units

Guodong Pang, Penn State University, College of Engineering, University Park, PA, United States of America, gup3@engr.psu.edu, Yasin Ulukus, Andrew Schaefer, Gilles Clermont

The efficient operation and management of ICUs is critical to providing high quality of care while managing costs. We construct a new Transfer Score to estimate readmission and death probabilities. We further show that an anticipative transfer request policy combined with effective use of clinical markers can significantly decrease transfer delays without increasing the capacity. We present a Markov Decision Process (MDP) model for the transfer request problem and solve it via approximations.

■ WD66

Parc- Cyril Magnin III

Decision Analysis Approaches and Predictive Modeling to Managing Uncertainty in Manufacturing and Service Systems Design & Operations

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Zhenyu Kong, Associate Professor, Virginia Tech, 1145 Perry Street, Blacksburg, VA, 24061, United States of America, zkong@vt.edu

1 - A Novel Method for Monitoring of Image Sequences

Kamran Paynabar, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, 30327, United States of America, kamran.paynabar@isye.gatech.edu, Hao Yan, Jianjun Shi

We present a novel monitoring method for monitoring and anomaly detection in image sequences and videos using the sparse-smooth decomposition (SSD). SSD significantly reduces the dimensions of images leading to more effective process monitoring. Using empirical data, we show the efficacy of the proposed method in terms of the detection power and computational speed.

2 - Prediction of Tissue-engineered Scaffold Degradation using Constrained Gaussian Processes

Li Zeng, Assistant Professor, University of Texas - Arlington, 500 West First Street, P.O. Box 19017, 4, Arlington, TX, 76019, lzeng@uta.edu, Xinwei Deng

Degradation prediction is a critical problem in tissue-engineered scaffold fabrication to produce products with desirable properties for the development of engineered tissues/organs. This research develops a constrained Gaussian Process approach for scaffold degradation prediction.

3 - Robust Predictive Modeling through Self-organized Variable Clustering

Gang Liu, Graduate Student, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, gliu@mail.usf.edu, Hui Yang

In the literature, the problem of variable clustering was not well-addressed especially when nonlinear and unsymmetrical dependence involved. In this paper, we propose a novel self-organizing algorithm to cluster variables with nonlinear and unsymmetrical dependence. The experimental results show that our method outperforms the previous methods. Further, the self-organized clusters of variables will be utilized in the predictive models to have a robust performance.

4 - Heterogeneous Sensor Data Fusion for Real-time Monitoring in Additive Manufacturing (AM) Process

Prahalad Rao, Assistant Professor, The State University of New York at Binghamton, Binghamton, NY, United States of America, prahalad.k.rao@gmail.com, Zhenyu Kong

In this talk, we present a non-parametric Bayesian analysis, namely, Dirichlet Process (DP)-based evidence theoretic decision-making approach for real-time process monitoring in Fused Deposition Modeling (FDM) Additive Manufacturing (AM) process using data from multiple, heterogeneous sensors.

■ WD67

Parc- Balboa

Gaussian Process and Spatial Data Analysis (II)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Chia-Jung Chang, Assistant Professor, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16802, United States of America, cchang@psu.edu

Co-Chair: Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall,, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

1 - Penalized Quantile Asymmetric Laplace Process Model for Computer Experiments

Yufan Liu, Dun & Bradstreet, Short Hills, NJ, 07078, United States of America, liuyuf@dnb.com, Ying Hung

Despite numerous research on computer experiment modeling, how to model conditional quantiles of the response and identify the corresponding important variables remain unresolved. In this talk, we present a new framework to address these issues.

2 - Spatial Data Classification in Biomedical Thermal Images

Xinwei Deng, Assistant Professor, Virginia Tech, 250 Drillfield Drive, 211 Hutcheson Hall, Blacksburg, VA, 24061, United States of America, xdeng@vt.edu, Ran Jin

In biomedical thermal image analysis, feature extractions and selections are widely used for image classification. However, useful information can be lost due to improper feature generations and selections. In this work, we present a novel method to perform image classification through spatial modeling. The proposed method not only provides good prediction, but also gives meaningful interpretation. The performance of the proposed method is evaluated by using organ thermal images.

3 - Statistical Surface Monitoring by Spatial-Structure Modeling

Andi Wang, HKUST, Academic Bldg 4223, HKUST, Hong Kong, Hong Kong - PRC, awangab@ust.hk, Kaibo Wang, Fugee Tsung

Surface data occurs frequently in manufacturing processes, but existing control charts in profile monitoring are not suitable for monitoring surfaces. In this research we propose a new chart based on the Gaussian-Kriging model that considers several surface patterns. We compare performance of this chart with that of an existing profile monitoring method through simulation.

4 - Profile Modeling for Geometric Shapes with Spatially Correlated Errors

Sobambo Sosina, Harvard University, Cambridge, MA, United States of Amaerica, sosina@fas.harvard.edu, Arman Sabbaghi, Qiang Huang, Tirthankar Dasgupta

We consider the problem of modeling profiles of geometric shapes which have spatially correlated error terms. We propose a maximum likelihood estimation procedure under a spatial autoregressive error model and demonstrate the procedure with applications from graphene synthesis and 3D-printing.

■ WD68

Parc- Davidson

Agent-Based Computational Models of Economic and Financial Processes

Sponsor: Simulation

Sponsored Session

Chair: Robert Axtell, Chair, Department of Computational Social Science, George Mason University, 4400 University Drive, Fairfax, VA, 22102, United States of America, rax222@gmu.edu

1 - Alternatives to Ideal Rationality

Steve Kimbrough, Professor, Department of Operations and Information Management, The Wharton School, 565 Huntsman Hall, Philadelphia, PA, 19104, United States of America, kimbrough@wharton.upenn.edu, Frederic Murphy

Ideal rationality models pervade economics and game theory. Such models have always been considered to be unrealistic in their assumptions regarding agent capabilities, except in special circumstances. A main reason that has been expressed for their continued use, even their continued prominence, is the lack of attractive alternatives. We review the scene and present a number of attractive minimal rationality" alternatives for modeling in economics and game theory.

2 - Agent-based Models of Microstructure for Order-driven Markets

Andrew Todd, PhD Candidate, University of Virginia, Dep't. of Systems and Info Engineering, 151 Engineer's Way, Charlottesville, VA, 22904, United States of America, aetodd@gmail.com, Matt Burkett, Roy Hayes, Peter Beling, William Scherer

Regulators and policy makers, facing a complicated, fast-paced and quickly evolving marketplace, require new tools and decision aides to inform policy. Agent-based models, which are capable of capturing the intricacies of market mechanisms and the heterogeneity of market participants, offer a powerful method for understanding the financial marketplace. We improve an existing statistical microstructure model by systematically introducing deterministic strategic behavior.

3 - A Multi-factor Model of Heterogeneous Traders in a Dynamic Stock Market

Dong-Jin Pyo, PhD Candidate, Iowa State University, Department of Economics, Ames, IA, 50011, United States of America, djpyo@iastate.edu

This study develops a computational stock market model in which each trader's buying and selling decisions are endogenously determined by multiple factors: namely, firm profitability, past stock price movement, and imitation of other traders. Each trader can switch from being a buyer to a seller, and vice versa, depending on market conditions. Simulation findings demonstrate that this model can generate many stylized facts regarding stock returns and volume of trade.

4 - The U.S. Housing Market Bubble: Why it Happened and How it Could Have Been Avoided

Robert Axtell, Chair, Department of Computational Social Science, George Mason University, 4400 University Drive, Fairfax, VA, 22102, United States of America, rax222@gmu.edu

An agent-based model of a city has been built, consisting of a large population of households and a corresponding stock of housing, in order to study house price bubbles. We have instantiated the model for the Baltimore-Washingtion, D.C. metro area. We demonstrate that low interest rates had little to do with the bubble but rather relaxed lending were the proximate cause of the take off phase of the bubble, and later responsible for its bursting.

■ WD69

Parc- Fillmore

Pollution Regulation and Abatement

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Francois Giraud-Carrier, Assistant Professor, University of Illinois Springfield, College of Business and Management, One University Plaza, UHB MS 4021, Springfield, IL, 62703, United States of America, fgira2@uis.edu

1 - Pollutant Abatement Investment under Ambiguity in a Two-Period Model

Motoh Tsujimura, Associate Professor, Doshisha University, Kamigyo-ku, Kyoto, 602-8580, Japan, mtsujimu@mail.doshisha.ac.jp

This paper investigates a pollutant abatement investment under ambiguity in a two-period setting. We consider there are representative consumer and firm in an economy and formulate the social welfare maximization problem. Then we derive the optimal level of abatement investment. Furthermore, we analyze the comparative static effects of the model's parameters.

2 - Model Design and Environmental Study on Radiative Forcing and Climate Change

Cheng-Marshal Wang, Cheng-Marshal.Wang@ec.gc.ca

I will introduce some primary study on how to model the economic impacts of Polar Vortex. First we will review what has happened of extreme cold in North American last winter. Is this a counter example of global warming? Then we will review our primary studies on modelling RCP scenarios in the climate module of our Integrated Assessment Model (IAM). The four RCPs are named after a possible range of Radiative forcing values in the year 2100 relative to pre-industrial values.

3 - Does Cap-and-Trade Enable Collusion?

Francois Giraud-Carrier, Assistant Professor, University of Illinois Springfield, College of Business and Management, One University Plaza, UHB MS 4021, Springfield, IL, 62703, United States of America, fgira2@uis.edu, Krishnan Anand

Carbon Taxes and Cap-and-Trade are the two leading approaches for pollution regulation. Proponents of Taxes have argued that Cap-and-Trade could facilitate collusion among firms via the trading mechanism, leading to suboptimal welfare outcomes. We examine this claim using a rigorous yet rich model of production and pollution under competition that allows for the possibility of collusion among firms via a market exchange for emission allowances.

4 - Incentives to Invest in Pollution Abatement Innovations

Krishnan Anand, Associate Professor, University of Utah, 1655 E Center Campus Dr, Salt Lake City, UT, 84112, United States of America, k.anand@utah.edu, Francois Giraud-Carrier

We analyze and compare three popular pollution control mechanismsóa strict pollution cap, a cap-and-trade system, and an emission taxóin a two-stage model in which the regulated firms first choose between two abatement technologies, and then produce a good or service with pollution as a byproduct. We find that the emission tax is a superior mechanism for many important performance measures.

■ WD70

Parc- Hearst

Forecasting 1

Contributed Session

Chair: Murat Fadiloglu, Professor, Yasar University, Department of Industrial Engineering, Yasar University Bornova, Izmir, 35100, Turkey, murat.fadiloglu@yasar.edu.tr

1 - Probabilistic Forecasting of Wind Power Ramps using Autoregressive Models

James Taylor, Professor, University of Oxford, Said Business School, Park End Street, Oxford, OX1 1HP, United Kingdom, james.taylor@sbs.ox.ac.uk

A challenge for the efficient operation of a wind farm is the occurrence of ramps, which are sudden large changes in generated power. We consider the probabilistic forecasting of a ramp, which we define as exceedance, beyond a chosen threshold, of hourly changes. We fit new autoregressive logit models, including a multinomial logit model that simultaneously estimates the ramp probabilities for different thresholds, and another that jointly models the ramp probability at more than one wind farm.

2 - The Influence of Weather in Online Retailing – An Empirical Analysis

Sebastian Steinker, Kühne Logistics University, Grofler Grasbrook 17, Hamburg, HH, 20457, Germany, Sebastian.Steinker@the-klu.org, Kai Hoberg

We incorporate weather data into the sales forecasting of the largest European online fashion retailer. Using weather forecasts we are able to improve the sales forecasting accuracy (measured as the mean absolute percentage error (MAPE)) by an incremental 62.4% on summer weekends. These considerable improvements in forecast accuracy may have an important impact on logistics and warehousing operations.

3 - A Close Investigation on Spare Parts Demand Patterns and Their Inventory Implications

Laura Turrini, PhD Student, Kühne Logistics University, Grofler Grasbrook 17, Hamburg, Germany, Laura.Turrini@the-klu.org, Joern Meissner

Spare parts are essential for many companies, but an effective management of their inventories is often very challenging due to their slow-moving and erratic demand,that almost never follows the commonly used Normal distribution. We study the case of a German worldwide leader in the wind-turbines market and analyze their weekly demand patterns in the last three years.We focus on testing the right tails of the distribution, a crucial element to implement a successful inventory management system.

■ WD72

Parc- Stockton

Energy VII

Contributed Session

Chair: Khashayar Mahan, Rutgers University, 1507 Azalea Drive, North Brunswick, NJ 08902, United States of America, mahani.khashayar@gmail.com

1 - Renewable Energy Export Planning under Uncertainty

Ebisa Wollega, Doctoral Candidate, University of Oklahoma, 202 W. Boyd St., Norman, OK, 73019, United States of America, ebisa@ou.edu, Soumyadip Ghosh, Ali Koc, Mark Squillante

In this presentation, we address a wind-hydro integrated energy that is exported as part of a day-ahead plan under stochastic demand and various wind supply scenarios. A profit maximization planning problem is formulated and its solution is computed via a stochastic gradient algorithm. From a practical perspective, renewable energy industry stakeholders can use the techniques we present to make optimal export planning decisions under uncertainty.

2 - Fast Pyrolysis Facility Investment Valuation via A Real Options Approach

Yihua Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, yihuali@iastate.edu, Chung-Li Tseng, Guiping Hu

The valuation of a fast pyrolysis facility investment at a predetermined location is studied under the consideration of multiple uncertainty factors. A real options approach takes into account the managerial options, e.g. optimal investment timing and optimal operating decisions, and maximizes expected gross present value of the project.

3 - Robustness of Renewable Energy Support Schemes Facing Operational and Regulatory Uncertainty

Ingmar Ritzenhofen, WHU - Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, ingmar.ritzenhofen@whu.edu, Stefan Spinler, John Birge

Renewable portfolio standards and feed-in-tariffs are widely used policy instruments to promote investments in renewable energy sources. Regulators continuously evaluate these instruments along the main electricity policy objectives ñ affordability, reliability, and sustainability. We quantitatively assess these policies along these dimensions using a long-term electricity capacity expansion model and compare their robustness in the light of uncertain renewable feed-in and future regulation.

4 - Comparison of Modeled and Actual Power Interchanges for the Eastern U.S.

Emily Fisher, Lawrence Berkeley National Lab, One Cyclotron Rd, MS 90R4000, Berkeley, CA, 94720, United States of America, esfisher@lbl.gov, Alan H. Sanstad

Planning models used in the electricity industry employ a variety of simplifications in order to make representations of the complex electricity system more tractable. One way to examine the impact of these simplifications is to compare the model results to actual data. In this talk we present a comparison of regional interchanges resulting from a resource expansion planning model to scheduled and actual system flows in the Eastern United States.

5 - Heuristic Optimization Technique for Storage Control with High Penetration of Renewables

Khashayar Mahan, Rutgers University, 1507 Azalea Drive, North Brunswick, NJ 08902, United States of America, mahani.khashayar@gmail.com,Mohsen Jafari

Finding near-optimal control schemes for energy storage units has always been a challenge for power utilities. We consider a microgrid with high penetration of renewable resources, such that renewable output may exceed system load from time to time. The reverse flow of renewable output could cause damage to distribution infrastructure. Energy storage can be used in such systems to not only absorb the excessive power from renewable but also reduce energy purchase from the grid during peak hours.

■ WD73

Parc- Mission I

Integrating High Resolution Spatial Data and Optimization Models for Energy Production/distribution Analysis

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: T. Edward Yu, Assistant Professor, University of Tennessee, 2621 Morgan Circle, 314A Morgan Hall, Knoxville, TN, 37996-4518, United States of America, tyu1@utk.edu

1 - Economic Impact of a Renewable Fuels Biorefinery Expansion: A Case Study in Mississippi

Burton English, Professor, The University of Tennessee, 2621 Morgan Circle, Knoxville, TN, 37996-4518, United States of America, benglish@utk.edu, Lixia He, T. Edward Yu, Brad Wilson, R. Jamey Menard

An advanced renewable fuels company has developed a proprietary technology platform to convert biomass into renewable oil used for gasoline, diesel and fuel oil blendstocks. The company now plans to double the production of its cellulosic fuel facility. This study aims to locate the residues from existing softwoods to meet expanding feedstock demand and to estimate feedstock harvesting costs. The regional economic impact from the transactions of softwood residues will also be assessed.

2 - Optimizing Economic and Environmental Performance of Advanced Biofuel Supply Chains in Tennessee

T. Edward Yu, Assistant Professor, University of Tennessee, 2621 Morgan Circle, 314A Morgan Hall, Knoxville, TN, 37996-4518, United States of America, tyu1@utk.edu, Lixia He, Burton English, James Larson

Given the surging pressure of making advanced biofuels empirically feasible in the US, a growing number of studies have integrated decision models with spatial data in the recent literature of biofuel supply chains. The present study identifies the crucial factors affecting the profit and greenhouse gas of switchgrass biofuel supply chains in Tennessee using a high-resolution GIS-based optimization model. The optimal location of feedstock area, refineries and blending sites are also determined.

3 - Renewable Energy and Carbon Capture and Storage: A Cost-Benefit Analysis of Technologies

Andrew Arnette, Assistant Professor, University of Wyoming, Laramie, Wyoming, United States of America aarnette@uwyo.edu

Built on a framework that combines GIS and a multi-objective optimization modeling that has been used to analyze costs and benefits of renewable energy sources (wind farms, solar farms, biomass co-fire, rooftop solar), this research introduces the potential for carbon capture at coal plants and the potential for storage of carbon in underground locations. The aim of this research is to provide a model that can allow for the comparison of greenhouse gas emission-reducing technologies.

4 - Refining the Economic Potential of Biofuel Production with CCS using Spatially-explicit Modeling

Nathan Parker, Postdoctoral Researcher, Institute of Transportation Studies, University of California, Davis, Institute of Transportation Studies, 1715 Tilia Street, Davis, CA, 95616, United States of America, ncparker@ucdavis.edu, Joan Ogden, Nils Johnson

To limit global warming to 2 degrees C, it is likely that net anthropogenic CO2 emissions will eventually need to go negative. One of the most promising options for achieving negative emissions is the production of electricity or fuels using biomass with carbon capture and storage. This project combines a spatially-explicit biorefinery siting model with a spatially-explicit CO2 transport and disposal model to optimize the deployment of biofuel production with CCS in the United States.

■ WD74

Parc- Mission II

Modern Optimization Techniques for Fundamental Computation Problems in Power Systems

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

1 - Spatial Branch-and-Bound for the Alternating Current Optimal Power Flow Problem

Chen Chen, University of California, Berkeley, 1561 Arch St., Berkeley, CA, 94708, United States of America, chenchen@berkeley.edu, Alper Atamturk, Shmuel Oren

Optimal Power Flow (ACOPF) is a problem of finding minimum-cost electric generation dispatch subject to network constraints. We develop a novel spatial branch-and-bound approach for ACOPF. We derive valid inequalities to strengthen the typical SDP relaxation, and introduce bound-tightening procedures based on the convex hull of certain nonconvex constraints. Experiments on IEEE test cases up to 118 buses help establish some intuition regarding conditions that may cause duality gap.

2 - Convex Relaxation for Optimal Power Flow Problem: Mesh Networks

Javad Lavaei, Assistant Professor, Columbia University, 120th St, New York, NY, 10027, United States of America, lavaei@ee.columbia.edu, Somayeh Sojoudi, Ramtin Madani

This talk is concerned with the optimal power floow (OPF) problem. We have recently shown that a semidefinite programming (SDP) relaxation is able to find a global solution of OPF over acyclic networks. The present work proposes a penalized SDP relaxation to find a near-global solution for mesh networks. The remarkable performance of this technique will be demonstrated on IEEE systems with more than 7000 different cost functions.

3 - New SOCP Relaxations for ACOPF Problem

Burak Kocuk, Georgia Institute of Technology, 765 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, burak.kocuk@gatech.edu, Santanu Dey, Andy Sun

In this work, we first present several examples where existing methods fail to solve ACOPF to global optimality even in the case of radial networks. Then, we propose two SOCP relaxations for ACOPF problem, which are targeted to solve radial and mesh networks. We come up with some heuristics to construct feasible solutions and give an MISOCP formulation, which can approximate a global optimal solution to arbitrary accuracy. Finally, extensive numerical analysis is provided.

4 - Large-scale Decentralized Unit Commitment

Mohammad Javad Feizollahi, Phd Candidate, Georgia Institute of Technology, 765 Ferst Drive NW, Suite 439 (main building), Atlanta, GA, 30332-0205, United States of America, feizollahi@gatech.edu, Santiago Grijalva, Mitch Costley, Shabbir Ahmed

A method for formulating and solving a decentralized unit commitment problem is presented in this work. The method, which extends the ADMM, is presented along with several heuristics to mitigate nonconvexity challenges, oscillations and traps in local solutions. We present the promising results from testing the method on large-scale power systems. The results suggest that this method is a practical option for use with large systems and may provide a significant benefit for computational speed.

■ WD75

Parc- Mission III

Simulation II

Contributed Session

Chair: Diana Pfeil, OptTek Systems, Inc, 2241 Seventeenth Street, Boulder, CO, United States of America, pfeil@opttek.com

1 - Comparison and Validation for Twospotted Spider Mites System

Yan Kuang, PhD Candidate, Kansas State University, 2020 Tunstall Cr, Apt. 31, Manhattan, KS, 66502, United States of America, ykuang@ksu.edu

The twospotted spider mite, Tetranychus urticae, is one of the most serious pests that cause damage to crops. Its predator, a mite of the family Phytoseiulus persimilis, plays an important role in keeping the spider mites population under control. There are many mathematical models for their system. The purpose of the work is to validate the models by fitting experimental data. The results are discussed from both the mathematical and the epidemiological perspective.

2 - Machine Learning Methods for Insightful Simulation Optimization

Diana Pfeil, OptTek Systems, Inc, 2241 Seventeenth Street, Boulder, CO, United States of America, pfeil@opttek.com

Simulation optimization is used to automatically find optimal or near-optimal parameter settings for a simulation model. Typically, these optimal settings do not yield insight into the simulation model or the parameter space. We introduce OptAnalysis, a suite of machine learning and analysis tools to automate the discovery of influential variables, to identify and characterize multiple good and bad regions of the model tradespace, and to classify the robustness of point solutions and regions.

3 - Health Care Supply Chain Coordination – Service Improvement and Cost Saving through Collaboration

Eike Nohdurft, WHU - Otto Beisheim School of Management, Burgstrasse 2, Vallendar, 56179, Germany, eike.nohdurft@whu.edu, Stefan Spinler

Facing enduring cost pressure, the health care industry has not yet applied supply chain (SC) management methods like collaborative forecasting and planning which improved SC performance in other industries. A model quantifying the impact of such an application in the health care sector is missing. This paper aims to close this gap through quantifying the corresponding impact on SC performance in health care. The study is based on a 3-tier downstream SC simulation using patient demand data.

■ WD76

Parc- Embarcadero

New Analytics Frontiers in Retail

Sponsor: The Practice Track

Sponsored Session

Chair: Paritosh Desai, paritosh.desai@stanfordalumni.org

1 - New Analytics Frontiers in Retail

Paritosh Desai, paritosh.desai@stanfordalumni.org

This talk will focus on some of the emerging needs for applying data science in the field of Retail. We will explore a range of decisions within the retail sector and then focus on some of the techniques for making good decisions.

2 - Personalizing Recommendations for Ubiquitous Shoppers – Challenges in Recommender Systems in Retail Setting

Shilad Sen, Assistant Professor, Macalester College, St. Paul, MN, United States of America, ssen@macalester.edu, Ramasubbu Venkatesh

Retail product recommendations have transcended simple associations like beer and diapers. Product recommendations now shape customer interactions across tremendously diverse channels: browsing store aisles, navigating a website, or redeeming a mobile coupon. These contexts produce rich, heterogenous datasets capturing a customer's clicks, purchases, searches, and sentiment. Data scientists charged with extracting value from these customer interactions face a bewildering sea of datasets and algorithms. This talk will outline common product recommendation scenarios and touch upon challenges for providing robust recommendations.

■ WD77

Parc- Market Street

Analytics at its BEST

Sponsor: Analytics

Sponsored Session

Chair: Tarun Mohan Lal, Senior Health Services Analyst, Mayo Clinic, Robert D. and Patricia E. Kern, Rochester, MN, United States of America, mohanlal.tarun@mayo.edu

1 - Analytics for Monitoring and Evaluation of Water Supply Sanitation and Hygiene (WASH)

Darshan Desai, Professor, Larry L. Luing School of Business, New York, NY, 10017, United States of America, darshudesai@gmail.com

In the world of business, analytics and "big data" have created huge hype. However, the field of international development, more specifically, the water supply sanitation and hygiene (WASH) sector lagged behind in applying analytics. Billions of poor people still lack access to the basic water and sanitation services. The WASH sector has chronically faced a wide range of diverse and complex challenges. In such scenarios, we'll discuss ways of applying analytics to create better future.

2 - The Five Minute Analyst
Harrison Schramm, Campaign Analysis Deputy, OPNAV N81, 1507 22nd Street South, Arlington, VA, 22202, United States of America, Harrison.Schramm@gmail.com

The Five Minute Analyst, appearing in INFORMS/Analytics Magazine, has, for the past 3 1/2 years looked at everyday, bite-sized problems through an Analytics lens. This presentation consists of 5-minute long vignettes, representing the 'best of'. How many Legos fit in a Brickbox? What's the best line position for airline seating? How can you tell if a long-running sports rivalry is fair? What were the odds of winning Buffet's Billions? Important note: There will be Zombies.

3 - Predicting Patent Litigations
Papis Wongchaisuwat, IEMS, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, papiswongchaisuwat2013@u.northwestern.edu, John Oldham McGinnis, Diego Klabjan

Patents form the backbone of intellectual property and as such are a common target of litigations. By using patents, court documents of litigations, and additional external data sources we develop a prediction model. Its accuracy for several keywords is approximately 75%.

4 - Large-scale Optimization with MapReduce
Alexandros Nathan, Northwestern University, 2145 Sheridan Road, Room C210, Evanston, IL, 60208, United States of America, alexandrosnathan2012@u.northwestern.edu, Diego Klabjan

In the age of Big Data, the need to train massive statistical models is ever-increasing. Parallel computing is arguably the most efficient way to train such models. In this work we use MapReduce, the popular programming paradigm, to develop parallel optimization algorithms for solving linear regression and binary classification problems. We conduct numerical experiments for different optimization methods and analyze their performance.

■ WD78

Parc- Mason

Decision Support Systems 2

Contributed Session

Chair: Sara Nourazari, PhD Candidate, Northeastern University, 360 Huntington Ave, Boston, MA, 02115, United States of America, s.nourazari@neu.edu

1 - Engineering Control of Appointment Access with Capacity Adjustment Time Delays
Sara Nourazari, PhD Candidate, Northeastern University, 360 Huntington Ave, Boston, MA, 02115, United States of America, s.nourazari@neu.edu, James Benneyan, Rifat Sipahi

Long waits to receive care plagues many patients and healthcare systems. While access delay is a quality care measure for timely service, it is also an indication of how well a healthcare system synchronizes utilization of resources and its patients' demands. This work proposes a semi-real time queue management approach for health systems with inherent time delays in service capacity adjustments.

2 - A Life Cycle-Based Framework to Support Energy Resource Use Decisions: Application to Oil Sands Coke
Jennifer McKellar, Assistant Professor, University of Ontario Institute of Technology, 2000 Simcoe Street North, Oshawa, ON, L1H 7K4, Canada, jennifer.mckellar@uoit.ca, Janne Kettunen, Heather MacLean, Joule Bergerson

A Decision-Support Framework is developed, combining two-stage life cycle assessment and life cycle costing analyses, feasibility screening and stakeholder preference analysis. As a case study, the Framework is applied to oil sands by-product coke. In the base case, selling coke to China for electricity generation performs best financially (NPV of $55/t coke). The Framework can inform strategic decisions on energy resource use and facilitate discussion internally and among stakeholders.

3 - Financial Decision Support in a Local Government
Armando Mendes, Professor, Azores University, Rua da Mae de Deus, Ponta Delgada, 9501-801, Portugal, amendes@uac.pt, Hugo Rego, Hélia Guerra

In a local government organization, management decisions are based on guidelines provided by areas of expertise. Thus, it is intended to create a Decision Support System for providing financial indicators to support management decisions. For this it is necessary to load the data for indicators creation from the IS in use on the organization. Then, tendencies and seasonality factors are identified by means of a forecasting model. These information will be accessible using an appropriate interface

■ WD79

Parc- Powell I

Project Analytics

Sponsor: Decision Analysis

Sponsored Session

Chair: Janne Kettunen, Assistant Professor, The George Washington University School of Business, 2201 G Street, NW, Funger Hall 415, Washington, DC, 20052, United States of America, jkettune@gwu.edu

1 - Causal Network Methods for Project Risk-Based Decision Analysis
Paul Govan, PhD Candidate, Texas A&M University, 3136 TAMU, College Station, TX, 77843, United States of America, pgovan1@neo.tamu.edu, Ivan Damnjanovic

The goal of this research is to develop a hybrid causal network methodology for general project risk-based decision making. The network method identifies causal relationships among events and conditions and integrates opinions with the observed data. The causal model also helps identify risk-related dependencies given varying levels of information and promote organizational learning by identifying what data to collect in order to create value for the organization.

2 - Estimation and Mitigation of Downside Risk in Project Portfolio Selection
Janne Kettunen, Assistant Professor, The George Washington University School of Business, 2201 G Street, NW, Funger Hall 415, Washington, DC, 20052, United States of America, jkettune@gwu.edu, Ahti Salo

We show that uncertainties in project portfolio selection have major implications for the development of risk estimates about portfolio value. To improve the accuracy of risk estimates, we propose the use of calibration curves which can be derived by analyzing past selection processes or by simulating the portfolio selection process. We also consider the introduction of risk constraints, but show that this approach may yield risk estimates which are too optimistic.

3 - EDM, an Innovative Approach to Schedule and Duration Estimation, Management and Control
Homayoun Khamooshi, Chair Project Management Program, George Washington University, Room 408, Funger Hall, 2201 G Street, NW, Washington, DC, 20052, United States of America, hkh@gwu.edu

Schedule control in comparison to cost control has not been fully exploited in projects and project management environments (PMOs). In contrast to Earned Value and Earned Schedule, we have developed the Earned Duration Management (EDM) in which we have decoupled schedule and cost performance measures and developed a number of indices to measure efficacy and efficiency of the schedule and planned duration at any level of the project. These tools can be used by contractors and clients alike.

4 - Strategic Risk Management
Ernest Forman, Professor, George Washington University, Decision Sciences, Washington, DC, 20052, United States of America, forman@gwu.edu

A framework and methodology for strategic risk management, including risk identification, risk assessment, and risk treatment/mitigation/response will be presented. The process includes the derivation of ratio scale measures of the likelihood and impact of risk events, effectiveness of controls to reduce risks, and the allocation of resources to reduce risk.

■ WD80

Parc- Powell II

Behavioral Decision Making

Sponsor: Decision Analysis

Sponsored Session

Chair: Matthias Seifert, Assistant Professor of Quantitative Methods, IE Business School, Maria de Molina 12 5∞, Madrid, 28006, Spain, Matthias.Seifert@ie.edu

1 - Research on Near Miss Events and Risky Choice: Challenges and Opportunities
Florian Federspiel, PhD Candidate, IE Business School, Maria de Molina 12, Bajo, Madrid, 28006, Spain, ffederspiel.phd2014@student.ie.edu, Matthias Seifert

We focus on the issues of definitional clarity and scope in defining near miss events and the ability to account for different kinds of near miss events in explaining differing risk perception and risky choice. We propose a new definition to bridge extant research from distinct fields and offer a conceptual framework that opens the way for further research on risk perception and risky choice following near miss events.

2 - Gender Bias in Hiring Decisions: The Role of Decoy Effects
Wenjie Tang, Assistant Professor, IE Business School, Calle de Maria de Molina 12, Piso 5, Madrid, 28006, Spain, Wenjie.Tang@ie.edu, Steffen Keck

Drawing on prior research on decoy effects, we suggest that a joint evaluation of candidates might introduce a new form of bias that could amplify the existing gender bias. In a laboratory experiment we find that the presence of asymmetrically dominated applicants in the choice set strongly increases the odds of a male applicant to be chosen, but does only have only very little positive effect for a female applicant and thus leads to a strong gender bias in participants' hiring decisions.

3 - Risky Business (for Women): understanding the Gender Gap in Risk-Taking Behavior
Susan Fisk, PhD Candidate, Stanford University Sociology Department, 450 Serra Mall, Building 120, Room 031, Stanford, CA, 94305, United States of America, sfisk@stanford.edu, Ross Shachter

It is a well-established fact that women take fewer risks than men, a disparity which has largely been attributed to gender differences in risk preferences. We explore the role that social forces play in women's and men's risk-taking decisions; specifically, we examine how gendered beliefs and expectations may cause women to experience greater sanctions when they take a risk and fail, and how these harsher consequences may cause women to experience greater negative affect in risky settings.

■ WD81

Parc- Divisadero

Data Mining in Renewable Energy

Sponsor: Data Mining

Sponsored Session

Chair: Zijun Zhang, Assistant Professor, City University of Hong Kong, SEEM Department, P6600, 6/F, Academic 1, Kowloon Tong, Hong Kong - PRC, zijzhang@cityu.edu.hk

1 - Wind Turbine Power Curve Monitoring and Clustering Analysis
Zhe Song, Associate Professor, Nanjing University, Business Adminstration Department, School of Business, Nanjing, China, zsong1@nju.edu.cn

The power curves are constructed using historical wind turbine data. Power curve models are developed by the least squares method or the other by the maximum likelihood estimation method. The models are solved by an evolutionary strategy algorithm. Power curve model is used for on-line monitoring of the power curve to identify abnormal data points. These abnormal data points are further analyzed by clustering algorithms to identify similar patterns which could be used for fault analysis.

2 - Plug-in Electric Vehicle (PEV) Load Pattern Analysis: A Data-mining Approach
Kai Yang, Director, Healthcare Systems Engineering Group, Wayne State University, 4815 4th Street, Detroit, MI, 48201, United States of America, kai.yang@wayne.edu, Anoop Verma, Satish Tyagi

The usage patterns of EVSE charging affects the overall electricity load and thus poses challenges to utility companies. There is a need to identify users with EVSE to better manage the load distribution. Analysis of load usage data with an aim to isolate the residential and aggregate usage patterns is targeted. The approach developed is tested and validated on real world data obtained from a regional utility company

3 - Optimization of Wind Power and Its Variability with a Computational Intelligence Approach
Zijun Zhang, Assistant Professor, City University of Hong Kong, SEEM Department, P6600, 6/F, Academic 1, Kowloon Tong, Hong Kong - PRC, zijzhang@cityu.edu.hk

An optimization model is presented for maximizing the generation of wind power while minimizing its variability. In the optimization model, data-driven approaches are used to model the wind-power generation process based on industrial data. A new constraint is developed for governing the data-driven wind-power generation model based on physics and statistical process control theory. Computational intelligence algorithms are utilized to solve the optimization model.

4 - Application of Computational Intelligence in Modeling and Optimization of HVAC Systems
Mingyang Li, University of Arizona, 1127 James E. Rogers Way, Tucson, AZ, 85721, United States of America, mingyangli@email.arizona.edu

HVAC (Heating Ventilating and Air-Conditioning) system is multivariate, nonlinear, and shares time-varying characteristics, posing challenges for both system modeling and optimization. In this research, computational intelligence methods are employed in modeling and optimization of HVAC systems. Energy savings are accomplished by minimizing the cooling output, reheating output or fan running time as well as on-line monitoring.

5 - Investigation of the Impact of Total Solids and pH on Biogas Production with a Data-driven Approach
Xiupeng Wei, Research Assistant, University of Iowa, 3131 Semans Center, Iowa City, IA, 52246, United States of America, xiupeng-wei@uiowa.edu

Biogas is a typical byproduct in wastewater treatment by anaerobic digestion the sludge. To improve biogas production, the impact of total solids and pH is investigated with a data-driven approach. Five data-mining algorithms have been used to build biogas production models. Based on the built production model, genetic algorithm is used to find the optimal control settings of total solids and pH value. The biogas production can be significantly increased with optimal settings.

■ WD82

Parc- Haight

Data Mining 7

Contributed Session

Chair: Mohammad S. Jalali, Virginia Tech / MIT, 113 Harvard St, Apt 1, Cambridge, MA, 02139, United States of America, mj@vt.edu

1 - Support Vector Machines Based on Convex Risk Functional and General Norms
Jun-ya Gotoh, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, 112-8551, Japan, jgoto@indsys.chuo-u.ac.jp, Stan Uryasev

We revisit the formulations of support vector machines (SVMs) for binary classification on the basis of convex analysis. Interpretability of dual formulations is related to properties of the convex empirical risk functionals. Besides, we demonstrated how robust optimization modelings are easily incorporated. With regularizers based on new families of polyhedral norms (in place of the lp-norms), regularizer tuning can be efficiently incorporated via (possibly, parametric) linear programming.

2 - Generating Contextual Insights for the Social Enterprise
Ying Li, Research Staff Member, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, yingli@us.ibm.com, Ashish Jagmohan, Yi-Min Chee, Krishna Ratakonda, Elham Khabiri

Social enterprise technology can enhance organizational productivity by surmounting knowledge silos and promoting collaboration. We present a social enterprise tool which uses natural language and machine learning algorithms to make sense of large enterprise data repositories. The tool extracts specialized knowledge from such repositories, and generates new contextual insights allowing users to leverage the organization's collective intelligence for problem-solving and collaboration.

3 - Quantitative Aggregation of Prior Statistical Findings
Mohammad S. Jalali, Virginia Tech / MIT, 113 Harvard St, Apt 1, Cambridge, MA, 02139, United States of America, mj@vt.edu, Hazhir Rahmandad, Kamran Paynabar

Taking stock of prior research requires combining previous findings yet current methods limit such quantitative aggregation to studies with very similar designs. We introduce Generalized Model Aggregation (GMA) that can consistently combine prior statistical findings of a phenomenon into a meta-model. Numerical and empirical examples demonstrate GMA's ability to extract the underlying data generating process from biased and incomplete prior studies.

4 - Global Bicycling Trends
Olufolajimi Oke, Johns Hopkins University, 3400 N Charles St, Baltimore, MD, United States of America, ooke1@jhu.edu, Sauleh Siddiqui, David Love, Kavi Bhalla

Over the past four decades, bicycle ownership has been tracked but not globally analyzed. We gather survey data from 155 countries, and assume ownership as a usage indicator. Performing cluster analysis, we identify five global trends cutting across geographical regions. We also observe relationships between bicycle usage and socio-economic indices. We determine a worldwide ownership trend and demonstrate a basis for understanding the global impact of cycling as a sustainable transit mode.

5 - eWOM Public Transportation Decision Making Variables
Benjamin George, University of North Texas, 1155 Union Circle, Denton, TX, 76203, United States of America, benjamin.george@unt.edu, Rebecca Scott

This research uses electronic word of mouth (eWOM) to identify public transportation decision-making factors. Text analytics techniques identify the frequency and strength of variables from end-user customer comments. Implications from the results address service issues and how to increase public transportation use.

■ WD83

Parc- Sutro

Data Mining 4

Contributed Session

Chair: Youqin Pan, Assistant Professor, Salem State University, 3 52 Lafayette Street, Salem, MA, 01970, United States of America, youqinpan@my.unt.edu

1 - File Classification Problem in Hybrid Cloud Storage Systems
Fan Liu, Kansai University, No. 306,1-17-13 Senriyamanishi, Suita, Osaka, 565-0851, Japan, liufan09006@gmail.com, Hiroyuki Ebara

In hybrid cloud storage system,it is important to solve the problem of file classification,in order to use effectively the storage space and improve security.In the classification process,we can analyze content of a file using machine learning,in addition to using the size and type of a file.

2 - What Drives Marketplace Effectiveness and Growth? An Empirical Investigation.
Pavel Izhutov, Stanford University, 736 Escondido Rd, Apt 203, Stanford, CA, 94305, United States of America, izhutov@stanford.edu, Haim Mendelson

Online marketplaces are becoming increasingly important mechanisms for matching supply and demand. This paper presents findings from a marketplace for services (in particular, a tutoring vertical). Using a rich data-set, we study the drivers of marketplace growth and the factors that lead to successful matching of supply and demand.

3 - A New Model for Binary Classification
Jian Luo, North Carolina State University, Daniels 443, North Carolina State University, Raleigh, NC, 27695, United States of America, jluo3@ncsu.edu, Zhibin Deng

In this study, a kernel-free soft quadratic surface support vector machine model is proposed for binary classification directly using a quadratic function for separation. We have also studied some properties of this proposed model such as the solvability, uniqueness of the solution and so on. Finally, our computational results on artificial data sets and four real-world benchmark data sets indicate that the proposed model outperforms Dagher's quadratic support vector machine model and soft support vector machine models with Gaussian or quadratic kernel.

4 - Predicting Stock Index Movement using Advanced Machine Learning Techniques
Youqin Pan, Assistant Professor, Salem State University, 352 Lafayette Street, Salem, MA, 01970, United States of America, youqinpan@my.unt.edu

In this study, advanced machine learning techniques are applied to predict the direction of stock market movement. Experimental results show that EMD transformation of original stock index into a time-frequency feature space improves the accuracy of the forecasting models commonly used in the literature. All models examined in this study generate an acceptable model performance, the EMD-Neural Network model seems to outperform other models in general.

5 - Mining Process Patterns from Noisy Audit Logs with Application to Electronic Medical Record Systems
He Zhang, Northwestern University, The Technological Institute, 2145 Sheridan Road, Room C210, Evanston, IL, 60208, United States of America, hezhang2012@u.northwestern.edu, David Liebovitz, Carl Gunter, Bradley Malin, Sanjay Mehrotra

Mining the process patterns in the access logs from information systems can provide useful insights for the workflow patterns. One important issue in process mining is that the workflow is usually highly dynamic and the access logs are noisy. We present a four-step framework to analyze process models with noisy data at an abstract level. We implement our approach using several months of data from a large academic medical center. Empirical results show that our framework can work effectively.

Wednesday, 4:30pm - 6:00pm

■ WE02

Hilton- Golden Gate 7

Technology Management

Contributed Session

Chair: Paola Gonzalez, PhD candidate, Queen's University, PhD Office, Goodes Hall, Kingston, ON, K7L 3N6, Canada, pgonzalez@business.queensu.ca

1 - Supporting or Killing Platform Design? Towards New Contingent Criteria for Strategies Selection
Olga Kokshagina, Mines ParisTech, 60 Boulevard Saint-Michel, Paris, 75006, France, olga.kokshagina@mines-paristech.fr, Pascal Le Masson, Benoit Weil, Hassen Ahmed

The circumstances in which firms operate have moved towards unknown environments, thereby rendering planning approaches inadequate. In these situations companies have to adapt more flexible approaches. When technology and markets are unknown an interesting solution is highlighted: the design of technological platform creating value across many emerging markets. A study is carried out to clarify the criteria in which the exploration of multiple technologies and markets lead to platform design.

2 - Capability Changes at a Firm Due to Offshoring: Antecedent to the Commons Challenge
Anshuman Tripathy, Indian Institute of Management Bangalore, Bannerghatta Road, Bangalore, India, atripathy@iimb.ernet.in, Shilpa Jaiswal

We use SD to model a firm's decision to increasing its offshoring content. As capabilities at the offshored agent develop, we find that the firm's system development capabilities increase though part development keeps diminishing, more so when parts have higher modularity. This further motivates firms in broadly similar industries to replicate the offshoring process; and over time, this leads to the loss of certain collective capabilities that sustain innovation (industrial commons).

3 - An Economic Analysis of Platform Structure with Hierarchies
Sunghee Lee, Researcher, Korea E-Trade Research Institute, Chung-Ang Univ., Heukseok-ro, Dongjak-gu, Seoul, 136-701, Korea, Republic of, shedawa@gmail.com, Byung Cho Kim, Daeki Kim

We compare two distinct settings in two-sided markets: simple platform versus hierarchical platform. Grounded on an analytical model, we investigate the incentives of a platform provider to adopt a hierarchical structure. Our findings indicate that that the presence of network externality creates such an incentive, especially when there is a need for load-sharing. Consequently, a hierarchical structure acts as a beneficial existence to consumers under certain conditions.

4 - Innovation and Policy Support for Platform Providers under Competition
Dawoon Jung, PhD Student, Korea University Business School, LG-Posco Hall, KUBS, 145 Anam-ro Seoungbuk-gu, Seoul, Korea, Republic of, bogsil@korea.ac.kr, Byung Cho Kim, Myungsub Park, Detmar Straub

Technological innovation becomes even more complicated for platform businesses whose fate is heavily influenced by the network externality stemming from a two-sided market. We introduce a model of competing platforms to examine whether platform providers have an incentive for technological innovation, while the existing literature on the two-sided market focuses on platform providers' pricing strategies for network expansion without paying much attention to innovation decisions.

■ WE04

Hilton- Continental 1

Remanufacturing

Contributed Session

Chair: Xiaoning Jin, Assistant Research Scientist, University of Michigan, 1031 H. H. Dow Building, 2350 Hayward Street, Ann Arbor, MI, 48109, United States of America, xnjin@umich.edu

1 - Admission Policies for End-of-Life Product Returns in a Remanufacturing System

Xiaoning Jin, Assistant Research Scientist, University of Michigan, 1031 H. H. Dow Building, 2350 Hayward Street, Ann Arbor, MI, 48109, United States of America, xnjin@umich.edu, S. Jack Hu, Jun Ni

This paper considers a reassemble-to-order system with admission control on product returns in a remanufacturing system. Warranty claims trigger orders for product replacement by new or remanufactured products and also generate returns of used products. The return process is a stochastic in terms of arriving time, quality and quantity. We develop a quasi-birth-and-death model to obtain the key performance measures of the system and provide managerial insights into decision-making.

2 - The Inter-Divisional Coordination of Manufacturing and Remanufacturing Operations in a CLSC

Tianqin Shi, University of Illinois at Urbana-Champaign, 350 Wohlers Hall, 1206 South Sixth Street, Champaign, IL, 61820, United States of America, tshi3@illinois.edu, Dilip Chhajed, Zhixi Wan

We consider a firm consisting of two divisions, one responsible for designing and manufacturing new products and the other responsible for remanufacturing operations. Both divisions operate independently and distribute through the same retailer. We show that divisional conflict can occur, which not only reduces sales and profit of the firm but also discourages remanufacturable product design. Thus, we propose an inter-divisional incentive scheme that facilitate divisional coordination.

3 - Remanufacturing with Competing Manufacturers

Kunpeng Li, Utah State University, 3555 Old Main Hill, Logan, UT, United States of America, kunpeng.li@usu.edu, Shaorui Li

Two manufacturers produce and sell substitute products through their respective retailers. Under such a setting, we study the optimal remanufacturing strategies with two competing manufacturers.

4 - Optimal Product Design in a Remanufacturing Setting

Mustafa Akturk, PhD Student, Texas A&M University, Mays Business School, 4113 TAMU 320 R, College Station, TX, 77845, United States of America, makturk@mays.tamu.edu

Benefits from remanufacturing do not come for free. The recovery of parts from returned products requires investment at the design stage. However, design for remanufacturing takes longer time to market than other design options. So, we model the optimal design philosophy at different market conditions both in a single-period and multi-period settings.

5 - A Fuzzy Linguistic Based Decision Support System for Evaluating Re-manufacturability of Products

Thomas Omwando, University of Wisconsin Milwaukee, 3200 N Cramer Street, EMS 503, Milwaukee, WI, 53211, United States of America, tomwando@uwm.edu, Wilkistar Otieno, Anthony Ross

Remanufacturing as an end of life disposal option faces challenges due to uncertainties associated with product attributes. This work presents a decision support system based on a 2-tuple fuzzy linguistic computing approach to integrate qualitative and quantitative product attributes in determining the remanufacturability of a product. The model is applied to assess the suitability of remanufacturing two products manufactured by a global industry based in the mid-west region of the USA.

■ WE05

Hilton- Continental 2

Supply Chain/Closed Loop I

Contributed Session

Chair: Mostafa Sabbaghi, PhD Student, University at Buffalo, State University of New York, 437 Bell Hall, Buffalo, NY, 14260, United States of America, mostafas@buffalo.edu

1 - Trends in Used Electronics Return Flows: A Perspective on Consumer Behavior and Design Features

Mostafa Sabbaghi, PhD Student, University at Buffalo, State University of New York, 437 Bell Hall, Buffalo, NY, 14260, United States of America, mostafas@buffalo.edu, Ardeshir Raihanian, Sara Behdad, Willie Cade

Inspired by the large amount of electronic waste (e-waste) discarded every year in the US, this study aims to investigate consumer behavior aspects of return flows. Using a large dataset consisting of characteristics of 44000 used personal computers returned back to a remanufacturing company, the study examines the connection among design features and consumers' behavior towards products usage duration and time-inñstorage.

2 - Network Design for Commercial Returns under Time Value Consideration.

Sung Ook Hwang, Texas A&M University, ETB Building 101, Bizzell St, College Station, TX, United States of America, hwang1227@tamu.edu, Halit Uster

We consider logistics network design problem for commercial returns. The problem is formulated as a multi-period mixed integer linear program with time parameters introduced to express product residual value based on return channel selections. We present an efficient solution approach and an analysis of network design and channel selection strategies based on product characteristics.

3 - Application of Robust Optimization to Mechanism Design in Waste Recycling

Kazuaki Okubo, Assistant Professor, Saitama University, 255 Shimo-okubo, Sakura-ku, Saitama, 338-8570, Japan, okubo@dp.civil.saitama-u.ac.jp, Makoto Okumura

In Japan, some recyclable wastes are collected by local governments and delivered to a contracted recycler, who is a winner of auction. However, there is uncertainty in the quantity of waste collected. We show that if a recycler has advanced technology, it will be less likely to be assigned a contract because of its high initial cost. We propose a mechanism with minimum contract quantity and show that the mechanism can increase the probability that the advanced recycler will win in the auction.

4 - Consumer Returns Policies for a Price Setting Retailer

Necati Ertekin, PhD Student, Texas A&M University, 320 Wehner Bldg. TAMU, College Station, TX, United States of America, nertekin@mays.tamu.edu, Michael Ketzenberg

We study a retailer that offers customers both returned and new products side by side under a partial return policy as is very common in practice. The retailer segments the market for new products and open-box returns based on customer valuation and pricing and faces stochastic demands from price-sensitive customers.

■ WE06

Hilton- Continental 3

Supply Chain/Closed Loop II

Contributed Session

Chair: Yohanes Kristianto, Postdoctoral Researcher, University of Vaasa, Yliopistonranta 10, Vaasa, 65101, Finland, ykristiantonugroho@gmail.com

1 - An Improved Reformulation for an Optimal Design Problem in Electronic Goods Recollection

Roger Rios-Mercado, Professor, Universidad Autonoma de Nuevo Leon, AP 111-F, CD. Universitaria, San Nicolas de los Garza, NL, 66450, Mexico, roger@yalma.fime.uanl.mx, Jonathan Bard

The problem addressed here is motivated by a real-world case arising in the recollection of waste electronic equipment in Europe. The process involves assigning recollection units to companies subject to some planning requirements. A new MILP model for this NP-hard districting problem is introduced. Empirical evidence illustrate the positive impact of the new model and the proposed algorithmic strategies resulting in dramatic speed-up of solution times when compared to existing approaches.

2 - Outsourcing Analysis in Closed-Loop Supply Chains for Hazardous Materials

Victor Manuel Rayas Carbajal, ITESM, Eduardo Monroy Cárdenas 2000, San Antonio Buenavista, Toluca, 50110, Mexico, victor.rayas@invitados.itesm.mx, Marco Antonio Serrato García

Environmental issues have become a main topic worldwide, forcing companies to satisfy specific requirements on their supply chain due to laws and policies to reduce the impact of their activity. This is why many companies consider outsourcing these functions. Through this research, a Markov decision models are developed to support outsourcing decisions in a closed-loop supply chain for hazardous materials. The models are based on the risk levels and sales behavior of the product considered.

3 - Procurement Maturity Model Reassures Contract System's Best Practices

Saroj Koul, Professor, OP Jindal Global University, Sonipat-Narela Road, NCR, 130001, India, skoul@jgu.edu.in

Procurement shares a significant responsibility towards ensuring organizational profitability and promoting organizational quality standards. In this research study, the Procurement Maturity Model was developed to assist procurement professionals in implementing procurement best practices as a means to improve the organizational performance and professional skills at a steel company.

4 - Decision Support Systems for Closed Loop Supply Chains under Uncertainties

Yohanes Kristianto, Postdoctoral Researcher, University of Vaasa, Yliopistonranta 10, Vaasa, 65101, Finland, ykristiantonugroho@gmail.com

This paper designs a decision support system to determine optimal poduct architecture modularity in closed loop supply chains. The objective is to investigate if remanufacturing and modular upgrading is appropriate at certain periods and in modules. The optimization model is tested under several production yield scenarios in order to determine manufacturing and remanufacturing capacity and production line scheduling under process yield uncertainty.

■ WE07

Hilton- Continental 4

Supply Chain Management IX

Contributed Session

Chair: Babak Abbasi, Senior lecturer, RMIT University, Swanston St, Melbourne, Australia, babak.abbasi@rmit.edu.au

1 - Driving Design Innovation up the Supply Chain

Ali Inay, PhD Student, McGill University, 3458 Rue Sainte Famille, Montreal, QC, H2X 2K8, Canada, ali.inay@mail.mcgill.ca

We consider innovative OEMs that design competing products relying on a key component sourced from a supplier with technological capability. Suppliers' innovation efforts define their capabilities, but OEMs can engage to enhance them (with spillovers). We derive equilibrium design (quality), innovation and capability investment, and pricing decisions for alternative configurations.

2 - The Centralization Impacts on the Two-echelon Supply Chain

Babak Abbasi, Senior lecturer, RMIT University, Swanston St, Melbourne, Australia, babak.abbasi@rmit.edu.au

This talk provides insights on the impacts of centralization in the second echelon of a two-echelon supply chain with perishable items and uncontrollable replenishment. The centralization in the second location means that agents in the second echelon share the inventory. We find that centralization is a key factor in the blood supply chain. For instance we observed reducing the number of inventory locations from 5 to 2 will reduce the total cost by around 21%.

3 - Cooperative Procurement in the Presence of Intermediaries

Behzad Hezarkhani, Technical University of Eindhoven, OPAC, Department of Industrial Engineeri, Eindhoven, No, 5600 MB, Netherlands, b.hezarkhani@tue.nl, Marco Slikker, Tom Van Woensel

In complex supply chains, agents who procure individually often find it beneficial to replenish their required products indirectly from a local intermediary rather than from the original manufacturers directly. But the agents could collectively benefit from aggregating their demands and placing joint orders with the manufacturers of specific products. This talk addresses the possibilities for cooperation in these situations and the structure of associated cooperative games.

4 - Impacts of Counterfeiting on a Global Supply Chain Impacts of Counterfeiting on a Global Supply Chain

Zelong Yi, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, yizl@ust.hk, Ki Ling Cheung, Man Yu

We investigate how a global supply chain is influenced by counterfeits and how the supply chain should take anti-counterfeit actions. Specifically, we consider a supply chain consisting of a manufacturer and a local retailer, and examine who should counteract counterfeits. We also evaluate the impact of counterfeits on supply chain profit, consumer surplus, and social surplus.

■ WE08

Hilton- Continental 5

Supply Chain Management X

Contributed Session

Chair: Shiqing Yao, PhD Candidate, Chinese University of Hong Kong, Rm 941, CYT Building, Shatin, Hong Kong - PRC, shiqing@baf.msmail.cuhk.edu.hk

1 - A Stochastic Programming Approach for Process Flexibility Design in Unbalanced Networks

Wancheng Feng, PhD Candidate, Tsinghua Univeristy, Dept. of Industrial Engineering, Beijing, 100084, China, fwc12@mails.tsinghua.edu.cn, Chen Wang, Jeffrey David Tew

This research proposes a stochastic programming model and an algorithm for solving process flexibility design problems in unbalanced networks. Our solution approach integrates the accelerated Benders decomposition algorithm in a Monte-Carlo Sampling approximation scheme, to quickly obtain high-quality solutions to SP models. Impacts of flexibility uniformity (e.g. plant uniformity and product similarity) when process flexibility is applied in real production system have been discussed as well.

2 - Concurrent Planning of Forward and After-sale Supply Chains Against Demand and Supply Side Uncertain

Shabnam Rezapour, Dr., University of Oklahoma, 2248 Houston Ave, Apt 2,, Norman, OK, 73071, United States of America, shabnam_rezapoor@yahoo.com, Farrokh Mistree, Janet Allen

A company supplying a product to its pre-markets through a forward supply chain (SC) is considered. Demand is a stochastic function of price, warranty time and service levels. Due of the warranty, returned defective products must be repaired or substituted. These parts are produced through an after-sale SC. Uncertainty in a) the demand of product and spare parts and b) qualified output of production facilities are considered. Nonlinear model of problem is linearized to be solvable globally.

3 - Traceability and Market Inspection

Shiqing Yao, PhD Candidate, Chinese University of Hong Kong, Rm 941, CYT Building, Shatin, Hong Kong - PRC, shiqing@baf.msmail.cuhk.edu.hk, Kaijie Zhu

We consider an industrial organization which assigns quality labels to its members in order to certify their products in the output market. By a desire of profits, its dishonest members may gain more through selling quality labels to an outside party. Traceable labels and market inspection might be advantageous to deter such under-the-table activity. However, under the leakage of market inspection, we show that this conventional wisdom may no longer be true.

4 - Evaluation and Selection of 3PL Provider using Taguchi Loss Functions and AHP

Sharon Ordoobadi, University of Massachusetts, 285 Old Westport Road, Dartmouth, MA, 02747, United States of America, sordoobadi@umassd.edu

The purpose of this study is to develop a model that helps manufacturers with decisions regarding the reverse supply chain. This is accomplished by using Taguchi loss functions and AHP methodology in the development of the model. Taguchi loss functions are used to calculate the loss scores based on the performances of the 3PL providers. AHP methodology is used to determine the relative importance of the criteria to the decision maker. The providers are ranked based on their loss scores.

■ WE09

Hilton- Continental 6

E-Business/ Commerce 3

Contributed Session

Chair: Nikunj Kumar Jain, Mr., Indian Institute of Management, Indore, Room No. 310, FPM Block,Rau, Indian Institute of Management, Indore, Indore, MP, 453331, India, f11nikunjk@iimidr.ac.in

1 - An Efficient Multi-attribute Reverse Auction Mechanism to Support the Repeated Procurement

Na Yang, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an, Shaanxi, China, yang.na616@stu.xjtu.edu.cn, Xiuwu Liao

The actual supply of the winning supplier may be different with her committed offer. We propose a novel multi-attribute reverse auction mechanism in a repeated e-procurement setting to discourage such untruthful behavior of the suppliers. The simulation study shows that the dishonest suppliers have less opportunity to win and the buyer derives higher utility by using the proposed mechanism as compared to the existing mechanism.

2 - Exclusive outlets & E-tailing – Manufacturer's strategic instruments

Nishant Kumar Verma, Doctoral Student, Indian Institute of Management Calcutta, India, A201, Tagore Hostel, IIM Calcutta, Joka, DH Road, Kolkata, WB, 700104, India, nishantkv11@email.iimcal.ac.in, Abhishek Shinde

In the world of e-commerce, where manufacturing firms are making their presence felt on the click of a mouse, the same are increasingly opening a considerable number of exclusive outlets too. In this research we aim to develop a game theoretic model to study "how a manufacturing firm uses both e-tailing and exclusive outlets as strategic instruments to influence the pricing behavior of the traditional independent retailers".

3 - Alternative Payment Schemes on Micro-task Crowdsourcing Platforms

Mohammadmahdi Moqri, UF, 299 Diamond Village, Apt15, Gainesville, Fl, 32603, United States of America, mahdi.moqri@warrington.ufl.edu, Hsing Cheng, Subhajyoti Bandyopadhyay

This study focuses on two interrelated challenges in crowdsourcing, namely designing an efficient payment scheme and assuring quality of work. We develop an economic model to explain the relation between pay and quality under the commonly used piece-rate payment scheme. Recognizing the inefficiency of this common payment system, we then propose an alternative payment scheme. The results of our experiments show a significant improvement in the quality of work under the proposed payment scheme.

■ WE11

Hilton- Continental 8

Supply Chain, Managing Disruptions II

Contributed Session

Chair: Abdulaziz Almaktoom, PhD Candidate, Wichita State University, 8488 E. Granite CT, Bel Aire, KS, 67226, United States of America, atalmaktoom@gmail.com

1 - An Evaluation of Supply Disruption Management Strategies using Mixed-Integer Programming

Mahour Parast, Assistant Professor of Technology Management, NC A&T State University, 4018 Smith Hall, 1601 E Market St, Greensboro, NC, 27411, United States of America, mahour@ncat.edu

The purpose of this paper is to develop a mathematical model to examine the impact of four disruption management strategies on supplier selection and allocation: Pre-positioning of emergency supplies, using back up supplier(s), protecting supplier(s) against disruption, and suppliers' production flexibility. We discuss contingency plans for each scenario, and provide the proper supplier selection and allocation to meet customer demand during disruptions.

2 - The Effect of Learning and Supply Disruptions under Dual Sourcing

Lena Silbermayr, Vienna University of Economics and Business, Welthandelsplatz 1, Vienna, 1020, Austria, lena.silbermayr@univie.ac.at, Stefan Minner

The suppliers face the risk of temporary supply disruptions and reduce future supply cost with cumulative productions, i.e. due to learning effects. Including these two factors we examine the buyer's optimal dual sourcing strategy. Hence, we study the interplay of learning and supply disruptions in the buyer's order allocation problem.

3 - Resilience Quantification of Complex Supply Chain Networks

Abdulaziz Almaktoom, PhD Candidate, Wichita State University, 8488 E. Granite Ct, Bel Aire, KS, 67226, United States of America, atalmaktoom@gmail.com, Krishna Krishnan, Pingfeng Wang, Samir Alsobhi

The objective of this research is to explore supply chain network resilience concept and introduce a novel measure to evaluate supply chain network resilience such that the design of a resilient supply chain becomes possible. The developed measure is able to evaluate the resilience of each entity in the network and the overall supply chain network. Case studies with multi-level complex supply chain networks are developed to demonstrate the proposed measure.

4 - Monitoring a Complex Supply Chain

Lei Liu, Arizona State University, 699 S. Mills Ave, Tempe, AZ, United States of America, lliu58@asu.edu, George Runger, Mani Janakiram, David Bayba

Supply chains (SC) performance is impacted by both supply and demand variability. A SC is complex in both the number of SKUs and dynamics, and agile detection of small-scale disruptions is important. We propose a quite robust, monitoring and visualization scheme for SCs that handle dynamic complexities. Diagnostic tools are embedded to analyze signals from the scheme.

5 - Joint Problem Solving and Planning Roles in Supply Chain Collaboration

Gopal Kumar, Postdoctoral Fellow, Dublin City University, Room SG24, School of Mechanical Engineering, Dublin, 9, Ireland, gopshal.kr@gmail.com, Ravindra Banerjee

This research uncovers joint problem solving and planning roles in developing culture in supply chain collaboration (SCC). Collaborative activities are viewed in terms of internal and external focused functional areas. The model was verified with data collected from industries. Joint problem solving and measurement found critical and affect core and non-core activities. Joint planning at operation level is very important in culture development which gives a platform for the SCC.

■ WE12

Hilton- Continental 9

Supply Chain Optimization III

Contributed Session

Chair: Gang Wang, Assistant Professor, University of Massachusetts Dartmouth, 800 Pleasant Street, Apt 401, New Bedford, MA, 02747, United States of America, wang.gaby@gmail.com

1 - Capacitated Supply and Distribution Network Design with Stochastic Demand and Delivery Deadlines

Gang Wang, Assistant Professor, University of Massachusetts Dartmouth, 800 Pleasant Street, Apt 401, New Bedford, MA, 02747, United States of America, wang.gaby@gmail.com

This paper studies a make-to-order supply chain where stochastic customer demand and order delivery deadlines are both considered. After formulating the problem as a stochastic mixed integer nonlinear program, three different variations of this problem are investigated in terms of three distinct cost functions.

2 - Concurrent Supply Chain Network and Manufacturing System Design under Uncertain Demand

Bulent Erenay, PhD Candidate, Ohio University, 289 Stocker Center, Athens, OH, 45701, United States of America, be977209@ohio.edu, Gursel A. Suer

Traditionally supply chain network (SCND) and manufacturing system designs (MSD) are done in two phases using rough capacity requirements. In this study, MSD and SCND are made concurrently in an uncertain demand environment. First, a stochastic layered cellular design approach is used to handle uncertain demand, and then MSD and SCND are done simultaneously with the objective of cost minimization considering minimum capacity utilizations.

3 - Optimizing Performance Based Contracting in Multi-Part Multi-Mode Supply Support Systems

Rana Afzali Baghdadabadi, University of Missouri, E3437 Lafferre Hall, Columbia, MO, 65201, United States of America, ragh2@mail.missouri.edu, Wooseung Jang

After-sales support services are often provided by two different organizations, where each party is usually interested in their benefits. To observe the best contractual terms under different environmental assumptions, an optimization model is provided, where the supplier's decisions on resource allocation and transportation modes and the optimized terms of contracting are developed to minimize the total system's cost.?

4 - Optimal Policy for the Stochastic Inventory Control Problem with Unreliable Sourcing

Shuohao Wu, North Carolina State University, 3515 Ivy Commons Dr, Apt 302, Raleigh, NC, 27606, United States of America, swu6@ncsu.edu, Sha Luo, Russell King, Donald Warsing, S.Sebnem Ahiska

We study a single-product inventory system under periodic review in the presence of two suppliers. Both suppliers charge a fix ordering cost. One supplier is perfectly reliable, and the other one offers a better unit price but may encounter supply interruptions, which is modulated by a discrete-time Markov chain. Orders can be placed at both suppliers or only one of them. Optimality of a parameter-dependent (s,S)-like policy is addressed.

5 - Optimizing the Profit under Performance-Based Maintenance Support

Xiaolong Guo, University of Science and Technology of China, 96 Jinzhai Road, Hefei, 230026, China, gxl@ustc.edu.cn, Nishant Mishra, Yugang Yu

We study how customers using systems with varying levels of profitability, decide contract terms for their maintenance suppliers, and how the suppliers set the spare-parts inventories when facing multiple customers with different contract terms. Also, by considering multiple customers and suppliers in our model, we are able to study when suppliers are benefitted by lower spare-parts inventory due to inventory pooling, and when they need to keep dedicated inventories for customers.

■ WE14

Imperial B

Retail Management II

Contributed Session

Chair: Anurag Agarwal, Professor, University of South Florida, 8350 N Tamiami Trail, SMC-C263, Sarasota, FL, 34243, United States of America, agarwala@usf.edu

1 - Data Driven Optimization for Retail Shelf Space

Anurag Agarwal, Professor, University of South Florida, 8350 N Tamiami Trail, SMC-C263, Sarasota, FL, 34243, United States of America, agarwala@usf.edu, Ramakrishna Govindu, Jim Curran

Retailers these days are collecting a lot of data and trying to optimize limited shelf space. In this paper, we propose optimization models for the retail shelf space problem and propose ideas on how to use data to make these models work in practice.

2 - Assortment Planning 2.0

Matthew Lanham, Doctoral Candidate, Virginia Tech, Dept of Business Information Technology, Pamplin Hall (0235), Blacksburg, VA, 24060, United States of America, lanham@vt.edu, Ralph Badinelli

Assortment planning is regarded as one of the most important decisions faced by retailers. We provide a taxonomy of the assortment planning problem and highlight extensions of the conventional assortment planning model which capture more realistic customer behavior, multi-channel coordination, supply-chain performance measures and cross-category tradeoffs. Opportunities for supporting these extensions through big data analytics are investigated.

3 - Market Dominance or Cost Advantage? The Effect of Retail Power on Assortment Planning Decisions

Hedayat Alibeiki, Desautels Faculty of Management - McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, hedayat.alibeiki@mail.mcgill.ca, Ramnath Vaidyanathan, Shanling Li

Some mass retailers are known to reduce their assortment, in certain product categories, more than other retailers. Some believe this phenomenon is because of their retail power. In this study, we investigate the underlying effect of 'market dominance' and 'cost advantage', as two important sorts of retail power, on assortment decisions. Our results show that 'market dominance', i.e. the ability to manipulate market price, is a necessary condition for assortment reduction.

4 - Delivery Planning in Retail Chains

Heinrich Kuhn, Professor, Catholic University Eichstatt-Ingolstadt, Auf der Schanz 49, Ingolstadt, Germany, heinrich.kuhn@ku.de, Michael Sternbeck, Andreas Holzapfel, Alexander Huebner

In grocery retail weekly repetitive delivery patterns have to be selected to deliver the products from the DC to the outlets. An IP model is presented which contains the decision relevant costs and capacities at the DC, in transportation and instore. We propose a simultaneous and a sequential solution approach. Applying the model and the solution approach at a major European grocery retailer leads to significant cost savings.

■ WE15

Hilton- Exec. Boardroom

Design Engineering

Contributed Session

Chair: Emrah Koksalmis, Teaching Assistant, Turkish Air Force Academy, Hava Harp Okulu Komutanligi Yesilyurt, Istanbul, 34149, Turkey, e.koksalmis@hho.edu.tr

1 - Health System Design Optimization using Taguchi Methods: A Necrotizing Enterocolitis Model

Emrah Koksalmis, Teaching Assistant, Turkish Air Force Academy, Hava Harp Okulu Komutanligi Yesilyurt, Istanbul, 34149, Turkey, e.koksalmis@hho.edu.tr, Gulsah Hancerliogullari

This study discusses the Taguchi method as an approach to design optimization and illustrates its application using a system optimization study for an experimental Necrotizing Enterocolitis (NEC) model, where NEC is one of the most common gastrointestinal emergencies in newborn infants. A series of parametric trade studies are conducted, and the results suggest that the Taguchi method is a systematic and efficient approach and its principal benefits include significant time and resource savings.

2 - Is Modeling Consideration Important to Product Strategy?

W. Ross Morrow, Assistant Professor, Iowa State University, 2104 Black Engineering Building, Ames, IA, 50011, United States of America, morrowwr@gmail.com, Minhua Long, Erin MacDonald

Operations researchers adopt marketing models of consumer choice to optimize decisions. Recent marketing research has shown that modeling non-compensatory consideration set formation improves model predictive power, but does not link this improvement to better strategic decisions. We compare decisions made using traditional compensatory choice models versus non-compensatory "consider-then-choose" models using a simulation based on a 2008 study of consideration in the new vehicle market.

3 - Linking Design and Engineering

Golnoosh Rasoulifar, Post Doctoral Research Fellow, University of Michigan, 3835 Green Brier Blvd 291B, Ann Arbor, MI, 48105, United States of America, golnoosh@umich.edu

Design of branded products involves consideration of both perceptual aspects of the product appearance (related to emotions and brand values) as well as the technical and engineering aspects. This research investigates the proposition and the evaluation of three potential approaches to support communication between product designers and engineering designers. An integration approach is also proposed following the three steps of modeling, transforming and integrating engineering and design.

4 - Estimating Expected Information Gain for Designing Calibration Experiments with Multiple Observables

Diane Villanueva, Research Engineer, Universal Technology Corporation, 1270 North Fairfield Rd, Dayton, OH, 45432, United States of America, diane.villanueva.ctr@us.af.mil, Benjamin Smarslok

The design of hypersonic air vehicles involves coupled interactions of physics, which are approximated by computational models and observed in a limited number of experiments. Global sensitivity analysis results are used with expected information gain for optimal design of an experiment for calibration of aerothermal models. The expected information gain will not only be used to compare specimen designs, but also the observables which provide the best trade-off with expected information gain.

■ WE17

Hilton- Franciscan B

Supply Chain, Design and Services

Contributed Session

Chair: Amir Masoumi, Assistant Professor, Manhattan College, 4513 Manhattan College Parkway, DLS 504, Riverdale, NY, 10471, United States of America, amir.masoumi@manhattan.edu

1 - A Supply Chain Network Model for Biological Medicinal Products

Amir Masoumi, Assistant Professor, Manhattan College, 4513 Manhattan College Parkway, DLS 504, Riverdale, NY, 10471, United States of America, amir.masoumi@manhattan.edu, Ashley Bowman

We develop a network model for the supply chain of "similar biological medicinal products". Often referred to as "biosimilars", these drugs have an active substance made by a living organism rather than being chemically synthesized. Our proposed multi-period framework captures inherent complexities in the manufacturing and inventory management of such sensitive products.

2 - Financing Contract For a Capital-constrained Newsvendor under Asymmetric Information
Kening Liu, Nanjing University of Science and Technology, Business School 624 Room, Xiaolingwei 200, Nanjing, 210094, China, kellyliu930@gmail.com, Huaming Song

This paper illustrates how a liquidity-constrained newvendor borrows funds from bank to procure the expect quantity. Since demand and selling price information is asymmetric to the bank, we design a screening model for both the bank to determine the interest rate and the retailer to optimize his procurement order. We uses Stackelberg game for newsvendor to make a strategic decision of how much to finance additional procurement.

3 - Integrated Optimization Model of Supply Chain Configuration for New Products with Two-Segment Market
Mehdi Amini, Professor, The University of Memphis, Fogelman College of Business & Economics, Department of Marketing & SCM, Memphis, TN, 38152, United States of America, mamini@memphis.edu, Haitao Li

We present an integrated optimization model to capture Supply Chain Configuration (SCC) for new products with the dual market. Computational comparison of one- versus two-segment market is offered based on 26 categories of consumer electronic products. We show that the dual-market consideration significantly improves the SCC profits over the single-market.

4 - Information Sharing in Two-stage Service Operations
Jin Kyung Kwak, Assistant Professor, Ewha Womans University, Ewhayeodaegil 52, Seoul, 120-750, Korea, Republic of, jkkwak@ewha.ac.kr

This study investigates a two-stage service operation to evaluate the value of information sharing between the stages. The demand observed at the first stage may be useful information to allocate labor capacity. By conducting extensive computational study, we can get some insights about information sharing in service operations.

5 - An Exploration of Industrial Vending Use within the Supply Chain
John Kros, Professor, East Carolina University, 3205 Bate, Greenville, NC, 27858, United States of America, krosj@ecu.edu, Jon Kirchoff

Industrial vending represents a very specific form of VMI that blends the benefits of point-of-need convenience, cost containment and control inherent to traditional consumer vending systems with the benefits of VMI in order to afford users access to real time information and the ability to assign costs more accurately. This study utilizes data obtained via a modified VMI survey instrument developed by Claassen in conjunction with transaction cost theory in order to test a proposed SEM model.

■ WE18

Hilton- Franciscan C

Optimal Pricing in E-commerce

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Wenbo (Selina) Cai, Assistant Professor, New Jersey Institute of Technology, MEC 308, University Heights, Newark, NJ, 07102, United States of America, cai@njit.edu

1 - Revenue-maximizing Pricing and Scheduling Strategies in Service Systems with Flexible Customers
Qiaochu He, University of California-Berkeley, Berkeley, CA, United States of Americaheqc0425@berkeley.edu, Ying-Ju Chen

Motivated by the presence of bilingual customers in the call centers, this paper investigates the design of service systems with flexible and dedicated customers. The service provider attempts to maximize revenue through jointly optimal pricing and scheduling. We analyze the system performances under different information structures and discriminatory service mechanisms, and illustrate the impacts of information asymmetry on the interplay between the flexible customers and the dedicated ones.

2 - Dynamic Pricing with Time-inconsistent Consumers
Xiangyu Gao, Department of Industrial and Enterprise Systems Engineering, University of Illinois at Urbana-Champaign, Room 04 Transportation Building, 104 S. Mathews, Urbana, Il, 61801, United States of America, xgao12@illinois.edu, Xin Chen, Ying-Ju Chen

We propose a dynamic pricing model in which consumers exhibit time-inconsistent behaviors, which is modeled by quasi-hyperbolic discounting, and may be partially aware of their self-control issues. We characterize the subgame perfect equilibrium for the full spectrum of consumers' naivete. Interestingly, consumers' time-inconsistent behaviors can actually boost the seller's profit. However, given time inconsistency, consumers' naivete may undermine the seller's profitability.

3 - New Product Pricing Strategy in the Social Media Era
Xiuli He, Associate Professor, UNC Charlotte, 9201 University City Blvd, BISOM Dept., Charlotte, NC, 28223, United States of America, xhe8@uncc.edu, Subodha Kumar, Qinglong Gou, Juzhi Zhang

With the popularity of various social media platforms, the impacts of the word of mouth effect and the reference price effect on a consumer's purchasing behavior have been significantly amplified in the current era. We incorporate these two effects into a two period pricing model to investigate whether and in which condition should a firm utilize a skimming or a penetration price strategy. Our results show how these two effects influence a firm's pricing strategy when he launches a new product.

4 - The Role of Social Planner in Closed-loop Supply Chain
Lan Wang, Student, University of Florida, 355B STZ, Gainesville, FL, 32603, United States of America, lan.wang@warrington.ufl.edu, Tharanga rajapakshe, Asoo Vakharia

Our paper studies the problem of legislation practices on who should be responsible for recycling, and compares the existing mechanisms on the efficiency of environmental protection. In particular, we compare three models, consumer-paid model(the social planner charges the consumer an electronic waste recycling fee), OEM-paid model(the social planner collects annual fees from OEM for recycling and disposal treatment) and OEM-recycling model(the OEM is responsible for recycling).

■ WE19

Hilton- Franciscan D

Sales Optimization Management System – A Combined Optimization and Statistical Approach to Proactively Managing Enterprise Sales Resource Requirements and Sales Forecasting & Funnel Management.

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: John Ryan, President, ORM Technologies, 4300 N. Central Expressway, Suite 365, Dallas, TX, 75206, United States of America, john.ryan@orm-tech.com

1 - Sales Headcount & Funnel Management Optimization – Quantifying the Risk in Sales Forecasting
John Ryan, President, ORM Technologies, 4300 N. Central Expressway, Suite 365, Dallas, TX, 75206, United States of America, john.ryan@orm-tech.com

This presentation outlines the design and actual implementation methodology of a Sales Headcount and Funnel Management Optimization System provided as a software as a service solution. The design approach is a unique combination of statistical cluster analysis and optimization to create a sales management system that defines the optimal headcount to achieve the company goals while also providing an optimal minimum sales deal flow required to the meet the company goals.

2 - Statistical Cluster Analysis as a Foundation for Estimating Future Revenues
Ryan Cooper, Vice President, ORM Technologies, 4300 N. Central Expressway, Suite 365, Dallas, TX, 75206, United States of America, ryan.cooper@orm-tech.com

This presentation documents the implementation approach to utilizing statistical cluster analysis to predict the revenue associated with a given sales funnel as recorded in Salesforce.com. The presentation will cover the methods utilized to not only predict the estimated revenue of categories of opportunities, it will also outline the methods used to determine the fallout" rate of opportunities and then outline the reporting process to quantify the risk vs. the planned revenue targets.

3 - Sales Optimization – Implementation Methods, Challenges and Outcomes
David Wagner, President, Entrust, 5430 LBJ Freeway, Suite 1250, Dallas, TX, 75240, United States of America, david.wagner@entrust.com

This presentation outlines the client experience of implementing a sales headcount optimization system combined with a sales opportunities statistical/optimization system. The presentation will outline the data input requirements and challenges. The system implementation lessons and the resulting benefits that resulted from implementing the system. The resulting benefits will include expected cost savings, revenue enhancements and the benefit of proactive identification of future revenue risks.

■ WE21

Hilton- Union Sq 1

Sustainable Transportation/Logistics System Design

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Guangrui Ma, The Hong Kong University of Science and Technology, Room 3208, Dept. of IELM, Clear Water Bay, Kowloon, Hong Kong - PRC, magr@ust.hk

1 - Coping with Uncertainties in Biofuel Supply Chain Design: A Continuum Approximation Approach

Xin Wang, PhD Candidate, University of Illinois at Urbana-Champaign, 205 N. Mathews Ave, Urbana, Il, 61801, United States of America, wangxin1@illinois.edu, Michael Lim, Yanfeng Ouyang

Rapid growth of biofuel industry brings challenges to its supply chain design coping with yield and disruption uncertainties under large-scale land use competition with the incumbent food market. We develop a game-theoretical modeling framework based on a continuum approximation to address the problem. Hypothetical problems and a U.S. Midwest case study are provided to show the algorithm effectiveness and managerial insights.

2 - Selection of Suppliers under Yield Uncertainty

Yan Li, PhD Candidate, HKUST, 3208, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, yliaj@ust.hk, Ho-Yin Mak

The selection of suppliers is a critical decision faced by all supply chain managers. We study the procurement problem for a manufacturer under supply uncertainty, where data on supply yield is limited. Using a distributionally-robust optimization model, we draw insights on the firm's optimal supplier selection and ordering strategies.

3 - Flexible Urban Car Sharing System Design and Operations

Guangrui Ma, The Hong Kong University of Science and Technology, Room 3208, Dept. of IELM, Clear Water Bay, Kowloon, Hong Kong - PRC, magr@ust.hk, Ho-Yin Mak

Car sharing becomes a popular solution to balance individual mobility and sustainability. However the unbalanced vehicle flow makes it difficult to match driving demand and vehicle availability, and leads to low vehicle utilization. In this paper, we propose two methods from revenue management perspective: 1) implementation of dynamic surcharge fees; 2) controlling vehicle returning destination, to overcome the above challenge. Finally, we compare the efficiency of the two strategies.

4 - A Review of Stabilizing Grand Coalition in Unbalanced Cooperative Game

Lindong Liu, PhD Candidate, Hong Kong University of Science and Technology, Room 5567, Academic Building, Hong Kong, Hong Kong - PRC, ldliu@ust.hk, Xiangtong Qi

Recently, stabilizing grand coalitions in unbalanced cooperative games are receiving increased attention. In this talk, we focus on the so called operations research game whose characteristic function is defined by an optimization problem. To stabilize its grand coalition, we first survey several types of instruments, including subsidy, penalty, simultaneous subsidy and penalty, and restricted coalition. Then, we show some new instruments by modifying the parameters of the optimization problem.

■ WE23

Hilton- Union Sq 3

Traffic Management II

Contributed Session

Chair: Regina Clewlow, Postdoctoral Scholar, Stanford University, Y2E2 Building, Room. 390C, 473 Via Ortega, Stanford, CA, 94305, United States of America, rclewlow@stanford.edu

1 - Forecasting Traffic Counts for High Tourism Areas

Joseph Wilck, East Carolina University, 204 Slay Building, Mail Stop 117, Greenville, NC, 27858, United States of America, joe.wilck@gmail.com

This presentation focuses on developing a method to predict tourist traffic. An implementation strategy for interpreting traffic counts in high tourism areas is provided to aid in the development of Comprehensive Transportation Plans (CTP). Because of the high variability of traffic counts in high tourism areas, it is unreasonable to apply the typical weekday traffic count as the baseline metric for developing the CTPs for these areas.

2 - Crash Prediction using Traffic Data

Kasun Wijayaratna, University of New South Wales, UNSW, Civil and Environmental Engineering, H20, CE111, Sydney, 2174, Australia, kasun.w@unsw.edu.au, Sisi Jian, Vinayak Dixit

Crash statistics and traffic flow data of four major motorways within the Sydney metropolitan area was used to develop a joint real time crash and severity prediction model. Statistical techniques were initially utilized to determine effects of various traffic flow parameters on the likelihood of crash involvement and the severity level. The predictions of these models were then evaluated over different time horizons. Finally, the models are cross validated between the motorways.

3 - using Analytics to Assess the Effect of Alcohol, Unemployment, and Education on Vehicle Fatalities

Hassan Marzoughi, Louisiana State University, 275 W. Roosevelt St., Apt # 2257, Baton Rouge, LA, 70802, United States of America, hmarzo2@tigers.lsu.edu, Helmut Schneider

This paper uses analytics to assess the relationship between alcohol uses, unemployment and education level of a state to predict motor vehicle fatalities. Employing descriptive and predictive analytics U.S. crash and census data are used to gain insight into factors that affect the vehicle fatalities in states.

4 - The Impact of Carsharing on Alternative Vehicle Ownership

Regina Clewlow, Postdoctoral Scholar, Stanford University, Y2E2 Building, Room. 390C, 473 Via Ortega, Stanford, CA, 94305, United States of America, rclewlow@stanford.edu

Over the past decade, carsharing has grown considerably, particularly in major metro areas. Utilizing California travel survey data, this paper presents an analysis of vehicle ownership among carshare adopters vs. non-adopters utilizing multinomial logit models. After controlling for demographic factors, a statistically significant relationship between carsharing and alternative vehicle ownership was found.

■ WE24

Hilton- Union Sq 4

Disaster and Emergency Management 2

Contributed Session

Chair: Paul Cronin, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, paul.cronin@utexas.edu

1 - Locating Mobile Telecommunications Infrastructure in Extreme Events

Nannan Chen, Industrial and Systems Engineering - Texas A&M University, 3131 TAMU, College Station, TX, 77840, United States of America, nnchen@tamu.edu, Justin Yates

This research develops an integer formulation for locating mobile telecommunications equipment in the context of regional hurricane evacuation to temporarily alleviate cellular system stress. Agent-based simulation modeling is used to investigate the effectiveness of telecommunications equipment location given the inherent diversity and uncertainty of individual decision-making during evacuation.

2 - Managing Inventory under Catastrophe Risk

Bahar Biller, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, billerb@andrew.cmu.edu, Elliot Wolf, Enver Yucesan

We study the problem of managing inventory when the facilities storing inventory have exposure to catastrophic events such as fires, tornados, floods, and earthquakes. We develop a graphical model to capture not only the individual catastrophe risk at a single location but also the spatial dependencies among events across locations. Combining our catastrophe risk model with simulation optimization, we identify how to optimally manage inventory while hedging against catastrophe risk.

3 - Optimal Procurement Policies for Goods from Genuine and Potentially Counterfeit Sources

Laura Wagner, Zaragoza Logistics Center, C/ Bari 55, Edificio N·yade 5, Zaragoza, 50197, Spain, laurawa@mit.edu, Mahmut Parlar, Mustafa Cagri Gürbüz

Dispensers frequently faced with shortages of medicines from their main source. These periods are exploited by some distributors to breach supply chains and push counterfeits, forcing dispensers to implement measures to mitigate social/financial costs. We study dispenser's replenishment policies under various detection methods and determine the optimal strategy to safeguard against spurious drugs, and quantify the optimal procurement decisions in a dual-supplier and multi-period setting.

4 - A Decision-Theoretic Model for Hurricane Inventory Planning
Paul Cronin, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, paul.cronin@utexas.edu, Douglas Morrice, John Butler, Fehmi Tanrisever

As a hurricane nears the coast, consumers stock up. Inventory allocation is challenging for retailers in the region. We use an econometric model to estimate demand using actual purchase data and NOAA data from 2003-2008. A stochastic inventory model is used to investigate the optimal timing and level of inventory allocation. We develop insights into the relationships among holding costs, shortage costs, initial inventory, and the value of a two-stage allocation policy.

■ WE25

Hilton- Union Sq 5

Transportation, Freight

Contributed Session

Chair: Kamal Lamsal, Emporia State University, S243, PBB, Emporia, KS, 52246, United States of America, kamal-lamsal@uiowa.edu

1 - Sugarcane Harvest Logistics in US
Kamal Lamsal, Emporia State University, S243, PBB, Emporia, KS, 52246, United States of America, kamal-lamsal@uiowa.edu, Barrett Thomas, Philip Jones

Louisiana sugarcane farms start harvesting early in the morning and deliver most of the cane to the mill within a few hours. The mill requires a steady supply, so current practice creates a mismatch between cane supply and demand, resulting in longer turn-around times for trucks at the mill which increases the number of trucks needed to haul the cane. We present a field logistics model that spreads arrivals at the mill to match cane supply and demand, thereby reducing turn-around time and cost.

2 - Strategies for Recovery from Railroad Disruptions
Manish Verma, Associate Professor, McMaster University, 1280 Main Street W, Hamilton, ON, L8S 4M4, Canada, mverma@mcmaster.ca, Elkafi Hassini, Nader Azad

Railroads can be disrupted due to accidents, work stoppages or natural disasters. In such events shipments may be delayed or damaged. In this presentation we propose a model for timely and efficient recovery from such disruptions in order to maintain high customer service levels.

3 - Transportation Options and Indexes
Ronald Lembke, Associate Professor, University of Nevada, MGRS / 0028, Reno, NV, 89503, United States of America, ronlembke@unr.edu, Dale Rogers

Transportation options provide the buyer the right, but not the obligation, to buy or sell transportation capacity at a future date. These options can provide shippers, carriers and logistics companies a significant opportunity to reduce risks and increase capacity flexibility. This paper summarizes some of these benefits, describes a number of issues to be resolved before trading transportation options can become a reality, and presents possible resolutions for these issues.

4 - Impact of Tollway Polices on Truck Route Selection for Shipping Containers of Specific Commodities
Mazen Hussein, Assistant Professor, University of Wisconsin Platteville, 1 University Plaza, Platteville, WI, 53818, United States of America, husseinm@uwplatt.edu

The cost model for shipping commodities by truck developed by Hussein M. (2010) is extended to consider the impact of tollway polices on truck route selection for shipping containers of specific commodity groups near a container terminal. A path-finding model is built for this purpose. The values of time were used to mimic the truck's choices to ship containers of different commodities between container terminal and different facilities.

5 - Exploring Shipper-Carrier Dynamics in a Truckload Environment
Alex Scott, PhD Student, Penn State University, 463 A Business Building, State College, PA, 16802, United States of America, alexscott@psu.edu, Chris Parker, Chris Craighead

Shippers share a common pool of for-hire truckload transportation providers. Short-term imbalances in supply and demand conditions can cause significant volatility in service levels and the cost of moving freight. When carriers reject tendered freight, shippers engage the spot market. The literature has acknowledged that not much is known about freight rejection and spot market prices. In this study, we explore shipper-carrier dynamics using a transactional data set from a large US shipper.

■ WE26

Hilton- Union Sq 6

Supply Chain, Shipping and Transportation

Contributed Session

Chair: Yann Bouchery, Ecole de Management de Normandie, 30, Rue de Richelieu, Le Havre, 76087, France, y.bouchery@tue.nl

1 - Raw Material Transportation System in Iron-steel Industry with Data-driven Consideration
Defeng Sun, PhD Candidate, The Logistics Institute, Northeastern University, NO. 3-11, Wenhua Road, Heping District, Shenyang, 110819, China, cdfsun@gmail.com, Lixin Tang

We considered the transportation system of multiple raw materials in iron-steel industry with a central warehouse and multiple production plants. The demand of each plant is uncertain and hard to predict, so we apply a data-driven approach to minimize the associated transportation and inventory costs.

2 - Modeling the Impact of Social Media on Collaborative Freight Transport
Michael Bartolacci, Pennsylvania State Univesity, Berks, Reading, PA, 19610, United States of America, mbartolacc@aol.com, Yasanur Kayikci

Collaborative transport is an ever-growing area of logistics and supply chain management. We investigate how to model the use of social media and utilize it in optimizing collaborative freight transport.

3 - Model and Analysis of Products Damage in Supply Chain Network
Samir Alsobhi, PhD Student, Wichita State University, 11328 E. Pine Meadow Ct., Wichita, KS, 67206, United States of America, saalsobhi@wichita.edu, Abdulaziz Almaktoom, Krishna Krishnan, Deepak Gupta

Supply chain complexity and uncertainty of transportations hazards and packaging quality increases product damages during shipping. Appropriate packaging quality and transportation method will help to reduce damage cost. A mathematical model has been developed and programed in MATLAB to find the best routes and packaging to minimize the cost of damages in transit. Case studies have been developed and implemented to illustrate and validate developed model.

4 - Cargo Driven Container Logistics for Fresh Products in the Netherlands
Yann Bouchery, Ecole de Management de Normandie, 30, Rue de Richelieu, Le Havre, 76087, France, y.bouchery@tue.nl, Jan C. Fransoo

To improve the competitiveness of hinterland supply chains, the traditional focus on containers has to be complemented by a focus on the cargo inside the containers. When taking this cargo driven perspective, new supply chain solutions such as cross-docking may be developed. This paper aims at identifying the key logistics factors affecting the location of a cross-docking facility by taking the example of the import of fresh products in the Netherlands.

5 - Determining Road Toll Charges: A Reference Model
Mario Dobrovnik, Research Associate, Vienna University of Economics and Business, Welthandelsplatz 1, Vienna, 1020, Austria, mario.dobrovnik@wu.ac.at, Sebastian Kummer

Numerous European countries have introduced road tolls as a means of traffic guidance and control. These policy decisions have significantly affected entire economic regions as well as individual companies along the supply chain. For transport companies, passing the additionally incurred cost to the (final) customer as reasonably as possible therefore is of utmost importance. We propose a reference model that allows for determining the additional toll costs for individual shipments.

■ WE28

Hilton- Union Sq 8

New Concepts to Minimize Delay in Terminal Area Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Heng Chen, Isenberg School of Management, University of Massachusetts, Amherst, MA, 01003, United States of America, heng@som.umass.edu

1 - Distance vs. Time Based Metering in Optimized Profile Descent Operations

Heng Chen, Isenberg School of Management, University of Massachusetts, Amherst, MA, 01003, United States of America, heng@som.umass.edu, Senay Solak

One of the NextGen operational concepts is the introduction of time-based metering, which is typically viewed as being more efficient. In this paper, we explore the optimal sequencing and spacing policies under the context of Optimized Profile Descent. Potential fuel and environmental savings are provided. A comparison between time-based metering method and distance-based metering is presented.

2 - The Departure Regulator

John-Paul Clarke, Associate Professor, Georgia Institute of Technology, 270 Ferst Drive, Atlanta, GA, 30332, United States of America, johnpaul@gatech.edu

Seventy percent of US airline passengers use at least one of the 35 OEP airports that serve major metropolitan areas, and 23 of these OEP airports have at least one pair of closely spaced parallel runways. The capacity of CSPRs and thus airport delay are strong functions of weather, therefore there is a great need for concepts and technologies that increase capacity in bad weather. To this end, we present a new concept of operations that increases the bad-weather capacity of CSPRs by up to 34%.

3 - Data-driven Approaches for Robust Airline Resource Allocation under Uncertainty

Lavanya Marla, University of Illinois, Urbana, IL, United States of America, lavanyam@illinois.edu, Vikrant Vaze, Garrick Li

We address the issue of pro-actively building robust airline networks that are less vulnerable to uncertainty. We demonstrate the necessity of data-driven models in the context of aviation and present new data-driven approaches that (i)are faithful to implicit information in the underlying data, and (ii)are less fragile to disruption. We conclude with results from a real-world case study.

4 - Managing Demand Uncertainty through En Route Speed Control

James Jones, University of Maryland, College Park, MD, 20742, United States of America, jonesjc1@umd.edu, David Lovell, Michael Ball

We present an approach for transferring terminal delay to the en route phase of flight. We propose two integer programming models designed to assign delays to flights in advance of the terminal. The first model attempts to assign controlled times of arrival to flights by reducing airborne queuing delay while the second reduces the probability of scheduling conflicts. Each model effectively transfers delay en route and yields significant fuel savings benefits on a per flight basis.

■ WE29

Hilton- Union Sq 9

Operations Management/inventory

Contributed Session

Chair: Qinan Wang, Associate Professor, Nanyang Business School, S3-B2A-31, Nanyang Business School, Nanyang Technological University, Singapore, 639798, Singapore, AQNWANG@ntu.edu.sg

1 - Optimal Responses to Stockouts: Lateral Transshipment versus Emergency Order Policies

Yi Liao, Southwestern University of Finance and Economics, 555 Liutai Ave, Chengdu, China, yiliao@swufe.edu.cn, Xinxin Hu, Wenjing Shen

When a stockout takes place, retailers often apply one of two strategies to resolve the issue ñ placing an emergency order or arranging a lateral transshipment. Choosing the optimal response to a stockout is complicated by customers' spontaneous reactions. In this study, under a single-period setting with two retail stores, we investigate the optimal inventory decisions under each strategy, and conduct a comparison between lateral transshipment and emergency order options.

2 - Optimal Decisions in Production-inventory System with Demand and Production Disruptions

Haiyan Wang, Southeast University, School of Economics and Management, Nanjing, China, hywang@seu.edu.cn, Xiaolin Xu

The paper discusses the optimal production-inventory decisions in a production-inventory system for products which have the characteristic of perishable items with demand and production disruptions. In order to lower the cost, we address these issues and propose optimal production run time, replenishment time and order quantity for manufacturer.

3 - Component Procurement Strategies in Decentralized Assembly Systems under Supply Uncertainty

Wenting Pan, Assistant Professor, Saint Mary's College of California, 380 Moraga Road, Moraga, CA, 94597, United States of America, wp3@stmarys-ca.edu, Rick So

We analyze the interactions among the assembler and two component suppliers in their procurement decisions under a vendor-managed inventory contract. We assume that one of the component suppliers suffers from the random yield. We first analyze the special case under deterministic demand, and then extend our analysis to the general case under stochastic demand. We derive the optimal component prices offered by the assembler and the equilibrium production quantities of the component suppliers.

4 - The Effect of Manufacturer-to-Consumer Rebates in Competition Environment

Pengyu Chen, PhD Student, Huazhong University of Science & Technology, School of Management, 1037 Luoyu Road, Wuhan, China, andychen@hust.edu.cn, He Xu, Shilu Tong

Previous research shows that M-to-C rebates help to manage strategic inventory in a serial supply chain. This paper extends this research by examining how competition from upstream firms or downstream firms may influence this effect of rebates. Our results show that this effect always exists under the downstream competition but may disappear if the upstream competition is intensive. We also observe that the intensity of competition has a negative externality towards the usage of rebates.

■ WE30

Hilton- Union Sq 10

Operations Management/Marketing Interface V

Contributed Session

Chair: Baozhuang Niu, Assistant Professor, Sun Yat-sen University, Lingnan College, No. 135, Xingangxi Road, Guangzhou, China, niubzh@mail.sysu.edu.cn

1 - Personalized Price Optimization through Controlled Price Experimentation

Yan Zhao, Graduate Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, zhaoyanmit@gmail.com, Xiao Fang, David Simchi-Levi

We consider the situation where customers can be randomly assigned to different groups and correspondingly offered different prices for a particular product. Customers' purchasing decisions, together with their characteristics, are observed. Our objective is to choose the revenue-maximizing price for each point in the space of customer characteristics.

2 - When and How to Rely on the Free-ride of Word of Mouth for a New Product Introduction

Vahideh Abedi, Assistant Professor, California State University Fullerton, Information Systems & Decision Sciences, 800 N State College Blvd, Fullerton, CA, 92834, United States of America, vabedi@fullerton.edu, Oded Berman, Dmitry Krass

The success of introduction of a new product or service significantly depends on the firm's marketing strategies and the word of mouth spread about the product between customers. The firm can partly rely on customer word of mouth to reduce its marketing expenditures, but such a strategy might fail if not properly encouraged by the firm's marketing strategies. Using the Bass model for sales of a new product, we provide insights on how and when the firm can earn a free ride from word of mouth.

3 - Manufacturer Warranties for Durable Goods and Channel Structure

Zeynep Kirkizoglu, MAN Truck and Bus Turkey, Esenboga Havalimani Yolu 22.km, Akyurt, Ankara, 06750, Turkey, zeynep.kirkizoglu@man.eu, Ozgen Karaer

Durable goods manufacturers usually provide sales and aftersales services through retailers. Especially aftersales revenues are essential for retailers that provide both the repair services for the manufacturer during the warranty period and all other repair and maintenance services demanded by the customer. In this study, we look into how the warranty period affects aftersales revenues, and the decisions made by the manufacturer and the retailer accordingly.

4 - Quality Yield Risk and Optimal Sourcing in a Co-opetitive Supply Chain

Baozhuang Niu, Assistant Professor, Sun Yat-sen University, Lingnan College, No. 135, Xingangxi Road, Guangzhou, China, niubzh@mail.sysu.edu.cn, Jiawei Li

Consider a co-opetitive supply chain comprising an OEM and a competitive supplier who provides qualified components, but also competes with the OEM in the downstream market. OEM may shift orders to a non-competitive supplier whose products have quality yield risk. We analyze the value of dual-sourcing for the OEM and the competitive supplier's optimal response.

■ WE31

Hilton- Union Sq 11

Data Analytics-based Service Concept Development

Sponsor: Service Science

Sponsored Session

Chair: Kwang-Jae Kim, Professor, Postech, Eng. Bldg. 4-316, 77 Cheongam-ro, Nam-gu, Pohang, Korea, Republic of, kjk@postech.ac.kr

1 - Analysis of Vehicle Operational Data for Driving Safety Enhancement

Min-Jun Kim, PhD Candidate, Postech, Eng Bldg. 4-316, 77 Cheongam-ro, Nam-gu, Pohang, Korea, Republic of, minjun@postech.ac.kr, Kwang-Jae Kim, Ki-Hun Kim, Chang-Ho Lee

The Korean government developed a system to collect the operational data of commercial vehicles. This talk presents an analysis of the operational data collected in conjunction with traffic accident data. The goal of the analysis is to gain insights for the development of new service concepts for driving safety enhancement. The relationship between the driving patterns and accident history of drivers is identified and utilized in developing service concepts supporting driving safety enhancement.

2 - Service Process Design for Hypertension Patient Management Services

Ryeok-Hwan Kwon, PhD Candidate, Postech, Engineering Building #4-316, Pohang, 790-784, Korea, Republic of, klh1706@postech.ac.kr, Ki-Hun Kim, Kwang-Jae Kim, Sung-Hong Kang, Yea-Eun Kim

The National Health Insurance Service of Korea has collected health service data of nearly all the citizens since 2001. This research aims to develop a new service model for hypertension patient management using a sample of the data set. This talk focuses on the process of designing and evaluating the service production and delivery processes reflecting the characteristics of target customers. The processes for a service supporting blood pressure self-control will be presented as an example.

3 - Development of Healthcare Service Concepts using National Health Insurance Service Database in Korea

Ki-Hun Kim, PhD Candidate, Postech, Eng Bldg. 4-316, 77 Cheongam-ro, Nam-gu, Pohang, Korea, Republic of, ksw12312@postech.ac.kr, Chi-Hyuck Jun, Chie-Hyeon Lim, Sung-Hong Kang, Kwang-Jae Kim

In Korea, the National Health Insurance Service (NHIS) has collected insurance and medical record data of nearly all the citizens since 2001. We developed eight new healthcare service concepts which utilize the NHIS database. In this talk, we present how the new service concepts were developed. We also discuss some challenges of developing healthcare service concepts.

■ WE32

Hilton- Union Sq 12

Operations/Economics Interface

Contributed Session

Chair: Augustine Osagiede, Professor, University of Benin, Ugbowo-Lagos Road, Benin City, Nigeria, augustine.osagiede@uniben.edu

1 - How Can Wholesale Price Contract Coordinate Supply Chain

Chongqi Wu, Associate Professor of Management, Cal State East Bay, 25800 Carlos Bee Blvd, Hayward, CA, 94542, United States of America, chongqi.wu@csueastbay.edu

Based on classic Hotelling model, I demonstrate that wholesale price contract and its derivative, two-part tariff contract, can coordinate a simple two-echelon supply chain, either with or without asymmetric information. Under some realistic conditions, not only is supply chain coordinated, both supply chain members make positive profits.

2 - The Transient Per Capita Income Shares in Continuous-time From a Tax-subsidy Perspective

Augustine Osagiede, Professor, University of Benin, Ugbowo-Lagos Road, Benin City, Nigeria, augustine.osagiede@uniben.edu, Virtue Ekhosuehi

We consider a scenario where individuals in an economy are classified according to their income. We determine the transient per capita income shares. The idea of entropy is employed as a theoretical underpinning to attain even per capita income shares. We provide a guide on subsidy selection from several alternatives.

3 - Rent Contracts Between Co-Stores

Lama Moussawi-Haidar, Assistant Professor, American University of Beirut, PO Box 11-0236 Riad El Solh, Beirut, 1107-2020, Lebanon, lm34@aub.edu.lb, Nagihan Comez Dolgan

High rental rates and space scarcity are pushing retailers to cooperate. One way of cooperating is co-location, where a retailer rents out some of his available floor space to another retailer. Using the double moral hazard theory, we show that a percentage revnue sharing contract results in the second-best optimal solution for the landlord. We analyze the properties of optimal contract, by assuming a Cobb-Douglas sales functions and exponential disutility functions of efforts.

4 - Impact of Upstream Strategic Alliance on Downstream Horizontal Competition

Jooyol Maeng, Assistant Professor, Pacific Lutheran University, 12180 Park Ave. S., Tacoma, WA, 98023, United States of America, maengjy@plu.edu

This paper examines a competition between two retailers sharing one upstream supplier. Dynamics between downstream firms is investigated when one of them has a strategic alliance with the supplier.

■ WE33

Hilton- Union Sq 13

Innovation/Entrepreneurship

Contributed Session

Chair: Abraham Lee, Professor of International Business, Handong Global University, 558 Handongro, Pohang, 791-708, Korea, Republic of, alee@handong.edu

1 - Innovation Diffusion in Citation Network

Chuanzhen Wu, Xiamen University, China, Boston University, Boston, MA, wuchzhen@126.com, Di Xu

This paper tries to use some open dataset to find the network structure and statistics of citation network. Characteristics for innovation diffusion process will be discovered and discussed.

2 - The Geography of Imitation: Global Innovation Ecosystems and the Risk of Being Infringed

J. Nils Foege, Research Associate, RWTH Aachen University, Kackertstrasse 7, Aachen, 52072, Germany, foege@time.rwth-aachen.de, Torsten-Oliver Salge, Erk Peter Piening

Firms are increasingly embedded in global innovation ecosystems, which enhance the potential for both valuable knowledge inflows and unintended knowledge leakage. Our analyses of 612 German manufacturing firms reveal the risk of collaboration-induced infringement of technical inventions to be greatest for those firms with a wide set of geographically distant innovation partners and a strong innovation track record increasing their perceived attractiveness as an imitation target.

3 - Startup Accelerators: The Role of Networks and Prior Experience

Jorge Mejia, PhD Candidate, University of Maryland, 421 A St NE #4, Washington, DC, 20002, United States of America, jmejia@rhsmith.umd.edu, Anand Gopal

There are approximately 2,000 startup accelerators worldwide. These programs provide entrepreneurs with mentorship, networking, and often capital to launch their business. Despite their importance in the current startup ecosystem, accelerators remain understudied in the management literature. Using team-level data from the full cohort of a major global accelerator, our study aims to understand the role of network ties and prior experience in the success of startups in these programs.

4 - Brazilian Laws of Industrial Property and Innovation: Analysis of Impact in Patent Applications

Suzana Russo, Dr, Federal University of Sergipe - UFS, Rua Josué de C. Cunha, Aracaju, SE, 49035490, Brazil, suzana.ufs@hotmail.com, Adonis Reis, Edilson Pires, Rafaela Silva, Ikaro Barreto, Stephane Fabris

This paper analyzes the behavior of the number of patent applications made in Brazil to identify the impacts, after the change in the Industrial Property Law. The analysis was performed globally, by residents and non-residents. Linear regression models were used. Data were analyzed seeking also compare and evaluate these indicators, so one can achieve a positive response or not for these law alterations, in order to support decision makers.

■ WE35

Hilton- Union Sq 15

Managing Supply Chains in the Public and Non-profit Sector

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Karthik Natarajan, Carlson School of Management, 321 19th Ave South, Minneapolis, MN, 55454, United States of America, knataraj@umn.edu

1 - Models for Allocation and Inventory Management of Specialized Nutritious Foods

Melih Celik, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, United States of America, melihcelik@gatech.edu, Ozlem Ergun, Pinar Keskinocak, Dima Nazzal

Specialized nutritious foods (SNF) are blended foods that contain a broad set of macro- and micro-nutrients to treat or prevent malnutrition. In this study, we consider the allocation of SNF from a central warehouse to distribution locations through (i) hubs that act as crossdocks, or (ii) district warehouses that hold stocks. Our models and solution approaches analyze the effects of network structure, uncertainty of demand, perishability, and equity considerations on the allocation structure.

2 - Quantifying the Impact of Decentralization through Robust Optimization

Luke Muggy, PhD Candidate, Kansas State University, Industrial and Manufacturing Systems Eng, 2037 Durland Hall, Manhattan, KS, 66502, United States of America, lmuggy@k-state.edu, Jessica Heier Stamm

Humanitarian operations are often characterized by decentralized decision making, in contrast to centrally coordinated actions. This research quantifies the impact of decentralized facility location decisions on beneficiary treatment access using a dynamic, robust facility location model as a centralized benchmark. The method is illustrated using data from the response to the 2010 Haiti cholera epidemic.

3 - Modeling for the Equitable and Effective Food Distribution under Uncertainty

Irem Sengul, North Carolina State University, 400 Daniels Hall College of Engineering, Raleigh, NC, United States of America, isengul@ncsu.edu, Julie Ivy, Reha Uzsoy

Our objective is to identify equitable and effective food distribution policies under conditions of uncertainty in partnership with a local food bank that provides food assistance to people at risk of hunger in 34 counties. The primary source of uncertainty is the county capacity that limits total food distribution due to equity requirements. We develop robust optimization and stochastic programming models for optimal food distribution under stochastic capacity constraints.

4 - Delivering Health Care to underserved and Impoverished Communities

Kingshuk Sinha, Professor, Mosaic Company Professor of Corporate Responsibility, Carlson School of Management, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Emily Kohnke

We report the development of a framework to inform the delivery of socially responsible health care innovations in underserved and impoverished communities. The framework was developed through the application of grounded theory and empirical research methods. The setting for the study is an underserved and impoverished community in China.

■ WE36

Hilton- Union Sq 16

Sports & Entertainment II

Contributed Session

Chair: Agha Iqbal Ali, Professor, Department Isenberg School of Management, 121 Presidents Dr., University of Massachusetts, Amherst, MA, 01003, United States of America, aiali@isenberg.umass.edu

1 - Logistical Impact of Stadium Locations for the Qatar 2022 FIFA World Cup

Agha Iqbal Ali, Professor, Department Isenberg School of Management, 121 Presidents Dr., University of Massachusetts, Amherst, MA, 01003, United States of America, aiali@isenberg.umass.edu, Ahmed Ghoniem, Mohammed Al-Salem

The number of venues for the twenty FIFA World Cups since 1930 has ranged from 3 to 20 and the number of participating teams has grown from 13 to 32. Due to the compactness of Qatar, the logistical impacts of different numbers and locations of venues can be significant for the Qatar 2022 FIFA World Cup. These impacts are studied in a scenario analysis using mathematical programming.

2 - Olympic Team Selection Optimization: The Dutch Speed Skaters Case

Gerard Sierksma, Professor, University of Groningen, PO Box 800, Groningen, 9747AE, Netherlands, g.sierksma@rug.nl

The Dutch speed skaters won 23 of the 36 medals during the Olympic Games. The success was preceded by a novel selection system. The IOC prescribes a maximum of 20 skaters so that choices between 500 and 5000m specialist needed to be made. We have applied an ILP-model with medal winning probabilities. We explain how this model was used for the final selection and elaborate on Gould's hypothesis: the differences between performances of top athletes become smaller and smaller over the years.

3 - Scheduling Games in Indian Premier League (IPL)

Amit Verma, Assistant Professor of Logistics, Delta State University, 120, Gibson Gunn Building, Cleveland, MS, United States of America, averma@deltastate.edu, Kamal Lamsal

Scheduling games in the IPL is a challenge. The global nature of the audience means that not all live broadcasts of games air during optimal viewing hours. TV viewership of a match is contingent on the presence of famous foreign players. These players drive the viewership in their respective countries of origin. The local timing of the live broadcast also impacts the viewership. We present a scheduling model that maximizes global TV viewership considering the constraints and discuss the results.

4 - Pathologies of Ranking: An Improvement to the Sensitivity of the Markov Method

Baback Vaziri, Purdue University, 315 N. Grant St., West Lafayette, IN, 47906, United States of America, bvaziri@purdue.edu, Tom Morin, Yuehwern Yih, PhD

The Markov method is a ranking method that uses Markov chains to rank items based on a collection of votes that represent pairwise comparisons between the alternatives. Its application spans from ranking webpages (PageRank) to sports teams. However, the Markov method has been shown to be sensitive to small perturbations, which can result in poor rankings. This study will propose a modified voting algorithm that will reduce the effect of unexpected results, and produce a more robust ranking.

5 - Stochastic Frontier Analysis Model of Players Performance Comparison for the NBA Teams

Wei Xiong, PhD Student, University of Cincinnati, 880 Rue de La Paix, Cincinnati, OH, 45220, United States of America, xiongwi@mail.uc.edu, Yi Tan

Instead of generally comparing all players in a league, we act ourselve as a manager of a NBA team, and then compare targeting players via stochastic frontier analysis model with only considering of the game strategy of our team". We create a mutual platform which connect all targeting players, and exclude the effect from each targeting player's original team. The goal of this project is to avoid the over-estimation and bias via players' performance comparison procedure for each team in NBA.

■ WE37

Hilton- Union Sq 17

Marketing 2

Contributed Session

Chair: Yoshiyuki Okuse, Professor, Senshu University, 2-1-1, Higashimita, Tama-ku, Kawasaki, Kanagawa, 2148580, Japan, okuse@isc.senshu-u.ac.jp

1 - An Empirical Analysis of Smartphone Diffusions by Mobile Platform

Daegon Cho, Assistant Professor, Pohang University of Science and Technology, 77 Cheongam-Ro, Nam-Gu, Pohang, 790-784, Korea, Republic of, dgcho@postech.ac.kr

This study examines the cross-country diffusion of the iPhone and the Android. A Bass diffusion model is applied, and we use a data set of aggregated smartphone sales from 15 countries between 2008 and 2013. Our result suggests that there would be a higher innovation effect for both platforms in developed countries than in developing countries. Our finding also suggests that the Android's diffusion negatively affects the iPhone's, but the iPhone's diffusion positively affects the Android's.

2 - A New Weighting Method of Measuring Corporate Social Performance (CSP)

Yoonsun Jeong, Masters Student, Korea University Business School, Anam-Dong, Seongbuk-Gu, Seoul, Korea, Republic of, yoonsun@korea.ac.kr, Shijin Yoo

The relationship between CSP and corporate financial performance(CFP) has been studied to find inconsistent results. This paper examines the possibility that the various ways of weighting CSP sub-dimensions can in fact determine the outcome of such results. A partial least squares model is proposed as a new way of weighting CSP sub-dimensions. In an empirical analysis using a database collected in Korea, the proposed PLS-weighted CSP only finds a significant relationship with CFP.

3 - An Empirical Analysis of Price Endings with Questionnaire data

YoshiyukiI Okuse, Professor, Senshu University, 2-1-1, Higashimita, Tama-ku, Kawasaki, Kanagawa, 2148580, Japan, okuse@isc.senshu-u.ac.jp

In the research area of pricing strategy, a lot of researches on price endings have been developed to date. This research attempted to specify the effect of price endings with data for Price Sensitivity Measurement (PSM). PSM is one of the most popular price research methods to understand consumers' acceptable price range. A questionnaire survey of Japanese people was conducted to collect PSM data. A total of 206 samples were collected for each of 9 product categories.

■ WE38

Hilton- Union Sq 18

Health Care Process 2

Contributed Session

Chair: Fan Tseng, Professor of Management Science, University of Alabama in Huntsville, AL, 301 Sparkman Dr., College of Business, Huntsville, Al, 35899, United States of America, tsengf@uah.edu

1 - Can Hospitals Streamline Patient Flow Through Identifying Sources of Variation? A Case Study

Nasim Arbabzadeh, Rutgers, The State University of New Jersey, 96 Frelinghuysen Road, Piscataway, NJ, 08854-8018, United States of America, nasim.rutgers@gmail.com, Kian Seyed, Mohsen Jafari

Each hospital inpatient is classified into one of around 500 Diagnosis-Related Groups, and the hospital is paid a fixed amount irrespective of what it charges for. Therefore, it is logical to expect that by reducing the within DRG discrepancies, hospitals can cut cost and improve patient safety. This paper demonstrates the applicability of classical process control tools and data mining methods for variation reduction using a real case of a chest pain inpatient process in a New Jersey hospital.

2 - Balancing Outcomes of Care: Examining the Contribution of Nurse Staffing to Patient Outcomes

Fan Tseng, Professor of Management Science, University of Alabama in Huntsville, 301 Sparkman Dr., College of Business, Huntsville, AL, 35899, United States of America, tsengf@uah.edu, Karen Frith, Faye Anderson, Eric Fong

In this study, We investigate the relationship between nursing care resources and performance as indicated by multiple outcomes at the nursing unit level by applying the Data Envelopment Analysis technique to sample data collected from multiple hospitals. We also use multivariate statistical techniques to identify critical factors that determine the efficiency of a nursing unit.

3 - The Impact of Discharge Policies on the Efficiency of a Pediatric Ward

Robert Saltzman, Professor, San Francisco State University, College of Business, 1600 Holloway Ave., San Francisco, CA, 94132, United States of America, saltzman@sfsu.edu, Theresa Roeder, Judith Lambton

Hospital patients are often moved from one bed to another for both medical and non-medical reasons. In a highly-utilized in-patient pediatric ward that we have studied, bed and nursing resources are stressed not only by frequent movement of patients but also by the ward's patient discharge policy. We present a discrete-event simulation model for examining how patient movement and the ward's efficiency may be improved by a better discharge policy.

■ WE39

Hilton- Union Sq 19

Risk Assessment in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Sanjay Mehrotra, Professor, Northwestern University, 2145 Sheridan Rd, Industrial Engineering and Mgmt. Sciences, Evanston, IL, 60208, United States of America, mehrotra@northwestern.edu

1 - Lifetime Risk Assessment in the Presence of Incomplete Data

Brittany Bogle, PhD Candidate, Northwestern University, 2 145 Sheridan Road, Room C210, Evanston, IL, 60201, BrittanyBogle2015@u.northwestern.edu

We assess lifetime risk of a binary outcome in a longitudinal cohort study. In a this type of dataset, variables are measured during each exam; however, participants miss exams, some data is missing, and not all variables are collected over all exams. We use a competing Kaplan-Meier approach to compute lifetime risk. Complete-case analysis results are presented as well as a comparison of imputation methods, using the Framingham Heart Study with an outcome variable of sudden cardiac death.

2 - A DOE Approach to Validation Sampling for Logistic Regression with Error-Prone Medical Records

Liwen Ouyang, Graduate Student, Northwestern University, 2145 Sheridan Rd, C217, Evanston, IL, 60208, United States of America, LiwenOuyang2011@u.northwestern.edu, Daniel Apley, Sanjay Mehrotra

Disease risk factors are often identified via logistic regression on medical record databases. However, high error rates in the recorded response (ICD-9 codes) will render the model unreliable unless a sample of cases are validated by manual chart review and incorporated into the modeling. In contrast to the random validation sampling used in existing approaches, we propose a new paradigm using DOE principles to judiciously select which cases to validate for maximum information content.

3 - Bayesian Component Selection in Multi-response Hierarchical Structured Additive Models

Kai Yang, Professor, Wayne State University, 4815 Fourth Street, Detroit, MI, 48201, United States of America, Saeede Ajorlou, Kai Yang

We develop a multivariate version of hierarchical structured additive regression (STAR) models involving a set of patient factors and also higher level effects to capture heterogeneity between patients within the same medical home team and facility. We propose a Bayesian component selection that allows inclusion or exclusion single effects as well as grouped coefficients representing particular model terms. A case study of from VA patient centered medical home data is presented.

■ WE40

Hilton- Union Sq 20

Optimization Models in Healthcare Applications

Sponsor: Health Applications

Sponsored Session

Chair: Shan Liu, Assistant Professor, Industrial and Systems Engineering, University of Washington, UW Box 352650, Seattle, WA, 98195-2650, United States of America, liushan@uw.edu

1 - Bayesian Learning for Optimal Dosing in Adaptive Clinical Trials

Jakob Kotas, University of Washington, Applied Mathematics, Seattle, WA, United States of America, jkotas@uw.edu, Archis Ghate

We investigate the problem of finding optimal dosing policies in adaptive clinical trials while learning dose response parameters for a cohort of patients. We first study the clairvoyant case where we establish monotonicity of optimal doses in patient disease states. We then propose approximate dynamic programming methods to solve the full-scale optimal learning problem. Results will be illustrated through exponential and Michaelis-Menten dose response functions.

2 - Network Optimization of Functional Connectivity MRI to Detect Cognitive Decline

Daehan Won, PhD Sstudent, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, wondae@uw.edu, W. Art Chaovalitwongse, Thomas J. Grabowski, Sherry Wills, Onur Seref, Paul Borghesani

We develop a sensitive non-invasive test to detect abnormal cognitive decline via fMRI. Default mode networks (DMN) have been identified to be sensitive to marker of abnormality. Since there is no exact physical information of the DMN, we suggest the k-cardinality tree (KCT) as a topological biomarker of functional connectivity network. In this study, we develop the IP model to find a KCT and conduct experiments to analysis our findings and provide the outcome from a population based comparison.

3 - Patient Transitions across Health Care Services: A Framework for Accountable Care Organizations

Zelda Zabinsky, Professor, University of Washington, Industrial & Systems Engineering, Box 352650, Seattle, WA, 98195-2650, United States of America, zelda@u.washington.edu, Joseph Heim, Paul Fishman

Managing care transitions is a critical aspect for successful implementation of Accountable Care Organizations (ACOs). We present a Markov model for how patients transition between and among providers and health care settings, using data from Group Health Cooperative with over 600,000 individuals enrolled. Our model allows us to explore different patterns of health service use and patient transitions in order to and assess the impact of alternative modes of care in particular medicine.

4 - Approximate Dynamic Programming for Advanced Scheduling with Cancellations and Overbooking

Mahshid Salemi Parizi, University of Washington, Industrial and Systems Engineering, Seattle, WA, United States of America, msalemip@uw.edu, Archis Ghate

Advanced scheduling arises in many applications including healthcare. The goal is to schedule randomly arriving jobs into future slots within a booking horizon. In practice, planners usually employ overbooking to mitigate adverse effects of cancellations. We present an MDP formulation of this problem and propose approximate dynamic programming methods for its solution. We compare the performance of these methods with simple heuristic scheduling policies.

■ WE41

Hilton- Union Sq 21

Supply Chain Management XI

Contributed Session

Chair: Ramakrishna Govindu, Instructor, University of South Florida, 8350 N Tamiami Trail, SMC-C263, Sarasota, FL, 34243, United States of America, rgovindu@usf.edu

1 - Minimizing Penalties in Supply Chain Scheduling Involving Multiple Customers

Ramakrishna Govindu, Instructor, University of South Florida, 8350 N Tamiami Trail, SMC-C263, Sarasota, FL, 34243, United States of America, rgovindu@usf.edu, Anurag Agarwal

We propose models, heuristics and results for a supply chain scheduling problem involving multiple customers operating in a just-in-time environment. The objective is to minimize penalties for late deliveries. The proposed heuristics involve splitting deliveries and lots to achieve its objectives.

2 - Pricing and Coordination Analysis of A Dual Channel Supply Chain in the Case of Free Riding

Shuzhen Sun, Oklahoma State University, 502 Engineering North, Oklahoma State University, Stillwater, OK, 74075, United States of America, shuzhen.sun@okstate.edu, Tieming Liu

We develop a Hotelling model to study a supply chain with one manufacture and two retail channels, where the manufacture-owned online channel free-rides the brick-and-mortar retailer's sales effort. To coordinate it, we examine two pricing scenarios: endogenous prices and exogenous prices. A new contract with selective rebate and revenue sharing under the price match policy is designed to coordinate the supply chain and realize the arbitrarily split of the system profit in the two scenarios.

3 - The Supply Chain Management of Fresh Produce with Price Fluctuation

Xiangyu Hou, Department of Industrial Engineering, Tsinghua University, Haidian District, Beijing, Beijing, China, houxy0727@gmail.com, Dacheng Liu

We study the supply chain of fresh produce in China, which is operated by many small self-employed vendors. For a typical supply chain, three echelons are included, i.e., supplier, wholesaler and retailer. The price at the wholesale market is fluctuant due to uncertainties such as weather. Such reasons make the supply chain cooperation almost impossible in China. We try to model this supply chain and propose a plan for the cooperation on the chain.

4 - Measurement and Optimization of Responsiveness in Supply Chain Networks

Sin-Hoon Hum, National University of Singapore, NUS Business School, 15 Kent Ridge Drive, Singapore, Singapore, bizhumsh@nus.edu.sg, Yun Zhou, Mahmut Parlar

We consider multi-stage supply chains of serial or network structure which are either exogenous or endogenous, and define supply chain responsiveness as the probability of fulfilling customer orders within a promised lead-time. We optimize the responsiveness of the supply chain by maximizing the probability that the order will be fulfilled within the promised lead-time subject to a budget constraint. With endogenous chains, we study the problem in the context of queuing effects.

5 - Strategic Debt and Supply Chain Games

Qiaohai Hu, City University of Hong Kong, AC-1, Room 7605, Dept. of Management Science, Kowloon, China, joice.hu@gmail.com, Ping Su

We examine the interaction of debt financing and supply chain competition. Two retailers use strategic debt to influence their product market competition. We find that both retailers will adopt strategic debt in equilibrium, producing more, but both worse off than if they were purely equity-financed. Their supplier(s), however, are better off. More interestingly, when the retailers have a common supplier and only one retailer use strategic debt, the leveraged one gains the first-move advantage

■ WE42

Hilton- Union Sq 22

Uncertainties in Radiation Therapy

Sponsor: Health Applications

Sponsored Session

Chair: Omid Nohadani, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, nohadani@northwestern.edu

Co-Chair: Arkajyoti Roy, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, arkajyoti.roy@northwestern.edu

1 - A Column Generation and Routing Approach to 4p Vmat Radiation Therapy Treatment Planning

Troy Long, University of Michigan, Ann Arbor, MI, troylong@umich.edu, Thomas Bortfeld, David Papp, Edwin Romeijn, Jan Unkelbach, David Craft

Volumetric Modulated Arc Therapy (VMAT) is rapidly emerging as a method for delivering radiation therapy treatments to cancer patients that is of comparable quality to IMRT but much more efficient. Since VMAT only uses coplanar beam arcs, the next step is to consider non-coplanar arcs in the 4p space around the patient as well. We propose a constructive approach that employs both column generation and routing heuristics.

2 - Incorporating Liver Functionality Information in Radiation Therapy Treatment Planning

Victor Wu, PhD Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, vwwu@umich.edu, Mary Feng, Edwin Romeijn, Martha Matuszak, Marina Epelman

Goals of radiotherapy include (i) eradicating tumor cells and (ii) sparing critical structures to ultimately preserve functionality. Liver perfusion (blood flow) maps show that functionality is non-homogenous, implying the dose distribution's spatial features matter. We propose an optimization model that explicitly incorporates functionality information from perfusion maps to redistribute dose from well-perfused areas without sacrificing tumor coverage. We validate our model with patient cases.

3 - Optimal Learning in Adaptive Biologically Conformal Radiotherapy
Fatemeh Saberian, University of Washington, Industrial & Systems Engineering, Box 352650, Seattle, WA, 98105, United States of America, negar.saberian@gmail.com, Archis Ghate, Minsun Kim

We present a Bayesian framework for learning radiobiological parameters for dynamically adapting treatment plans based on information acquired from functional images over the treatment course. We model this as a high-dimensional stochastic control problem and discuss approximation algorithm rooted in convex programming. Computational results on head-and-neck test cases will be discussed.

4 - Robust Dynamic Multi-Objective IMRT
Arkajyoti Roy, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, arkajyoti.roy@northwestern.edu, Omid Nohadani

Traditionally, competing objectives in radiation therapy are addressed using ad hoc weights to achieve desired dose distributions. Resulting plans are delivered repeatedly over several weeks. However, spatiotemporal anatomical changes often diminish the quality of such plans. We present a novel approach that exploits anatomical variations, improves plan quality, and is robust to model uncertainties.

■ WE43

Hilton- Union Sq 23

Computational Network Flows and Routing

Sponsor: Computing Society

Sponsored Session

Chair: Matthew Saltzman, Associate Professor, Clemson University, Dept. of Mathematical Sciences, Martin Hall, Box 340975, Clemson, SC, 29634-0975, United States of America, mjs@clemson.edu

1 - Capacitated Flow-path Inequalities
Birce Tezel, University of California, Berkeley, Sutardja Dai Hall (CITRIS), Room # 450/63, Berkeley, CA, 94720-1764, United States of America, btezel@berkeley.edu, Simge Kucukyavuz, Alper Atamturk

We derive strong inequalities for capacitated fixed-charge network flow problems based on path-set relaxations. These inequalities are based on exact characterizations of submodular value functions for fixed-charge flow on simple paths and they generalize the well-known flow cover inequalities.

2 - Generalized Interval-flow Networks: Models, Applications, and Solution Methods
Angelika Leskovskaya, Southern Methodist University, PO Box 750123, Dallas, TX, 75275, United States of America, aleskovs@mail.smu.edu, Richard Barr

Generalized interval-flow networks are a new extension of the classic generalized network formulation that adds a conditional lower bound constraint on the arcs. Practical applications of this modeling technique are presented along with efficient solution methods that exploit the underlying network structure.

3 - Vehicle Scheduling with Time Windows and Business-driven Priorities
Barin Nag, Towson University, Towson, MD, United States of America, bnag@towson.edu, Natalie Scala

Customer priorities and preferences from business needs and strategies may exist in an applied routing problem. This research includes these factors by using the Analytic Hierarchy Process to map factors to consistent values, forming inputs to various algorithms developed to satisfy business strategies. Algorithmic results are compared using various metrics.

4 - Integer Programming Models for the Backhaul Vehicle Routing Problem
Yuanyuan Dong, PhD Student, Southern Methodist University, 3145 Dyer Street, Suite 337, Dallas, TX, 75205, United States of America, ydong@mail.smu.edu, Eli Olinick, Andrew Yu

We present a MIP for the backhaul vehicle routing problem whereby profit is maximized by accepting unscheduled deliveries during the time-limited backhaul trip to the vehicle's starting location. The MIP is inspired by a novel formulation of multicommodity flow that significantly reduces the size of the constraint matrix compared to a model based on the classical approach. We show that our model is a stronger formulation and present computational results using the two approaches.

■ WE44

Hilton- Union Sq 24

Strategy/Strategic Planning II

Contributed Session

Chair: Pooya Tabesh, Instructional Assistant, University of Houston, Department of Management, Bauer College of Business, Houston, TX, 77204, United States of America, ptabesh@uh.edu

1 - The Impact of Slack Resources on Exploration and Exploitation: An Upper Echelons Perspective
Pooya Tabesh, Instructional Assistant, University of Houston, Department of Management, Bauer College of Business, Houston, TX, 77204, United States of America, ptabesh@uh.edu, Dusya Vera

Slack is a pool of excess resources that can be critical for organizational success, but cumulative research on the slack-performance link has resulted in mixed findings. We untangle the effect of slack by differentiating between the impact of absorbed slack and unabsorbed slack and investigating their effects on exploratory and exploitative activities in organizations. Furthermore, we highlight the critical role of CEO tenure, functional track, and education level in slack resource deployment.

2 - Barbarians at the Gate: How Firm Competition Affects Intraorganizational Conflict
Bryan Hong, Assistant Professor, Ivey Business School, 1255 Western Road, London, ON, N6B 3R7, Canada, bhong@ivey.ca

Although intraorganizational conflict contributes to the economic rents extracted from a firm's resources and capabilities, little is known about how firm competition influences the degree of conflict within firms. In this study, I estimate the effect of foreign competition on the likelihood and prevalence of conflicts using a novel dataset of representative establishments in the Canadian economy. The results show that competition leads to a lower likelihood of strikes and fewer grievances.

3 - Healthcare Supply Chain: A Comparative Study of Practices in Emerging Economies
Mario Ferrer-Vasquez, Assistant professor of Operations Management, College of Business Alfaisal University Riyadh, KSA, P.O. Box 50927, Takhasusi Road, Riyadh, P.O. 50927, Saudi Arabia, mferrer@alfaisal.edu, Daniel Romero, Alvaro Sierra, Julio-Mario Daza-Escorcia

This paper is motivated by the significant economic importance of the healthcare industry in emerging economies, which needs to be modeled, understood and managed.The research involves conceptualizing the key healthcare supply chain coordination factors. We propose and test a model, that is founded constructs such as access, affordability, and awareness and their impact on supply chain operatives performance of two emerging economies.

4 - Applying Strategic Decision Analysis (Game Theory) to Project Dispute Resolution
James Lee, Staff Economist, Shell Exploration & Production, Woodcreek Center, Suite 7520, 200 North Dairy Ashford, Houston, TX, 77079, United States of America, James.Lee@Shell.com

An integrated business team added significant amount of value through acquiring working interests from partners by creating a win-win outcome with minimal cost. The decision analyst provided material advice during negotiation and dispute resolution. Strategic Decision Analysis (SDA) was applied and dynamic deal spaces of key players were quantified. This paper is to illustrate how to replicate this success and to apply SDA broadly, by using this actual project as case study.

■ WE45

Hilton- Union Sq 25

Behavioral Operations 3

Contributed Session

Chair: Matthew Walsman, Cornell University, 455 Statler Hall, Ithaca, NY, 14853, United States of America, mcw237@cornell.edu

1 - Allocating Service Capacity through a Multi-Item Second Price Auction: A Lab Experiment
Matthew Walsman, Cornell University, 455 Statler Hall, Ithaca, NY, 14853, United States of America, mcw237@cornell.edu, Chris Anderson, Scott Sampson

We investigate a service capacity problem where human subjects often attempt to "game the system" (i.e. course registration). By adapting auction and matching theory from economics, we developed an allocation system designed to discover true preferences and reduce gaming. We then test this system through a behavioral experiment.

2 - Epistemic Demand Uncertainty and Inventory Control: The Ambiguity Effect and Performance

Siqi Ma, University of Arkansas, Sam M. Walton College of Business, Business Building 475, Fayetteville, AR, 72701, United States of America, siqima@uark.edu, John Aloysius

Demand uncertainty due to incomplete information from the environment creates challenges for inventory control. Prior literature has mostly studied risky inventory decisions, but we experimentally study the behavior of replenishment managers in the face of ambiguity. We find evidence for the ambiguity effect on both decision behavior and task performance.

3 - The Role of Diasporas in the Facility Location Decision

Peruvemba S. Ravi, Associate Professor, School of Business & Economics, Wilfred Laurier University, 75 University Ave, West Waterloo, ON, N2T1H9, Canada, pravi@wlu.ca, Peruvemba S. Jaya

It is often assumed that facility location decisions are based on an evaluation of the quantifiable costs and benefits associated with candidate locations. However, intangible factors such as the preferences and biases of the decision-maker may play a significant role. The fact that several decision-makers in multinational companies are members of diasporic communities may have a significant impact on the facility location decision.

■ WE46

Hilton- Lombard

Mixed Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Mahdi Doostmohammadi, Research Associate, University of Strathclyde, 40 George Street, Glasgow, G1 1QE, United Kingdom, mahdi.doostmohammadi@strath.ac.uk

1 - Approximation Algorithms for the Incremental Knapsack Problem via Disjunctive Programming

Chun Ye, PhD Candidate, Columbia University, 500 West 120th Street, IEOR Department Rm 315, New York, NY, 10027, United States of America, cy2214@columbia.edu, Daniel Bienstock, Jay Sethuraman

We consider an incremental version of the knapsack problem (IK), where we wish to find an optimal packing of items in a knapsack whose capacity grows weakly as a function of time. We will first show that the problem is strongly NP-hard. We will then discuss a constant factor approximation algorithm for IK, under mild restrictions on the growth rate of the knapsack capacity, and a PTAS for IK when the time horizon T is a constant. Both of our algorithms uses ideas from disjunctive programming.

2 - Multiperiod Optimization for Fleet Defense: Centralized and Distributed Approaches

Nikita Korolko, PhD Candidate, Massacusetts Institute of Technology, 77 Massachusetts Avenue, E40-149 Operations Research Center, Cambridge, MA, 02139, United States of America, korolko@mit.edu, Dimitris Bertsimas, Patrick Jaillet

We prove that the highly nonlinear discrete fleet defense problem can be solved online with MIP callback techniques. A new extended MIP formulation is also introduced for multiperiod scenario when the fleet has to plan the defense for several consecutive attacks. Finally, we develop a cooperation protocol for the decentralized setting in which captains of the assets have to make local decisions based on their own objectives and some limited communication with other ships.

3 - Valid Inequalities for Two-Period Relaxations of Big Bucket Lot-Sizing Problems

Mahdi Doostmohammadi, Research Associate, University of Strathclyde, 40 George Street, Glasgow, G1 1QE, United Kingdom, mahdi.doostmohammadi@strath.ac.uk, Kerem Akartunali

Although many researchers have studied big bucket lot-sizing problems, they are still difficult to solve to optimality. In previous research different relaxations such as single-item and single-period have been investigated. In this study, we present two-period relaxations, and then we study the polyhedral structure of such a mixed integer set. We derive several families of valid inequalities, investigate facet-defining conditions, and present preliminary computational results.

4 - Three-partition Inequalities for Fixed-charge Network Flows

Andres Gomez, University of California at Berkeley, 2020 Delaware St. Apt. 3, Berkeley, CA, 94709, United States of America, a.gomez@berkeley.edu, Alper Atamturk, Simge Kucukyavuz

We define new valid inequalities for the capacitated fixed-charge network flow problem by exploiting the internal structure of the subgraphs defining the cuts. In particular, the new inequalities are based on three-partitioning of the nodes.

■ WE47

Hilton- Mason A

Theory and Applications of Robust Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Phebe Vayanos, MIT Sloan School of Management, 50 Memorial Dr., Cambridge, MA 02142, United States of America, pvayanos@mit.edu

1 - Two-Stage Robust Integer Programming

Wolfram Wiesemann, Imperial College London, SW7 2AZ, London, United Kingdom, ww@imperial.ac.uk, Grani Hanasusanto, Daniel Kuhn

In this talk, we approximate two-stage robust optimisation problems with integer recourse by their corresponding K-adaptability problems, in which the decision maker pre-commits to K second-stage policies here-and-now and implements the best of these policies once the uncertain parameters are observed. We study the approximation quality and the computational complexity of the K-adaptability problem, and we propose two MILP reformulations that can be solved with off-the-shelf software.

2 - Robust Inventory Routing

Joel Tay, MIT Operations Research Center, 77 Massachusetts Avenue, Building E40-149, Cambridge, MA, 02139, United States of America, joeltay@mit.edu, Dimitris Bertsimas, Swati Gupta

We consider the finite horizon inventory routing problem with uncertain demand. Current techniques that solve an exact formulation of this problem with stochastic demand do not scale to large problems. We propose an efficient and scalable algorithm via robust and adaptive optimization, and present very promising computational results.

3 - Optimal Crowdsourcing via all Pay Auctions – A Robust Optimization Approach

Chaithanya Bandi, Kellogg School of Management, Northwestern University, Evanston, IL, United States of America c-bandi@kellogg.northwestern.edu, Rajarshi Ghosh

In this talk, we present and analyze a model in which users select among, and subsequently compete in, a collection of contests offering various rewards. The objective is to capture the essential features of a crowdsourcing system, an environment in which diverse tasks are presented to a large community. We answer this question in the setting of incomplete information via All pay auctions and robust optimization.

4 - Data-driven Approaches for Adaptive Optimization

Vishal Gupta, Assistant Professor, USC Marshall School of Business, Data Sciences and Operations, Bridge Hall, 401, Los Angeles, CA, 90089-0809, United States of America, vishal.gupta@aya.yale.edu, Dimitris Bertsimas

Inspired by machine learning algorithms, we propose data-driven constructions of uncertainty sets and policies for adaptive optimization. Both our sets and policies are theoretically tractable and enjoy probabilistic performance guarantees. We illustrate the methods through a case-study of the unit commitment problem using real data from ISO. Overall, both our sets and policies successfully exploit structure in the data, yielding higher quality solutions than non-data-driven robust approaches.

■ WE48

Hilton- Mason B

Resource Allocation

Contributed Session

Chair: Ju Myung Song, Rutgers Business School, PhD Program, 1 Washington Park, Room 430C, Newark, NJ, 07102, United States of America, jumyung.song@rutgers.edu

1 - Designing Allocation Mechanism for Scarce Capacity: Reserve and Trade

Ju Myung Song, Rutgers Business School, PhD Program, 1 Washington Park, Room 430C, Newark, NJ, 07102, United States of America, jumyung.song@rutgers.edu, Chan Choi, Yao Zhao

Turn-and-earn depends on only sales history and ignores market signals. Proportional, a well-known allocation rule, can include forecast and other private information, but it may inflate order. For unknown demand, we modified the proportional rule by a general two-stage mechanism using reservation fee and trade. We found the conditions under which this mechanism design works and mitigate inflation of retailers.

2 - Staffing under Uncertainty: The Case of Fast-food Industry
Raha Akhavan Tabatab, Los Andes University, Cra 1 Este # 19A-40, Apartment 2625, Bogota, 76155, Colombia, r.akhavan@uniandes.edu.co, Diego Javier Rodriguez, Carlos Felipe Ruiz, Andrés L. Medaglia, Leonardo Lozano

Fast-food managers often face the problem of allocating human resources (cashiers, chefs or dispatchers), to meet a service level target at the minimum cost. Since in most cases, the demand is uncertain and highly volatile, determining the right number of staff to satisfy a predetermined service level can be a challenging task. We apply optimization techniques and queueing theory to find a near-optimal staffing policy that minimizes the costs subject to meeting a service level.

3 - Project Scheduling Methods: A Synthesis
Osman Oguz, Associate Professor, Bilkent University, 06800 Ankara Turkey, osoguz@gmail.com

Traditionally, there are three basic models of scheduling projects: i-Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT) PERT. ii-Time-cost trade off analysis using linear programming. iii-Integer programming models to allocate scarce resources to activities. The new approach proposed in this study consists of a new deterministic combined model that provides a single solution in one shot

4 - Analysis of Congestion Pricing Model to Handle Day of Operations" Airport Capacity Reduction
Abdul Qadar Kara, Asst. Professor, King Fahd University of Petroleum and Minerals, KFUPM Box 1819, Dhahran, 31261, Saudi Arabia, aqkara@kfupm.edu.sa

In my earlier work, a model was built on basic econometric principle of congestion pricing embedded within an optimization model. The model provided a mechanism to manage airport runway capacity reduction. The current work reports further analysis of the model and its response against the effect of airline's disagreement on assigned runway slots.

■ WE49

Hilton- Powell A

Statistical Analysis of Network Structures

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Xin Chen, Assistant Professor, Southern Illinois University, PO Box 1805, Edwardsville, IL, United States of America, xchen@siue.edu

1 - Complex Network Modeling using MLE and EM
Xin Chen, Assistant Professor, Southern Illinois University, PO Box 1805, Edwardsville, IL, United States of America, xchen@siue.edu

Structure of a complex network provides important information about its performance and may be used to predict changes in network performance. Four degree distributions, including the power law, Weibull, Poisson, and negative binomial, are applied to model three complex networks, the Krebs, HIV, and Power Grid networks. To improve accuracy of network modeling, the MLE method and EM algorithm are used to estimate parameters of the four degree distributions.

2 - Optimal Development of Wind Farm under Uncertainty
Qing Li, PhD, Rutgers University, 96 Frelinghuysen Road, CoRE Building, Room 201, Piscataway, NJ, 08854, United States of America, ql78@rutgers.edu, Honggang Wang

Renewable resources, e.g. wind and solar, provide clean and zero-carbon emission energy. In this work, we propose stochastic models for optimal development of wind farm. Specifically, we aim to explore the number and placement of turbines considering wind uncertainty and dynamic interactions in the field. Computational models are demonstrated with wind/farm data for wind farms in the central US. Discrete field modeling and optimization methods of wind farm development will be discussed as well.

3 - Sustainable Wind Energy Distribution Network Based on Failure Prediction and Collaboration Protocols
Xin Chen, Department of Industrial and Enterprise Systems Engineering, University of Illinois at Urbana-Champaign, 216C Transportation Building, 104 S. Mathews, Urbana, IL, 61801, United States of America, xinchen@illnois.edu, Shimon Nof, Hoo Sang Ko, Ehsan Jahanpour

Wind energy has gained more attention as a green alternative. Uncertainties in power generation, however, limit its penetration into power grids. This study applies pattern recognition for improved output estimation by failure prediction. Also presented is a collaboration platform to support demand-and-capacity sharing and best matching protocols that facilitates collaboration to create sustainable networks. A simulation study of two communities is illustrated to show the impact of the platform.

■ WE50

Hilton- Powell B

Optimization, Application

Contributed Session

Chair: Mariya Naumova, Rutgers University, 100 Rockafeller Rd, Piscataway, NJ, 08854, United States of America, mnaumova@rci.rutgers.edu

1 - Optimizing Employee Compensation Plans: A Restless Bandit Approach
Munish Goyal, IBM Research, MEBP, Bangalore, India, mungoyal@in.ibm.com, Alankar Jain, Parijat Dube

Rewarding and Retaining productive employees is one of the most important functions of HR organizations. In this work we derive a productivity maximizing compensation investment strategy in a restless bandit framework. Specifically, given the attrition risk scores and the productivity levels of employees, we derive an index heuristic that determines a subset of employees and their respective compensation investment amounts while maximizing a long run expected return on investment.

2 - Application of the Discrete Moment Problem in Option Valuations
Mariya Naumova, Rutgers University, 100 Rockafeller Rd, Piscataway, NJ, 08854, United States of America, mnaumova@rci.rutgers.edu

We present a brief survey of some of the basic results related to the discrete moment problems (DMP) and a new numerical integration method, based on DMP that can be used for univariate piecewise higher order convex functions. We present novel applications of the DMP to valuations of financial instruments.

3 - Complexity and Approximation Algorithms in Elastic Optical Networks
Sahar Talebi, NCSU, 2113-A Gorman St, Raleigh, NC, 27606, United States of America, stalebi@ncsu.edu, George Rouskas

The routing and spectrum assignment (RSA) problem has emerged as the key design and control problem in elastic optical networks. We show that the RSA and its simpler version, i.e. the spectrum assignment (SA) problem, in mesh networks transforms to the multiprocessor scheduling problem. This new perspective helps us to investigate the complexity of the RSA/SA problem under different scenarios. We also develop new constant-ratio approximation algorithms for the SA problem.

■ WE51

Hilton- Sutter A

Game Theory 3

Contributed Session

Chair: Mikhail Sher, PhD Candidate, Decision Sciences Department, Drexel University, 3141 Chestnut St, Philadelphia, PA, 19104, United States of America, MikhailSher@gmail.com

1 - Price and Quality Competition with Quality Positions
Shogo Kurokawa, Keio University, 3-14-1, Hiyoshi Kouhoku-ku, Yokohama City, Japan, scarletcurio@gmail.com, Nobuo Matsubayashi

We investigate price and quality decisions under duopoly in the presence of firms' quality positions given as the quality levels of their existing core products. Based on a standard model of vertical differentiation, we incorporate a repositioning cost"which is in proportion to the quality differences between their core and new products. With varying quality levels of the core products, we analyze the impact of this cost on the equilibrium outcomes.

2 - Extensive-Form Game Abstraction with Bounds
Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, sandholm@cs.cmu.edu, Christian Kroer

Abstraction has emerged as the key to solving large extensive-form games of incomplete information. We develop the first analysis framework that can be used to give bounds on solution quality for extensive-form game abstraction. While it can be used for lossy abstraction, it is also powerful for lossless abstraction. Prior abstraction algorithms typically operate level by level in the game tree; we prove hardness results and an impossibility for that family. Experiments are presented.

3 - Stochastic Duopoly Market Share Competition with Asymmetric Exercising Delay

KiHyung Kim, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, kihyung.kim.1@purdue.edu, Abhijit Deshmukh

Option exercise games have become a popular approach for academic researchers and industry practitioners to deal with competition under stochastic environments. We investigated the mixed strategy closed loop equilibrium of R&D and patent protected technology competition in a stochastic duopoly market governed by a continuous time stochastic process. The main difference between the two players within the model is assumed to be the length of delay of the exercise decision.

4 - Supply Chain Coordination with Quantity Discount for Seasonal Demand

Mikhail Sher, PhD Candidate, Decision Sciences Department, Drexel University, 3141 Chestnut St, Philadelphia, PA, 19104, United States of America, MikhailSher@gmail.com, Seung-Lae Kim

In this paper,we develop a supply chain coordination mechanism in a system with a dominant manufacturer that delivers seasonal products to a group of buyers. A twice-stage ordering and production system is introduced in which the first order is placed at some time prior to the selling season and a second order is placed closer to the selling period. This twice-stage model allows the buyer to collect additional seasonal demand information resulting in savings for both manufacturer and the buyers.

■ WE52

Hilton- Sutter B

Optimization, Other

Contributed Session

Chair: Mahendra Prasad Biswal, Professor, Indian Institute of Technology, Kharagpur, Department of Mathematics, IIT Kharagpur, Kharagpur, WB, 721302, India, mpbiswal@maths.iitkgp.ernet.in

1 - A MIP Formulation for the Capacitated Stochastic Lot Sizing Problem with Service-level Constraints

Huseyin Tunc, Hacettepe University, Institute of Population Studies, Sihhiye, Ankara, Turkey, huseyin.tunc@hacettepe.edu.tr, Onur A. Kilic, S. Armagan Tarim

We study the capacitated stochastic lot-sizing problem with service level constraints under static uncertainty strategy and propose a mixed integer programming formulation thereof. We modify an earlier formulation of static-dynamic uncertainty strategy developed for the uncapacitated stochastic lot-sizing problem. We conduct an extensive numerical study and show that the formulation can optimally solve large problem instances in reasonable computation time.

2 - Application of the Penalty Function Method to Generalized Convex Programs

Chandal Nahak, Associate Professor, IIT Kharagpur, Department of Mathematics, Kharagpur, 721302, India

We use the Penalty Function Method to study duality in generalized convex (invex) pro- gramming. In particular, we will obtain a new derivation under which the generalized convex (invex) programs do not have duality gaps.

■ WE54

Hilton- Taylor B

Risk Analysis

Contributed Session

Chair: Jonathan Crook, Professor, University of Edinburgh, 29 Buccleuch Place, Edinburgh, United Kingdom, j.crook@ed.ac.uk

1 - Competitive Analysis with Risk Considerations

Jian Yang, Associate Professor, Rutgers University, Dept. of MSIS, Newark, NJ, 07102, United States of America, jyang@business.rutgers.edu

We explore games in which players are with risk considerations. Particular attention will be paid to the coherent risk measure. We address existence and various other issues.

2 - Intensity Modelling with Macroeconomic Effects and Simulated Transitions

Jonathan Crook, Professor, University of Edinburgh, 29 Buccleuch Place, Edinburgh, United Kingdom, j.crook@ed.ac.uk, Mindy Leow

We estimate intensity models to predict probabilities of delinquency and default for individual credit card accounts over duration. We find different trends for different groups of accounts, and over time. Random distributions based on properties of observed transition rates are generated and compared against predicted probabilities to get predicted transitions for each account over time. From the results of this simulation, we calculate distributions for the transitions and losses.

3 - Resource Allocation to Reduce Active Shooter Risk

Robert Brigantic, Operations Research Scientist, Pacific Northwest National Laboratory, 902 Battelle Blvd, Richland, WA, 99352, United States of America, robert.brigantic@pnnl.gov

An active shooter is defined by the U.S. Department of Homeland Security as "an individual actively engaged in killing or attempting to kill people in a confined and populated area." We present a methodology to quantify risk from an active shooter in a large scale venue (e.g., transportation system) and a means to reduce the risk from an active shooter via the efficient allocation of constrained security resources.

4 - Variance Reduction Techniques for Estimation of Distortion Risk Measures

Lihua Sun, Tongji University, School of Economics and Management, Tongji Univ. 1239 Siping Road, Shanghai, China, sunlihua@tongji.edu.cn

Distortion risk measures has traditionally been used in insurance for premium setting and had been extended to various places such as calculating risk capitals of banks and insurers. In this paper, we propose several variance reduction methods to improve the accuracy in estimation of distortion risk measures via Monte Carlo simulation. We then prove the efficiency of our method theoretically and numerically.

5 - Analytics-based Method to Support Telecommunication Software Testing Design

Adi Fledel Alon, Senior Data Scientist, Amdocs, Ganey Shefa, Raanana, Israel, adifl@amdocs.com, Gilli Shama, Sagar Surana

Software testing plays an important role in any software development project and the price of fixing a defect increases as the lifecycle of the software progresses. Testing under all combinations of inputs and prerequisites is not feasible, even with a simple product. Here, we present a big data analytics approach for planning of software testing in the Telecommunications industry. We developed a new risk based methodology and tool for efficient and effective test plan design.

■ WE55

Hilton- Van Ness

Tractable Models and Algorithms for Optimization in Engineering

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Cristobal Guzman, Georgia Tech, 755 Ferst Drive NW, Atlanta, GA, United States of America, cguzman@gatech.edu

1 - Additive Consistency of Risk Measures and Its Application to Risk-averse Routing in Networks

Alfredo Torrico, Georgia Tech, 755 Ferst Drive, NW, Atlanta,GA, United States of America, atp.13jvl@gmail.com, Roberto Cominetti

This paper investigates the use of risk measures and theories of choice for modeling risk-averse route choice with random travel times. We interpret the postulates of these theories, and we identify additive consistency as a plausible condition that allows to reduce risk-averse routing to a standard shortest path problem. Within the classical theories of choice under risk, we show that the only preferences that satisfy this consistency property are the ones induced by the entropic risk measures.

2 - The Little Grothendieck Problem – Generalization and Applications to Orthogonal Procrustes

Christopher Kennedy, christopher.garrett.kennedy@gmail.com

The little Grothendieck problem from combinatorial optimization consists of optimizing a quadratic objective function over binary variables. We first discuss an approximation algorithm for this problem and then consider the natural extension from binary variables to the general Orthogonal and Unitary groups. Our proposed algorithm - Orthogonal Cut - uses techniques in semi-definite programming to achieve a constant approximation ratio for the generalized Grothendieck problem. We will mention applications of this generalized algorithm to the Orthogonal Procrustes problem, global registration over Euclidean transforms, and others.

3 - Minimizing an Indefinite Quadratic Function Subject to a Single Indefinite Quadratic Constraint

Maziar Salahi, Associate Professor, University of Guilan, Namjoo Street, Rasht, Iran, salahim@guilan.ac.ir, Saeed Fallahi, Tamas Terlaky

In this paper we consider the problem of minimizing an indefinite quadratic function subject to a single indefinite quadratic constraint. We show that it can be solved by solving a linearly constrained convex univariate minimization problem. Our preliminary numerical experiments on several randomly generated test problems show that the new approach is much faster in finding the global optimal solution than the semidefinite relaxation approach especially on large scale problems.

■ WE64

Parc- Cyril Magnin I

Customer Performance ñ Models and Applications

Sponsor: Applied Probability Society

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, ananth@engr.wisc.edu

1 - Employing the EDD Rule in MTO Production Systems with External Due Dates

Miray Oner-Kozen, Technische Universitat München, Arcisstr. 21, Munich, 80333, Germany, miray.koezen@tum.de, Stefan Minner

We model a single machine MTO production system as a discrete time M/M/1/K queuing system. The due date of an order is random. We perform an exact analysis for evaluating the effect of the earliest due date first rule (EDD) on the system performance and compare the results to the first-in-first-out (FIFO) rule as a benchmark. Our numerical results show that, although the EDD rule seems intuitive to improve the customer related performance, its effect is dependent on the performance criteria.

2 - Self-Interested Routing with Path-Flexible Agents

Andrew Frazelle, Duke University, Durham, NC, 27708, United States of America, andrew.frazelle@duke.edu, Yehua Wei, Alessandro Arlotto

We introduce a queueing network with self-interested, route-flexible agents who seek to minimize their individual wait times. Agents have no preference over the route they take through the network apart from the impact of the route on their total wait time. We model the system as an extensive-form game and derive subgame perfect Nash equilibria under several slightly different assumptions. Motivations/applications include amusement parks, grocery stores, and shopping malls (e.g. Black Friday).

3 - Estimating the Likelihood the Democrats will Retain Control of the Senate in the 2014 Midterms

James Cochran, University of Alabama, Culverhouse College of Commerce and Bus, 347 Alston Hall, Tuscaloosa, AL, 35487, United States of America, jcochran@cba.ua.edu

Control of the Senate is critical to both parties, but is of particular important to the party that does not hold the Presidency; this allows the party to wield greater power during confirmation proceedings and coordinate legislation with the House so as to force compromise from the White House. We apply a randomization test to the FiveThirtyEight forecasted probability a Democrat will win each contested seat in 2014 to estimate the likelihood the Democrats will retain control of the Senate.

■ WE65

Parc- Cyril Magnin II

Bayesian Approach

Contributed Session

Chair: Hiba Baroud, University of Oklahoma, 202 West Boyd St, Room 124, Norman, OK, 73019, United States of America, hbaroud@ou.edu

1 - An Proposal of How to Improve Conjoint Measurement Model using Hierarchical Bayesian Method

Sakamaki Yoshikazu, Miyagi University, 1, Gakuen,Taiwa-Cho,Kurokawa-Gun, Miyagi, Japan, megacity@f3.dion.ne.jp

Recent years, hierarchical Bayesian statistics that estimates model parameters by assuming prior distribution for each parameter gets high attention. In this study, we apply hierarchical Bayesian method to traditional conjoint measurement and show our proposal can improve fitness degree and forecasting power.

2 - A Dynamic Sampling Framework for Medical Overpayments

Rasim Musal, Assistant Professor of QM, Texas State University, 601 University Dr. McCoy 404F, Austin, TX, 78746, United States of America, mmusal@gmail.com, Tahir Ekin

Sampling methods take front stage in estimating loss due to over-payments to providers participating in Medicare/Medicaid programs. We propose a dynamic sampling framework for medical assessment that can capture the skewed nature and multi-modality of medical claims data. Our framework considers two decision indices that are based on estimated over-payment values and entropy based expected information gain. The model considers over-payments as a mixture of fixed number of populations.

3 - A Bayesian Dynamic Probit Approach to Predict Bidders' Behavior in Secondary Market Auctions

Babak Zafari, The George Washington University School of Business, 2201 G Street NW, Funger Hall, Suite 415, Washington, DC, 20052, United States of America, zafari@gwu.edu

The experience of the bidders in the market and the available information in auctions can shape bidders' bidding behavior. In this study, we use the Bayesian data augmentation algorithm for dynamic probit models in an attempt to predict whether a bidder will be the first bidder in an upcoming auction. While we're mainly focusing on the predictive modeling aspect of this problem, we're also observing the underlying dynamics and change of behavior of the bidders over the time (learning).

4 - Bayesian Modeling of Global Supply Chains Risk Analysis

Hiba Baroud, University of Oklahoma, 202 West Boyd St, Room 124, Norman, OK, 73019, United States of America, hbaroud@ou.edu, Kash Barker, Royce Francis

Companies often operate facilities or have suppliers in countries prone to natural hazards, extreme weather, or political turmoil. While such business strategies offer low operating costs, they might be introducing risks leading to high impact disruptions in global supply chains. Bayesian kernel methods are used here to assess the probability of a supply chain disruption given information on past disruptions and the company's risk management strategies.

■ WE66

Parc- Cyril Magnin III

The Impact of Heterogeneity in Reliability Prediction and Maintenance Planning

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Yisha Xiang, Assistant Professor, Sun Yat-sen University, 135 W. Xingang Rd., Guangzhou, 57025, China, xiangysh@mail.sysu.edu.cn

1 - Condition-Based Maintenance using the Inverse Gaussian Degradation Model

Nan Chen, Assistant Professor, National University of Singapore, 1 Engineering Drive 2, Singapore, Singapore, isecn@nus.edu.sg

Condition-based maintenance (CBM) has been proven effective in reducing unexpected failures with minimum operational costs. This study considers an optimal CBM policy with optimal inspection interval when the degradation conforms to an inverse Gaussian process with random effects. The random effects parameter is used to account for heterogeneities among a product population. We prove that the monotone control limit policy is optimal. We also provide numerical studies to validate our results.

2 - An Opportunistic Maintenance Model for Multi-component Systems under Mixed Policies

Qiushi Zhu, PhD Candidate, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, Q.Zhu@tue.nl, Hao Peng, Geert-Jan Van Houtum

We propose an opportunistic maintenance model for multi-component systems. Different components may follow different maintenance policies (i.e., age-based, corrective, and condition-based maintenance). The coordination of the maintenance actions is crucial since there is a high fixed setup cost for maintenance visits. To solve real-world problems, we propose a heuristic algorithm to optimize the opportunistic maintenance policy and verify its accuracy by comparing it with simulated results.

3 - Optimization of Manufacturer's Warranty Period in Consideration of After-sales Service Contract

Jin Qin, University of Science and Technology of China, 96 Jinzhai Rd, Hefei, China, qjin@ustc.edu.cn

Retailers, like bestbuy and buy.com, are zealously promoting after-sales warranty service contract to gain more profit from customers. Manufacturer needs to rethink its warranty policy considering customer heterogeneity and competition from the retailers. What is the optimal warranty period under this new situation?

4 - Approximating Weibull Renewal via Regression and Sinc Function
Tongdan Jin, Associate Professor, Texas State University, 601 University Drive, San Marcos, TX, 78666, United States of America, tj17@txstate.edu, Jose Espiritu, Fei Sun, Heidi Taboada

Weibull distribution is perhaps the most popular model for lifetime analysis, yet the closed-form solution to Weilbull renewal equation is not tractable. We propose a hybrid method to approximate the Weibull renewal equation. The method is built upon partial numerical computation together with a sinc function. We compare our model with the actual renewal data, and the result shows that the approximation model is quite satisfactory for a wide range of shape parameter between 1 and 10.

■ WE67

Parc- Balboa

Gaussian Process and Spatial Data Analysis (III)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

Co-Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, kbwang@tsinghua.edu.cn

1 - Development of Modeling and Control Strategies for Approximated Gaussian Process
Shisheng Cui, The Pennsylvania State University, 355 Leonhard Building, University Park, PA, 16802, United States of America, suc256@psu.edu, Chia-Jung Chang

The Gaussian Processes Model has been widely used as priors of functions with good performance. However, specifying the large number of parameters correctly affects efficiency in computation and feasibility of implementing control strategies. We propose a linear model to approximate GP, which expands the GP model by basis functions. Several examples and simulation studies are presented to demonstrate the advantages of the method. A control strategy is provided with the proposed linear model.

2 - A Spatial Calibration Model for Nanotube Film Quality Prediction
Xin Wang, Tsinghua University, Zijing Apt 14, Room 406A, Tsinghua Univ, Haidian District, Beijing, 100084, China, xinwang09@mails.tsinghua.edu.cn, Su Wu, Kaibo Wang, Xinwei Deng

The anisotropy of CNTs film, which is a spatially distributed quality index, is hard to be measured in practice. As anisotropy is correlated with height and height can be measured much easier, we here propose a spatial model for predicting anisotropy using height. A hierarchical model is built to characterize the relationship between the spatial input and output; the proposed model is verified using both numerical simulations and a real data set.

■ WE68

Parc- Davidson

Sustainable Infrastructure Management and Decision-Making: Construction, Energy and Transportation Industries

Sponsor: Simulation

Sponsored Session

Chair: Hakob Avetisyan, Assistant Professor, California State University Fullerton, Department of Civil and Env. Engineering, 800 N. State College Blvd, Fullerton, CA, 92834, United States of America, havetisyan@fullerton.edu

1 - When Combining Sustainable Design with Sustainable Construction
Uksun Kim, Chair and Associate Professor, California State University - Fullerton, 800 N. State College Blvd., Fullerton, CA, 92834, United States of America, ukim@fullerton.edu, Hakob Avetisyan

This research will incorporate sustainable design with sustainable construction. The outcome of this research directly affects the construction. The selection of construction equipment and methods for construction are highly dependent on the design outcomes. A modeling framework will be developed to analyze its consequence on equipment. As a case study a real life infrastructure project will be considered. Several scenarios will be compared to assess the overall sustainability practice.

2 - State Recognition of Construction Equipment for Emission Simulation Modeling and Control
Reza Akhavian, University of Central Florida, 4000 Central Florida Blvd, Orlando, FL, 32816, United States of America, reza@knights.ucf.edu, Amir Behzadan

Extensive use of energy-intensive equipment in construction and infrastructure industries results in a high level of greenhouse gas emission. In particular, different working states of construction machinery such as idling modes (e.g. different rpm levels) and busy modes (e.g. different activities) produce different levels of emission. In this research, a data-driven simulation modeling approach using mobile sensor nodes for equipment state recognition and emission modeling is investigated.

3 - Integrating Qualitative and Quantitative Assessment Outcomes for Sustaining Long Term Projects
Deepak Sharma, Visiting Assistant Professor, University of Baltimore, 1420 N Charles Street, Business Center BC475, Baltimore, MD, 21201, United States of America, dsharma@ubalt.edu

Procurement decisions of long term infrastructure projects are based on the "value" expected from a candidate project. The value is determined by analyzing a project quantitatively and qualitatively and then integrating the outcomes. Review shows that the procurement guidelines have remained silent about the integration. This work introduces Data Envelopment Analysis (DEA) as a tool that can be used to integrate the assessment outcomes for better decision making.

■ WE69

Parc- Fillmore

Optimization Approaches for Designing a Green Energy System

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Hayri Onal, Professor, University of Illinois, Urbana, IL, United States of America, United States of America, h-onal@illinois.edu

1 - A Stochastic Multi-criteria Decision Model for Sustainable Biomass Crop Selection
Halil Cobuloglu, PhD Candidate, Wichita State University, 1845 Fairmount St, Wichita, KS, United States of America, halil.cobuloglu@gmail.com, Esra Buyuktahtakin

Biomass crop type selection is a multi-criteria decision-making (MCDM) problem since it has various environmental and economic impacts. In this paper, we determine criteria for decision makers (farmers) to select the most sustainable biomass crop type. We build up the Stochastic AHP evaluation model and criteria with respect to economic, environmental, and social aspects based on the literature. As an illustration of the model, we rank biomass crop type alternatives in Kansas.

2 - Integrated Sustainable Bioenergy Pathways: An Agent Based Modeling Approach
Liu Su, Iowa State University, 301 S. 4th Street, #13, Oakridge Apartment, Ames, IA, 50010, United States of America, suliu@iastate.edu, Lizhi Wang, Guiping Hu

We study the interactions between different interdependent market players in a bio-energy supply, which consists of land owners, biofuel producers, biopower producers, biofuel market, food market, biopower marker, and policy makers. We integrate the agent based modeling approach with actual agricultural data to analyze and predict potential interactions between different marker players under various policy scenarios.

3 - Metaheuristics applied to Biorefinery Supply Chain Problems
Krystel Castillo, Assistant Professor, The University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, krystel.castillo@utsa.edu

Metaheuristics are strategies for solving complex and large-scale optimization problems which provide a near-optimal or practically useful solution. The aim of this talk is to present a survey of metaheuristics and the available literature regarding the application of metaheuristics in the bioenergy supply chain field as well as the uniqueness and challenges of the mathematical problems applied to bioenergy.

4 - Green Building Decision-Making using Sequential Design and Optimization

John Dickson, University of Texas at Arlington, IMSE Dept, Arlington, TX, 76019, United States of America, john.dickson@mavs.uta.edu, Victoria Chen, Jay Rosenberger, Anthony Robinson

A decision making model is developed for green buildings to select a set of building options that will improve the building performance. A sequential design of experiments approach is used to select the design points to perform the simulation. A metamodel is created using treed regression which is then optimized using a mixed integer linear programming model. A single story residential building based in California is used as a case study

■ WE70

Parc- Hearst

Forecasting 2

Contributed Session

Chair: Semco Jahanbin, Doctoral Researcher, University of Bath, Flat 8, Royston House, 5 Duke Street, Bath, BA24AH, United Kingdom, s.jahanbin@bath.ac.uk

1 - DYI Forecasting: Judgment, Models and Judgmental Model Selection

Konstantinos Nikolopoulos, Bangor Business School, Bangor University, College Road, Bangor, LL57 2DG, United Kingdom, k.nikolopoulos@bangor.ac.uk, Nikolaos Kourentzes, Fotios Petropoulos

In this paper we explore how judgment can be used to improve statistical model selection for forecasting. We investigate the performance of various judgmental model selection methodologies against the benchmark statistical one, based on information criteria. We evaluate the performance of experts in terms of selecting the best model and forecasting performance, identifying major improvements. We examine how to extend statistical model selection to incorporate additional insights from experts.

2 - Determining an Optimal Hierarchical Forecasting Model Based on the Characteristics of the Data Set

Zlatana Nenova, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, United States of America, zdn3@pitt.edu, Jerrold May

High-dimensional pyramidal databases are common in the supply chains of large manufacturing companies. Such organizations often forecast shipments and consumption patterns at different hierarchical levels. Determining the most appropriate forecast aggregation approach is often a very computationally intensive task. Using a large food-processing firm data, we built a model that requires only correlation metrics and produces an accurate prediction of the optimal forecasting approach.

3 - How Change of the Relative Importance of Product Attribute to Consumers can Influence Sales Forecast

Semco Jahanbin, Doctoral Researcher, University of Bath, Flat 8, Royston house, 5 Duke Street, Bath, BA24AH, United Kingdom, s.jahanbin@bath.ac.uk, Sheik Meeran, Joao Quariguasi Frota Net, Paul Goodwin

Customer preferences are not stable, especially where a consumer needs to make a complex or unfamiliar decision. In this research, the instability of consumer preferences for different attributes for a purposive sample of electronics products will be examined and compared from different angles with the aim of finding its influence on choice based conjoint analysis as a new product sales forecasting method.

■ WE72

Parc- Stockton

Energy VIII

Contributed Session

Chair: Masood Parvania, Postdoctoral Scholar, University of California, Davis, One Shields Avenue, Davis, CA, 95616, United States of America, mparvania@ucdavis.edu

1 - Multiscale Analysis of Wind Power Ramping Events

Masood Parvania, Postdoctoral Scholar, University of California, Davis, One Shields Avenue, Davis, CA, 95616, United States of America, mparvania@ucdavis.edu, Anna Scaglione

The stochastic nature of wind speed makes the output power of wind plants highly variable in various time scales. Advanced knowledge about the time, magnitude, speed and frequency of large wind power variations, also called wind power ramping events, is of great importance for secure and economic operation of power systems. In this presentation, we will present our efforts for multiscale analysis of stochastic wind power generation and the associated ramping events.

2 - The Impact of Supply Chain Resilience on the Business Case for Smart Meter Installation

Behzad Samii, Vlerick Business School, Ave. du Boulevard 21, Brussels, Belgium, behzad.samii@vlerick.com, Hakan Umit, Kris Meyers

To produce realistic cost benefit assessments for the rollout of electricity smart meters, financial and operational decision-makers can collaborate using the framework of operational excellence and supply chain resilience. Strategies of product standardization, installation cost unification, onsite uncertainty reduction, and binding investments deferral not only reduce electricity supply chain vulnerabilities but also provide considerable cost reduction and resource optimization.

3 - Influence of Pricing Policies on Industrial Competition among Different Energy Technologies

Zhaomiao Guo, University of California, Davis, One Shield Ave., Davis, CA, United States of America, zmguo@ucdavis.edu, Yueyue Fan

Most U.S. electricity markets impose some pricing regulations, e.g. price cap, to mitigate market power abuse, which makes frequently-assumed smooth demand function unrealistic. In general, pricing policies directly affect companies' revenue. Moreover, in imperfect competition, they might also affect companies strategic behaviors. In this paper, we investigate how pricing policies might influence industrial competition among renewable and conventional energy technologies.

4 - Effects of Human Health Externalities on Generation Expansion Plans

Mark Rodgers, PhD Candidate, Rutgers University, 96 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, mdrodgers07@gmail.com, David Coit, Frank Felder

Generation expansion planning problems are least-cost, optimization problems, and the resulting expansion plans include fossil fuels, which satisfy the load on the system, but produce emissions that are health hazards. These health hazards as negative externalities realized by consumers. In this research, mixed-integer, multi-period optimization problems are solved to find the optimal expansion plan in order to minimize total system-wide costs, including human health externalities.

5 - Maximizing Wind Power Capture Considering Wind Turbine Dynamics

Fran Li, Associate Professor, University of Tennessee, 1520 Middle Drive, MHK 523, Knoxville, TN, 37996, United States of America, fli6@utk.edu, Can Huang

This paper aims to achieve a balance between maximization of power output and minimization of the drive train torsional torque fluctuation for a wind energy conversion system (WECS). A realistic model of a box uncertain set is applied to consider spatial and temporal distribution of wind speed forecast error. Then, the box uncertainties are combined with a proposed Intelligent Maximum Power Point Tracking method to a WECS robust optimization problem solved by semi-definite programming (SDP).

■ WE73

Parc- Mission I

Targeted Demand Side Management: Uncovering Energy Usage Decisions from Data

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Adrian Albert, Senior Scientist, C3 Energy, 1300 Seaport Blvd, Redwood City, CA, 94062, United States of America, adrian.albert@c3energy.com

1 - Detecting Thermal and Occupancy-related Energy Use from Smart Meter Data: An Experimental Validation

Adrian Albert, Senior Scientist, C3 Energy, 1300 Seaport Blvd, Redwood City, CA, 94062, United States of America, adrian.albert@c3energy.com, Ram Rajagopal

We present an experimental evaluation of a methodology that decomposes single-point source smart meter data into thermal, baseload, and occupant-driven components by viewing consumption as a sequence of user decisions of what level of each of these components to consume. We show that, given just hourly consumption time series data, the model is able to accurately detect significant levels of HVAC, as well as usage induced by occupant activity.

2 - Negative Dividends: Internality Losses can Outweigh Externality Gains

Anshuman Sahoo, PhD Candidate, Stanford University, 473 Via Ortega, Stanford, CA, 94305, United States of America, asahoo@stanford.edu, Nik Sawe

The Energy Star label could increase or decrease a consumer's focus on the energy consumption of alternatives. We ask if individuals of different types respond to the label in systematically different ways and, if so, what these differences imply about its value to consumers. Results from a stated choice experiment suggest an affirmative answer to the first question. Moreover, heterogeneity in responses implies that losses from larger internalities outweigh gains from lower externalities.

3 - Do Wind Power Producers have Market Power and Exercise It?

Yang Yu, PhD Candidate, Stanford University, 139 Running Farm Ln Apt 104, Stanford, CA, 94305, United States of America, yangyu1@stanford.edu

In this paper, we developed a theoretical framework to measure the ability and willingness of wind power producers in manipulating the market price. Through a case study of the ERCOT control area, we demonstrate these producers do posses market power even at relatively low penetrations.

4 - Scalable Algorithms for Control and Assessment of Electric Vehicle Charging Services

Jing Ma, PhD Candidate, Stanford University, Management Science and Engineering Dept, Stanford University, Stanford, CA, 94305, United States of America, jingma@stanford.edu, Ram Rajagopal, Erica Plambeck

We consider electric vehicle (EV) charging models for different scenarios. Our optimal charging rules are characterized by explicit equilibrium equations and are efficiently computable. The framework of our analysis gives rise to the scalable algorithms for control of large-scale EV charging systems and services. Simulation results involving real-life EV data (taking into account both energy and emission cost) are discussed.

■ WE74

Parc- Mission II

Power System Resilient Design and Optimization

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Seyedamirabbas Mousavian, Assistant Professor, Clarkson University, School of Business, Potsdam, NY, 13699, United States of America, amir@auburn.edu

1 - Optimal Resilient Distribution Grid Design

Russell Bent, Los Alamos National Laboratory, PO Box 1663, MS C933, Los Alamos, NM, 87545, United States of America, rbent@lanl.gov, Scott Backhaus

Natural disasters such as earthquakes, hurricanes, and other extreme weather pose serious risks to modern critical infrastructure such as electrical distribution grids. Here, we present optimization methods for designing and upgrading these grids with smart devices to better withstand and recover from these threats, i.e. so that the post-event damaged grid meets a minimum standard of service (98% of the critical demand is met and 50% of all other load is served).

2 - Software System for Large-Scale Decentralized Unit Commitment

Mitch Costley, PhD Candidate, Advanced Computational Electricity Systems (ACES) Laboratory, Georgia Institute of Technology, Atlanta, GA, United States of America, mitch.costley@gatech.edu, Mohammad Javad Feizollahi, Sungkap Yeo

In this work, we describe the implementation of a novel decentralized algorithm for solving power system unit commitment problems. The algorithm itself, based on ADMM, is described, and its performance is evaluated in a computing cluster. Test systems include various configurations of openly available 3,000-bus power systems and a utility system model of over 12,000 buses. The software architecture using both Open MPI and the CPLEX C++ API is discussed along with dynamic job migration features.

3 - Resilient Distribution System by Microgrids Formation After Disastrous Events

Chen Chen, Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221, Argonne, IL, 60439, United States of America, morningchen@anl.gov, Jianhui Wang, Feng Qiu

We propose a novel distribution system operational approach that will build on recent industry trends and form multiple microgrids from the distribution network in real-time operations, to restore the loads of customers from power outage. Specifically, an integer linear program is formulated for the self-adequacy microgrids formation problem. A distributed multi-agent coordination scheme is designed via local communications for the global information discovery as inputs of the optimization.

4 - Investment Decisions on Optimal Resilient Allocation of Phasor Measurement Units

Seyedamirabbas Mousavian, Assistant Professor, Clarkson University, School of Business, Clarkson University, Potsdam, NY, 13699, United States of America, amir@auburn.edu, Jianhui Wang, Jorge Valenzuela

Reliability of the electrical power systems necessitates full observability of the power grid. PMUs collect synchronized phasors of voltages and currents in real time and are utilized for full observability of the power systems. Due to considerable cost of installing PMUs, it is not possible to install PMUs at all buses. We study the effect of transmission switching and single contingencies on the optimal placement of PMUs and propose an ILP model to find the optimal two-phase PMU allocation.

■ WE75

Parc- Mission III

Simulation III

Contributed Session

Chair: Amine Kamali, The University of Oklahoma, 202 W. Boyd St., Room 436, Norman, OK, 73019, United States of America, amine@ou.edu

1 - Simulation Optimization of Production and Maintenance Policies for Manufacturers with Deterioration

Héctor Rivera-Gómez, Researcher, Autonomous University of Hidalgo, Pachuca-Tulancingo Road, km. 4.5, Pachuca, Hg, 42184, Mexico, hriver06@hotmail.com, José Ramön Corona-Armenta, Ali Gharbi, Eva Selene Hernández-Gress, Jaime Garnica-Gonzalez

We investigate the simultaneous production and maintenance planning for an unreliable manufacturing system subject to deterioration, whose effect is observed mainly on the rate of defectives. Overhaul activities can be conducted to counter the effect of deterioration. A stochastic dynamic programming model is proposed, where we approximate the related control parameters, through a simulation optimization approach. Sensitivity analyses are conducted to show the usefulness of the policy obtained.

2 - Reducing Water Discharges Exceedances a Wastewater T reatment Plant

Jean Carlos Rivera, Universidad del Turabo, P.O. Box 3030, Gurabo, PR, 00778-3030, Puerto Rico, jrivera735@email.suagm.edu, Wesley Marrero, Marie Velazquez, Martha A. Centeno

We present the modeling of a water treatment plant that serves four industrial plants. Water discharges are regulated by the Puerto Rico Aqueduct & Sewer Authority, which has established a maximum of 130,000 GPD. The plant has had 90 exceedances from 08/2013 to 04/2014, representing $505,814 in penalties. Solutions include reusing and manage stored water to balance discharge flow. Using a simulation model, we determine a configuration for the tank pump set points that reduces the exceedances.

3 - Design and Analysis of Agent Based Simulation for Cellular Transport System

Elif Karakaya, TU Dortmund, Leonhard-Euler-Str. 5, Dortmund, 44227, Germany, elif.krky@gmail.com, Tobias Hegmanns, Axel Kuhn

Recent developments in the field of intralogistics have led to fully automated warehouses in order to obtain high throughput volume and improve the accuracy.However, intralogistics systems are not flexible enough due to bulk conveyor systems, huge sorters with installation cost.In accordance with this purpose,Cellular Transport System (CTS) has been developed as an alternative intralogistics system by Fraunhofer Institute (IML).This study examines CTS as a whole by using Agent-Based Simulation.

4 - Natural Gas Trading: A Simulation Optimization Approach

Amine Kamali, The University of Oklahoma, 202 W. Boyd St., Room 436, Norman, OK, 73019, United States of America, amine@ou.edu, Hank Grant

This research focuses on developing a simulation optimization framework that models the price impact of high-frequency trading on the natural gas market. The objective is to maximize the expected profit subject to multiple constraints over a limited time horizon. Different scenarios are simulated and the data collected are compared to historical data. In this setting, high-frequency trading can disturb temporarily or permanently natural gas market equilibrium price.

■ WE76

Parc- Embarcadero

Practicum and Internship Experiences at Analytics Programs

Sponsor: The Practice Track

Sponsored Session

Chair: Jeff Hamrick, Associate Professor of Finance and Analytics, University of San Francisco, 2130 Fulton Street, San Francisco, CA, 94117, United States of America, jhamrick@usfca.edu

1 - LSU Master of Science in Analytics Practicum

James Van Scotter, Associate Professor of ISDS, Louisiana State University, 2215 Business Education Complex, Baton Rouge, LA, 70803, United States of America, jvanscot@lsu.edu, Joni Shreve, Saumitra Sharma

Team-based projects are at the core of LSU's M.S.in Analytics program. These projects are intended to produce tangible value for sponsors and help students learn important lessons about the practice of analytics that can't be taught in a classroom. Key lessons include: critical thinking, understanding business models, choosing appropriate analytical approaches, project management, team work, maintaining relationships with company sponsors, and communicating results to executives.

2 - Overview of the USFCA MS in Analytics Practicums

Matthew Dixon, Assistant Professor of Analytics, University of San Francisco, 2130 Fulton Street, San Francisco, CA, 94117, United States of America, mfdixon@usfca.edu

This talk describes the USFCA MS in Analytics Practicum - a 9 month industry collaborative course designed for students to solve data mining intensive analytics problems posed by participating companies. We describe the process by which student teams use state-of-the-art technical skills to provide research insights across a range of business functions. Example projects shall be used to illustrate the value of the Practicum through advancing a company's analytics capabilities.

3 - An Exploratory Study of the Development of Analytics Capabilities within Organizations

Matthew Liberatore, Director, Center for Business Analytics, Villanova University, 800 E. Lancaster Avenue, Villanova, PA, 19085, United States of America, matthew.liberatore@villanova.edu, Bruce Pollack-Johnson, Suzanne Clain

Little is known about the characteristics of firms that decide to invest in analytics. Do the factors that influence IT investment intensity also relate to investing in analytics? The purpose of this research is to determine what factors influence a firm's decision to invest in analytics. This study draws on data obtained from firms that participated in a series of intensive workshops held by IBM over 2009 - 2011.

4 - University of Tennessee Business Analytics Capstone Experience

Melissa Bowers, Beaman Professor of Business, University of Tennessee at Knoxville, 255 Stokely Management Center, Knoxville, TN, 37996, United States of America, mrbowers@utk.edu

The University of Tennessee, Knoxville offers a Master's Degree in Business Analytics. The academic program is three semesters in length. In the third semester of the program, each student enrolls in a three-hour "Business Analytics Experience" capstone class in which student teams work on a real world problem with a business partner in real time. The administrative and pedagogical structures of the capstone experience will be outlined.

5 - The Practicum Experience at NC State's Institute for Advanced Analytics

Christopher West, Practicum Manager, North Carolina State University, 920 Main Campus Drive, Suite 530, Raleigh, NC, 27606, United States of America, cjwest4@ncsu.edu

Our practicum learning experience involves 5 person student teams conducting real-world analytics projects for sponsors, understanding the business problem, then cleaning and analyzing the data. Projects span 7 months and culminate with a report and presentation to the sponsor. Teams perform their work under confidentiality agreement. Results are the sole property of the sponsor. There is no sponsorship fee. Past projects span every industry segment and include the world's best known brands.

■ WE77

Parc- Market Street

Joint Session Analytics/HAS: Strategic Payment and Pricing Healthcare Analytics

Sponsor: Analytics & Healthcare Applications

Sponsored Session

Chair: Thomas Roh, Mayo Clinic, 200 1st St. SW, Rochester, MN, 55905, United States of America, roh.thomas@mayo.edu

1 - Healthcare Asset Replacement Problem under Technological Change and Deterioration

Emmanuel des-Bordes, Graduate Research Assistant, Wichita State University, 1845 Fairmount Street, Wichita, KS, 67260, United States of America, exdes-bordes@wichita.edu, Esra Buyuktahtakin

This paper presents a discrete optimization model for keeping or replacing a group of aging assets that operate in parallel under a limited budget. Numerical results and sensitivity analyses are presented to illustrate the optimal replacement strategies for Magnetic Resonance Imaging (MRI) and Extremity-MRI machines (eMRI).

2 - Identifying Episodes-of-Care Trough Data Mining

Seyed Emami, RIT, 716 Merchants Road, Rochester, NY, United States of America, sme3279@rit.edu

We designed a clustering based methodology to identify episodes-of-care for medical conditions in order to assess the implementation of bundled payment reimbursement system. Our methodology automatically determines the set of services that constitute an episode-of-care for discrete group of diagnoses and patient cohorts.

3 - Fair Division of Shared Savings for Value-Based Purchasing Payment Model

Brendan Bettinger, Northeastern University, 360 Huntington Ave, Boston, MA, 02115, United States of America, b.bettinger@neu.edu, James Benneyan

The goal of this research is to design a new payment model between a nonprofit care delivery organization and skilled nursing facilities to reward a better standard of care at lower cost. Mechanism design is applied to define and calibrate financial incentives so the expected division of savings satisfies both parties.

■ WE78

Parc- Mason

Decision Support Systems 3

Contributed Session

Chair: Thomas Edmunds, Associate Program Leader - Energy Systems Analysis, Lawrence Livermore National Laboratory, 7000 East Av. L-175, Livermore, CA, 94550, United States of America, edmunds2@llnl.gov

1 - Stochastic Optimization of Renewable Generators

Thomas Edmunds, Associate Program Leader - Energy Systems Analysis, Lawrence Livermore National Laboratory, 7000 East Av. L-175, Livermore, CA, 94550, United States of America, edmunds2@llnl.gov

Wind and solar renewable generators increase the variability and uncertainty in power grid operations. Demand response, where consumers choose to reduce or increase energy usage in response to grid states, and energy storage can be used to mitigate uncertainty and variability. We describe coupled stochastic weather, renewable generator, and production simulation models that can assess the value that demand response and storage can provide.

2 - Tips and Tricks to Write Scalable Models using Cplex Optimization Studio

Arnaud Schulz, Software Architect, IBM, 1681 Route Des Dolines, Les Taissounieres HB2, Valbonne, 06560, France, arnaud.schulz@fr.ibm.com

A good optimization model has to execute fast, but also it has to be scalable to adapt to changes in data and/or constraints. In this software tutorial, we will give you tips and tricks to write such models using the OPL Language.

3 - Evaluation Model for Signal Coverage of Satellite Communication, Navigation and Positioning System

Maria José Pinto Lamosa, Dra., IEAv/CTA, Trevo Cel Av. José A. A. do Amarante, 1, São José dos Campos, Brazil, maju@ieav.cta.br, Monica Maria De Marchi, Diogo Maciel Almeida, Osvaldo Catsumi Imamura

Embedded spatial sensor coverage evaluation takes into account spatial and temporal parameters. Decision making process often requires data associated to the monitored targets and their features. To provide satellite attitude and sensor positioning optimized control, the model takes sensor and target characteristics for coverage planning and performance analysis, matching the sensor capacity with the target in the observed scenario. Sensor technical characteristics and limitations are simulated.

4 - Detecting Knowledge Transitions between Science and Technology for Forecasting Growing Fields

Hajime Sasaki, The University of Tokyo, #307 Build. Engineering 3, 7-3-1, Hongo, Bunkyo-ku, Tokyo, To, 1138656, Japan, sasaki@pp.u-tokyo.ac.jp, Yuya Kajikawa, Ichiro Sakata

The purpose of this research is to suggest a methodology for identifying promising fields by grasping dynamic transition between science and technology. We extracted 50,913 academic papers and 63,972 patent gazettes with solar cell" as search queries. We applied Newman clustering to these citation networks for identifying fields and tracked time-series of Cosine similarity within the clusters thorough the time window. Then we grasped a forerunner of transition between science and technologies.

■ WE79

Parc- Powell I

Model and Model Validation in Disaster Management

Sponsor: Decision Analysis

Sponsored Session

Chair: Jing Zhang, University at Buffalo,SUNY, 2 Bristol Ct, Apt B, Buffalo, NY, 14228, United States of America, jzhang42@buffalo.edu

1 - Measuring a Community's Resilience to Disasters

Julia Phillips, 9700 S. Cass Avenue, Argonne, IL, United States of America, Argonne National Laboratory, phillipsj@anl.gov

Community resilience is often viewed as a combination of societal, organizational and infrastructure resilience. Holistically capturing this symbiotic relationship is challenging. Community resilience studies have traditionally required large amounts of data and significant time to complete. We present a decision analytic approach to capturing components of community resilience and discuss a potential framework to provide the holistic view necessary for disaster management and recovery efforts

2 - Risk Tolerance Model Validation Before and After Significant Disasters

Darlene Alexander-Houle, UoP/HP, 14207 Torrey Vista Dr, Houston, TX, 77014, United States of America, dalexhoule@att.net, Gary Houle

The RiskPACK model measures individuals' risk tolerance in decision making. A change in risk tolerance after weather and financial disasters validate the model using the FRB's SCF data for the USA over a 21-year period. Results propose characteristics of risk takers and avoiders, controlling for age and education.

3 - Defensive Resource Allocations of Assembly Occupancies System in a Sequential Defender-attacker Game

Shuying Li, Tsinghua University, Institute of Public Safety Research, 1018 Liuqing Building, Beijing, 100084, China, lishuying_susie@qq.com, Shifei Shen, Jun Zhuang

Optimal defensive resource allocation was studied facing with intentional attacks using game theory and risk analysis methods. This research considers a series of assembly occupancies, such as large railway stations, as the system targets (classified into two categories). The consequences of attack are calculated, based on the optimal resource allocations for both attackers and defenders studied in an n-period game. We illustrated the model using the 2014 Kunming terrorist attack case study.

4 - Modeling Ballistic Missile Defense Deterrence

Jonathan Trexel, Program Manager, SAIC, 7416 Grand Oaks Drive, Lincoln, NE, 68516, United States of America, trexelj@saic.com

This presentation explores the role of Japan's ballistic missile defense (BMD) program and its deterrent effect upon North Korean behavior during general deterrence conditions. A mixed-methods approach is employed. Empirical quantitative data included tabulated monthly cooperative-conflictual behavioral interaction between Japan and North Korea. A strategic profile developed from deterrence theory provided essential qualitative background to compliment the quantitative analysis.

5 - Optimal Allocation of Defensive Resources for Counter-Terrorism: Modeling and Validation

Jing Zhang, University at Buffalo,SUNY, 2 Bristol Ct, Apt B, Buffalo, NY, 14228, United States of America, jzhang42@buffalo.edu, Jun Zhuang

In this research, we study the optimal defensive resource allocation by proposing a novel class of multi-period and multi-target attacker-defender games where the attackers may have multiple attacking options. We provide both analytical results and algorithm to solve this game, as well as numerical illustration and model validation using real data. This research provides some new insights to homeland security resource allocation.

■ WE81

Parc- Divisadero

Predictive Models in Data Mining

Sponsor: Data Mining

Sponsored Session

Chair: Onur Seref, Assistant Professor, Virginia Tech, Pamplin 1007, Blacksburg, VA, 24061, United States of America, seref@vt.edu

1 - Relaxed Support Vector Machine Extensions

Talayeh Razzaghi, Postdoctoral Research Fellow, School of Computing, Clemson University, Clemson, SC, 29634, United States of America, trazzag@clemson.edu, Onur Seref, Petros Xanthopoulos

Relaxing the constraints of support vector classifiers has been found to work well for classification problems in the presence of outliers. Here we present the extension of this concept for applications beyond supervised learning and compare against traditionally popular algorithmic schemes.

2 - Inferring Correlated Consumer Valuations for Data-Driven Bundle Pricing

Ben Letham, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, United States of America, bletham@mit.edu, Anshul Sheopuri, Wei Sun

Optimal bundle pricing requires learning the joint distribution of consumer valuations for the items in the bundle, that is, how much they are willing to pay for each item. We suppose that a retailer has sales transaction data, and the corresponding consumer valuations are latent variables. We develop a statistically consistent and computationally tractable inference procedure for fitting a copula model of correlated valuations, using only sales transaction data for the individual items.

3 - A Latent State Hazard Model

Ramin Moghaddass, MIT Sloan School of Management, Cambrdige, MA, United States of America, raminm@mit.edu, Cynthia Rudin

We present a new statistical model for reliability analysis that is able to distinguish the latent internal vulnerability state of the equipment from the vulnerability caused by temporary external sources. If we can isolate the underlying latent state, we will better understand the effects of external sources, leading to more robust decision making. Our hazard model has been effective both in simulations and on a wind farm study based on SCADA data from 28 turbines in Italy.

4 - The L1-Norm Best-Fit Line Problem

Paul Brooks, VCU, PO Box 843083, Richmond, VA United States of America, jpbrooks@vcu.edu, Jose Dula

The L1-norm best-fit line problem has applications in facility location and robust principal component analysis. In this talk we present properties of the L1-norm best-fit line that suggest an efficient heuristic.

■ WE82

Parc- Haight

System Analysis

Contributed Session

Chair: Ali Shafaat, Purdue University, 3386 Peppermil Dr., Apt 2A, West Lafayette, IN, 47906, United States of America, ashafaat@purdue.edu

1 - A Photo Elicitation of Systemic Perception

James Corner, University of Waikato, 12 Bronte, Cambridge, 3432, New Zealand, jcorner@waikato.ac.nz, Raimo Hamalainen, Rachel Jones

Systems perception is important as a necessary ingredient for acting with systems intelligence. However, research shows that the average person is unable to articulate their understanding of systems and apply systems thinking formally. This study attempts to expand our understanding of how people perceive the systems around them. A photo elicitation methodology, coupled with thematic analysis, shows how the use of photos can significantly improve one's understanding of the complexity of systems.

2 - A System Dynamics Model for Estimating the Energy Imbalance Among US Children

Saeideh Fallah-Fini, Assistant Professor, California State and Polytechnic University, Pomona, 3801 W. Temple Ave, Pomona, CA, 91768, United States of America, sfallahfini@csupomona.edu, Hazhir Rahmandad, Regina Bures, Terry Huang

This paper uses systems dynamics to present a population-level model that quantifies the energy imbalance gap responsible for the obesity epidemic among U.S. children (across different gender/ethnicity/age subpopulations) during the past decades. Our model creates a platform to better understand obesity intervention targets in different segments of children.

3 - Measuring Complexity in Mechanical Systems

Ali Shafaat, Purdue University, 3386 Peppermill Dr., Apt 2A, West Lafayette, IN, 47906, United States of America, ashafaat@purdue.edu

In engineered systems, complexity of human-human and human-mechanical system interactions absorbed the main attention. This paper tries to fill the gap by using a forward approach with clear terminology. This research would take a simple reactive mechanical system and make it gradually more complex. Each step increases the system adaptivity by getting farther from reactivity. It makes the measurement, comparison, and judgment of the system complexity more precise.

4 - Implementations of Remote Sensing and Traceability Technologies

Chun-Hung Cheng, Associate Professor, The Chinese University of Hong Kong, Dept of Syst. Engg. & Engg. Mgmt., Shatin, NT, Hong Kong - PRC, chcheng@se.cuhk.edu.hk, Dorbin Tobun Ng, Ziye Zhou

In this project, we will talk about implementations of remote sensing and traceability technologies in an airmail center and a museum. Remote traceability technology is used to track air mail bags more efficiently and remote sensing technology is designed for real-time monitoring the environment of the museum. The implementation challenges in these facilities are discussed. Initial experiences in using these systems are shared. Other applications of the technologies are also explored.

5 - Linking Requirements Change to Project Performance

Sherrica Holloman, Aerospace Corporation, 2100 Crystal Drive, Arlington, VA, 22315, United States of America, ssn@gwu.edu

Requirements is often implied or cited as critical to overall project performance; however, little empirical data outside of interview or survey data exists to support the notion. This gap in literature can be addressed by analyzing requirements change over the life-cycle of select NASA projects. It is expected that measurements of requirements change is an early indicator of project performance.

■ WE83

Parc- Sutro

Data Mining 5

Contributed Session

Chair: Fakhrosadat Mohammadi, PhD Student in Library and Information Sciences, Chamran Univeristy, Motahayeri Street, Sohrevardi Shomali, Tehran, Iran, fmohamadi1@gmail.com

1 - Functional Hazard Analysis of Call Center Data

Gen Li, UNC-CH, 100 Rock Haven Road E207, Carrboro, NC, 27510, United States of America, ligen@live.unc.edu, Jianhua Huang, Haipeng Shen

We build a novel two-dimensional hazard model to study customer patience and offered waiting time across different time of a day of a call center. The smooth hazard surface is estimated by maximizing a regularized likelihood function. The optimization problem is efficiently addressed by an alternating direction method of multipliers (ADMM) algorithm. We apply the method to US bank call center data. The proposed method reveals interesting patterns of calls being abandoned or answered.

2 - The Ten Killer Data Mining Errors:

Sam Koslowsky, VP Modeling Solutions, Harte Hanks, 1271 Ave. of the Americas, 43rd Floor, New York, NY, 10020, United States of America, sam.koslowsky@hartehanks.com

Most errors that occur in a data mining exercise are ones that can easily be avoided. Indeed, contrary to what many analysts may believe, these issues are non-technical in nature. From using biased samples to employing inappropriate predictors,these errors can easily be avoided. And they come from all three phases of a project-data preparation,algorithm development,and model deployment.I show some actual mini case studies, and provide some quick rules that will aid in avoiding these problems.

3 - Learning Product Knowledge from Online Reviews

Feng Mai, PhD Student, University of Cincinnati, Carl H. Lindner Hall, 2925 Campus Green Drive, Cincinnati, OH, 45221, United States of America, maifg@mail.uc.edu, Xin Wang, Roger Chiang

We investigate how consumer generated product reviews can facilitate product designing and brand positioning. We propose and evaluate a new framework for learning from unstructured online reviews to conduct market structure analysis.

4 - using Data Mining Techniques for Reaching to Competitive Edge, Evaluating Customer Loyalty

Fakhrosadat Mohammadi, PhD Student in Library and Information Sciences, Chamran Univeristy, Motahayeri Street, Sohrevardi Shomali, Tehran, Iran, fmohamadi1@gmail.com, Farideh Osareh, Behzad Sanayei

Customer loyalty have critical role in reaching to competitive edge in market. We evaluate it using data mining techniques by focusing on the numbers like lifetime customer value. Mining these data can help us improve acquisition costs and also identify why customers bail. The combination of tacit may come in handy because of the data will tell us where they are falling off.

5 - A New MIP Model for Clustering Binary Networks

Harun Pirim, KFUPM, Dhahran, Saudi Arabia, harunpirim@gmail.com

Integer programming models for clustering have applications in market segmentation, facility location problems. Models are important for guiding clustering algorithms that are capable of handling high dimensional data. Here, a new mixed integer programming model for clustering relational networks is presented. Relational networks are mainly used in social sciences and bioinformatics. The model is applied on several social networks.

Session Chair Index

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

SESSION INDEX

Sunday, 8:00am- 9:30am

Sunday, 11:00am - 12:30pm

SB51 Optimization in Dynamics and Control
SB52 First-Order Methods for Huge-Scale Optimization
SB53 Systemic Risk
SB54 Financial Engineering & Risk Management
SB55 Integer Nonlinear Programming and Applications - I
SB56 Software Demonstrations
SB64 Applications of Approximate Queueing Analysis
SB65 Systemic Financial Risk
SB66 QSR Student Introductions and Interactions
SB67 Condition Monitoring and Degradation Modeling
SB68 Reliability Evaluation and Maintenance Optimization
SB69 Design and Optimization of Sustainable Supply Chains
SB70 Open Pit Mining and Logistics
SB71 Auctions and Markets for Information
SB72 Demand Response in Electricity Markets
SB73 New Paradigms in Transmission Expansion Planning
SB74 Mitigating Uncertainty in Power System Operations through Market Design and Computational Methods
SB75 Simulation Modeling for Anaysis
SB76 Cloud Infrastructure Planning and Optimization
SB77 Stochastic Models in Health Care
SB78 Nicholson Student Paper Prize I
SB79 Decision Analysis and Behavioral Research
SB80 Decision Analysis in Integrated Care (Healthcare and Social care)
SB81 The Role of Information in Dynamic Games
SB82 Choice Behavior in MCDM
SB83 Doing Good with Good OR - Student Paper Competition

Sunday, 1:30pm - 3:00pm

SC01 MAS Tutorial Session. A Quick Peek at Predictive Analytics
SC02 Organizational Issues in Technology Management
SC03 Business Model Innovation in Cleantech Markets
SC04 Strategic Decision Making in Manufacturing & Service Operations
SC05 Innovation in the Supply Chain
SC06 Topics in Sustainable Operations
SC07 From Data to Assessments and Decisions: Epi-Spline Technology
SC09 The Impact of Workload and System Factors on Patient Outcomes
SC10 Supply Risk Management/Inventory Control
SC11 Competition and Coordination in Supply Chains
SC12 Sustainable Operations Management with Public Interest
SC15 Computational Issues and the Relationships Between Related Models
SC16 Operations and Finance Interface
SC17 Retail Operations
SC18 Choice Models in Revenue Management and Pricing III
SC19 Topics in Revenue and Capacity Management
SC20 Matching and Market Design
SC21 Traffic Flow Modeling and Management
SC22 Optimization and Disaster Management
SC23 Rich Vehicle Routing Problems I
SC24 Traffic and Emissions Modeling
SC25 Flexible Transit and Ride-Share Systems
SC26 Location Optimization I
SC27 Roundtable Discussion on Bridging Data and Decisions I
SC28 Advanced Analytics: Applications to Solve Aviation System Level Problems
SC29 "Just the Facts" Papers in Strategy
SC30 Scheduling in Maritime Logistics
SC31 Delivering Services Over the Digital Media
SC32 Accelerate Service Innovations with Data Mining and Machine Learning
SC33 Managing the Innovation Process for New Product Development
SC34 Humanitarian Logistics and Development
SC35 Public Health I
SC36 Telecommunications Best Paper Award
SC37 Methods and Models for Large Social Networks
SC38 Systems Engineering and Public Health
SC39 Medical Decision Making
SC40 Scheduling Problems in Healthcare
SC41 Medical Decision Making: Research by Bonder Scholars
SC42 Network Epidemics: Theory Advancements and Applications
SC43 Software and Tools for Large-Scale Optimization
SC44 Service Operations and Information Systems
SC45 Service Operations Management
SC46 Joint Session OPT/ENRE: Mixed-integer Robust Optimization Models and Applications in Electric Power Systems
SC47 Computational Stochastic Dynamic Optimization
SC48 Stochastic Integer Programming
SC49 Connectivity and Cluster Detection in Networks
SC50 Network Analysis
SC51 Methods in Nonlinear Optimization
SC52 Optimization, Variational Inequality Problems, and Games: Uncertainty, Imperfect Information, and Distributed Computation
SC53 Data Driven Computational Finance
SC54 Financial Risks
SC55 Global Optimization: Algorithms and Applications
SC56 Software Demonstrations
SC64 Data-driven Decisions in Healthcare
SC65 Case Competitions I
SC66 Data Fusion in Manufacturing and Biomedical Systems
SC67 System Informatics and Control: Learning from Complex Data
SC68 Simulation Optimization and Sequential Sampling Rules
SC69 Land Use, Conservation and Sustainability
SC70 Topics in Underground Mine Planning
SC71 Incentive Auctions
SC72 Energy Storage for Grid Integration of Renewable Energy
SC73 Policy Analysis and Planning in Energy Sector
SC74 Strategic and Complementarity Models in Energy Markets
SC75 Efficient Learning in Stochastic Optimization
SC76 Community Service OR: Learn By Doing
SC77 Joint Session Analytics/HAS: Topics of Healthcare Analytics I
SC78 Panel Discussion: Promoting INFORMS International Activities
SC79 Joint Session DAS/SPPSN: Societal Applications of Decision Analysis
SC80 Ensembles and Big Data
SC81 The Role of Information in Dynamic Games
SC82 Business Location Analysis with MCDM
SC83 INFORMS Data Mining Best Student Paper Award

Sunday, 4:30pm - 6:00pm

SD01 Mathematical Modeling and Operations Research in Military Decision Making I
SD02 Entrepreneurial Innovation Process (Discussant Session)
SD03 Innovating in the Mobile World using Analytics
SD04 Empirical Research in Operations Management
SD05 Supplier Responsibility Management
SD06 Strategic Supply Risk Management
SD07 Global Healthcare Operations
SD09 Tackling Readmissions: From Policy to Practice
SD10 Crowdsourcing
SD11 Joint Session M&SOM Supply Chain/BOM: Pricing from the Practitioner's Perspective
SD12 Sustainability Impacts of Operational Choices in Energy Generation and Storage
SD15 Stochastic Alternatives: SFA and StoNED
SD16 Information, Risk Management, and Production Strategies
SD17 Customer Behavior and Call Center Management
SD18 Choice Models in Revenue Management and Pricing IV
SD19 Integrating Pricing and Supply Chain Planning
SD20 Matching Markets
SD21 Transportation and Routing under Uncertainty I
SD22 Preparing for and Responding to Disaster with Tools of OR
SD23 Rich Vehicle Routing Problems II

SD24 Modeling of Emerging Sensor Technologies
SD25 Advances in Routing and Scheduling Problems
SD26 Location Optimization II
SD27 Roundtable Discussion on Bridging Data and Decisions II
SD28 AAS Dissertation Prize Finalists
SD29 New Directions in Understanding Buyer-Supplier Relations
SD30 Supply Chain and Scheduling
SD31 Theory Development, Measurement and Testing in Service Science
SD32 Data Science in Online Retailing
SD33 Incentives and Organizational Issues In New Product Development
SD34 Humanitarian Operations Management Applications
SD35 Decisions in a Nonprofit Supply Chain I
SD36 Wireless Mobility Modeling
SD37 Social Intelligence: Learning, Aggregation and Applications
SD38 Healthcare Analytics
SD39 Joint Session HAS/Analytics/CPMS: Practicing OR/OM in Healthcare Providers - A Panel
SD40 Public Health Applications
SD41 Decision Modeling for Disease Prevention Considering Imperfect Screening
SD42 Healthcare Operations
SD43 Sparse Optimization: Theory and Applications
SD44 Social Media and Virtual Worlds
SD45 INFORMS BOM Best Working Paper Award Finalist Presentations
SD46 New Developments on MINLP and MIQCP
SD47 Computations and Applications of Stochastic/Robust Optimization
SD48 Applications of Stochastic Programming
SD49 Optimal Allocation of Scarce Infrastructure Capacity: Lessons from Different Network Industries
SD50 Network Design with Hubs I
SD51 Recent Advances in Numerical Aspects for Nonlinear Programming
SD52 Advances in Binary Quadratic Programming
SD53 Robust and Data-Driven Portfolio Optimization
SD54 Financial Services Section Student Paper Competition
SD55 Meta-control Techniques for Non-convex Optimization
SD56 Software Demonstrations
SD64 Scaling Limits of Stochastic Networks
SD65 Case Competitions II
SD66 Recent Advances in Experimental Designs
SD67 Data Mining in Medical Decision Making and Bioinformatics Applications
SD68 Interfaces Between Simulation and Optimization
SD69 Sustainable and Responsible Supply Chain Management
SD70 Analytics in the Petrochemical/Petroleum Industry
SD71 Panel Discussion: Government Auctions of Spectrum Licenses
SD72 KINFORMS
SD73 ENRE Awards Session
SD74 Analytics Case Studies
SD75 Simulation Methods for Risk Analysis and Finance
SD76 Innovations in Supply-Chain Operations
SD77 Joint Session Analytics/CPMS: Panel Discussion: Making the Connection Between Analytics and OR
SD78 Predictive Analytics Models and Methods
SD79 Applications of Decision Analysis
SD80 Real Option Applications
SD81 Optimization and Modeling in Radiation Therapy Treatment Planning
SD82 Bilevel Optimization: Algorithms and Applications
SD83 Machine Learning, Data Mining, and Statistics I

Monday, 8:30am -9:30am

MA01 Advances in Military Healthcare Operations Research
MA02 Growth Oriented Innovation in Entrepreneurial and Ecosystem Settings
MA03 Social Networks, Personal Information, and Open Innovation
MA04 Empirical Research in Operations / Supply Chain
MA05 Supply Chain Operations
MA06 Information in Supply-Chains
MA07 From OR to OM: Observations on the Emergence of a Discipline
MA08 Applications of Little's Law
MA09 Healthcare Operations
MA10 Stochastic Models for Service Operations
MA11 Pricing and Contracts in Supply Chains
MA12 Pricing and Regulation Issues in Sustainable Operations
MA14 Air Traffic Control: Safe and Sound?
MA15 Applications in Electricity Networks and Natural Disasters
MA16 Operations and Finance
MA17 Empirical Research in Service Operations
MA18 Choice Models in Revenue Management and Pricing V
MA19 Operations and Marketing Interface
MA20 Pricing & Revenue Management Convergence
MA21 Transportation and Routing under Uncertainty II
MA22 Post-Disaster Relief and Response
MA23 Uncertainty in Transportation Models I
MA24 Active Traffic Control Strategies for Real-Time Management
MA25 Infrastructure Investment and Management
MA26 Urban Operations Research
MA27 Railroad OR Models
MA28 Airline Network Planning and Schedule Development
MA29 Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice
MA30 Stochastic Scheduling and Supply Chains
MA31 Service Operations and Marketing Inter-Related Issues
MA32 Frontiers in Service Science
MA33 Incentives for Innovation/Innovative Projects
MA34 Modeling the Education System
MA35 Public Health II
MA36 Network Design
MA37 Predictive Analytics for Social Media
MA38 Exploring Strategies for Innovation and Learning
MA39 Hospital-based Challenges
MA40 Monitoring and Prevention of Hospital Acquired Infections
MA41 Online Decision Making in Healthcare
MA43 Computational Optimization
MA44 Information Systems and the Digital Society
MA45 Behavioral Research on Inventory and Pricing
MA46 Convexification Techniques in MIP & MINLP
MA47 Stochastic/Robust Optimization in Energy Systems
MA48 Decomposition Algorithms for Stochastic (Integer) Programs
MA49 Network Analysis Methods and Applications
MA50 Network Design with Hubs II
MA51 Optimization of Energy Systems
MA52 Stochastic Methods and Machine Learning in Optimization
MA53 Portfolio Planning
MA54 Stochastic Control and Optimal Stopping in Finance
MA55 Expediting Global Optimization Algorithms via Special Mathematical Structure
MA56 Software Demonstrations
MA64 Matching in Markets
MA65 Diffusion Models for Queues
MA66 QSR Best Student Paper Competition
MA67 Reliability Analysis and Fault Management for Complex Engineering Systems
MA68 Recent Advances in Simulation-Based Optimization
MA69 Applications of OR in Bioenergy
MA70 Natural Hazard Management
MA70 Natural Hazard Management
MA71 Auctions for Procurement
MA72 Study of Reliability and Security in Power Systems
MA73 Investment in Renewables & CCS Technology and

Cost of Renewables
MA74 Design and Control of Energy Systems
MA75 Simulation and Optimization I
MA76 Predictive Analytics for Structured and Unstructured Data
MA77 Joint Session Analytics/CPMS: Predictive Analytics Applicatons
MA78 JIPE and IJOR Special Session on Analytics
MA79 Panel Discussion: Early DA Applications – What Would We Do Differently Today? A Panel of Early DA Pioneers will Review The Classic Applications and Share what they Would do Differently Today
MA80 Evaluating Forecasts
MA81 Data Analytics & Optimization with its Applications
MA82 Multi-Criteria Analysis for Supply Chain and Logistics
MA83 Statistical Approaches for Medical Engineering

Monday, 11:00am - 12:30pm

MB01 Analytics for New Efficiencies: Quality and Lifecycle Management in the DoD
MB02 Best Dissertation Award Finalists - Technology, Innovation Management and Entrepreneurship Section
MB03 Economics of Information
MB04 Information, Incentives and Behavioral Decision Making in Operations Management
MB05 Empirical Research and Quality Risk
MB06 Contract Design in Various Operations
MB07 Clearing the Jungle of Stochastic Optimization
MB08 Celebrating the Contributions of George Dantzig: Applications and Software
MB09 Empirical Studies on Hospital Operations
MB10 Learning in Queues
MB11 Empirical Research in Supply Chain Management
MB12 Environmental Sustainability in Service Operations
MB14 Airport/Airline Operations Management
MB15 Efficiency Analysis Applications
MB16 Managing Financial Flows in Supply Chain
MB17 Queuing Models for Service Management
MB18 RM & Pricing Topics
MB19 Demand Response Pricing in Data Centers and Grids
MB20 Pierskalla Award
MB21 Novel Techniques for Vehicle Routing
MB22 Disaster Planning
MB23 Uncertainty in Transportation Models II
MB24 Advances in Network Modeling
MB25 New Methods for Leveraging Open Data in Public Transit Analysis and Modeling
MB26 Location Modeling & Applications
MB27 Railway Analytics
MB28 Air Cargo and Aviation Operational Performance
MB29 Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice
MB30 Scheduling in Practice
MB31 Stochastic Methods in Cloud Computing Services
MB32 Service Science Best Paper Award
MB33 New Research Topics on Innovation
MB34 Joint Session SPPSN/MIF: Disaster Relief and Humanitarian Logistics
MB35 Decisions in a Nonprofit Supply Chain II
MB36 Reliable Sensor Cover and Network Design
MB37 Joint Session AI/QSR: Multidisciplinary Information Fusion for System Informatics
MB38 Cognition and Positioning
MB39 Joint Session HAS/Analytics: Learning from Healthcare Data
MB40 Payment Innovations in Health Care
MB41 Patient-Centric Healthcare and Personalized Medicine
MB42 Using OR to Model Healthcare Policy
MB43 Quadratic Assignment Problems and Applications
MB44 Digital Content Distribution and Management
MB45 Inspections and Improvement Initiatives in Supply Chains
MB46 Advances in Discrete Optimization
MB47 Computational Methods for Stochastic Optimization and Variational Problems
MB48 Multistage Stochastic Optimization and Applications in Healthcare
MB49 Interdiction Models in Complex Networks
MB50 Network Design in the Automotive Industry
MB51 Optimization for Large-scale Data Analysis and Optimization
MB52 Recent Progresses on Solving Markov Decision Processes
MB53 Mathematical and Statistical Analysis of High Frequency Tradings
MB54 Some Recent Topics in Financial Engineering
MB55 Optimization for Dimension Reduction
MB56 Software Demonstrations
MB64 Applied Probability for Smart Cities
MB65 Fluid and Diffusion Approximations of Stochastic Systems
MB66 Simulation and Computer Experiments
MB67 Industrial Data Analytics
MB68 Simulation Methodology Applications
MB69 Models for Electric Vehicle Charging Infrastructure Network
MB70 Using Optimization for Wildfire Preparation and Mitigation
MB71 Procurement and Auction Markets
MB72 Assorted Topics in Distributed Energy Generation
MB73 Uncertainty in Climate Policy Modeling
MB74 Existing Challenges in Non-convex Electricity Markets
MB75 Simulation and Optimization II
MB76 Making Operations Research Deliver
MB77 Joint Session Analytics/CPMS: The Whys Hows and Whats of Analytics Certification
MB78 Big Data Industry Applications
MB79 Decision Analysis in Organizations
MB80 Value of Information Analysis: Theory and Applications
MB81 Joint Session Data/AI/HAS: Big Data Analytics and Smart Health I
MB82 Multiple Criteria Decision Making Applications
MB83 Optimization Models in Data Mining

Monday, 12:30pm - 2:30pm

Interactive Session

Monday, 1:30pm - 3:00pm

MC01 Sensors and Weapons
MC02 Rx for Patent Fatigue in Innovation Research: New Data, New Causal Methods, and New Results
MC03 Data-Driven Analysis in eBusiness
MC04 New Topics in Supply Chain Network and Design
MC05 MSOM Student Paper Competition Finalists
MC06 Operations and Marketing Interface
MC07 Cloud Computing for Optimization
MC08 George Dantzig?s Continuing Impact on Advances in Optimization
MC09 Appointment Scheduling Models
MC10 New Advancements in Classic Inventory Problems
MC11 Incentives for Socially-beneficial Goods
MC12 Green Business Models and Strategies
MC14 Best Practices in Reviewing Papers
MC15 Banking and Manufacturing Applications
MC16 Mitigating Supply Risk
MC17 Pricing and Strategic Behavior in Queueing Systems
MC18 Practice-driven Revenue Management I
MC19 New Applications in Pricing and Revenue Management
MC20 Joint Session Analytics/CPMS: Business Analytics in Higher Education Industry
MC21 Freight Fleets Logistics and Management
MC22 Application of Machine Learning in Transportation
MC23 Multimodal Transportation
MC24 Network Science and Transportation
MC25 Recent Advances in Day to Day Traffic Assignment

MC26 New Directions in Location Research
MC27 Models for Fleet Management and Scheduling
MC28 Airline Operations
MC29 Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice
MC30 Uncertainty and Cooperation
MC31 Service Queues
MC32 Service Science Best Paper Award
MC33 Managing Uncertainty in Innovation
MC34 Humanitarian Logistics
MC35 Socially Responsible Operations
MC36 Network Traffic Modeling
MC37 DM2: Data Mining in Decision Making with Theory & Applications
MC38 Scheduling Staff and Space in Healthcare
MC39 Innovations in Healthcare Delivery Systems
MC40 Methodologies for Health Policy Making
MC42 Healthcare Operations and Scheduling
MC43 Decision Diagrams in Optimization I
MC44 Multi-Channel Advertising
MC45 Field Experiments
MC46 Advances in MIP Modeling Systems
MC47 Stochastic Optimization for Natural Resources
MC48 Network and Graphs 1
MC49 Networks Robustness and Vulnerability Analysis
MC50 Service Parts Networks and Inventory Optimization
MC51 Recent Advances in First Order Methods
MC52 Recent Advances in Linear Programming and Complementarity Problems
MC53 Optimization and Financial Engineering
MC54 Default and Systemic Risk
MC55 MINLP Methodology and Applications
MC56 Software Demonstrations
MC64 POMDPs and Applications
MC65 Stochastic Systems
MC66 Joint Session QSR/DM: Panel Discussion: Funding Opportunities
MC67 IIE Transactions Session
MC68 Recent Trends in Composing Heterogeneous Simulation Models
MC69 Carbon Footprint and the Management of Supply Chains
MC70 Incorporating Ecological Concerns into Harvest Scheduling
MC71 Analysis of Matching Markets
MC72 Optimization and Analysis of Smart Grids with Renewable Energy and Storage
MC73 Investment in Electricity Markets
MC74 Stochastic and Robust Optimization in Electric Power Systems Operations and Planning
MC75 Operations Research to Inform Health Policies
MC76 The Data Lifecycle - Selected Case Studies
MC77 Joint Session Analytics/HAS: Predictive and Prescriptive Analytics for Reducing Health Risks
MC78 Dynamic Decision Making
MC79 50th Anniversary Update from Some Ramsey Award Winners
MC80 Price, Ambiguity and Value of Information
MC81 Joint Session Data/AI/HAS: Big Data Analytics and Smart Health II
MC82 Tutorial: Exact Methods for Multi-Objective Combinatorial Optimization
MC83 Big Data Analytics for Various Applications

Monday, 4:30pm - 6:00pm

MD01 Analytics for Surviving Austerity: Doing More with Less
MD02 TIMES Distinguished Speaker - Haim Mendelson
MD03 Experimental Economics in E-Commerce
MD04 Social Operations Management
MD05 MSOM Student Paper Competition Finalists
MD06 Nonprofit Operations
MD07 Simulation Based Education in Supply Chain and Project Management
MD09 Big Data Optimization for Data Mining and Statistical Analysis
MD10 Disruptive Technologies and Business Models
MD11 Managing Relationships in Supply Chains
MD12 Empirical Operations Management and Sustainability
MD14 External Letters of Recommendation for Tenure: Hear from Those Who Write and Read Them
MD15 Applications of DEA
MD16 New Models in Revenue Management and Pricing
MD17 Innovation in Services and Retail
MD18 Practice-driven Revenue Management II
MD19 Product Quality, Information, Social Learning, and Pricing
MD20 Transportation Analytics
MD21 Electrical Vehicles Routing
MD22 Energy Logistics and Supply Chains
MD23 Same-Day Delivery and Routing
MD24 Parking and Network Modeling Innovations
MD25 Transportation Network Design and Pricing
MD26 Reliable Facility Location Models
MD27 Railway Operations Modeling and Analysis
MD28 Aviation Applications Section: Keynote Presentation
MD29 The George B. Dantzig Disseration Award
MD30 Contemporary Scheduling
MD31 Digital Services in the Sharing Economy
MD32 Workforce Planning I
MD33 Organizing for Successful Product Development
MD34 Community-Based Operations Research
MD35 Operations Research in Public Policy Analysis
MD36 Topics In Telecommunications
MD37 Supply Chain Optimization and Analytics
MD38 OR Techniques to Improve Patient Scheduling
MD39 Operations Analysis for Health Care
MD40 Bundled Payments and Payment Systems
MD41 Stochastic Models in Healthcare Delivery
MD42 Health Care Supply Chain, Competition, and Risks Management
MD43 Decision Diagrams in Optimization II
MD44 Information, Information Accuracy and Information Policy in E-commerce Applications
MD45 Opportunities in Behavioral Operations: Different Perspectives
MD46 Cutting Plane and Formulation Techniques for Mixed Integer Programming
MD47 Joint Session Optim/ MIF: Developments in Stochastic Integer Programming Methods
MD48 Network and Graphs 2
MD49 Supply Chain Network Competition: Advances in Models
MD50 Optimization, Network 1
MD51 First-order Methods for Large-scale Convex Optimization
MD52 Algorithms for Optimization and Learning
MD53 Portfolio Optimization and Solution Methods
MD54 Joint Session FSS/OPT: Optimal Portfolio Management and Execution
MD55 Optimization Modeling and Methodologies in Big Data
MD56 Software Demonstrations
MD64 Markov Lecture
MD65 Modeling & Simulation in Healthcare Service Delivery
MD66 Applied Probability and Bayesian Models for Industrial Statistics
MD67 Statistical Approaches to Personalized Healthcare I
MD68 Recent Advances in Simulation Metamodeling Techniques
MD69 Joint Session ENRE/DAS: Expert Judgment and Learning Curves in Energy & Environment
MD70 Supply Chain Management in the Forest Sector
MD71 Dynamic Matching Markets
MD72 Energy I
MD73 Energy/Climate Modeling
MD74 Stochastic Control and Optimization of Power Systems with Renewables
MD75 Joint Session MIF/HAS: Healthcare Analytics
MD76 O.R. Approaches to Plan and Build Data Networks
MD77 Joint Session Analytics/CPMS: 2014 Innovative Applications in Analytics
MD78 Decision Analysis 1
MD79 Decision Analysis Society Awards

MD80 Panel Discussion: Meet the Editors ? Service Science Track
MD81 Joint Session Data/Computing: Statistical Learning in Stochastic Optimization
MD82 Preferences and Multiple Objectives
MD83 Machine Learning, Data Mining, and Statistics II

Tuesday, 8:00am - 9:30am

TA01 Mission Planning I
TA02 Outsourcing, Offshoring, and the Changing Nature of Organizational Boundaries and Architectures
TA03 Social Media and Business Marketing
TA04 Operations Management and Marketing
TA05 Bayesian Estimation and Optimization
TA06 Operational Issues in Trade-in Programs
TA07 Service Science: Toward Systematic Service System Innovation
TA08 Optimization and Modeling for Individual Decision-Making
TA09 Novel Techniques in Integer Programming
TA10 Dynamic Optimization with Uncertain Demand
TA11 Topics in Supply Chain Management
TA12 Doctoral Work in Sustainable Operations Management
TA14 Panel Discussion on Journal Publication Tips
TA15 DEA Methodology
TA16 Dynamic Mechanism Design in Revenue Management
TA17 Behavioral Perspectives
TA18 Revenue Management in Retail and Service I
TA19 Dynamic Learning and Pricing
TA20 Facility Logistics I
TA21 Innovative Solutions for Congestion Mitigation I
TA22 Selective and Time Dependent Routing Problems
TA23 Network Design and Repositioning for Bike-sharing Systems
TA24 Emerging Vehicle and Sensor Technologies
TA25 Public Transportation
TA26 Facility Location
TA27 Demand-Responsive Rail Service Design
TA28 Air Transport Data Analysis for Safe and Efficient Operations
TA29 Project Management 1
TA30 Vacation and Online Scheduling
TA31 Analytics in Cloud
TA32 Team Performance
TA33 Product Design and Manufacturing
TA35 Risk Analysis Models for Critical Infrastructure and Service Systems
TA36 Telecommunications Network Flows and Design
TA37 Public-Private Partnership and Performance Based Logistics Contract Design
TA38 Health Care Modeling Optimization I
TA39 Optimization in Radiation Therapy and Epidemic Control
TA40 Healthcare Delivery Optimization
TA41 Workload, Quality, and Staffing
TA42 Inventory Management in Healthcare
TA43 Issues Related to Large-scale Data Mining
TA44 Energy Information Systems
TA45 Behavior in Supply Chains and Procurement
TA46 Non-traditional Topics in Integer Programming
TA47 Robust and Prior-free Optimization - Theory and Applications
TA48 Network and Graphs 3
TA49 Network Interdiction Applications
TA50 Optimization, Network 2
TA51 Network Flow & Nonlinear Optimization
TA52 Conic Optimization
TA53 Operations - Finance Interface
TA54 Stochastic Modeling in Financial Engineering
TA55 Improved Methods for Solving Special Classes of MINLP
TA56 Software Demonstrations
TA57 Assessment Techniques
TA58 Production and Scheduling 1
TA59 Joint Session JFIG/ENRE: Optimization Methods for Invasive Species Control
TA60 INFORMS Undergraduate Operations Research Prize
TA61 MAS Tutorial Session. Management Innovation to Transform The Department of Defense Logistics Enterprise: An Update
TA64 Optimal Policies - Supply Chain Applications
TA65 Stochastic Analysis in Games
TA66 Smart Monitoring of Complex Systems
TA67 Statistical Approaches to Personalized Healthcare II
TA68 Data Analytics in Simulation
TA69 Biofuel Supply Chain and Market
TA70 Analytics in the Petrochemical and Petroleum Industries
TA71 Bidding and Behavior in Procurement Markets
TA72 Energy II
TA73 Optimization for Critical Infrastructure Resilience
TA74 Renewable Energy Integration and Trading in Electricity Markets
TA75 Simulation and Optimization III
TA76 Succeeding with Revenue Management
TA77 Joint Session Analytics/HAS: Topics of Healthcare Analytics II
TA78 The Past, Present and Future of Teaching Decision Analysis
TA79 Medical Applications in Decision Analysis
TA80 Real Options in Business Strategy
TA81 Joint Session Data/AI/HAS: Big Data Analytics and Smart Health III
TA82 Behavioral Issues in Adversarial Preference Modeling
TA83 Quality and Statistical Decision Making in Health Care Applications

Tuesday, 11:00am - 12:30pm

TB01 Mission Planning II
TB02 Business Ecosystem, Networks and Innovation
TB03 IS Research with Policy Implications
TB04 Empirical Supply Chain Studies
TB05 Dynamic Learning and Decision Making
TB06 Practice-Based Research in Humanitarian Operations Management
TB07 Cloud Computing
TB08 Joint Session Social Media/MAS: Social Media in Disaster Response
TB09 Crowdsourcing and the Cloud
TB10 Economics of Operations Management
TB11 Procurement
TB12 Regulation Issues in Sustainable Operations
TB14 Panel Discussion: Philosophy of Hiring and Advising Graduate Students
TB15 Data Envelopment Analysis 1
TB16 Revenue Management and Pricing of Multiple Products and Assortments
TB17 Contact Centers
TB18 Revenue Management in Retail
TB19 Choice and Pricing Models in Revenue Management
TB20 Facility Logistics II
TB21 Innovative Solutions for Congestion Mitigation II
TB22 Designing, Modeling and Managing Disrupted Transportation Networks
TB23 Inventory Routing Models
TB24 ITS Best Presentation Award Session
TB25 Public Transportation - Railroad
TB26 Facility Planning and Design
TB27 Rail System Performance
TB28 Airline Choice-based Pricing and Revenue Management
TB29 Project Management 2
TB30 Supply Chain Scheduling and Optimization
TB31 Overcoming Business Impact Uncertainty
TB32 Workforce Planning II
TB33 Operations/Finance Interface 1
TB34 Models for Emergency Medical Services
TB35 Joint Session SPPSN/Minority Issues: Panel Discussion–Publishing Community and Humanitarian Operations Research in High-Impact Journals
TB36 Optimization Techniques for Reliable Operation of

Mobile Communication Systems
TB37 Data Mining and Machine Learning
TB38 Health Care Modeling Optimization II
TB39 Managing Capacity and Demand in Healthcare Services
TB40 Stochastic Modeling in Healthcare Delivery
TB41 OR/MS in Healthcare Quality and Patient Safety
TB42 Joint Session HAS/QSR/Analytics: Advanced Predictive Analytics for Health and Wellness Assurance
TB43 Data Analysis
TB44 Economics of Information Systems
TB45 Modeling Human Behavior in OM
TB46 Recent Advances in Conic Integer Programming
TB47 Risk-Averse Dynamic Optimization
TB48 Optimization, Combinatorial 1
TB49 Social and Economic Network Models
TB50 Optimization Methodologies 1
TB51 Data-driven Methods for Decision Making
TB52 Linear Programs and Generalizations
TB53 Economics/ Finance
TB54 Tutorials in Financial Services
TB55 Euclidean Distance Geometry Problems
TB56 Software Demonstrations
TB57 Flipped Classrooms
TB58 Production and Scheduling 2
TB59 Panel Discussion: Academic Leadership
TB60 Inventory Management I
TB61 DIME/PMESII 2
TB64 Scheduling of Queues
TB65 Academic Job Search Panel
TB66 Technometrics Invited Session: Novel Statistical Methods with Interesting Applications
TB67 Complex Process Modeling and Monitoring
TB68 Learning in Optimization and the Exploration/Exploitation Tradeoff
TB69 Socially-Responsible Operations Management
TB70 Natural Resources
TB71 Auctions and Mechanism Design
TB72 Energy - Optimization
TB73 Multilevel Optimization Problems in Energy I
TB74 Accounting for Risk in Investments in Electric Power Systems
TB75 Stochastic Processes
TB76 Joint Session CPMS/Analytics: Panel Discussion: What is Industry Looking for in Analytics Hires?
TB77 Applications and Spreadsheets
TB78 Spatial Analysis for Multicriteria Decisions
TB79 Organizational Challenges in Decision Making
TB80 Behavioral Decision Theory
TB81 Analytics for Network and Text Data
TB82 Advances in Multiobjective Programming
TB83 Image and Functional Data Analysis: Methods and Applications

Tuesday, 12:30pm - 2:30pm

Interactive Session

Tuesday, 1:30pm - 3:00pm

TC01 Mission Planning III
TC02 Technology, Innovation Management and Entrepreneurship Section Best Paper Winner Presentation
TC03 The Social Crowd: New Research in Social Media and Crowdsourcing
TC04 Energy Markets and Demand Management
TC05 Retail Operations
TC06 Managing Supply Chain Disruptions
TC07 Identification, Assessment and Correction of Ill-Conditioning and Numerical Instability in Linear and Integer Programs
TC08 Joint Session Social Media/MAS: Diplomacy, Sentiment, & Social Network Analysis Using Social Media
TC09 Cognitive Decision Support Tool for Policy Makers
TC10 Information and Competition in Supply Chains and Service Systems
TC11 Supply Chain Risk Management
TC12 Sustainability Issues in Supply Chain Management
TC14 Joint Session JFIG/ENRE: Models and Analysis of Invasion Processes
TC15 Data Envelopment Analysis 2
TC16 Omni-channel Retail Analytics
TC17 Dynamic Pricing in Service Systems
TC18 Managing Customer Behavior in Service and Retail Systems
TC19 Contemporary Topics in Revenue Management
TC20 Facility Logistics III
TC21 TSL Prize Winners
TC22 Coordinating Decentralized Transportation Systems
TC23 Network Design Models and Methods
TC24 Professional Development Workshop
TC25 Transportation Planning I
TC26 Transportation, Maritime I
TC27 Advanced Analytics Tools for Smart Railroad Terminal Operations
TC28 Emerging Issues in Airport-Airline Gate Management and Operations
TC29 Project Management 3
TC30 Models and Algorithms for Sequencing and Scheduling in Applied Transportation Problems
TC31 Staffing and Resource Allocation in Public and Private Service Systems
TC32 Service Science - Telemarketing and Call Centers
TC33 Operations/Finance Interface 2
TC34 Transportation and Security under Uncertainty
TC35 Models for Health Care Delivery
TC36 Information Systems 1
TC37 Intelligent Heuristics and Systems
TC38 Health Care Modeling Optimization - Planning and Optimization
TC39 Hospital Capacity and Resource Management
TC40 Healthcare Operations Research
TC41 Health Care, Strategy, and Policy 1
TC42 Joint Session HAS/Analytics: Analytics for Chronic Care Decision-Making
TC43 Computational Optimization and Applications
TC44 Online Social Networks and Content Generation
TC45 Behavioral Aspects in Forecasting and Inventory decisions
TC46 MIP Theory and Multi-level Applications
TC47 Stochastic/Robust Optimization Application in Energy Systems
TC48 Optimization, Combinatorial 2
TC49 Network Optimization and Routing Problems
TC50 Optimization Methodologies 2
TC51 Optimization Society Prizes
TC52 Optimization, Convex
TC53 Finance, Portfolio Analysis 1
TC54 Quantitative Financial Risk Management
TC55 Stochastic MINLP With Endogenous Uncertainty
TC56 Software Demonstrations
TC57 Curriculum Development
TC58 Production and Scheduling 3
TC59 Special Session: Best of Women in OR/MS
TC60 Inventory Management II
TC61 Military Applications Research at RAND
TC64 Market Microstructure and High Frequency Asymptotics
TC65 Industry Job Search Panel
TC66 Panel Discussion on "Publishing in Quality and Reliability: The Editor's Perspective
TC67 Application of Game-Theoretical Methods in Supply Chain
TC68 New Directions in Applied Probability
TC69 Joint Session ENRE/JFIG: Analysis of Biomass/Biofuel Production: Economic and Environmental Impacts
TC70 Sustainability I
TC71 Pricing and Computation in Package Auctions
TC72 Energy III
TC73 Storage and Demand Side Resources in Power Systems

TC74 Stochastic Programming in Energy
TC75 Reliability I
TC76 Practical & Tactical Pricing Decision Support Approaches
TC77 Joint Session Analytics/HAS: Clinical Analytics
TC78 Decision Analysis 4
TC79 Joint Session DAS/SPPSN: Decision Analysis in Policy Applications
TC80 Recent Advances in Utility Theory
TC81 Social Media and Network Analysis in Data Mining
TC82 MCDM & Service Science: Theory and Applications
TC83 Optimization Models and Algorithms for Data Mining with Uncertainties

Tuesday, 4:30pm - 6:00pm

TD01 Search Theory
TD02 Technology Entrepreneurship in China
TD03 Economics of Online Services
TD04 Pharmaceutical and Healthcare Supply Chains
TD05 Retail Operations
TD06 Disruption Risk Management
TD07 INFORMS Analytics Maturity Model
TD10 Supply Chain Design
TD11 MSOM Fellows Session
TD12 Emerging Issues in Sustainable Operations
TD14 Joint Session WORMS/JFIG/MIF: Speed Networking
TD15 Revenue/Yield Management I
TD16 New Applications of Pricing and Revenue Management
TD17 Empirical Studies in Healthcare Operations Management
TD18 Customer Choices, Upgrades and Prices
TD19 Pricing and New Product Development in Supply Chains
TD20 Facility Logistics IV
TD21 Innovative Solutions for Congestion Mitigation III
TD22 Emergency Response Capability Modeling
TD23 Joint Inventory and Location Models
TD24 Optimal Sensor Locations in Traffic Networks
TD25 Transportation Planning II
TD26 Transportation, Maritime II
TD27 Optimization for Rail Planning
TD28 Control of Airport Operations for Congestion Mitigation
TD29 Operations Management/Manufacturing
TD30 Operations Management/Marketing Interface I
TD31 Retail Service Operations
TD32 Service Science II
TD33 Health Care Modeling Optimization III
TD34 Transport Risk Management
TD35 Joint Session DAS/SPPSN: Decision Analysis Insights for Homeland Security
TD36 Information Systems 2
TD37 Big Data 1
TD38 Health Care Modeling Optimization IV
TD39 Kidney Exchange Models
TD40 Dynamic Programming in Health Care
TD41 Health Care, Strategy and Policy 2
TD42 Joint Session HAS/Analytics: Big Data Analytics in Healthcare
TD43 Data-driven Service Systems
TD44 Social Media Consumer Analytics
TD45 Quality and Inventory Issues in Behavioral Operations
TD46 Dynamic Combinatorial Optimization under Uncertainty
TD47 Information, Networks and Big Data
TD48 Optimization, Robust 1
TD49 Combinatorial Optimization and Social Network Analysis
TD50 Optimization, Robust 1
TD51 Data Mining in Medical and Engineering Domain
TD52 Optimization, Constraint Programming
TD53 Finance, Portfolio Analysis 2
TD54 Optimal Stopping with Applications to Finance and Economics
TD55 Integer Nonlinear Programming and Applications - 2
TD56 Software Demonstrations
TD57 Panel Discussion: Publishing in INFORMS Transactions on Education
TD58 Scheduling I
TD59 Panel Discussion with Department Chairs: How to Recruit, Retain, and Support Women and Minority Students
TD60 Inventory Management III
TD61 Joint Session MAS/DAS: Military Decision Analysis Applications
TD62 Social Media Sentiment
TD63 Behavioral OR and Applications of Cognitive Analytics
TD64 Rare Events, Sensitivity, and Exact Simulation
TD65 Stochastic Control Applications
TD66 Data Fusion for Prognostics
TD67 Data Driven Scientific Discovery
TD68 Emerging Topics in Simulation Analysis & Optimization
TD69 Carbon-Considerate Operations Management
TD71 The Economics of Auction Markets
TD72 Energy IV
TD73 Energy Planning and Uncertainty
TD74 Stochastic Programming for Planning Electricity Supply
TD75 Reliability II
TD76 Revenue Management Applications for non-Travel Industries
TD77 Joint Session Analytics/SPPNS: Analytics in Government
TD78 Decision Analysis 5
TD79 Forecasts and Judgments
TD80 Graphical Models in Decision Analysis
TD81 Time Series Data Mining
TD82 Building MCDM Models: Practical and Methodological Issues
TD83 Advances in Business Data Analytics

Wednesday, 8:00am - 9:30am

WA01 Mathematical Modeling and Operations Research in Military Decision Making II
WA02 Knowledge, Learning and Intellectual Capital (KLIC)
WA03 The Economic and Social Impacts of Mobile Apps
WA04 Entrepreneurial/Innovative Operations Management
WA05 Supply Chain Management
WA06 Data-Driven Methods in Inventory Management
WA07 Supply Chain Management I
WA08 Military Application 1
WA09 Applications of Cognitive Analytics
WA10 Operations/Sustainability 1
WA11 Supply Chain, Risk Management I
WA12 Sustainable Operations in Electric Vehicle and Electricity Generation Systems
WA13 Education 1
WA15 Revenue/Yield Management II
WA16 Returns Management at the Operations-Marketing Interface
WA17 Managing Queues in Service Systems
WA18 Data-driven Revenue Management Studies
WA19 Innovative Applications in Pricing and Revenue Management
WA20 Analytics for the Tactical Edge: Better Business through Operations Research in the DoD
WA21 Maritime Logistics and Operation
WA22 Business and the Bottom of the Pyramid
WA23 Sustainable Logistics: Models and Applications
WA24 Challenges in Dynamic Ride-sharing
WA25 Transportation Planning III
WA26 Vehicle Routing I
WA27 Logistics 1
WA28 Airline Crew Management
WA29 Manufacturing 1
WA30 Operations Management/Marketing Interface II
WA31 Matching-Based Service Allocation Models
WA32 Operations/Service 1
WA33 Health Care Modeling Optimization IV
WA34 Homeland Security and Energy Policy
WA35 Healthcare and Humanitarian Logistics
WA36 Information Systems 3
WA37 Big Data 2
WA38 Health Care Modeling Optimization VI

WA39 Inverse Optimization in Healthcare
WA40 HSEA -I- Undergraduate Projects in Healthcare Engineering
WA41 Health Care, Public Health
WA42 System Dynamics in Health I
WA43 Applications and Computation
WA44 Strategic Value of IT/IS
WA45 Behavior, Queueing, and Processing Times
WA46 Games and Optimization Over Networks
WA47 Computational Challenges for Sequential Stochastic Optimization
WA48 Optimization, Robust 2
WA49 Routing Problems
WA50 Optimization, Integer 1
WA51 Operations/Quality Management
WA52 Optimization, Heuristic
WA53 Finance, Financial Engineering 1
WA54 Behavioral Portfolio Selection and Asset Pricing
WA55 Industrial Applications of MINLP
WA56 Software Demonstrations
WA57 Teaching Sustainability
WA58 Scheduling II
WA59 Inventory Management V
WA60 Inventory Management IV
WA61 Organization Theory 1
WA62 Applied Probability 1
WA63 Dynamic Programming/ Control 1
WA64 Flexibility, Inventory and Resource Pooling
WA65 Learning in Stochastic Systems
WA66 Journal of Quality Technology Invited Session
WA67 Gaussian Process and Spatial Data Analysis (I)
WA68 Recent Advances in Stochastic Simulation
WA69 OR for the Developing World
WA70 Economics
WA71 Ad Auctions
WA72 Energy V
WA73 Models and Algorithms for Renewable Energy Integration
WA74 Advanced Algorithms for Power System Operations
WA75 Reliability III
WA77 Exposing Students to Practice with a Case Competition
WA78 Decision Analysis 6
WA79 Joint Session DAS/MAS: Game Theory, Decision Analysis, and Homeland Security, Part I
WA80 How Sound Decision-making Can be Taught and Measured
WA81 Data Analytics for Manufacturing System Design
WA82 Multicriteria Decision Making 1
WA83 Data Mining 1

Wednesday, 11:00am - 12:30pm

WB01 New Voices in Military Operations Research
WB02 Modularity in the Context of Service Management
WB03 Social Media and Business Analytics
WB04 Operations Management and Marketing Interface
WB05 Economics in Operations
WB06 Urban Spatial Issues
WB07 Supply Chain Management III
WB08 Text Analytics Applications in Social Media
WB09 Meta-Algorithms - Algorithms that Improve other Algorithms
WB10 Operations/Sustainability 2
WB11 Supply Chain, Risk Management II
WB12 Incentive Issues in Sustainable Operations
WB13 Education 2
WB14 Supply Chain, Practice, Empirics
WB15 Revenue/Yield Management III
WB16 Behavorial Bias and Revenue Management
WB17 Reducing and Accommodating Customer Variability in Services
WB18 Joint Session RM/TSL: Pricing Applications in Logistics: Inventory Control, Distribution, and Transportation
WB19 Revenue Optimization under Uncertainty in Healthcare
WB20 Analysis
WB21 Maritime Transportation
WB22 Identity and Change in Organization Science
WB23 Container Supply Chain Coordination
WB24 Transportation, Intelligent Systems I
WB25 Transportation Planning IV
WB26 Vehicle Routing II
WB27 Logistics 2
WB28 Breaking the Silos in Airline Crew Scheduling
WB29 Manufacturing 2
WB31 Applying Computational Creativity in Service Industries
WB32 Operations/Service 2
WB33 New Product Development 1
WB34 Preposition and Distribution Decisions in Humanitarian Operations
WB35 Next Generation Decision Support for the Next Pandemic
WB36 Information Systems 4
WB37 Big Data 3
WB38 Health Care Modeling Optimization VII
WB39 HSEA -II-Spotlight on HSEA Student Research
WB40 Inverse Planning for Cancer Treatment
WB41 Supply Chain Management II
WB42 System Dynamics in Health II
WB43 Computational Integer Optimization
WB44 The Interface Between Information Systems and Operations Management
WB45 From Deadline to Reciprocity: Assorted Topics in Behavioral Operations
WB46 Advances in Mixed-integer Programming Theory
WB47 Monte Carlo Simulation-Based Methods for Stochastic Programming
WB48 Optimization, Robust 3
WB49 Network Optimization and its Applications
WB50 Optimization, Integer 2
WB51 Optimization, Nonlinear 1
WB52 Optimization, Large Scale 1
WB53 Finance, Financial Engineering 2
WB54 Control Methods in Finance
WB55 Algorithmic and Computational Aspects of Mixed-Integer Nonlinear Optimization
WB56 Software Demonstrations
WB57 Technology in the Classroom
WB58 Scheduling III
WB59 Group Decisions and Negotiation
WB60 Inventory Management VI
WB61 Organization Theory 2
WB62 Applied Probability 2
WB63 Dynamic Programming/ Control 2
WB64 Methods for Staffing Nonstationary Queueing Systems
WB65 Large-scale Stochastic Systems and Resource Allocation
WB66 Predictive Modeling and Control for Additive Manufacturing
WB67 Data Fusion in Manufacturing Systems
WB68 Initialization Bias and Related Problems
WB69 Decision Making for Holistic Sustainability Assessment
WB70 Economics (Game Theory)
WB71 Auctions/ Mechanism Design 1
WB72 Data Analytics for Healthcare Applications
WB73 Multilevel Optimization Problems in Energy II
WB74 Robust and Stochastic Modeling in Power System Operations and Planning
WB75 Queuing Models
WB76 Analytics in Bioinformatics and Healthcare
WB77 Joint Session Analytics/SpORts: Baseball Analytics
WB78 Analytic Hierachy Process
WB79 Joint Session DAS/MAS: Game Theory, Decision Analysis, and Homeland Security, Part II
WB80 Infrastructure Modeling for Improved Decision Making
WB81 Analytics and Energy
WB82 Multicriteria Decision Making 2
WB83 Data Mining

Wednesday, 12:45pm - 2:15pm

WC02 Risk, Incentives and Cooperation in Technology Management
WC03 Economics of Information Systems
WC04 Service Operations Design and Management
WC05 Collaboration and Information in Supply Chains
WC06 Service Business Models
WC07 Supply Chain Management V
WC08 Models of Human Dynamics in Social Data
WC09 E-Business/ Commerce 1
WC10 Supply Chain/Green I
WC11 Supply Chain, Risk Management III
WC12 Supply Chain Optimization I
WC14 Supply Chain/Decision Analysis
WC15 Semiconductor Industry
WC16 Empirical Studies in Revenue Management and Pricing
WC17 Design and Control of Service Systems
WC18 Big Data Analytics and Predictive Modeling in Revenue Management
WC19 Retail Operations
WC20 Homeland Security Applications II
WC21 Maintenance Problems in Transportation and Routing
WC22 Organizational Behavior and Ethics
WC23 Topics in Freight Transport and Logistics
WC24 Transportation, Intelligent Systems II
WC25 Transportation, Operations I
WC26 Vehicle Routing III
WC27 Logistics 3
WC28 Measuring and Managing Delay through Trajectory Analysis
WC29 Manufacturing 3
WC30 Operations Management/Marketing Interface III
WC31 Incorporated Models in Business Processes Optimization
WC32 Supply Chain, Game Theory & Combinatorial Auctions
WC33 New Product Development 2
WC34 Performance Measurement 1
WC35 Fire and Emergency Medical Services
WC36 Humanitarian Operations in a Response Supply Chain
WC39 Operations Research Methods for Cancer Care
WC40 New Models of Health Care Delivery: Reengineering for Efficient
WC41 Supply Chain Management IV
WC42 HSEA - III - Undergraduate Student Research Presentation
WC43 Constraint Programming
WC44 IT in Healthcare and Education
WC45 Behavioral Operations 1
WC46 Advances in Theory and Computation of Integer Programming
WC47 Stochastic Optimization in a Data-Driven Context
WC48 Optimization, Stochastic 1
WC49 3Rs of Networks: Restoration
WC50 Optimization, Integer 3
WC51 Game Theory 1
WC52 Optimization, Linear Programming 1
WC53 Finance
WC54 Financial Regulation and Risk Management
WC55 Global Optimization in Graphs/Networks
WC57 Academic Projects and Cases Using Real-world Data and Scenarios to Prepare Students for the Workforce
WC58 Scheduling IV
WC59 Operations Management
WC60 Inventory Management VII
WC61 Military Application 2
WC62 Homeland Security
WC63 Decision Analysis 3
WC64 Probability Theory and Combinatorial Optimization
WC65 Optimal Control in Queueing Networks
WC66 Sensor-based System Informatics and Control
WC67 Data Fusion for Process Monitoring and Diagnosis
WC68 Simulation Applications of Supply Chain and Reverse Logistics
WC69 Expert Elicitation, Climate, and Energy Technologies
WC70 Economics- Policy
WC71 Auctions/ Mechanism Design 2
WC72 Energy VI
WC73 Optimization for Distributed Power Systems
WC74 Modelings in Electricity Markets for Policy Insights
WC75 Simulation I
WC76 Multi-Channel Attribution Modeling
WC77 Theory and Applications of Analytics and Big Data
WC78 Decision Support Systems 1
WC79 OR Models in Decision Analysis
WC80 Joint Session DAS/ENRE: Energy Infrastructure: Decisions and Models
WC82 Data Mining 6
WC83 Data Mining 3

Wednesday, 2:45pm - 4:15pm

WD01 MAS Tutorial Session. The State of Operations Research in the US Military: A 75th Anniversary Perspective
WD02 Product Development and Process Development in Pharmaceutical Industry
WD03 Electronic Markets and Mechanisms
WD04 Topics in Supply Chain Management
WD05 Multichannel Retailing
WD06 Humanitarian-Driven Inventory Management: Pre-positioning and Responses
WD07 Supply Chain Management VII
WD08 Supply Chain Management VIII
WD09 E-Business/ Commerce 2
WD10 Supply Chain/Green II
WD11 Supply Chain, Managing Disruptions I
WD12 Supply Chain Optimization II
WD14 Retail Management I
WD15 Procurement and Purchasing Management 1
WD16 Joint Session RMP/BOM: New Results on Strategic Consumer Behavior in RM
WD17 Customer Differentiation in Services
WD18 New Topics in RM: Demand Learning
WD19 Revenue Optimization in Retail and Services II
WD21 Supply Chain and Transportation
WD22 Historical and Microfoundations of Strategy
WC22 Organizational Behavior and Ethics
WD23 Traffic Management I
WD24 Disaster and Emergency Management 1
WD25 Transportation, Managing Disruptions I
WD26 Vehicle Routing IV
WD27 Aviation
WD28 Data Mining and Optimization for Air Traffic Operations
WD29 Operations Management/others
WD30 Operations Management/Marketing Interface IV
WD31 Innovation and Quality in Service Delivery
WD32 Supply Chain/Competition
WD33 Research and Development
WD34 Performance Measurement 2
WD35 Dynamic and Stochastic Models in Emergency Response and Preparedness
WD36 Sports & Entertainment I
WD37 Marketing 1
WD38 Health Care, Process 1
WD39 Optimization in Radiation Therapy
WD40 Center for Systems Engineering in Health
WD41 Supply Chain Management VI
WD42 HSEA -IV- Undergraduate Projects in Healthcare Engineering
WD43 Network Flow Optimization
WD44 Strategy/Strategic Planning I
WD45 Behavioral Operations 2
WD46 Complexity and Algorithmic Aspects in Linear and Nonlinear Optimization
WD47 Topics in Stochastic Programming
WD48 Optimization, Stochastic 2
WD49 Network Analytics
WD50 Optimization, Integer 4

WD51 Game Theory 2
WD52 Optimization, Linear Programming 2 Integer 4
WD53 Finance Theory and Empirics
WD54 Modeling and Computations in Financial Engineering
WD55 Chance, Inference and Robustness
WD58 Scheduling V
WD63 Decision Analysis 2
WD64 Algorithms on Graphs and Trees
WD65 Performance Evaluation and Optimal Policies
WD66 Decision Analysis Approaches and Predictive Modeling to Managing Uncertainty in Manufacturing and Service Systems Design & Operations
WD67 Gaussian Process and Spatial Data Analysis (II)
WD68 Agent-Based Computational Models of Economic and Financial Processes
WD69 Pollution Regulation and Abatement
WD70 Forecasting 1
WD72 Energy VII
WD73 Integrating High Resolution Spatial Data and Optimization Models for Energy Production/distribution Analysis
WD74 Modern Optimization Techniques for Fundamental Computation Problems in Power Systems
WD75 Simulation II
WD76 New Analytics Frontiers in Retail
WD77 Analytics at its BEST
WD78 Decision Support Systems 2
WD79 Project Analytics
WD80 Behavioral Decision Making
WD81 Data Mining in Renewable Energy
WD82 Data Mining 7
WD83 Data Mining 4

Wednesday, 4:30pm-6:00pm

WE02 Technology Management
WE04 Remanufacturing
WE05 Supply Chain/Closed Loop I
WE06 Supply Chain/Closed Loop II
WE07 Supply Chain Managemen IX
WE08 Supply Chain Management X
WE09 E-Business/ Commerce 3
WE11 Supply Chain, Managing Disruptions II
WE12 Supply Chain Optimization III
WE14 Retail Management II
WE15 Design Engineering
WE17 Supply Chain, Design and Services
WE18 Optimal Pricing in E-commerce
WE19 Sales Optimization Management System – A Combined Optimization and Statistical Approach to Proactively Managing Enterprise Sales Resource Requirements and Sales Forecasting & Funnel Management
WE21 Sustainable Transportation/Logistics System Design
WE23 Traffic Management II
WE24 Disaster and Emergency Management 2
WE25 Transportation, Freight
WE26 Supply Chain, Shipping and Transportation
WE28 New Concepts to Minimize Delay in Terminal Area Operations
WE29 Operations Management/inventory
WE30 Operations Management/Marketing Interface V
WE31 Data Analytics-based Service Concept Development
WE32 Operations/Economics Interface
WE33 Innovation/Entrepreneurship
WE35 Managing Supply Chains in the Public and Non-profit Sector
WE36 Sports & Entertainment II
WE37 Marketing 2
WE38 Health Care Process 2
WE39 Risk Assessment in Healthcare
WE40 Optimization Models in Healthcare Applications
WE41 Supply Chain Management IX
WE42 Uncertainties in Radiation Therapy
WE43 Computational Network Flows and Routing
WE44 Strategy/Strategic Planning II
WE45 Behavioral Operations 3
WE46 Mixed Integer Programming
WE47 Theory and Applications of Robust Optimization
WE48 Resource Allocation
WE49 Statistical Analysis of Network Structures
WE50 Optimization, Application
WE51 Game Theory 3
WE52 Optimization, Other
WE54 Risk Analysis
WE55 Tractable Models and Algorithms for Optimization in Engineering
WE64 Customer Performance – Models and Applications
WE65 Bayesian Approach
WE66 The Impact of Heterogeneity in Reliability Prediction and Maintenance Planning
WE67 Gaussian Process and Spatial Data Analysis (III)
WE68 Sustainable Infrastructure Management and Decision-Making: Construction, Energy and Transportation Industries
WE69 Optimization Approaches for Designing a Green Energy System
WE70 Forecasting 2
WE72 Energy VIII
WE73 Targeted Demand Side Management: Uncovering Energy Usage Decisions from Data
WE74 Power System Resilient Design and Optimization
WE75 Simulation III
WE76 Practicum and Internship Experiences at Analytics Programs
WE77 Joint Session Analytics/HAS: Strategic Payment and Pricing Healthcare Analytics
WE78 Decision Support Systems 3
WE79 Model and Model Validation in Disaster Management
WE81 Predictive Models in Data Mining
WE82 System Analysis
WE83 Data Mining 5