Tuesday, 8:00am - 9:30am

■ TA01
01-Room 301, Marriott
Military Manpower and Force Management
Sponsor: Military Applications
Sponsored Session
Chair: Andrew Hall, COL, U.S. Army, 4760 40th St N, Arlington, VA, United States of America, AndrewOscarHall@aol.com

1 - Air Force Officer Accession Planning: Addressing Key Gaps in Meeting Career Field Academic Degree Requirements
Tara Terry, Operations Researcher, RAND Corporation, 1200 S. Hayes St., Arlington, VA, 22202, United States of America, terryt@rand.org
The goal of the Air Force officer accession process is to ensure the USAF accesses officers with the knowledge, skills and attributes to perform missions in particular career fields. Key to this goal for non-rated officers is establishing and enforcing academic degree requirements. We uncovered gaps in accession processes that undermine meeting career field education requirements. We introduced recommendations toward correcting the accession process and meeting career fields academic needs.

2 - A Methodology for Estimating Caseload in the U.S. Army’s Disability Rating Process
James Broyles, Operations Researcher, RAND Corporation, 1776 Main Street, Santa Monica, CA, 90401, United States of America, jbroyles@rand.org, Mustafa Oguz
As U.S. Army soldiers separate from service, a portion of them enter the disability rating process to obtain a rating that determines their level of benefits and compensation. The process involves several evaluation steps and appeal processes that cause highly variable and sometimes long processing durations. This research presents a methodology that uses a non-Markovian probability model for estimating disability rating caseload given forecasted future soldier separations.

3 - Aligning Officer Personnel Requirements with a Sustainable Career Lifecycle Model
Michael Needham, DCS G-1, HQDA, 300 Army Pentagon, Washington, DC, United States of America, michael.p.needham2.mil@mail.mil
The U.S. Army is at a critical juncture in determining a supportable military personnel structure that is limited by mandated force structures. Personnel structure adjustments drive near-term force-shaping personnel policies, such as accessions, promotions, and separations. We identify sustainable standards of grade using historical data while accounting for future personnel management policies. The model uses sixteen years of historical data as a foundation to determine future behavior.

4 - Army Officer Grade Distribution for the Army Competitive Category
Francisco Baez, DCS G-1, HQDA, 300 Army Pentagon, Washington, DC, United States of America, francisco.r.baez.mil@mail.mil
The Army’s Grade Structure has become significantly senior impacting the potential health of the current and future force by reducing selectivity and competition rates, and forcing early promotions. The propose distribution of officers focuses on re-balancing grade structure for each career management field to ensure balance and health of the force by ensuring leader-to-led ratios, quality, and viable career paths for all soldiers.

■ TA02
02-Room 302, Marriott
Optimization Applications in Homeland Security
Cluster: Homeland Security
Invited Session
Chair: Daniel Faisool, Lawrence Livermore National Laboratory, Livermore, CA, United States of America, faissol1@llnl.gov

1 - Modeling the Global Spread and Impact of Diseases at Various Levels of Aggregation
Daniel Skorski, Operations Research Scientist, Pacific Northwest National Laboratory, 301 Hills Street, Richland, WA, 99352, United States of America, Daniel.Skorski@pnnl.gov, Robert Braginic, Brent Daniel, Matthew Oster
Diseases spread by various modes of transportation is a never-ending modeling and analysis need. GlobalCURE provides a framework to study the interplay between global infrastructure, epidemiology, economics, government policy, and regional and/or international populations. This presentation summarizes the development (web and desktop) and use of the GlobalCURE tool. In our analysis, we specifically focus on the interplay of factors across levels of aggregation (e.g., tract through country).

2 - Optimization Planning Tool for Urban Search Missions
Daniel Faisool, Lawrence Livermore National Laboratory, Livermore, CA, United States of America, faissol1@llnl.gov, Claudio Santiago, Richard Wheeler, Thomas Edwards
We present a prototype tool to support planning of radiological and nuclear search missions in an urban environment using mobile detectors. Two distinct problems are considered with proposed solutions: (1) a nonconvex optimization problem that solves for detector dwell times and locations that maximize the probability of detection for building interiors, and (2) a multiple vehicle routing problem on a directed multigraph that solves for the maximum net benefit given a fixed total search time.

3 - Optimal Sonar Deployment in a Maritime Environment: A Fortification Approach
Taoleek Biobakuk, University of Houston, Houston, TX, United States of America, tobobakuk@uh.edu, Gino Lim, Jaeyoung Cho, Hamid Parsaeli, Seon Jin Kim
We describe a model for routing UAVs which are launched and recovered from airborne drone carriers. We formulate and solve this problem with a given fleet of UAVs subject to technical and operational constraints. The spatio-temporal model captures important aspects of a UAV deployment in counterfire operations including collaboration tactics and overlapping observation. The model is designed to provide an insight into issues associated with operating UAVs aided counterfire operations system.

■ TA03
03-Room 303, Marriott
Scheduling in Practice
Cluster: Scheduling and Project Management
Invited Session
Chair: Emrah Cimren, Nike, 1 SW Bowerman Dr., Beaverton, OR, 97005, United States of America, Emrah.Cimren@nike.com

1 - A Sample-Gradient-Based Algorithm for Multiple-OR and PACU Surgery Scheduling
Miao Bai, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, mib411@lehigh.edu, Gregory Tonkay, Robert Storer
We address a multiple-OR surgery scheduling problem constrained by shared PACU capacity within the block-booking framework. Given the surgery sequence, a Discrete Event Dynamic System-based stochastic optimization model is formulated in order to minimize the cost incurred by patient waiting time, surgeon idle time, OR blocking time, OR overtime and PACU overtime. A sample-gradient-based algorithm is proposed to solve the sample average approximation of our formulation.

2 - Leveraging Predictive Analytics for HPC Scheduling in Dynamic Environments
Sarah Powers, Oak Ridge National Laboratory, One Bethel Valley Road, Oak Ridge, TN, United States of America, powersso@ornl.gov
Improvements in heterogeneous HPC scheduling can be obtained by leveraging predictive analytics of job submissions. Development of the necessary workflow models requires historical data and is costly due to the potential high diversity of job types and their evolving patterns over time. We propose a method which learns these patterns dynamically, allowing for unknown job types and changing arrival patterns. Prediction gains are thus automated and utilisable in dynamic environments.
3 - Driver Scheduling Optimization Method Proposal for the J.B. Hunt Intermodal Division
Luisa Janer, Graduate Student, University of Arkansas, 759 S Royal Oak Pkwy #201, Fayetteville, AR, 72701, United States of America, mjanerri@uark.edu, Valeria A. Remon Perez, Nicole Taborga Delius, Nakia Lynn Lee

A scheduling tool based on optimization was developed in order to improve the driver and truck scheduling process of the J.B. Hunt Intermodal Division. After having developed six prototypes of an optimization model, the tool manages to effectively lower the outsourcing percentage to ten percent and increases the driver-truck ratio to 1.8.

TA04
04-Room 304, Marriott
Panel Discussion: Journal Publication Tips
Sponsor: Junior Faculty Interest Group
Sponsored Session
Chair: Cameron MacKenzie, Assistant Professor, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, camacken@lastate.edu

1 - Panel Discussion: Successful Journal Publication Tips
Moderator: Cameron MacKenzie, Assistant Professor, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, camacken@lastate.edu, Panelists: Chris Tang, Martin Savelsbergh, Serguei Netessine, Stefanos Zenios, Jay Simon

Panel discussion will include editors and associate editors from Management Science, Operations Research, Decision Analysis, Manufacturing & Service Operations Management, and Transportation Science.

TA05
05-Room 305, Marriott
Social Media and Networks in Business
Cluster: Social Media Analytics
Invited Session
Chair: Xiaojing Dong, Associate Professor, Santa Clara University, 500 El Camino Real, Lucas Hall, Marketing, Santa Clara, CA, 95053, United States of America, xdong1@scu.edu

1 - Predicting Social Influence Based on Dynamic Network Structures
Mandy Hu, Assistant Professor, The Chinese University of Hong Kong, CUHK Business School, Marketing, Shatin, Hong Kong - PR, mandyhu@baf.cuhk.edu.hk

This study examines how network structure and dynamics interplay with the effect of social influence to facilitate diffusion. The context we consider is the diffusion of a new smartphone from a major wireless carrier in two medium-sized cities in China. We are able to identify the two most significant network measures related to social influence are diversity of connection and time variation of edge numbers. Our findings provide foundation on the network-based targeting strategy.

2 - Matrix Metrics: Network-based Systemic Risk Scoring
Sanjeev Das, William And Janice Terry Professor Of Finance, Santa Clara University, Leavey School of Business, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, srdas@scu.edu

I develop a network-based systemic risk score that depends on individual risk at each financial institution and interconnectedness across institutions. This risk metric is decomposable into risk contributions from each entity, forming a basis for taxing each entity appropriately. Spillover risk determines the scale of externalities that one institution might impose on the system. Splitting up too-big-to-fail banks from the system does not lower systemic risk.

3 - Motivation of User-Generated Content in a Social Network
Xiaojing Dong, Associate Professor, Santa Clara University, 500 El Camino Real, Lucas Hall, Marketing, Santa Clara, CA, 95053, United States of America, xdong1@scu.edu

This study focuses on understanding the motivation of user-generated content in open-source environments and online social networks. In our data, to encourage members to contribute more reviews on the site, the community introduced cash payment to those who offered reviews. We find the effect of such reward actually depends on the level of social connectedness. Those with fewer connections responded positively to the reward, and those with more connections responded negatively.

TA06
06-Room 306, Marriott
Systemic Risk
Sponsor: Financial Services
Sponsored Session
Chair: Stathis Tompaidis, Professor, University of Texas at Austin, Office of Financial Research, Austin, TX, 78712, United States of America, stathis.tompaidis@mccombs.utexas.edu

1 - Gauging form PF: Data Tolerances in Regulatory Reporting on Hedge Fund Risk Exposures
Phillip Monin, Researcher, Office of Financial Research, 717 14th St. NW, Washington, DC, 20005, United States of America, phillip.monin@treasury.gov, Mark Flood, Lina Bandyopadhyay

We examine the precision of Form PF as an instrument for measuring risk exposures in the hedge fund industry. Using a novel simulation methodology, we assess the measurement tolerances of Form PF by examining the distribution of actual portfolio risk exposures that are consistent with a fixed presentation on Form PF. We find that Form PF’s measurement tolerances are sufficiently large to allow private funds with dissimilar actual risk profiles to report similar risks to regulators.

2 - Systemic Risk: The Dynamics under Central Clearing
Agostino Capponi, Columbia, Mudd 313, New York, NY, 10027, United States of America, ac3827@colubria.edu

We develop a tractable model for asset value processes of financial institutions trading with one central clearinghouse. Each institution allocates assets between his loan book and his clearinghouse account. We show that a unique equilibrium allocation profile arises when institutions adjust trading positions to hedge risks stemming from their loan books. The stochastic dynamic equilibrium path shows a buildup of systemic risk manifested through the increase of market concentration.

3 - Hidden Illiquidity with Multiple Central Counterparties
Kai Yuan, Columbia Business School, 3022 Broadway, 4J, Uris Hall, New York, United States of America, kyuuan17@mail.columbia.edu, Paul Glasserman, Ciamac Moallemi

Convex margin requirements from CCPs create an incentive for a swaps dealer to split its positions across multiple CCPs, effectively “hiding” potential liquidation costs. To compensate, each CCP needs to set higher margin requirements than they would in isolation. In the case of linear price impact, we show that a necessary and sufficient condition for the existence of an equilibrium is that the two CCPs agree on liquidity costs and a difference in views can lead to a race to the bottom.
2 - “If at First You Don’t Succeed”: Understanding Serial Entrepreneurs on Kickstarter
Hallie Cho, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, hallie.cho@insead.edu, David Clough
From the crowdfunding platform Kickstarter, we have data on 27,399 technology and design projects created by 6960 entrepreneurs—1376 of whom are serial entrepreneurs. We examine characteristics of the projects and the entrepreneurs to understand what distinguishes a serial entrepreneur from a one-timer. For 779 of the serial entrepreneurs, their first projects were failures. We investigate how serial entrepreneurs respond to setbacks and how their resource gathering strategy changes over time.

3 - Wisdom or Madness? Comparing Crowds with Expert Evaluation in Funding the Arts
Ethian Mollick, Assistant Professor, U. Penn, 2000 Steinberg Hall-Dietrich Hall, 3620 Locust Walk, Philadelphia, PA, 19004, United States of America, emollick@wharton.upenn.edu, Ramana Nanda
Drawing on a panel of experts and data from the largest crowdfunding site, we examine funding decisions for proposed theater projects. We find significant agreement between the funding decisions of crowds and experts. Our findings suggest that crowdfunding can play a role in complementing expert decisions by allowing projects the option to receive multiple evaluations and thereby lowering the incidence of false negatives.

4 - Crowdsourcing Exploration
Yi Yangos Papastasiou, Haas School of Business, UC Berkeley, Berkeley, CA, 94720, United States of America, yiyang@haas.berkeley.edu, Nicos Savva, Kostas Bimpikis
In an online review platform, information on the quality of alternative service providers is both generated and utilized by the consumer population. Inefficiencies arise from the fact that information is generated as a byproduct of self-interested consumer choices, rather than with the benefit of future consumers in mind. Within a multi-armed bandit framework, we study how such inefficiencies relate to alternative policies of information-disclosure to the platform’s users.

2 - On Minimizing Drawdown Risks of Lifetime Investments
Bin Li, University of Waterloo, 200 University Avenue West, M3 Building, Waterloo, Canada, b226l@uwaterloo.ca, David Landriault, Dongchen Li, Xinfu Chen
We study a lifetime investment problem to minimize the risk of occurrence of significant drawdowns. We examine two financial market models and closed-form optimal strategies are obtained. Our results show that it is optimal to minimize the portfolio variance when the fund value is at its historic high-water mark. When the fund value drops, the fund manager should increase the proportion invested in the asset with a higher instantaneous rate of return.

3 - Beating the Omega Clock: An Optimal Stopping Problem with Random Time-horizon
Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave, New York, NY, 10027, United States of America, hzz2244@columbia.edu, Nofeytos Rodosthenous
We study the optimal stopping of a perpetual call option in a random time-horizon under exponential spectrally negative Levy models. The time-horizon is modeled as the so-called Omega default clock, which is the first time the occupation time of the underlying process below a level exceeds an independent exponential random variable. We show that the shape of the value function varies qualitatively with model parameters. In particular, we show the possibility of two disjoint continuation regions.

4 - Impact of Bayesian Learning and Externalities on Strategic Investment
Wenxin Xu, University of Illinois, Urbana IL 61801, United States of America, wxux9@illinois.edu
We investigate the interplay between learning effects and externalities in the problem of competitive investments with uncertain returns. We find a region of a war of attrition between the two firms in which the interplay between externalities and learning gives rise to counterintuitive effects on investment strategies and payoffs.

e-Business Models
Cluster: Business Model Innovation
Invited Session
Chair: Simone Marinesi, Wharton, 562 Jon M. Huntsman Hall, 3730 Walnut St, Philadelphia, PA, 19104, United States of America, marinesi@wharton.upenn.edu
1 - Online Grocery Retailing
Elena Belavina, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, United States of America, elena.belavina@chicagobooth.edu
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.).
bridges the gap between classical adversarial and stochastic demand models, and predictability of the demand. In the two extreme cases of fully learnable and fully downstream members.

We prove that these inequalities are superior to the traditionally used triangle setting, where, instead, requests arrive at random times. In particular, we do not suppose that container departure times are only partially known and propose an efficient branching algorithm using sampling and pruning to solve this problem. Moreover, the second variation assumes that none of the departure times are known in advance. In that case, we provide lower bounds to support the intuition that the "lowest-height" policy is optimal in both static and dynamic case.

We study a real-time revenue management problem where stochastic information about the future demand is unknown a priori and can only be partially learned. We develop adaptive and non-adaptive booking-limit policies parameterized by predictability of the demand. In the two extreme cases of fully learnable and fully unpredictable demand, we recover the known performance guarantees. Our work bridges the gap between classical adversarial and stochastic demand models, and defines value of learning.

This paper reviews the adoption factors of smart phones in emerging regions. Saudi Arabia is studied as a case study. This presentation will cover the qualitative part of the work. This part helped filter factors and finalize the survey instrument.

TA10
10-Room 310, Marriott
Contextual Factors Affecting eBusiness Initiatives
Sponsor: E-Business
Sponsored Session
Chair: Frank MacCrory, Massachusetts Institute of Technology, MIT Initiative on the Digital Economy, 355 Main Street - NE25-768D, Cambridge, MA, 02142, United States of America, maccrory@mit.edu

1 - Social Media Usage Implications for Project Success, Political Preferences, and Leisure Activities
Joseph Vithayathil, Assistant Professor, Washington State University, Carson College of Business, Pullman, WA, 99164, United States of America, joseph.vithayathil@wsu.edu, John Kalu Osiri, Majid Dadgar
We use a survey to empirically analyze the effect of social media usage on workplace project success, political preferences, and leisure activities such as shopping and television viewing behavior. This work adds to the emerging literature on the impact of social media. We find weak association of social media usage with project success, political preferences and leisure activities. Results are interpreted using social presence and media richness theories, and implications are discussed.

2 - Content Pricing Strategies under Dual Medium Access
Ran Zhang, UC Irvine, CA, ran28@uci.edu, Shivendu Shivendu Pricing information goods on physical and digital medium is a challenging question for content providers. We develop an analytical model where consumers are heterogeneous in both valuation for content and preference for medium. We show that while offering both bundle of mediums and digital medium is optimal under some market conditions, offering digital medium only is optimal under other conditions. The optimal price for digital medium can decrease with marginal cost of physical medium.

3 - Incentives for Selective Information Sharing
Aditya Saharia, Associate Professor, Gabelli School of Business - Fordham University, 113 W. 60th Street, New York, NY, 10023, United States of America, saharia@fordham.edu
An increased transparency in inter-organizational systems does not make members of a value chain equally better off. Individual members may then try to influence other members' decisions by introducing strategic ambiguity by not collect demand information or by selectively share information with only some downstream members.

TA11
11-Franklin 1, Marriott
Online Optimization with Integer Applications
Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session
Chair: Virgile Galle, PhD Candidate, MIT, vgalle@mit.edu

1 - Real-time Revenue Management under Partially Learnable Demand
Dawsen Hwang, PhD Candidate, MIT, 77 Massachusetts Avenue, 32-6768, Cambridge, MA, 02139, United States of America, dawsen@mit.edu, Le Nguyen Hoang, Vahideh Manshadi, Patrick Jaillet
We study a real-time revenue management problem where stochastic information about the future demand is unknown a priori and can only be partially learned. We develop adaptive and non-adaptive booking-limit policies parameterized by predictability of the demand. In the two extreme cases of fully learnable and fully unpredictable demand, we recover the known performance guarantees. Our work bridges the gap between classical adversarial and stochastic demand models, and defines value of learning.

TA12
12-Franklin 2, Marriott
Convexification-based Algorithms for Solving Quadratic and Polynomial Programs
Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization
Sponsored Session
Chair: Jitamitra Desai, Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, jdesai@ntu.edu.sg

1 - Minimum Triangle Inequalities and Algorithms for 0-1 QCPs
Jitamitra Desai, Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, jdesai@ntu.edu.sg, Xiaolei Qi, Rupaj Nayak
We present a new class of minimum triangle inequalities (MINTI) for 0-1 QCPs. 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.

2 - Non-negative Polynomial and Moment Conic Optimization
Mohammad Mehdi Ranjbar, Rutgers, 100 Rockafeller Rd, Rutgers Business School, Piscataway, NJ, 08854, United States of America, 59ranjbart@gmail.com, Farid Alizadeh
Non-negative polynomial cone and its dual, moment cone, are non-symmetric cones and extremely bad scaled. Then common primal-dual method will not be a good algorithm to be used. Recently Nesterov has proposed a new predictor-corrector path-following method. Skajaa-Ye have proposed a homogeneous interior point method using Nesterov's predictor-corrector path-following method for some non-symmetric conic problem. We will extend that to non-negative polynomial and moment conic programming.

3 - Robust Sensitivity Analysis of the Optimal Value of Linear Programming
Guanglin Xu, PhD Student, University of Iowa, 321 Finkbine Ln Apt. 11, Iowa City, IA, United States of America, guanglin-xu@uiowa.edu, Samuel Burer
We study sensitivity analysis in linear programming problems where general perturbations in the objective coefficients and right-hand sides are considered. This generality leads to non-convex quadratic programs (QPs) that are difficult to solve in general. We investigate corrective formulations and tight semi-definite relaxations of these QPs and validate our approach on examples existing in the literature, as well as our own examples.
4 - Higher Rank-Order Semidefinite Cutting Planes for Nonconvex QCQPs
Xiaofei Qi, PhD Student, Nanyang Technological University, 50 Nanyang Ave, Singapore, Singapore, zg6081@e.ntu.edu.sg, Jitamitra Desai, Rupaj Nayak

We introduce a polynomial-time scheme to generate higher rank-order semidefinite cutting planes that serve to tighten convex relaxations of nonconvex quadratically constrained quadratic programs (QCQPs) and significantly improve lower bounds. Suitable defined row-and-column based operations are used to speed up the process of generating these cuts, and computational comparisons across different types of relaxations shows the efficacy of these new cutting plane strategies.

■ TA13
13-Franklin 3, Marriott
Optimizing Sharing Service/Economy Under Uncertainty
Sponsor: Optimization/Operations Under Uncertainty
Sponsored Session
Chair: Siqian Shen, Assistant Professor, University of Michigan, 1205 Real Avenue, Ann Arbor, MI, 48105, United States of America, siqian@umich.edu

1 - Optimal Location Design of Carsharing Fleet under Uncertain One-way and Round-trip Demands
Zhiliang Chen, zhiliang@umich.edu, Siqian Shen

We allocate vehicles in a homogenous carshare fleet to contracted locations, to maximize the expected revenue from random demand for one-way and round trip rentals. We use a spatial-temporal network and optimize both risk-neutral and CVaR-based risk-averse two-stage stochastic programs with high demand satisfaction rates. The two-stage problems are solved via branch-and-cut with mixed integer rounding and we give insights on carsharing location design from data reported by Zipcar in Boston.

2 - Online Resource Allocation with Limited Flexibility
Xuan Wang, New York University, 44 West 4th Street, Suite 8-154, New York, NY, 10012, United States of America, xwang38@stern.nyu.edu, Jiawei Zhang, Arash Asadpour

We consider a general class of online resource allocation problems with limited flexibility, where a type of request can be fulfilled by resource j or resource j+1, and we call this limited flexibility the long chain pattern. The long chain has been studied in process flexibility and has been shown to be very effective in coping with demand uncertainty under offline arrivals. We provide preliminary results that show the effectiveness of the long chain when the arrivals are online.

3 - On-demand Staffing: Incentive Wage Contracts with Guaranteed Fill Rates
Zhichao Zheng, Singapore Management University, Lee Kong China School of Business, 50 Stamford Road, Singapore, 178989, Singapore, danielzheng@smu.edu.sg, Tao Lu, Yuqiang Zhong

We study the on-demand economy and its impact on labor market efficiency. We consider n employers with uncertain and time-varying demands, and a platform operator providing on-demand staffing services. We propose a novel fill rate-based allocation policy enabling the on-demand workforce to be shared efficiently among employers. We propose a form of incentive contracts based on fill rate guarantees, and show that our contracts can induce the system-wide optimality in decentralized systems.

■ TA14
14-Franklin 4, Marriott
Data-driven Optimization
Sponsor: Optimization/Operations Under Uncertainty
Sponsored Session
Chair: Gah-Yi Vahn, Assistant Professor, London Business School, Sussex Place, Regent’s Park, London, NW1 4SA, United Kingdom, gahn@london.edu

1 - Data-driven Estimation of (s, S) Policy
Gah-Yi Vahn, Assistant Professor, London Business School, Sussex Place, Regent’s Park, London, NW1 4SA, United Kingdom, gahn@london.edu

I derive a tractable algorithm for computing the optimal (s, S) policy when the decision maker has access to historical demand data. I show that this scheme yields asymptotically optimal (s, S) policy and derive analytical characterizations of confidence intervals, which is useful for operational decision-making.

2 - Near Optimal Ambiguity Sets in Distributionally Robust Optimization
Vishal Gupta, Assistant Professor, USC Marshall School of Business, 3670 Trousdale Parkway, Bridge Hall 401 G, Los Angeles, CA, 90089-0809, United States of America, guptavis@usc.edu

We assess the strengths of data-driven ambiguity sets in distributionally robust optimization (DRO) by bounding the relative size of a candidate set to a specific, asymptotically optimal set. We find popular ambiguity sets are much larger than this asymptotically optimal set, suggesting current DRO models are overly conservative. We propose new “near-optimal” sets that are only a constant factor larger than the optimal set and satisfy the usual robustness properties.

3 - A Time Based Choice Model
Taufik Zaman, MIT Sloan School of Management, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, zlisto@mit.edu

We present a choice model which incorporates the time it takes the user to make a decision. Our model assumes that the further apart two items are in terms of user preference, the faster a decision is made. We conduct a set of online polls and find that this model captures actual human behavior. We also show that using this time based choice model can learn user preferences with high accuracy than standard choice models for a fixed sample size.

■ TA15
15-Franklin 5, Marriott
Patient Scheduling in Health Care
Sponsor: Optimization in Healthcare
Sponsored Session
Chair: Joseph Milner, Associate Professor Of Operations Management, Rotman School of Management, University of Toronto, 105 St.George Street, Toronto, ON, M5S3E6, Canada, Joseph.Milner@Rotman.utoronto.ca

1 - Dynamic Patient Scheduling for Multi-Appointment Health Care Programs
Adam Diamant, Assistant Professor Of Operations Management, Schulich School of Business, York University, 111 Macdonald Boulevard, Toronto, ON, M3J1P3, Canada, adiamant@schulich.yorku.ca, Fayez Quareshy, Joseph Milner

We investigate the scheduling practices of a multidisciplinary, multistage, outpatient health care program with no-shows. We formulate the problem as a Markov Decision Process and use approximate dynamic programming to find policies to schedule patients to appointments. We examine the quality of our solutions via structural results and compare them to a simulation of the clinic. Our results applied to the operation of a bariatric surgery program at a large tertiary hospital in Toronto, Canada.

2 - Flexible Hospital-wide Patient Scheduling
Daniel Gartner, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu, Rema Padman

We study a patient scheduling problem with admission decisions, clinical pathways, day and overnight hospital resources, ward and surgical team assignment flexibility, and overtime considerations. We model the problem using Mixed-Integer Programming and embed it in a rolling horizon planning to take into account uncertain recovery times of and remaining resource capacity for patients. We analyze the impact of flexibility and uncertainty on several metrics.

3 - Coordinated Scheduling for a Multi-station Healthcare Network
Esther Dongyang Wang, PhD Candidate, University of Texas, IROM Dept., Austin, TX, United States of America, wdy@utexas.edu, Douglas Morrice, Kumar Muthuraman

As the population ages, our healthcare industry must face the challenge of increasing demand for care under constrained budget and resources. Our research focuses on one of the central factors to the success of healthcare reform—outpatient appointment scheduling. We develop a mechanism that coordinates appointment scheduling among multiple services in a healthcare network to improve access of care and reduce patient no-show rate. Our approach has the potential to yield a global optimal solution.

4 - Appointment Scheduling and Walk-in Strategies with Unpainful Patients
Mohamad Soltani, University of Alberta, PhD Office, Business Building., University of Alberta, Edmonton, AB, T6G 2R3, Canada, soltani@ualberta.ca, Michele Samorati

It is commonly believed that clinics that schedule appointments have lower patients’ waiting time and providers’ overtime than clinics that only allow walk-ins. However, if we consider patient unacceptability, walk-in-only clinics may achieve a higher performance. In this research, we investigate the conditions under which each strategy is preferable.
1 - A Generalized Trust Region Subproblem with Hollows and Non-Intersecting Linear Constraints

Boshi Yang, The University of Iowa, 14 MacLean Hall, Iowa City, IA, 52242, United States of America, boshi-yan@uiowa.edu, Samuel Burer, Kurt Anstreicher

We studied an extended trust region subproblem (eTRS) in which a nonconvex quadratic function is minimized over a structure nonconvex feasible region: the unit ball with r hollows (or holes) and m linear cuts. Under some non-intersecting assumptions, when \( r = 0 \) or when \( r = 1 \) and \( m = 0 \), it is known that the eTRS has a tight, polynomial-time solvable conic relaxation. We show that the conic relaxation is also tight for general \( r \) and \( m \) precisely when some non-intersecting assumptions are satisfied.

2 - On Disjunctive Conic Cuts: When They Exist, When They Cut?

Mohammad Shahsabali, Lehigh University, 14 Dush Dr, Apt. 221, Bethlehem, PA, 18015, United States of America, mos313@lehigh.edu

The development of disjunctive conic cuts (DCCs) for MISOCO problems has recently gained significant interest in the optimization community. Identification of cases when DCCs are not existing, or not useful, saves computational time. In this study, we explore cases where either the DCC methodology does not derive a DCC, which is cutting off the feasible region, or a DCC does not exist. Among others, we show that deriving DCCs directly for \( k \)-order cone optimization problems seems to be impossible.

3 - Disjunctive Conic and Cylindrical Cut Management Strategies for Portfolio Optimization Problems

Sertalp Cay, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, sec312@lehigh.edu, Tahis Tertiary, Julio Goez

Disjunctive conic and cylindrical cuts lead significant positive impact while solving Mixed Integer Second Order Cone Optimization (MISOCO) problems. The decision for adding and removing these cuts should take depth of the cut and structure of the problem into consideration. In this study, we explore strategies to apply these novel cuts to discrete portfolio optimization problems within a Branch-and-Convex-Cut software package. Preliminary results are provided to compare these strategies.

4 - Novel Family of Cuts for SDP Relaxations for Some Classes of Combinatorial Problems

Elspeth Adams, elspeth.adams@polyml.ca, Miguel Antjos

The family of polytope constraints (\( \Pi \)-PCs) are a family of constraints that tighten SDP relaxations using the inner description of small polytopes, as opposed to the typical facet description. We examine the properties of \( \Pi \)-PCs, methods for separating violated \( \Pi \)-PCs, and their impact on the bounds in a cutting plane framework. Problems satisfying the required projection property, such as the max-cut and stable set problems, will be considered and results will focus on large instances.

Network Resilience and Applications

Sponsor: Optimization/Network Optimization

Chair: Konstantin Pavlakov, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States of America, kpvilakov@ufl.edu

1 - Resilient and Structurally Controllable Supply Networks under Disruptions

Amirhossein Khojasteh, The University of Oklahoma, 202 West Boyd Street, Suite 218, Norman, OK, 73071, United States of America, akhojasteh@ou.edu, Farrokhi Mistree, Janet K. Allen, Krishnaiyan Thuliraman

A resilient supply network is one that has the ability to recover quickly from disruptions and ensures customers are minimally affected. Designing the structure of supply networks to be controllable is a way toward resilience. A three-stage method is proposed to design a resilient and controllable supply network under structural disruptions. The method is exercised using an example from the petroleum industry.

2 - Embedding Resilience on Logistic and Supply Chain Networks

Jose Santivanaz, Associate Professor, Universidad del Turabo, P.O. Box 3030, Gurabo, PR, 00778, Puerto Rico, j.santivanaz@uasrm.edu, Emanuel Mallachintoudis

This paper develops models for improving resilience to disruptions on critical infrastructures such as logistics and supply chain networks through locational, coverage, and path selection decisions. Network resilience is measured by the ratio of the delivered amount of service over the total requested service when a propagating disruption occurs. Availability of service depends on the capability of the network to establish connectivity between service facilities and customers.

Improving Supply Chain Network Resilience with Preferential Growth Decision Making

Ashley Skeete, PhD Fellow, Western New England University, 1215 Willbraham Road, Springfield, MA, 01119, United States of America, ashley.skeete@wne.edu, Julie Drozynski

Network resilience is the ability to maintain operations and connectedness under the loss of some structures or functions. This research develops decision making techniques in the supply chain context to improve resiliency of existing supply chain networks as they grow with time. Consideration is given to factors such as network topology, production requirements, the presence of redundancies and costs.

Hub Location-allocation for Combined Fixed-wireless and Wireline Broadband Access

Ramesh Bollapragada, Professor, College of Business, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA, 94132, United States of America, ramesh@sfu.edu, Udai Rao, Min Li, Junying Wu

This paper studies a telecommunications hub location model that includes the classical capacitated facility location problem on a wireline network, as well as a wireless network with technological as well as capacity constraints. There are multiple wireline and wireless hub types, differing in costs and capacities. We present a mathematical model to maximize network profit, build and test a quick greedy heuristic with the optimal, and conduct sensitivity analysis using representative data.

Network Resilience and Applications

Sponsor: Optimization/Network Optimization

Chair: Dohyun Kim, Myongji University, Yongin, Korea, Republic of, norman.kim@gmail.com

1 - Ranking Outliers in Patent Citation Network using Attributes and Graph Structure

Ali Tosyali, Rutgers, the State University of New Jersey, Dept. of ISE 96 Frelinghuysen Road, CoRE Building, Room 201, Piscataway, NJ, United States of America, alitosyali4778@gmail.com, Byunghoon Kim, Jeongsub Choi, Byoung-yul Koh, Jae-min Lee, Myong K (MK) Jeong, Andrew Rodriguez

Being able to rank patents in outlierness is a crucial task for patent analysis. In the past, existing general outlier ranking methods have been applied to patent data. In this work, we propose a new outlier ranking method developed especially for patents in attributed patent citation network. We utilized both graph structure and attributes to rank outlier patents in patent citation network.

Scientometric Analysis of Carbon Capture and Storage Research

Faizeh Karimi, Dr. University of Sydney, Project Management, Sydney, 2006, Australia, faizeh.karimi@sydney.edu.au, Rajah Khalipour

This study investigates the evolutionary trends of the international collaborations among the research community of carbon capture and storage (CCS) by looking at the collaboration network of countries publishing on CCS. The study elaborates how international collaboration network and knowledge structure of the field have notably developed and interlinked over the years especially after 2005 during which almost 94% of the publications appeared.

Keyword Hierarchy Detection using Keyword Network Analysis

Dohyun Kim, Myongji University, Yongin, Korea, Republic of, norman.kim@gmail.com, Sanghyun Oh, Jin-kwon Ahn, June Young Lee, Sejung Ahn

We developed a keyword hierarchy detection algorithm using the keyword network. Using the detection method, the hierarchy of keywords collected from the same semantic field may be built. The keyword hierarchy detection method can be used for a automatic pre-processing step to refine keywords in various topic modeling methods.
INFORMS Philadelphia – 2015

4 - Integrated Variable Importance Assessment in Multi-stage Manufacturing Processes
Gianluca Gazzola, Rutgers Center for Operations Research, 100 Rockafeller Road, Picataway, NJ, 08854, United States of America, gazzola@scarletmail.rutgers.edu, Jeongsub Choi, Myong K (MK) Jeong, Byunghoon Kim

We introduce a method for the assessment of variable importance in manufacturing processes characterized by a hierarchy of technical relationships between stage variables. Regression models of direct technical relationships and a novel permutation measure are employed to quantify the local contribution of every variable. Global contributions are finally obtained by integrating these local assessments, based on the overall structure of indirect and direct technical relationships in the process.

1 - Revealing Power Structures through Novel Biclustering Approaches
Sabine Baumann, Professor Dr., Jade University, College of Mgmt, Info., Tech., Friedrich-Paaffath-Str. 101, Wilhelmshaven, 22880, Germany, sabine.baumann@jade-hs.de, Oliver Eulenstein, Christoph Wunck

Cloud and big data provide unprecedented access to massive interaction networks of people and organizations. However, exploring such rich data environments encounters equally extensive challenges: unreliable, incomplete or distorted information, or computational limitations. We recover missing interactions from vast corporate networks using novel biclustering techniques to detect the most significant edges, and hence provide new insights into power structures.

2 - Running Your Optimization Model on the Cloud with the IBM CPLEX Studio IDE
Frederic Delhoume, Software Engineer, IBM, 9 Rue de Verdun, Gentilly, 94233, France, delhoume@fr.ibm.com

We will show how to easily run optimization models from the IBM CPLEX Studio IDE. We will also demonstrate how to monitor the cloud service and get local results from the remote optimization service. A REST API way of running models on the cloud will be shown.

Computational Integer Optimization

Sponsor: Computing Society
Sponsored Session
Chair: Yan Xu, Director, SAS, 100 SAS Campus Dr., Cary, NC, United States of America, yan.xu@sas.com

1 - Recent Advances in the FICO Xpress MIP Solver
Michael Perregaard, Xpress Team, FICO, International Square, Starley Way, Birmingham, B37 7GN, United Kingdom, MichaelPerregaard@fico.com

We will present some of the recent MIP advances in the FICO Xpress solver, with an emphasis on how it is able to exploit the ever increasing core counts of modern CPUs.

2 - The SAS MILP Solver: Current Status and Future Developments
Philipp Christophel, SAS Institute Inc., 100 SAS Campus Dr., Cary, NC, 27607, United States of America, Philipp.Christophel@sas.com, Menal Guzelsoy, Imre Polik, Amar Narisetty

We give an overview of the current status of the SAS mixed integer linear programming (MILP) solver that is part of the SAS/OR product. The focus will be on describing recent implementation efforts for the MILP presolver as well as future development directions.

3 - Performance Improvements and New Features in the Gurobi Optimizer
Chris Maes, Senior Developer, Gurobi Optimization, Inc., 125 Beacon St, Apt. #4, Boston, MA, 02116, United States of America, maes@gurobi.com

This talk will cover the latest developments in the Gurobi Optimizer. We’ll discuss the new Gurobi Cloud, which makes it easy to launch one or more Gurobi machines when you need them. We’ll also talk about our upcoming release, which includes significant performance enhancements and several new features.

4 - CPLEX Keeps Getting Better
Andrea Tramontani, CPLEX Optimization, IBM Italy, Via Martin Luther King 38/2, Bologna, Italy, andrea.tramontani@it.ibm.com

We present some of the new features and algorithmic techniques that have been recently added to IBM ILOG CPLEX Optimizer, and we give detailed benchmark results that demonstrate the performance improvements achieved in latest CPLEX versions.

Cloud Services and Applications

Cluster: Cloud Computing
Invited Session
Chair: Grace Lin, Data Analytic Technology and Applications (DATA), Data Analytic Technology and Applications (DATA), Taipei, Taiwan - ROC, gracelin@iii.org.tw

1 - Revealing Power Structures through Novel Biclustering Approaches
Sabine Baumann, Professor Dr., Jade University, College of Mgmt, Info., Tech., Friedrich-Paaffath-Str. 101, Wilhelmshaven, 22880, Germany, sabine.baumann@jade-hs.de, Oliver Eulenstein, Christoph Wunck

Cloud and big data provide unprecedented access to massive interaction networks of people and organizations. However, exploring such rich data environments encounters equally extensive challenges: unreliable, incomplete or distorted information, or computational limitations. We recover missing interactions from vast corporate networks using novel biclustering techniques to detect the most significant edges, and hence provide new insights into power structures.
2 - Short Lists in Centralized Clearinghouses
Nick Arnosti, Stanford University, Stanford, CA, United States of America, arnosti@stanford.edu

In the presence of frictions, participants in centralized clearings generally fail to list all acceptable match partners. As a consequence, mutually acceptable pairs are left unmatched. The number of unmatched agents (and the happiness of matched agents) depends crucially on the structure of correlations in participants' preferences. This work identifies a fundamental tradeoff between match quality and quantity, and uses this to offer guidance for the design of school choice mechanisms.

3 - How Much Choice is There in Two-sided Matching Markets?
Itai Ashlagi, MIT, 100 Main St, Cambridge, MA, 02139, United States of America, iashlagi@mit.edu

We study the structure of two-sided random matching markets with tiers. Our results provide insights on the amount of choice agents have in the core.

2A23

23-Franklin 13, Marriott
Asymptotic Optimality in Processing Networks
Sponsor: Applied Probability
Sponsored Session
Chair: Itai Gurvich, Professor, Kellogg School of Management, Northwestern, 2001 Sheridan Rd., Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu

1 - Approximations to Non-stationary Diffusion Processes
Harsha Honnappa, Purdue University, West Lafayette, IN, United States of America, honnappa@purdue.edu, Peter Glynn

Non-stationary diffusion processes emerge as limits to time inhomogeneous queueing processes in appropriately defined ‘high intensity’ regimes. In general, however, the transition densities of non-stationary diffusion processes are not known in closed form. Thus, in this talk, we present analytical approximations to expectations of these diffusion processes. This is joint work with Peter Glynn.

2 - On the Control of Fork-join Networks
Erhun Özkın, University of Southern California, Marshall School of Business, Los Angeles, CA, 90089, United States of America, eozkan@usc.edu, Amy Ward

We study a prototypical fork-join network with two job classes and a shared server that processes both job types. We show that a cmu-type static priority policy is asymptotically optimal when the shared server is in some sense slow at processing the more expensive jobs. Otherwise, a state-dependent slow departure pacing control, under which the shared server sometimes gives priority to the less expensive jobs, is asymptotically optimal.

3 - Insensitivity and Optimality of Load Balancing with Processor Sharing Servers
Varun Gupta, Varun.Gupta@chicagobooth.edu, Neil Walton

We present some recent results and ongoing work on near-optimality and insensitivity properties of shortest queue load balancing under a carefully constructed many-servers asymptotic regime, when all the servers use the Processor Sharing scheduling rule.

4 - Capacity of Information Processing Systems
Kuang Xu, Stanford University, United States of America, kuangxu@stanford.edu, Laurent Massoulié

We study an information processing system where jobs are to be inspected by a set of experts. Inspections produce noisy results depending on the jobs’ hidden labels and the expert types, and an inspection occupies an expert for one time unit. The manager's objective is to assign inspections so as to uncover the jobs’ hidden labels, using a minimum number of experts. Our main result is an asymptotically optimal inspection policy as the probability of error tends to zero.
1 - First-mover Advantage in Online Review Platform
Qianran Jin, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, qianran.jin@mail.mcgill.ca, Animesh Animesh, Alain Pinsonneault
While first-mover advantage has been widely studied at firm-level, our research focuses on individual-level first-mover advantage in online review platform. We study whether early reviews receive higher proportion of helpful votes than later reviews. Our preliminary results show that early reviews are perceived to be more helpful than later reviews. The first-mover advantage is greater for high frequency reviewer than low frequency reviewer.

2 - What Makes Geeks Tick? A Study of Stack Overflow Careers
Lei Xu, McGill University, 855 Sherbrooke Street West, Montreal, Canada, lei.xu20@mail.mcgill.ca, Tingning Nian, Luis Cabral
The success of a platform depends crucially on a thorough understanding of motivations behind user participation. The identification has always been a challenging task. We use a revealed preference approach to show that career concerns play an important role in user contributions to Stack Overflow, the largest online programming community. We show that career concerns explain 16% drop in answers activity after a job change. Robustness tests are conducted to tease out alternative explanations.

3 - The Dynamics of Online Referral Channels and E-commerce Website Performance
Wenjing Duan, Associate Professor, The George Washington University, 2201 G St NW, Washington, DC, 20052, United States of America, wduan@gwu.edu, Jie Zhang
This study investigates the dynamic relationship between three referral channels — search engine, social medial, and third-party advertising — and e-commerce website performance. Our results derived from vector autoregressive models suggest a significantly differential predictive relationship between referrals from the three channels and sales performance measures.

4 - The Interactions Between Herding and Social Media Word-of-Mouth: Evidence from Groupon
Xitong Li, Dr., ISEC Paris, 1 Rue de la Liberation, Batiment V, 2eme etage, Bureau 207, Jouy-en-Josas, 78351, France, lix@hec.fr, Lynn Wu
This study aims to test if there is any complementary interaction between herding and social media WOM. Using a panel data set from Groupon.com, we show they reinforce each other in driving product sales. To explore the underlying mechanisms behind the complementarities, we find the herding effect is more salient for experience goods than for search goods, but the effect of Facebook-mediated WOM does not significantly differ between the two product categories.

2 - Dynamic Supply Risk Management with Multisourcing, Discretionary Selling, and Signal-based Forecast
Ting Luo, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ting.luo@utdallas.edu, Long Gao, Nan Yang, Renyu Zhang
We study a firm’s procurement and selling decisions in a multiclass demand and multisupplier inventory system. The optimal procurement is driven by multisourcing and intertemporal substitution and optimal selling is driven by customer segmentation and intertemporal rationing, they are synchronized with dynamic forecast for adaptive and resilient risk mitigation. We examine the critical role of advance supply signals and understand when and how to use them.

3 - Optimal Procurement Design for a National Brand Supplier in the Presence of Store Brand
Xinyan Cao, PhD Student, University of Wisconsin - Milwaukee, 3202 N Maryland Avenue, Milwaukee, WI, 53202, United States of America, xinyan@uwm.edu, Xiang Fang
We consider a supply chain consisting of a national brand supplier and a retailer which intends to develop its own store brand. We develop a game-theoretic framework to analyze the strategic interaction between the two players in the presence of asymmetric information.

4 - Duopolistic Procurement Contracts with Horizontal Information Asymmetry
Hongyan Xu, Professor, Chongqing University, School of Econ. and Bus. Administration, Chongqing, China, xuhongyan@cqu.edu.cn, Yu Tang, He Huang
We formulate a Cournot competition model of two chains where suppliers possess private information of reliability and manufacturers may or may not share cost information with the opponent. This paper under various scenarios aims to examine the contract design and the interplay of horizonatal information asymmetry and vertical information asymmetry.

Optimal Sourcing, Procurement Design, and Eco-label System in Supply Chain Management
Cluster: Operations/Marketing Interface
Chair: Xiang Fang, Associate Professor, University of Wisconsin-Milwaukee, 3202 N Maryand Avenue, Milwaukee, WI, 53211, United States of America, xiangf@uwm.edu
Co-Chair: He Huang, Professor, Chongqing University, School of Economics and Business Admin., Chongqing, China, huanghe@cqu.edu.cn
1 - Eco-label System Impact on Market Share and Profit
Yu Xia, Associate Professor, Northeastern University, 214 Hayden Hall, 560 Huntington Ave, Boston, MA, 02115, United States of America, Y.Xia@neu.edu, Xu Yang, Shilei Yang
This research works on the design of the eco-label and its impact on market share and profit for the company that adopts the eco-label system. To design an eco-label system, we need to determine number of levels of labels to structure and the index standard of each level. The gaps between levels should be significant enough to promote effort in producing greener product. In addition, reaching a higher level will bring additional business benefit such as profit for the engaged manufacturers.

2 - Preference Preservation in Inverse Multi-objective Convex Optimization
Taewoo Lee, University of Toronto, 5 King’s College Road, Toronto, Canada, taewoo.lee@mail.utoronto.ca, Timothy Chan
We present a new inverse optimization model for convex multi-objective optimization that accommodates any input solution and determines a nonzero weight vector that preserves the original preference of the decision maker who generated the solution. We demonstrate how a linear approximation to the model and a successive linear programming algorithm can trade-off between preference preservation and computational efficiency, using data from prostate cancer radiation therapy.

2 - Biobjective Robust Optimization Problem over the Efficient Set to Aid Decision Making
Daniel Jornada, Texas A&M University, 1700 Research Pkwy, 280B Schlumberger Bldg, College Station, TX, 77843, United States of America, djornada@tamu.edu, Jorge Leon
We present a biobjective robust optimization formulation for identifying robust solutions from a given Pareto set arising from a multiobjective program (MOP). The objective functions consider both solution and model robustness when decision values are subjected to uncertainty at the time of implementation. The solution approach is based on facial decomposition. We illustrate the applicability of the methodology to aid decision making in the area of energy planning.

3 - Spatial Data for Multiobjective Shortest Path Analyses: Small Decisions with Large Consequences
F. Antonio Medrano, Post Doctoral Researcher, University of California at Santa Barbara, Santa Barbara, CA, 93106, United States of America, medrano@geog.ucsb.edu, Richard Church
Multiobjective shortest path analysis is often used for developing alternatives in the engineering design of new infrastructure over terrain. While such analysis may appear to be non-subjective, the decisions made in assigning costs from features and in the connectivity of the raster network will have major impacts on the number of solutions, their spatial configuration, and their objective values. We discuss these factors and decisions when using GIS data, and their impacts on the solution set.
everybody has updated. Our mechanism is based on a technique for making 
GSP when nobody has updated their bid and is equivalent to VCG when 
much of this revenue loss. The mechanism is equivalent to 
GSP to VCG incurs significant revenue loss. We introduce a transitional 
settings. Truthful mechanisms, such as VCG do. However, a straight switch from 
GSP to VCG incurs significant revenue loss. We introduce a transitional 
mechanism which mitigates this revenue loss. The mechanism is equivalent to 
GSP when nobody has updated their bid and is equivalent to VCG when 
everybody has updated. Our mechanism is based on a technique for making 
around the convergence analyses lead to a MultiObjective Decomposition Algorithm (MODA) that is 
oneself. ose are equivalent to to its operations, research, and engineering in clinical care, research and education for achieving 
excellence. 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.

4 - Analytics to Support Innovation in Outpatient Care 
Delivery Processes
Tarun Mohan Lal, Mayo Clinic, mohanlal.tarun@mayo.edu
With the growing trend and concern surrounding health care workforce 
shortages, there is an increasing call for the redesign of office practices to reduce 
inefficiency and improve capacity through better use of existing office staff. In this presentation, we will discuss some innovative models of care delivery such as 
increase pre-visit work, non-face face visits being implemented at Mayo Clinic 
that has potential for improved operational performance and staff satisfaction.

- Distributed Computation of Pareto Sets
Margaret Wiecek, Department of Mathematical Sciences, 
Clemson University, Clemson, SC, 29634, United States of 
America, wiecek@clemson.edu, Brian Dandurand
The needs of multidisciplinary engineering design have motivated the 
development of a distributed solution approach to computing Pareto solutions to 
nonconvex decomposable multiobjective optimization problems. Existing results 
on augmented Lagrangian coordination techniques and the block coordinate 
descent method are extended into the multiobjective setting. These convergence 
analyses lead to a MultiObjective Decomposition Algorithm (MODA) that is 
oma for a straw, with no one else.

- Mechanism Design for Mixed Ads
Ian Kash, Microsoft Research, 21 Station Road, Cambridge, 
United Kingdom, ian.kash@microsoft.com, Sofia Ceppi, 
Reza Khani, Yoram Bachrach, Peter Key
The GSP auction works when ads are simple, but does not generalize to richer 
settings. Truthful mechanisms, such as VCG do. However, a straight switch from 
GSP to VCG incurs significant revenue loss. We introduce a transitional 
mechanism which mitigates this revenue loss. The mechanism is equivalent to 
GSP when nobody has updated their bid and is equivalent to VCG when 
everybody has updated. Our mechanism is based on a technique for making 
around the convergence analyses lead to a MultiObjective Decomposition Algorithm (MODA) that is 
applications for analytics. Questions such as whether or not analytics is a discipline, and what 
type of relationship it has to disciplines such as statistics, computer science and 
operations research, have been unanswered. In this talk, a framework will be 
presented that explains the emergence of analytics, and logically relates it to other 
disciplines.

2 - Spreadsheet Software for Linear Regression Analysis
Robert Nau, Professor, Duke University, Fuqua School of 
Business, Durham, NC, 27708, United States of America, 
robert.nau@duke.edu
Spreadsheet add-ins for statistical analysis vary widely in terms of their user 
facades, the detail and design of their output, and support for best practices of 
analysis. This talk will give a brief overview of some of the market-leading 
products and compare their linear regression features features with a free add-in, RegressIt 
(http://regressit.com), which was originally designed for teaching an advanced 
elective on forecasting at Duke University and is now publicly available and 
widely used.

3 - Strategic Research: Analytics Excellence
Charity Maynard, Senior Health System Engineer, Mayo Clinic, 
200 First Street SW, Rochester, MN, 55905, United States of 
America, Maynard.Charity@mayo.edu
Mayo Clinic has a long rich legacy of integrating analytics, operations research 
and industrial engineering in clinical care, research and education for achieving 
excellence. 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.

4 - Analytics to Support Innovation in Outpatient Care 
Delivery Processes
Tarun Mohan Lal, Mayo Clinic, mohanlal.tarun@mayo.edu
With the growing trend and concern surrounding health care workforce 
shortages, there is an increasing call for the redesign of office practices to reduce 
inefficiency and improve capacity through better use of existing office staff. In this presentation, we will discuss some innovative models of care delivery such as 
increase pre-visit work, non-face face visits being implemented at Mayo Clinic 
that has potential for improved operational performance and staff satisfaction.
2 - Optimization of Resource use in Massively Multiplayer Online Games
Betty Love, University of Nebraska at Omaha, UNO Mathematics Dept., 60th & Dodge Sts., Omaha, NE, 68182, United States of America, blove@unomaha.edu, Andrew Cockerill
With over 400 million players worldwide, massively multiplayer online games (MMOs) continue to be a popular source of online recreation. MMOs frequently involve resource management and virtual economies. This project demonstrates the introduction of optimization strategies in the MMO game World of Warcraft. A simulated annealing algorithm was implemented in a Lua script which runs in the game's user interface and determines how to use the player's current resources to maximize virtual profit.

3 - A Gravity Model for Tourist Forecasting at FIFA Soccer World Cups
Ghaith Rabadi, Associate Professor, Old Dominion University, 2102 Eng Systems Build, Dep. of Eng.Mntg. and Systems Eng., Norfolk, VA, United States of America, grabadi@odu.edu, Mohammed-saleh.hassan@odu.edu
FIFA Soccer World Cups are sport mega-events that enjoy tremendous popularity worldwide. This paper analyzes historical bilateral tourist flows over the last two decades to forecast the number of inbound tourists into future World Cup host countries. Hosting sport mega-events will be considered as one of the input factors to measure their impact on the number of tourists forecasted.

4 - Optimal Hiking: Bi-modal Variation of the Traveling Salesperson Problem
Roger Grinde, Associate Professor, University of New Hampshire, Paul College of Business & Economics, 10 Garrison Avenue, Durham, NH, 03824, United States of America, roger.grinde@unh.edu
The problem addressed is motivated by a mountain hiking scenario where there is a network of peaks (destinations) connected by trails and a network of parking areas connected by roads. Various objectives are possible, generally one wishes to construct a series of hikes that together visit all the destinations. A formulation and solution approach is presented.

5 - Analysis of Potential Solutions to Competitive Imbalance in the NBA
Stephen Hill, Assistant Professor, UNC Wilmington, 601 South College Road, Wilmington, NC, 28403-5611, United States of America, hills@uncw.edu
The National Basketball Association (NBA) is in the midst of an extended period of competitive imbalance with teams in the Western Conference widely viewed as being stronger than those in the Eastern Conference. In this work, we evaluate a set of possible changes to the structure of the NBA. Each of these changes is analyzed via Monte Carlo simulation with the impacts on competitive balance and playoff participation described.

■ TA31
31-Room 408, Marriott
Financial Applications of Data Mining and Machine Learning Techniques
Sponsor: Data Mining
Sponsored Session
Chair: John Guerard, Director Of Quantitative Research, McKinley Capital Management, LLC, 3301 C Street, Suite 500, Anchorage, AK, 99503, United States of America, jguerard@mckinleycapital.com
1 - Optimal Global Efficient Portfolio with Emerging Markets using Earning Forecasts
Shijie Deng, Georgia Inst of Tech, 755 Ferst Dr, Atlanta, GA, United States of America, sd111@gatech.edu
We apply a multi-factor stock selection model which includes earning forecast to analyze the performance of the optimal global portfolio which includes the emerging markets. Under the Markowitz mean-variance framework, applied optimization techniques are employed to address the practical issues of risk tolerance, turn-over, and tracking-error. The impacts of these practical constraints on the portfolio performance are analyzed through extensive numerical experiments.

2 - Data Mining Corrections Testing
John Guerard, Director of Quantitative Research, McKinley Capital Management, LLC, 3301 C Street, Suite 500, Anchorage, AK, 99503, United States of America, jguerard@mckinleycapital.com, Harry Markowitz, Ganlin Xu
Data mining corrections (DMC) tests of Global, Russell 3000, Non-U.S. stocks, Emerging Markets, Japan-only, and China-only during the 2000-2014 period for 21 individual financial variables and two composite (robust, PCA-based) regression models. We find that earnings forecasting models and regression-based models emphasizing forecasted earnings acceleration and price momentum models dominate the DMC tests which allow us to statistically dismiss Data Mining as a potential source of modeling bias.

3 - Applications of Machine Learning over Alpha Signals to Improve Stock Selection and Boost Returns
Abhishek Saxena, Quantitative Research Analyst, McKinley Capital Management, LLC, Suite 500, 3301 C Street, Anchorage, AK, 99503, United States of America, asaxena@mckinleycapital.com, Sundaram Chettiappan
The paper explores the possibility of enhancing an alpha model through various machine learning techniques. We show that these techniques can have statistically significant additions to both raw returns and simulated returns in various equity universes. These excess returns are mostly attributed to improved stock selection as the risk profile doesn’t change significantly in terms of both direct risk measurements (standard deviation based risk models) and exposures to various fundamental factors.

■ TA32
32-Room 409, Marriott
Principles in Applied Probability
Sponsor: Applied Probability
Sponsored Session
Chair: Josh Reed, Associate Professor, NYU, 44 W. 4th St., New York, NY, 10012, United States of America, jreed@ stern.nyu.edu
1 - Relating Busy Period Duration and the Single Big Jump Principle in Heavy Traffic
Bart Kamphorst, PhD Student, CWI, Science Park 123, Amsterdam, 1098 XG, Netherlands, B.Kamphorst@cwi.nl, Bert Zwart
Queueing literature shows many results for the M/G/1 queue with a fixed server utilization. However, in practice the server utilization may be increasing due to a growing number of jobs per time unit. This causes a significant increase in waiting times and the busy period duration. We will present asymptotic relations for the tail probabilities of the former characteristics. Moreover, we will illustrate a typical long busy period and discuss its relation with the Principle of a Single Big Jump.

2 - Capacity Allocation in a Transient Queue
Britt Mathijsen, PhD Student, Eindhoven University of Technology, P.O. Box 513, 5600 ME, Eindhoven, Netherlands, b.w.j.mathijsen@tue.nl, Bert Zwart
We consider an optimal capacity allocation problem of a two-period queueing model, being in steady-state in the first time interval, but changing parameters at the instance of the new period. The error in the objective function made by disregarding the transient phase before reaching stationarity in this second interval is quantified and approximated. Furthermore, we analyze the consequence of staffing the system according to its steady-state behavior and propose a corrected staffing rule.

3 - Analysis of Cascading Failures
Fiona Sloothaak, PhD Student, Eindhoven University of Technology, P.O. Box 513, 5600 ME, Eindhoven, Netherlands, f.sloothaak@tue.nl, Bert Zwart
Inspired by analyzing the reliability of energy networks, particularly the occurrence of large blackouts, we consider a stylized model of cascading failures. By using connections with extreme value theory and Brownian bridge approximations, we establish that the number of failed nodes follow a power law. Time permitting, we also discuss connections with similar models and questions from material science.
on large datasets from US prisons. Therefore, prisons are pressed to prioritize treatment decisions for HCV-infected populations, which represent about 30% of the national Hepatitis C (HCV) prevalence, offer a great opportunity to control the HCV epidemic. New HCV treatments are very effective but also outrageously expensive. Screening and treatment strategies, models’ assumptions and structures can vary dramatically, leading to differing conclusions about the most effective strategy. Using robust and stochastic optimization, we identify screening strategies that are effective across multiple models, which could increase confidence in the quality of the identified strategies.

4 - On a Class of Reflected AR(1) Processes

Josh Reed, Associate Professor, NYU, 44 W. 4th St., New York, NY, 10012, United States of America, jreed@stern.nyu.edu, Michel Mandjes, Omno Boxma

We study the recursion Z(n+1) = max(aZ(n) + X(n),0) when X(n) is i.i.d. with distribution the same as the difference of a positive random variable and an independent, exponential random variable. We find the transform of Z(n) and, when |a|<1, we perform a stationary analysis. In heavy-traffic, we show that the process converges to a reflected Ornstein-Uhlenbeck process and the steady-state distribution converges to the distribution of a normal random variable conditioned to be positive.
We present an optimization model that combines hospitals' nurse staffing decisions with two classes of quick-response decisions: (i) adjustments to the assignment of cross-trained nurses working the current shift in each unit and (ii) transfers of patients between units and off-unit admissions. We use a simulation to derive insights into the level of benefit that can be expected from integrating the aforementioned quick-response methods in the staffing process.

3 - Analyzing the Relationship Between Two-phased Room Allocation Policies in an Outpatient Clinic
Vahab Vahdatzad, PhD Candidate, Northeastern University, 360 Huntington Avenue, Boston, MA, 02215, United States of America, vahdatzad.v@husky.neu.edu, James Stahl, Jacqueline Griffin

This research analyzes the relationship between two phases of room assignment in an outpatient clinic. Specifically, we studied the interplay between the use of rooms for Medical Assistant and physicians during a patient visit. We demonstrate that policies for assigning rooms to MA and physicians has a significant impact on patient wait time and length of stay. Several room allocation policies are examined using discrete event simulation and interactions between two phases are investigated.

4 - An Agent-Based Simulation Model of HIV Transmission and Control among Men who Have Sex with Men in Baltimore City
Parastu Kasaei, Postdoctoral Fellow, Johns Hopkins University, 615 N. Wolfe st, E6039, Baltimore, MD, 21205, United States of America, pkasaei@jhu.edu, David Dowdy

We present an agent-based simulation model to project the population-level impact of implementing HIV preventive therapy (PrEP) and treatment (ART) for high-risk men who have sex with men (MSM) in Baltimore city. We compare a counterfactual scenario in which PrEP and ART continue to be used at current (low) levels against scenarios in which different levels of coverage and adherence are achieved. The primary outcome of interest is the HIV incidence among MSM in Baltimore over five years.

5 - Estimating the Energy Imbalance Characterizing the Rise in Obesity Among Adults in England
Saiedeh Fallah-Fini, California State and Polytechnic University, Pomona, 3801 W. Temple Ave, Pomona, CA, 91768, United States of America, sfallahfini@cpp.edu

This paper uses systems dynamics to present a population-level model that quantifies the energy imbalance gap responsible for the obesity epidemic among adults in England (across different gender and ethnicity subpopulations) during the past two decades. The developed model also estimates the magnitude of calorie reduction that should be targeted by obesity interventions to reverse the current trajectory of the obesity epidemic.
3 - Co-operation in Services: The Boardwalk Phenomenon
Lucy Gongtiao Chen, National University of Singapore, 15 Kent Ridge Drive, Singapore, Singapore, bxcg@nus.edu.sg.
Tinglong Dai, Nagesh Gavirneni, Xichuan Yuan
We consider two service firms (e.g. restaurants) that compete on price and waiting time and cooperate on entertainment effort that reduces the waiting cost of the patrons. We study monopoly and duopoly settings and in the latter, we consider both individual and joint entertainment efforts. We show that by cooperating on entertainment, the competing service firms are able to achieve efficiency levels equivalent to that of monopoly setting.

**TA40**

40-Room 101, CC

Behavioral Operations III

Contributed Session

Chair: Ling Li, Professor, Department Chair of IT, Old Dominion University, 2064 Constant Hall, Norfolk, VA, 23529, United States of America, ili@odu.edu

1 - NewsVendor Decision with Multiple Reference Points
Feng Li, Dr., South China University of Technology, Wushan Road, Guangzhou, China, fenglee@scut.edu.cn, Ying Wei
This paper studies how bottom line and status quo as reference profits influence the newsvendor behavior and the optimal order quantity. Employing tri-reference point theory, psychological value of the profit is regarded as gain, loss, or failure based on the two benchmarks. We find that the presence of bottom line decreases the optimal order quantity. In addition, the optimal order quantity may decrease with the wholesale price and increase with the retail price.

2 - Prediction on Network Public Opinion in Online Communities of Different Age Structures
Tianjiang Bongin, Master, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, HU, 430074, China, t.j.mcriyad@hotmail.com
We get the evolution law of different age structures in different internet public opinion events through simulation and analysis, and analyze the effect of youth group, middle-aged group and elderly group in each community on internet public opinion respectively, and also find the special role that the elderly group plays during the public opinion evolution processes. In the end, we propose some effective suggestions for Government according to simulation results.

3 - Employees’ Cyber Security Behavior and Information Security Policy
Ling Li, Professor, Department Chair of IT, Old Dominion University, 2064 Constant Hall, Norfolk, VA, 23529, United States of America, ili@odu.edu, Li Xu, Wu He
This research focuses on cybersecurity by theoretically defining the conceptual domains of employees’ online security behavior and beliefs. We examined the relative importance of 10 factors that will be used for developing new training methods and materials to improve employees’ awareness and skills to defend against cybersecurity risks, and investigated the relationship between the availability of cybersecurity policy and individual employee’s behavior and beliefs toward cybersecurity issues.

**TA41**

41-Room 102A, CC

Studies in Healthcare Productivity

Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations
Sponsored Session

Chair: Robert Batt, Asst. Professor, Wisconsin School of Business, UW-Madison, 975 University Ave., Grainger Hall, 5279, Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

1 - Mining for Content: A Study of E-visits
Hessam Bavafa, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hbaavafa@bus.wisc.edu
We study the micro-structure of e-visits, electronic communications between patients and providers through patient portals. The main promise of e-visits as a new channel for providing primary care services is to decrease the number of office visits and improve patient health. We examine detailed information about the patients, providers, and e-visit details (e.g., timings and text of e-visits) to establish a better understanding of e-visits.
3 - Screening for Hepatocellular Carcinoma: A Restless Bandit Model
Elliott Lee, University of Michigan, 1205 Real Ave, Ann Arbor, MI, 48109, United States of America, elliotld@umich.edu,
Marti Lavlert, Michael Volk
Currently, all patients at risk for hepatocellular carcinoma (HCC) are screened every six months. Recent medical discoveries have found a correlation between a biomarker measured at each screening, and his/her risk of developing HCC. We model the problem of simultaneously learning while allocating a limited number of screening resources across a population as a restless bandit model. We prove several structural properties of this problem, and ultimately derive a corresponding optimal policy.

4 - Enhancing FDA's Decision Making using Data Analytics
Vishal Ahuja, Southern Methodist University, P.O. Box 750333, TX, United States of America, vahuja@smu.edu, John Birge
Existing FDA surveillance methods are based on voluntary reporting or meta-analysis primarily geared towards identifying new/unknown adverse events. We propose a statistically robust and evidence-based empirical approach that focuses on evaluating specific drug-related adverse outcomes to aid in the FDA decision-making. We demonstrate our approach using a controversial black box warning. Based on a large dataset from the Department of Veterans Affairs, we find that the warning was not warranted.

Sponsored Session
Chair: Rene Caldentey, NYU, 44 W 4th St, New York, NY, 10012, United States of America, rcaldent@stern.nyu.edu
Co-Chair: Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu

1 - Incorporating Online Customer Ratings in Pricing Decisions
Marie-claude Cote, Manager, Data Science, JDA Software - Innovation Labs, 4280 Saint-Laurent #407, Montreal, QC, H2W 2R2, Canada, Marie-Claude.Cote@jda.com, Philippe Tilly, Nicolas Chapados
Research have demonstrated that online customer ratings have a huge impact on the decision to choose a product. In hospitality, where the product is a hotel room for a length of stay, customers consult an increasing number of reviews prior to booking. We will describe an approach to automatically incorporate online user rating impact in the pricing decisions of a hospitality revenue management system.

2 - On the Equivalence of Quantity Pre-commitment and Cournot Games
Ammar Farahat, Washington University in St. Louis, One Brookings Drive, St. Louis, MO, 63104, United States of America, farahat@wustl.edu, Hongmin Li, Tim Huh
We establish sufficient conditions under which Cournot outcomes solve quantity-followed-by-pricing games. Kreps and Scheinkman (1983) established this connection for homogeneous product duopolies and Friedman (1988) for certain differentiated product oligopolies under restrictive assumptions. Our research provides conditions for more general differentiated product settings, including multinomial logit models.

3 - Pricing Policies for Perishable Products with Demand Substitution
Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu, Rene Caldentey
We study a monopolist's optimal dynamic pricing policy for a family of substitute perishable products. Customers arrive to the market according to an exogenous stochastic process, each with a budget constraint. Upon arrival, each customer first makes a decision among subfamilies that are differentiated by quality, and then selects among horizontally differentiated products within the subfamily. We characterize the optimal pricing policy and study the asymptotic approximation.

4 - Optimal Time and Price of Dynamic Upgrade
Xiao Zhang, PhD Candidate, University of Texas at Dallas, Richardson, TX, United States of America, xxz085020@utdallas.edu, Ozalp Ozer
Upgrade, a strategy used in travel industry to balance the supply-and-demand mismatches among products of different quality levels, is usually offered either at the booking time or the consumption time. We study a revenue management problem of a firm which sells two products at fixed prices and offers upgrade options anytime after necessary. The optimal policy specifies the time and price of the upgrade option, and how many existing customers should be offered this option.
1 - Monopoly Pricing in the Presence of Social Learning
Davide Crapis, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, dcrapis16@gsb.columbia.edu, Bar Ifrach, Costis Maglaras, Marco Scarsini

A monopolist offers a product to a market of consumers with heterogeneous preferences. Consumers are uninformed about product quality and learn from reviews of others. First, we show that learning eventually occurs. Then, we characterize the learning trajectory via a mean-field approximation that highlights how the learning process depends on price and heterogeneity. Finally, we solve the pricing problem and show that policies that account for social learning increase revenues considerably.

2 - Networks, Shocks, and Systemic Risk
Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Urs Hall 418, New York, NY, 10023, United States of America, alirezat@columbia.edu, Daron Acemoglu, Asu Ozdaglar

We develop a unified framework for the study of how network interactions can function as a mechanism for propagation and amplification of macroeconomic shocks. The framework nests various classes of games over networks, models of macroeconomic risk originating from microeconomic shocks, and models of financial interactions.

3 - Market Entry under Competitive Learning
Kimon Drakopoulos, kimondr@mit.edu, Asu Ozdaglar, Daron Acemoglu

We consider a market entry game with two players, an incumbent and an entrant. The market can be of two types: (a) bad in which case the demand is fully elastic at a price (bartr) or (b) good in which case there is a positive arrival rate of consumers who are willing to buy at higher prices. The entrant is learning the type of the market by observing the flow of payoffs. We prove that the problem has a structure of a war of attrition game and study its weak perfect Bayesian equilibrium.

4 - Social Learning with Differentiated Products
Arthur Campbell, Associate Professor, Yale University, School of Management, 135 Prospect Street, P.O. Box 208200, New Haven, CT, 06520-8200, United States of America, Arthur.Campbell@yale.edu

This paper embeds social learning in a model of firms producing differentiated products. We consider how the structure of social relationships between consumers influence pricing and welfare. The model considers how a variety of characteristics of the social network influence these outcomes. It also serves to highlight the challenges one faces in using metrics such as consumer awareness and the sensitivity of demand to prices as measures of informational efficiency in markets.

2 - Spatial Competition and Preemptive Entry in the Discount Retail Industry
Fanyin Zheng, Columbia Business School, 3022 Broadway, New York, NY, United States of America, fanyin.zheng@gmail.com

I study the competitive store location decisions of discount retail chains in this paper. I model firms’ entry decisions using a dynamic duopoly location game and allow stores to compete over the shopping-dollars of close-by consumers. I use various economic modeling techniques to make the model tractable and infer market divisions from data using a clustering algorithm. The empirical analysis suggests that dynamic competitive considerations are important in chain stores’ location decisions.

3 - Using Real-time Operational Data to Increase Labor Productivity in Retail
Marcelo Oliveras, Assistant Professor, Universidad de Chile, Republica 701, Santiago, Chile, molivares@u.uchile.cl

We develop a methodology to re-assign sales employees across departments in a large retail store in order to improve productivity. Our method seeks to maximize the effectiveness of labor by allocating employees to departments that require immediate assistance and where this assistance has a larger impact of sales. The method combines empirical methods to measure the impact of assistance and store operational data collected through video analytics to reassign employees in real-time.

4 - Consumer Search and the Structure of Personal Networks
Raghuram Iyengar, Associate Professor, The Wharton School, University of Pennsylvania, 3730 Walnut Street Suite 700, Philadelphia, PA, 19104, United States of America, riyengar@wharton.upenn.edu

We study how consumers’ information search for and purchase of new products are affected by structure of their personal network. To address threats to internal validity common in network studies, we conduct a randomized experiment in which study participants manipulate the similarity of information among consumers and their network contacts. We estimate consumers’ utility function and determine how network antecedents moderate the weight on others’ information.
4 - Improving Food Bank Gleaning Operations: An Application in New York State
Erkut Sommez, Assistant Professor, Boston College, 140 Commonwealth Ave, Fulton Hall, Chestnut Hill, 02446, United States of America, erkut.sommez@bc.edu, Miguel Gomez, Dezhin Lee, Xiaoli Fan
We develop a stochastic optimization model to help food banks to improve their gleaning operations. Gleaning refers to collecting food from what is left in the fields after harvest, and donating the goods to food banks or pantries that serve food insecure individuals.

5 - TA48
48-Room 105A, CC
Managing Contracts and Financial Flow in Supply Chain
Sponsor: Manufacturing & Service Oper Mgmt/FORM
Sponsored Session
Chair: Bingxiu Dong, Associate Professor, Washington University in St. Louis, One Brookings Drive, St. Louis, MO, 63132, United States of America, dong@wustl.edu
1 - Buyer Intermediation in Supplier Finance
Tunay Turca, t.trunca@rhsmith.umd.edu, Weiming Zhu
We analyze the role and the efficiency of buyer intermediation in supplier financing (BIF). We theoretically demonstrate that BIF can significantly improve the supply chain surplus over traditional financing. Using data from a large Chinese online retailer, we estimate model parameters, empirically verify the theory, and predict efficiency gains.

2 - Financial Pooling in Supply Chains
S. Alex Yang, Assistant Professor, London Business School, Sussex Place, London, United Kingdom, sayang@london.edu, Qu Qian, Ming Hu
Trade credit pools liquidity between suppliers and retailers. Due to this pooling effect, even if the supplier's cost of capital is higher, the retailer may still demand trade credit. Supply chain finance increases the efficiency of this pooling effect, and hence reduces the overall chain financing cost.

3 - Trade Credit and Supplier Competition
Jiri Chod, Boston College, Carroll School of Management, Chestnut Hill, MA, jiri.chod@bc.edu, S. Alex Yang, Evgeny Lyandres
We study the effect of competition among suppliers on their willingness to provide trade credit. Providing trade credit to a financially constrained buyer allows this buyer to reallocate his cash budget to purchasing from competing suppliers. Thus, relaxing the buyer's financial constraint may backfire at the supplier who provides financing. This is a possible explanation of the empirical regularity that firms selling differentiated products tend to offer more trade credit.

4 - Push, Pull, and Delayed Payment Contracts when a Manufacturer Expands his Product Line
Xiaomeng Guo, PhD Candidate, Olin Business School, Washington University in St. Louis, Campus Box 1156, One Brookings Drive, St. Louis, MO, 63130, United States of America, xiaomeng.guo@wustl.edu, Lingxiu Dong, Danko Turcic
A manufacturer's ability to sell a new product often depends on a retailer's willingness to stock the product. We construct a game-theoretic model of a supply chain with stochastic, price-sensitive demand and consider three basic wholesale price contracts: push, pull and delayed payment contracts. We show how a manufacturer can influence the retailer's incentive to carry a second product by choosing a "correct" contract type and clarify which contract should be expected in equilibrium.

5 - TA50
50-Room 106A, CC
Operations Management and Marketing Interface
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Ozge Sahin, Johns Hopkins University, ozge.sahin@jhu.edu
Co-Chair: Yao Cui, Cornell University, 401N Sage Hall, Ithaca, United States of America, yao.cui@cornell.edu
1 - Econometric Models of Pairwise Externalities and Social Attractiveness for the Music Industry
Stefano Nasini, Post-doctoral Researcher, IESE Business School, 3-7, Armas i Gari, Barcelona, Spain, snasini@iese.edu, Victor Martinez-de-Albéniz
We developed an econometric model of social attractiveness that integrates time variation of individual decisions with the structural information concerning their spillovers. The exponential family of distributions is used to jointly deal with the dynamic and structural aspect of such a complex statistical setting. It resulted in a well-suited model for the analysis of artist goods. An application to a large data set of song diffusion on the radio is presented.

2 - Inventory Management for Luxury Goods
Ruslan Momot, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, ruslan.momot@insead.edu, Elena Belavin, 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 behavior 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.

3 - A Newsvendor Model with Product Bundling
Qingning Cao, University of Science and Technology of China, Jinzhai Rd, SM 611, Hefei, China, caoq@ustc.edu.cn, Jun Zhang, Kathy Stecke, Xianjun Geng
This paper studies a firm's optimal ordering decision of a primary product when the firm can bundle this product with another product. The firm makes an ordering decision before demand uncertainty resolves, and then retails this primary product either alone or in a mixed bundle with a secondary product. Our result suggests that as compared to a no-bundling benchmark, the firm should overstock (understock) when the wholesale price is high (low).
4 - Strategic Consumers, Revenue Management and the Design of Loyalty Programs
So Yeon Chun, McDonough School of Business, Georgetown University, 3700 O St. NW, Washington, DC, United States of America, sc1286@georgetown.edu, Anton Ovchinnikov

Several major airlines recently switched their loyalty programs from "mileage-based" toward "spending-based". We study the impact of this switch on firm's profit and consumer utility. We present a novel model of strategic consumers' response to firm's pricing and loyalty program decisions, incorporate such response into the firm's pricing and loyalty program design problem, compare the solutions under the mileage-based versus spending-based design, and discuss managerial implications.

**TA51**
51-Room 106B, CC
Economics of Innovation in Supply Chains
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Ayhan Aydin, Assistant Professor Of Operations Management, George Mason University School of Business, 4400 University Drive MS 5F4, Fairfax, VA, 22030, United States of America, aaydin2@gmu.edu

- Product Quality in a Decentralized Supply Chain: Value of Information Asymmetry
Narendra Singh, Narendra.Singh@scheller.gatech.edu, Syllanios Kavadias, Ravi Subramanian

We study an OEM's optimal product design quality and sourcing strategies in a supply chain consisting of an OEM, who has in-house option, and a supplier, who has more favorable cost structure and the power to dictate contract terms. We show that a two-tier supply contract, as opposed to a price-only contract, may leave both the OEM and the supplier worse off. Further, we show that asymmetric information about the OEM's cost structure may lead to higher profits for both the OEM and the supplier.

- Information Acquisition and Innovation in Competitive Markets
Yi Xu, Associate Professor, Smith School of Business, University of Maryland, College Park, MD, 20742, United States of America, yxy@rhsmith.umd.edu, He Chen, Manu Goyal

In this paper, we study firms' information acquisition strategies and innovation strategies in a competitive market with uncertainty. The firms can resolve the market uncertainty through different information acquisition methods. We highlight the strategic interactions between information acquisition and innovation investments in such a market.

- Investment in Core Technologies and Consumer Markets
Ayhan Aydin, Assistant Professor Of Operations Management, George Mason University School of Business, 4400 University Drive MS 5F4, Fairfax, VA, 22030, United States of America, aaydin2@gmu.edu, Rodney Parker

We consider a two-tier supply chain, an upstream tier composed of two competing providers of a component that is used by multiple OEMs (integrators) in the lower tier. Upstream firms invest to develop the technology of the component further. We investigate the effects of downstream market factors, the nature of technology competition, and the level of uncertainties in the R&D process on the level of upstream investments and the adoption of the higher technologies by the downstream firms.

**TA52**
52-Room 107A, CC
Consumer-driven Management Science
Sponsor: Marketing Science
Sponsored Session
Chair: Ricardo Montoya, Assistant Professor, University of Chile, Republica 701, Santiago, Chile, rmontoya@di.uchile.cl

1 - Product Showcasing in the Presence of Experience Attributes
Daria Dzyabura, Assistant Professor of Marketing, NYU Stern School of Business, 40 West 4th Street, Tisch 805, New York, NY, 10012, United States of America, ddzabur@stern.nyu.edu, Srikanth Jagabathula

We formalize a firm's showcase decision, or selecting a subset of products to carry in a physical store, while a "large" product line is offered through the online channel. Some customers visit the offline store to gain information about product features. We formalize the showcase problem as an IP, which we show to be NP-complete, derive closed-form solutions for special cases, and adapt the local search heuristic to the general problem. We gather conjoint data to estimate the model parameters.

2 - Price Drop Protection Policy with Partial Refunds
Dinah Cohen-Vernik, Assistant Professor Of Marketing, Rice University, 6100 Main St, Houston, TX, 77005, United States of America, dv6@rice.edu, Amit Paggal

Many retailers now offer to refund customers the full price difference as long as the price drop occurred within a specified period of time after the purchase. Despite the popularity of such policy, the existing marketing research on the topic is scarce. In this paper we investigate the price difference refund policy (referred to as price drop protection) and demonstrate how it can improve retailer's profits.

3 - Clicks and Editorial Decisions: How Does Popularity Shape Online News Coverage?
Pinar Yildirim, Assistant Professor Of Marketing, The Wharton School, University of Pennsylvania, 748 Huntsman Hall, Philadelphia, PA, 19104, United States of America, pylid@wharton.upenn.edu, Ananya Sen

Using online news data from a large Indian English daily newspaper, this paper analyzes how demand side incentives shape news media reporting. To establish a causal link, we instrument the views of articles using days with rain and days with electricity shortage as exogenous shocks to reader attention. We provide evidence for extended coverage and higher resource allocation to issues which receive high number of clicks.

**TA53**
53-Room 107B, CC
Behavior in Operational Contexts
Sponsor: Behavioral Operations Management
Sponsored Session
Chair: Anton Ovchinnikov, Queen's University, 143 Union Str, West, Kingston, Canada, anton.ovchinnikov@queensu.ca

1 - Behavioral Ordering: Inventory, Competition and Policy
Bernardo Quiroga, Assistant Professor, Business And Behavioral Science, Clemson University, 100 S irstine Hall, Clemson, SC, 29634, United States of America, bquirog@gmail.com, Anton Ovchinnikov, Brent Moritz

We study the effect of observed inventory decisions on performance. Our goal is to measure and understand profit losses due to behavioral (intuitive but suboptimal) ordering. The current literature, primarily focused on a newsvendor making decisions in isolation, reports results implying profit losses of 1-5% compared to the analytical optimum. In contrast, we show that when a behavioral inventory manager competes against a management-science-driven competitor, profit losses are much larger.

2 - Inequity and Loss Aversion in Pay What You Want
Yulia Vorotyntseva, PhD Candidate, The University of Texas at Dallas, Richardson, United States of America, Yulia.Vorotyntseva@utdallas.edu, Ozalp Ozer

Pay-What-You-Want pricing is an exemplar of fairness-driven behavior in a business context: the price for a product is fully determined by a buyer, and the seller cannot reject any offer. The objective of our work is to find out key factors affecting the buyers' selection of prices under PWWW. We use a distributional fairness approach and build a hierarchical Bayesian model of buyers' behavior. We then test it in a controlled laboratory experiment.

3 - Inventory Decisions in the Presence of Strategic Consumers
Yaozhong Wu, National University of Singapore, NUS Business School, Singapore, Singapore, yaozhong.wu@nus.edu.sg, Yong Zhang, Benny Mantin

In the presence of strategic consumers, who may delay their purchase to the markdown season, a retailer is faced with an extra consideration in addition to the traditional newsvendor setting: excess inventory may induce strategic consumers to delay their purchase and may further harm the revenue. We develop a model that accounts for both the strategic consumers and the retailer's inventory decisions. We design behavioral experiments to test our model predictions.
4 - When to Hire the First Employee? Behavioral Evidence and Insights
Beatrice Boulu-resheb, Behavioral Research Associate, Darden School of Business, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, Boulu-Resheb@duarden.virginia.edu, Anton Ovchinnikov, Charles Corbett
Effectively any entrepreneur shifts from doing all the work him/herself to hiring someone to do part of that work. We use an analytical model and behavioral experiments to study when entrepreneurs should and do hire their first employee. Understanding both the optimal timing/conditions of hiring and the deviations of the hiring patterns from optima have the potential to provide insights to a very broad spectrum of entrepreneurs at the critical early stage of their new venture formation process.

■ TA54
54-Room 108A, CC
Applying Machine Learning in Online Revenue Management
Cluster: Tutorials
Invited Session
Chair: David Simchi-Levi, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dslevi@mit.edu
1 - Tutorial: Applying Machine Learning in Online Revenue Management
David Simchi-Levi, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dslevi@mit.edu
In a dynamic pricing problem where the demand function is unknown a priori, price experimentation can be used for demand learning. In practice, however, online sellers are faced with a few business constraints, including the inability to conduct extensive experimentation, limited inventory and high demand uncertainty. In this talk we discuss models and algorithms that combine machine learning and price optimization that significantly improve revenue. We report results from live implementations at companies such as Rue La La, Groupon and a large European Airline carrier.

■ TA55
55-Room 108B, CC
Extensions of DEA
Cluster: Data Envelopment Analysis
Invited Session
Chair: Endre Bjørndal, Associate Professor, Norwegian School of Economics, Helleveien 30, Bergen, 5045, Norway, Endre.Bjorndal@nhh.no
1 - Assessment of Alternative Approaches to Include Exogenous Variables in DEA Estimates
Jose M. Cordero, Universidad de Extremadura, Av Elvas sn, Badajoz, Spain, jmcordero@unex.es, Daniel Santin
The aim of this paper is to compare the performance of some recent methods developed in the literature to incorporate the effect of external variables into the estimation of efficiency measures such as the conditional approach developed by Darcio and Simar (2005, 2007) or the one-stage model proposed by Johnson and Kuusmanen (2012). To do this, we conduct a Monte Carlo experiment using a translog function to generate simulated data.

2 - Compensating for Exogenous Cost Drivers in the Regulation of Electricity Networks
Endre Bjørndal, Associate Professor, Norwegian School of Economics, Helleveien 30, Bergen, 5045, Norway, Endre.Bjorndal@nhh.no, Maria Nieswand, Mette Bjørndal, Astrid Cullmann
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 nonparametric methods to current benchmarking model, and we discuss whether the choice of method affects the revenue cap of companies in a systematic manner.

3 - Slacks-based Measure Variations Revisited
Kaoru Tone, Professor, National Graduate Inst. for Policy Studies, 7-11-1 Roppongi, Minato-ku, Tokyo, 106-8677, Japan, tone@grips.ac.jp
In Tone (2010), I developed four variants of the SBM model where main concerns are to search the nearest point on the efficient frontiers of the production possibility set. However, in the worst case, a massive enumeration of facets of polyhedron associated with the production possibility set is required. In this paper, I will present a new scheme for this purpose which requires a limited number of additional linear program solutions for each inefficient DMU.

■ TA56
56-Room 109A, CC
Execution Mode Choices for NPD
Cluster: New Product Development
Invited Session
Chair: Pascale Crama, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, pcrama@smu.edu.sg
1 - Managing Exploration and Execution
Nittala Lakshminarayana, University of California San Diego, 9256 Regents Road Apt. G, La Jolla, CA, 92037, United States of America, Lakshminarayana.Nittala@rady.ucsd.edu, Sanjiv Erat, Vish Krishnan
We model Innovation as a multi-stage activity consisting of Exploration and Execution. Within this paradigm, we mimic many contexts in Innovation, we consider the effect of incentives and several institutional features on the optimal idea generation and development strategy.

2 - Customer Co-design: The Role of Product Lines
Sreekumar Bhaskaran, sbhaskar@mail.cox.smu.edu, Amit Basu
Involving customers in the new product design can be a powerful means to achieve high levels of customer satisfaction and market success. However, the “co-design” process may require participating customers to commit significant time and effort, while facing the uncertainty that the firm may overprice the custom product. Since this reduces a customers incentive to commit effort upfront, co-design can be difficult to motivate. We develop analytical models that capture these various effects.

3 - Flexibility and Knowledge Development in Product Development: Insights from a Landscape Search Model
Mohsen Jafari Songhori, Jsp Research Fellow, Tokyo Institute of Technology, 12 Bldg., Room 1704, 4239 Nagatsuta-cho., Tokyo, 226-8502, Japan, mj2417@gmail.com, Majid Abdi, Takao Terano
This study introduces a landscape model of Product Development (PD). The model captures different PD performance aspects (e.g. development time, quality and cost) and their trade-offs. Moreover, knowledge development dynamics and flexibility are incorporated in the model to investigate how strategies toward these, in PD process, are associated with the performance measures.

■ TA57
57-Room 109B, CC
Applications of Stochastic and Dynamic Programming in Energy
Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)
Sponsored Session
Chair: Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, andrewliu@purdue.edu
1 - Approximate Dynamic Programming for Pricing-based Real-time Demand Management
Ozgur Dalkilic, The Ohio State University, 205 Dreese Labs, 2015 Neil Ave, Columbus, OH, 43210, United States of America, dalkilic.1@buckeyemail.osu.edu, Atilla Eryilmaz, Antonio Conejo
We consider the real-time demand management problem of a load aggregator that coordinates the consumer demand to match a predetermined daily load. The aggregator’s objective is to minimize its payment to the real-time market. Under uncertainty of the market prices, we derive dynamic pricing algorithms that approximate the optimal dynamic programming solution. We show via numerical investigations that the proposed algorithms coordinate flexible demand and achieve close to optimal allocation.
2 - A Revenue Adequate Stochastic Programming Market Clearing Mechanism for Effective Integration of Volatile Renewable Generation
Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N. Charles St. Latrobe 205, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu, Adam Christensen
We apply a Multiobjective Program with Equilibrium Constraints to the United States renewable fuel market to help understand why it has been so difficult in recent years to implement the Renewable Fuel Standard. Our analysis provides a variety of policy alternatives to aid in setting these volume obligations and is applicable to a wide variety of climate and energy market settings.

3 - Parallel Computing of Stochastic Programs with Application to Energy System Capacity Expansion
Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, andrewliu@purdue.edu, Run Chen
Power grids’ planning and operations exhibit extreme multiscale, ranging from hourly operation to decades of planning. The linkage between decisions at different time scales may be relaxed to produce multiple independent subproblems. We propose to use an augmented Lagrangian multiplier method to design parallel algorithms to solve such multiscale problems. Convergence of the embedded algorithm for convex problems will be shown, along with preliminary numerical results.

4 - Volumes for the Renewable Fuel Standard using Multiobjective Programs with Equilibrium Constraints
Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N. Charles St. Latrobe 205, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu, Adam Christensen
We apply a Multiobjective Program with Equilibrium Constraints to the United States renewable fuel market to help understand why it has been so difficult in recent years to implement the Renewable Fuel Standard. Our analysis provides a variety of policy alternatives to aid in setting these volume obligations and is applicable to a wide variety of climate and energy market settings.

TA60
60-Room 111A, CC
Education 1
Contributed Session
Chair: Nabil Belacel, Senior Research Officer, NRC, 100 des Aboiteaux Street, Moncton, NB, E1A7R1, Canada, nabil.belacel@nrc.gc.ca
1 - Co-Author Network Analysis of Operations Management Journals
Bonnie M. Blank, PhD Candidate, Rutgers Business School, 1 Washington Park, Newark, United States of America, boni.m.blank@rutgers.edu, Yao Zhao, Xinxin Yuan
We study the co-author network of flagship INFORMS journals in operations management such as Management Science and Operations Research. Our empirical exploration characterizes the changing patterns of the co-author network and provides insights to authors on how to improve productivity through exploitation of the academic social network.
In this case we discuss the revenue model for a rental car business in India. The case can be used for teaching topics in probability and decision modeling at both undergraduate and graduate level. The first part of the case focuses on expected value and the second part of the case involves decision making under uncertainty and strategic choices. It can also be extended to train students in basic simulation using Crystal Ball or other such tools.

**3 - A Learner-Analytics Based Approach for Attenuating the Course-Level Dropout Rate**

Aysegul Demirtas, Graduate Student, Arizona State University, 699 S Mill Avenue, Tempe, AZ, 85281, United States of America, ademir2@asu.edu, Jennifer Bekki, Esma Gel, George Runger Despite their potential to attract larger numbers of students, online courses remain plagued by a student attrition problem. We apply data mining and learner analytics techniques to better understand online learner behavior in an effort to attenuate the online course drop-out rate. We present our modeling approach, utilizing data from student interactions with the course LMS, and our findings on course-level persistence based on the application of our approach to data from multiple courses.

**4 - The School Closing Problem**

Jing Xu, University of Pennsylvania, 209S 33rd Street, Department of Mathematics, Philadelphia, PA, 19104, United States of America, jxl@math.upenn.edu When school districts face declining enrollments, schools must be closed to reduce costs. The choice of which schools to be shuttered is controversial. Surprisingly, few papers have considered this problem. This paper considers the effect of using existing school choice mechanisms to close schools. It turns out simple modifications of existing algorithms produce perverse results. We also establish non-existence of a Pareto-efficient and strategy-proof mechanism in a basic school closing model.

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**TA61**

61-Room 111B, CC

**Sustainability in Energy Sector: Policy Analysis and Technology Assessment**

Sponsor: ENRE – Environment I – Environment and Sustainability Sponsored Session

Chair: Yihsu Chen, Associate Professor, University of California, Merced, 5200 N. Lake Rd, Merced, CA, 95343, United States of America, ychen26@ucmerced.edu


Afzal Siddiqui, University College London, Department of Statistical Science, Gower Street, London, UK, WC1E 6BT, United Kingdom, afzal.siddiqui@ucl.ac.uk, Vilma Virašjoki, Paula Rocha, Ahti Salo Intermittent renewable energy (RE) technologies require conventional power plants to ramp up more often. In turn, energy storage may offset the intermittency of RE technologies and facilitate their integration into the grid. In order to assess the consequences of storage, we use a complementarity model with market power, transmission constraints, and uncertainty in RE output. We find that although storage reduces congestion and ramping costs, it may actually increase greenhouse gas emissions.

2 - Do Emissions Caps Lead to Carbon Leakage in Regional Markets? The Case of South-east Europe

Verena Viskovic, PhD Student, University College London, 50 Tiber Gardens, London, N, N10XE, United Kingdom, verena.viskovic@gmail.com, Yihsu Chen, Afzal Siddiqui We examine the extent of carbon leakage in neighbouring jurisdictions with different carbon emissions reduction policies. We use a complementarity model to illustrate carbon leakage on a three-node power system. Subsequently, we model a 19-node Southeastern European network in order to study carbon leakage on the periphery of the EU.

3 - Equilibrium Investment Strategies in Renewable Portfolio Standards under Uncertainty

Yuta Kamobayashi, Tokyo University of Science, 2641 Yamazaki, Noda–shi, Chiba, Japan, 741-4609@ed.tsu.ac.jp, Ryuta Takashima, Makoto Tanaka, Yihsu Chen 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 RPS. 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.

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**TA62**

62-Room 112A, CC

**Reliability and Random Factors in Power Systems**


Chair: Bo Zeng, Assistant Professor, University of South Florida, Tampa, 4202 E. Fowler Avenue, Tampa, FL 33620, United States of America, bzeng@usf.edu

1 - Protect Power System from Electromagnetic Pulse

Feng Pan, Research Engineer. Pacific Northwest National Laboratory, P.O. Box 999 MSIN K1-85, Richland, WA, 99352, United States of America, feng.pan@pnnl.gov, Russell Bent, Art Hagberg Power grids are vulnerable to Electromagnetic pulse (EMP) that can lead a power grid to collapse in a short time. We introduce an optimization model to configure a power grid prior to an EMP so that the damage caused by EMP is reduced. This talk will focus on the modeling aspect.

2 - Modeling Cascading Failures and Restoration Times in Power Networks to Address Resilience

Sinan Tas, Assistant Professor, Penn State University-Berks College, sut12@psu.edu, Vicki Bier Prevention is generally the default solution in security investments of critical infrastructure. Electric power networks are capacity-constrained systems, which makes them a perfect candidate for cascading failure. Moreover, different components take substantially different times to recover. In this study, we will analyze investments that will possibly improve overall resilience of the network (rather than preventive ones that decreases the likelihood of such attacks).

3 - Joint Planning of Energy Storage and Transmission for Wind Energy Generation

Wei Qi, PhD Candidate, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, CA, 94720, United States of America, qiwee@berkeley.edu, Yong Liang, Zuo-jun Max Shen Abstract: Regions with abundant wind energy usually have no ready access to power infrastructure. We propose models of transmission network planning with co-location of energy storage systems for wind energy delivery. Our models determine the sizes and sites of storage stations as well as the corresponding topology and capacity of the transmission network. Then we present various insights regarding storage value, technology advancements and layout robustness.
2 - Retailer's Optimal Sourcing Strategy under Consumer Stockpiling: A Risk Management Approach

Jiho Yoon, Michigan State University, N468 North Business Complex, Michigan State University, East Lansing, MI, 48824-1121, United States of America, yoon@broad.msu.edu, Ram Narasimhan, Myungkyo Kim

We study a retailer's sourcing strategy under consumers' stockpiling behavior and the factors associated with the selection of an optimal strategy in multi-tier supply chains in the presence of supply disruption risk. Stockpiling behavior occurs when consumers attempt to mitigate the negative impact of a supply shortage. Our analysis shows that optimal sourcing strategy is highly dependent on multiple factors.

3 - Relationships in Servitization, Satisfaction and Intention to Reuse: Customers' Perspective

Sang Hyung Ahn, Professor, Seoul National University, Graduate School of Business, Seoul, Korea, Republic of, shahn@snu.ac.kr, Chang Won Lee

This study presents a relationship among characteristics of servitization, satisfaction, and intention to reuse in terms of customers' perspective. The results examined identify significant factors affecting satisfaction, satisfaction, and intention to reuse. The study provides decision-makers with more accurate information to develop appropriate servitization practices in terms of customers' perspective.

4 - Industrialization, Productivity and the Shift to Services

Hosun Rhim, Professor Of Logistics, Service, And Operations Management, Korea University Business School, Anam-dong, Seongbuk-gu, 136-701, Seoul, Korea, Republic of, hhrim@korea.ac.kr, Uday Karmarkar, Khiloon Kim

The traditional explanation for the shift to services was the steady growth of manufacturing productivity. But this does not explain the initial growth in manufacturing, or that of information intensive services relative to physical services. The authors adduce a second factor that explains both trends: the manufacturing productivity. But this does not explain the initial growth in manufacturing, or that of information intensive services relative to physical services. The authors adduce a second factor that explains both trends: the relative maturity of a market.

2 - Lessons Learned Deploying ODQ

Larry Neal, Independent, 3667 Cantelow Rd, Vacaville, CA, 95688, United States of America, l Neal@wildblue.net, Frank Koch

A panel of seasoned practitioners will discuss the lessons learned in deploying the concepts of Decision Quality throughout their organization, or ODQ. After brief opening remarks, the panel will discuss the learnings both positive and negative, of their experiences. The focus of this session is to help other institutions follow suit and raise the bar on their organization decision making practices. Attendees will come away with readily usable insights and tips for their own use.

3 - Applying Decision Analysis at Pfizer – Lessons Learned from the Field

Rodger Thompson, Sr. Director/team Leader, Pfizer, Inc., 500 Arcola Road, Collegeville, PA, 19426, United States of America, rodrger.thompson@pfizer.com

This presentation will discuss the journey that the Portfolio and Decision Analysis (PDA) group at Pfizer has undertaken to bring decision excellence to the Pfizer organization. The discussion will focus on lessons learned on adapting the Dialog Decision Process to Pfizer to enable integration of the six components of decision quality.

2 - Eliciting and Modeling Continuous Forecasts

Joe Tidwell, University of Maryland, Biology/Psychology, Building, College Park, United States of America, jtidwell@umd.edu

Accurate forecasting models for continuous outcomes offer many benefits, including eliminating most close-call counterfactuals, better information about tail risks, and the ability to obtain forecasts for any value across the range of possible outcomes. In a series of experiments, we evaluate various methods for eliciting small sets of judgments from individual forecasters regarding real-world events and then aggregating these judgments over forecasters into continuous forecast models.

3 - Estimating Continuous Distributions by Quantifying Errors in Probability Judgments for Fixed Values

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, Saurabh Bansal

In many managerial decision problems, the distribution for a continuous random variable must be obtained from expert judgments. Using a scale-free model of judgmental errors, we present a method for estimating distribution parameters through linear combinations of the judgments provided, where the weights are explicit functions of the expert's errors. Finally, we demonstrate the applicability and benefits of our approach using data collected in an experimental study.

4 - A Turning Point Model Based on Exponential Smoothing

Xiaojia Guo, University College London, Dept. of Management and Innovation, Gower Street, London, WC1E 6BT, United Kingdom, x.guo.11@ucl.ac.uk, Casey Lichtiendahl, Yael Grushka-Cockayne

We propose a turning point model that extends the damped multiplicative trend exponential smoothing model. Our model offers the ability to dynamically update the local level and the growth trend, and ultimately to predict the turning point. This dynamic turning point model can be contrasted with non-dynamic models that are popular in the literature, such as the Bass diffusion model. We fit the model to several well-studied time series and examine the model's performance.
1 - A Simulation-optimization Approach for Robust Aircraft Routing and Flight Retiming
Mohamad Haouari, Professor, Qatar University, BP 2713, Doha, Qatar, mohamad.haouari@qu.edu.qa, Mohamed Ben Ahmed, Farah Zeghal Mameri
We propose a novel simulation-optimization approach for solving the robust aircraft routing and flight retiming problem. The approach requires iteratively solving a mixed-integer quadratic programming problem that aims at optimally inserting buffer times between consecutive flights, and invoking a Monte-Carlo procedure for assessing the robustness of the generated schedules. We present the results of extensive computational experiments that were carried out on a real data set.

2 - Airlines' Hedging Policies: An Empirical Approach to the U.S. Domestic Market
Soheil Sabdari, Associate Professor, UMass Dartmouth, 285 Old Westport Rd, North Dartmouth, MA, Dartmouth, United States of America, ssabdari@umassd.edu
We study airlines' hedging policies during years 2002-2015 according to their corporate's yearly report. An empirical study examines airlines' policy and determine the impact of airline size, market share, and the airlines' aircraft sizes on the hedging effectiveness.

3 - Meta-heuristic Algorithm for the Multiple Runway Aircraft Scheduling Problem
Bulent Soykan, Old Dominion University, Dept. of Eng., Mngt. and Systems Eng., Norfolk, VA, United States of America, bsoykan01@odu.edu, Ghaith Rabadi
Multiple Runway Aircraft Scheduling Problem involves assigning both landing and taking-off aircrafts to runways, sequencing them on each runway and assigning each aircraft a landing or take-off time while considering predetermined time windows for each aircraft to land or take-off. This research aims to develop a tabu search/path relinking algorithm for the static case of the problem, where all information of aircraft is known in advance.

4 - A Two-Stage Airport Surface 4D Taxing Trajectory Scheduling Strategy Considering Runway Exit Select
Xiang Zou, Tsinghua University, Room 430, Main Building, Tsinghua Univ., Beijing, China, x-zou10@mails.tsinghua.edu.cn, Bang An
This paper proposes a two-stage airport taxing scheduling policy. In the first stage, all of the interested aircrafts are assigned initial routes. Then, aircrafts unavailable to fulfill their initially assigned routes are rescheduled. We do not fix the runway exits of landing aircrafts. Instead, we introduce Runway Exit Availability and a MIP model to assign 4D taxing trajectories. Test in the environment of Beijing Capital Airport shows the effectivity and efficiency of the approach.

2 - Exact Formulations and Algorithms for the Pollution Routing Problem
Yongjia Song, Virginia Commonwealth University, 821 W Franklin Street, Richmond, VA, United States of America, ysong3@vcu.edu, Ricardo Fukasawa, Qie He
We propose for the first time exact formulations of the pollution routing problem. These formulations are all mixed integer convex programs, with one being a mixed integer second-order cone program. The lower bounds provided by the continuous relaxations of these formulations are compared theoretically. Based on our formulations, instances with up to 25 customers in the literature are solved to optimality for the first time.

3 - A Column Generation Algorithm to Solve the Pollution Routing Problem
Fernando Santos, PhD, University of Waterloo, 200 University Avenue West, Waterloo, Canada, fernandoa@watson1.com, Qie He, Ricardo Fukasawa, Yongjia Song
We introduced a set partitioning formulation and a column generation algorithm to solve the Pollution Routing Problem (PRP). To price out negative reduced cost routes we proposed a labeling algorithm that derives novel dominance rules in order to prune out unpromising labels and perform faster.

4 - The Deterministic Dispatch Waves Problem
Mathias Klapp, PhD Student, Georgia Tech, 755 Ferst Drive NW, Main Building #326, Atlanta, GA, 30332-0205, United States of America, maklap2@gatech.edu, Alan Erera, Alejandro Toriello
We study last-mile delivery systems by formulating the deterministic dispatch waves problem (DWP) that models a distribution center where geographically positioned orders arrive at known action periods (waves) throughout the day. At each wave, the decision maker chooses whether to dispatch a single vehicle or not and the subset of open orders to serve in the vehicle’s route, with the objective of minimizing operational costs and penalties for unserved requests.

2 - Quantifying the Resilience of an Urban Traffic – Electric Power Coupled System
Ellis Miller-Hooks, Professor, University of Maryland, College Park, MD, elisemh@umd.edu, Seksun Moryadee, Steven Gabriel, Hossein Fotouhi
A nonlinear, stochastic, mixed integer program is presented for quantifying the resilience of the coupled traffic-power network to a disruption. The model captures interdependencies in this system, and seeks an optimal allocation of limited mitigation, preparedness and response resources to obtain an efficient resource allocation plan and maximum resilience estimate.

3 - Improving the Resilience of Multiple Energy Carrier Microgrids Against Deliberate Disruptions
Saeed Dehghan Manesh, Southern Methodist University, 6251 Airline Rd, Junkins Bldg, suite 334, Dallas, TX, 75275, United States of America, mshadiy@smtp.smu.edu, Mohammad Khodayar
This paper proposes a framework to identify the vulnerable components in the coordinated natural gas and electricity distribution networks in microgrids and to ensure the resilient operation of such interdependent networks. The proposed framework addresses deliberate actions to disrupt the energy flow in the microgrids and proposes reinforcement strategies to increase the resilience of the energy supply.
1 - Solving the Pre-Marshalling Problem to Optimality

Kevin Tierney, Assistant Professor, University of Paderborn, Würburger Straße 100, Paderborn, 33098, Germany, kevin.tierney@upb.de, Stefan Voss, Dario Pacino

The pre-marshalling problem is a key problem at container terminals. The goal is to find a minimal sequence of re-shuffling containers in a set of stacks such that they are arranged according to the time each container must leave the stacks. We present a novel algorithm using A* and IDA* combined with several novel branching and symmetry breaking rules. We solve over 500 previously unsolved benchmark instances to optimality clearly outperforming current state-of-the-art methods.

2 - A Genetic Algorithms Based Approach to Develop Cost-Effective Annual LNG Delivery Program

Fatih Mutlu, Asst. Professor, Qatar University, Doha, Doha, Qatar, fatihmutlu@qu.edu.qa

Developing a cost-effective annual delivery program for liquefied natural gas suppliers is known to be among the most challenging integrated inventory, production, and maritime delivery routing problems. We use a genetic algorithms based approach to solve this problem. We produce alternative routes for the vessels, each of which represents a chromosome. Our method performs better than the exact solution method in all of the problem instances we solved.

3 - A Mathematical Model for the Ship Scheduling and Cargo Assignment Problem

Salomon Wollenstein Betech, Student, Instituto Tecnológico de Estudios Superiores de Monterrey, Av Carlos Lazo 100, Alvaro Obregón, DF, 01389, Mexico, s.wollenstein@gmail.com

Middle-size companies with maritime shipping face a scheduling and cargo-assignment problem. Given a set of demands, suppliers, contracts, and ships, the company must design its operations to minimize cost. A mathematical model is proposed that simultaneously solves the ship scheduling and cargo assignment problem for a period of a year, discretizing time in days. The algorithm is capable of solving the problem at a rate of five ships and ports in ten minutes.

4 - A Bivariate Probit Model to Analyze Perspectives for Container Shipping on the Northern Sea Route

Irina Benedyk, United States of America, birina@purdue.edu, Srinivas Peeta

This study seeks to explore opportunities and barriers for container freight shippers to use the Northern Sea Route. A stated preference survey of freight shippers in East Asia and Europe is conducted. A Bivariate Probit Model is used to investigate attitudes towards the usage of the North Sea Route, and identify key factors that influence them.

2  - Failure Prediction and Sensor Spacing Optimization Along Track Corridors

Yanling Ouyang, Univ. Of Illinois, 205 N. Mathews Ave, Urbana, United States of America, yfouyang@illinois.edu, Zhadong Wang

This talk describes a machine-learning based framework for determining sensor deployment to ensure optimal reporting of potential incident-prone failures of the passing traffic. A simulation-based optimization model is used to find the optimal sensor spacing.

3  - Development and Application of Line-of-road Emulator Tool in CSX

Yu Wang, Manager Operations Research, CSX Transportation Inc., 500 Water Street, Jacksonville, FL, 32202, United States of America, Yu.Wang@csx.com, Eric Pachman

Line-of-Road Emulator is a web-based tool to visualize train movements in a GIS view. The tool can highlight slow-moving and/or long-dwell trains with different styles of bubbles, which provides informative insights to help railroad managers understand the situation and investigate the reasons causing congestions. The tool was used to create an illustration video about the congestion happened on the northern tier of CSX network in 2014 winter, and has received high evaluation from the users.

Optimization Algorithms for Hump Yard Decision Support System

Alexey Sorokin, Senior Systems Engineer, Optym, 7600 NW 5th Place, Gainesville, FL, 32607, United States of America, alexey.sorokin@optym.com, Ravindra Ahuja, Krishna Jha

Rail cars are classified to their appropriate outbound trains in yards. Important decisions made by yardmasters include the order in which trains should be bumped and classification track on which a block should be built at any point in time. We developed optimization modules for a real-time decision support system that can assist yardmasters with these decision. Benefits of the optimization algorithms were computed using a hump-yard simulation system previously developed by Optym.

Advanced Analytics in Tactical Decision Making

Sponsor: Railway Applications

Chair: Krishna Jha, Vice President Research And Development, Optym, 7600 NW 5th Place, Gainesville, FL, 32607, United States of America, krishna.jha@optym.com

1  - Forecast Locomotive Surplus and Deficit to Balance the Terminals and Shops

Kamalesh Somani, CSX Transportation, 500 Water St, Jacksonville, Fl, 32202, United States of America, Kamalesh_Somani@CSX.com, Shankara Kuppa, Artymy Nahapetyan

Number of locomotives coming into a terminal may not be exactly the same as number of locomotives going out. This creates imbalance where some terminals are in constant need for locomotives and some other terminals usually have spare locomotives. Similarly a shop may receive more locomotive than its capacity and at the same time another shop may not be used to its full capacity. We developed advance analytics tools which help to minimize network balancing cost and any train delay because of locomotives.

2  - Offline Learning for Dynamic Data-driven Capability Estimation for Self-aware Aerospace Vehicles

Douglas Allaire, Assistant Professor, Texas A&M University, 425 MEOB, 3123 TAMU, College Station, TX, 77843, United States of America, dallaire@tamu.edu, Benson Isaac

A self-aware aerospace vehicle can dynamically adapt the way it performs missions by gathering information about itself and its surroundings and responding intelligently. We present an information-theoretic approach to offline learning via the optimization of libraries of strain, capability, and maneuver loading using physics-based computational models. Online capability estimation is then achieved using by a Bayesian classification process that fuses dynamic, sensed data.
Funding for this project was provided by the National Science Foundation under Grant No. 1902345 and Grant No. 1953179.

1 - On the Use of Gaussian Processes for Surface and Profile Data
Enrique Del Castillo, Penn State University, Industrial Eng. and Statistics Depts., State College, United States of America, edx13@psu.edu

Standard applications of Gaussian Processes in manufacturing data have traditionally been based on models of the form z(x,y) where x,y,z are coordinates acquired with some sensor, so correlation is assumed to occur on euclidean space external to the surface. We show new methodology that assumes instead correlation exists on the intrinsic surface points along geodesic distances, and show how this leads to better surface reconstruction in both simulated and real datasets.

2 - Functional Clustering with Applications in Single Molecule Experiments
Ying Hsiung, yhing@st.fsu.edu

Cell adhesion experiments refer to biophysical experiments that study protein, DNA, and RNA at the level of single molecules. Motivated by analyzing a single molecule experiment, a new statistical framework is proposed based on functional clustering approaches. Simulations and applications to real experiments are conducted to demonstrate the performance of the proposed method.

3 - Design of Experiments for Functional Response
Moein Saleh, Discover Financial Services/Arizona State University, 699 S Mill Ave, Tempe, AZ, 85281, United States of America. Moein.Saleh@asu.edu, Rong Pan

Applications of DOE for single response variable can be seen in nearly every discipline in science and engineering. However, there are very few publications that discussed optimal design for the experiments with multiple responses taken over different points of a continuum variable. This continuum can be any other continuous variable for functional data analysis such as time in longitudinal study. My study focuses on developing a framework for designing the experiments for functional response.

4 - Monitoring and Diagnostics of High Dimensional Multi-stream Data
Samaneh Ebrahimi, Research Assistant, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, samaneh.ebrahimi@gatech.edu, Kamran Paynabar, Chitta Ranjan

Correlated high-dimensional data streams (HDDS) pose significant challenges in Statistical Process Monitoring. In this research, we integrate PCA and Adaptive Lasso, and propose a novel approach for effective process monitoring and diagnosis of HDDS. The effectiveness of the proposed approach is validated through simulation and a case study.

2 - Concurrent Process Plan Optimization for Additive Manufacturing
Bahir Khoda, Professor, North Dakota State University, Room # 202F Civil and Industrial Engineering, 1410 14th Avenue North, Fargo, ND, 58102, United States of America, akm.khoda@ndsu.edu, Amm Nazmul Ahsan, Md Habib

Implementing additive manufacturing processes effectively requires addressing issues of process efficiencies and resource utilization, both of which have a strong environmental impact. In this paper, both part build orientation and material deposition direction are concurrently optimized by analyzing part geometry to minimize the resource requirement. A concurrent multicriteria process plan optimization framework is developed using Genetic Algorithms (GA) technique.

3 - Online Sensor-based Monitoring in Aerosol Jet Printing Process
Pralad Rao, SUNY Binghamton, 4400 Vestal Pkwy. E, Binghamton, NY, United States of America, prao@binghamton.edu, Rozoebh Salary, Jack Lombardi, Matthew Poliks

Aerosol Jet Printing (AJP) is an additive manufacturing process (AM) that is emerging as a viable method for printing conformal electronics. However, treathing quality related problems in AJP remains unresolved. We propose approaches based on image processing and sensor data analytics to achieve online quality monitoring in the AJP process. The effectiveness of the proposed approach is assessed and evaluated with several real case studies implemented on an aerosol jet printer setup.

TA75
IBM Research Best Student Paper Award I
Sponsor: Service Science

Chair: Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmhh@ntu.edu.tw

1 - Best Student Paper Competitive Presentation
Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmhh@ntu.edu.tw

Finalists of the IBM Research Best Student Paper Award present their research findings in front of a panel of judges. The judging panel will decide the order of winners, which will be announced during the business meeting of the Service Science Session at the Annual Conference.

1 - Service Innovation and the Role of Collaboration
Cong Feng, Syracuse University, 721 University Avenue, Syracuse NY, United States of America, feng@cornfeng.net, K. Sivakumar

Results show that (1) the effect of service innovation on firm performance is greater for service firms than manufacturing firms; (2) the relationship between the propensity for service innovation and three types of collaboration is significant; and (3) vertical and third-party collaborations are more beneficial than horizontal collaboration for service firms.

2 - Brand Equity and Extended Service Contract Purchase Decisions
Moein Khanlari Larimi, University of Alberta, Canada, khanlari@ualberta.ca, Paul Messinger

In this paper, we explore the role of brand equity on consumers' extended service contract (ESC) purchase decisions. We draw from past findings to show that higher brand equity has an overall positive impact on ESC purchase decisions. We also explore the positive impact of stores on ESC purchase decisions.

3 - Regulating Greed over Time
Stefano Traca, Massachusetts Institute of Technology, Cambridge, MA, United States of America, stev@mit.edu, Cynthia Rudin

In retail, there are predictable yet dramatic time-dependent patterns in customer behavior, such as periodic changes in the number of visitors, or increases in visitors just before major holidays (e.g., Christmas). The current paradigm of multiarmed bandit analysis does not take these known patterns into account, which means that despite the firm theoretical foundation of these methods, they are fundamentally flawed when it comes to real applications. This work provides a remedy that takes the time-dependent patterns into account, and we show how this remedy is implemented in the UCB and e-greedy methods. In the corrected methods, exploitation (greed) is regulated over time, so that more exploitation occurs during higher reward periods, and more exploration occurs in periods of low reward. In order to understand why regret is reduced with the corrected methods, we present a set of bounds that provide insight into why we would want to exploit during periods of high reward, and discuss the impact on regret. Our proposed methods have excellent performance in experiments, and were inspired by a high-scoring entry in the Exploration and Exploitation 3 contest using data from Yahoo! Front Page. That entry heavily used time-series methods to regulate greed over time, which was substantially more effective than other contextual bandit methods.
4 - Assessing the Impact of Product and Service Quality on Consumer Returns: A Data Analytics Study
Necati Ertekin, Texas A&M University, Mays Business School, College Station TX 77840, United States of America, nertek@mays.tamu.edu, Gregory Heim, Michale Ketzenberg
We contribute to the understanding of consumer return behavior by examining the association between in-store customer experience during a purchase and a subsequent return. We demonstrate that retail efforts such as increasing salesperson competence and improving store environment that are so long believed to prevent returns may indeed induce returns.

TA76
76-Room 204C, CC
Advances in Simulation-based Optimization I
Sponsor: Simulation
Sponsored Session
Chair: Jie Xu, George Mason University, 4400 University Dr., MS 4A6, Engr Bldg, Rm 2100, Fairfax, VA, 22030, United States of America, jxu13@gmu.edu
1 - Estimating the Probability of Convexity of a Function Observed with Noise
Nanjing Jian, PhD Student, Operations Research and Information Engineering, 288 Rhodes Hall, Cornell University, Ithaca, NY, 14850, United States of America, nj2276@cornell.edu, Shane Henderson
Given estimates of the values of a function observed with noise from simulation on a finite set of points, we wish to sequentially estimate the probability that the function is convex. By updating a Bayesian posterior on the function values, we iteratively estimate the posterior probability of convexity by solving certain linear programs in a Monte Carlo simulation. We discuss a variety of variance reduction methods for the estimation and the linear programs associated with each.

2 - Adaptive Sampling Trust Region Optimization
Sara Shashaani, Associate Professor, Department of Statistics, Purdue University, 250 N University Street, West Lafayette, IN, 47907, United States of America, pasupathi@purdue.edu, Raghuraj Pasupathy
We develop derivative free algorithms for optimization contexts where the objective function is observable only through a stochastic simulation. The algorithms we develop follow the trust-region framework where a local model is constructed, used, and updated as the iterates evolve through the search space. We incorporate adaptive sampling to keep the variance and the squared bias of the local model in lock step, in a bid to ensure optimal convergence rates.

3 - Parallel Empirical Stochastic Branch & Bound
Sajjad Taghiy, George Mason University, 4400 University Dr., MS 4A4, Engr Bldg, Rm 2100, Fairfax, VA, 22030, United States of America, staghiy2@gmu.edu, Jie Xu
To efficiently solve problems with time-consuming high-fidelity simulations, we develop a new parallel algorithm known as parallel empirical stochastic branch & bound (PESBB) to exploit the power of high-performance computing. We will discuss synchronous and asynchronous versions of PESBB and present initial numerical results to demonstrate the scalability of PESBB.

4 - Finding the Best using Multivariate Brownian Motion
Seong-hee Kim, Professor, Georgia Institute of Technology, 755 Ferst Dr NW, Atlanta, GA, 30332, United States of America, skim@isye.gatech.edu, Tom Dieter, Seungjunh Lee
We present a new fully sequential procedure based on multivariate Brownian motion when variances are known but unequal. The procedure uses an ellipsoid as a continuation region, and a system with the worst sample mean is eliminated whenever the procedure’s statistic exits the ellipsoid. The size of the ellipsoid changes as the number of survivors decreases. Experimental results are provided for both equal and unequal variances.

TA77
77-Room 300, CC
Green Supply Chain Management
Contributed Session
Chair: Vinay Gonela, Assistant Professor Of Management, Southwest Minnesota State University, CH 214, 1501 State Street, Marshall, MN, 56258, United States of America, vinay.gonela@smsu.edu
1 - The Impact of Contracts on Environmental Innovation in a Supply Chain
Seyoun Jung, PhD Student, KAIST (Korea Advanced Institute of Science and Technology), 85 Hoegiro, Dongdaemun-gu, Seoul, Korea, Republic of, ssbea@business.kaist.ac.kr, Bosing Kim, Kun Soo Park
We examine the impact of contracts between a supplier and a manufacturer on the supplier’s environmental innovation. We calculate and compare the equilibrium outcomes under three types of contract such as wholesale-price, revenue-sharing, and quality-dependent contracts.

2 - Producer-dominated Green Supply Chain Collaboration under Trade-in Programs
Chih-Tien Chiu, Doctoral Student, National Taiwan University, No.1,Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan - ROC, d03741001@ntu.edu.tw, Mu-chen Chen, Jhih-bing Sheu
This paper aims to address new-product/used-product pricing in a green logistics. We adopt the dynamic programming approach integrated with the logit model to formulate the n-period trade-in pricing-logistics problem, where the logit model is utilized for trade-in service channels choice. Data collected via stated preference experiments are used for the parameter estimation of the logit model, followed by conducting quantitative analyses to provide important findings and managerial insights.

3 - Metrics for Sustainable Operations: Current State and Path to Improvement
Remi Chargin, Clemson University, 100 Sirius Hall, Clemson, United States of America, rcharpig@ Clemson.edu, Aleda Roth
From an operations and supply chain management lens, we examine sustainability metrics currently being reported by firms. We propose that certain metrics are ‘attractors,’ as they are apt to lead the business towards sustainability, whereas others are deemed to be ‘detractors’ that are likely to be used for ‘greenwashing.’

4 - Stochastic Optimization of Sustainable Industrial Symbiosis Based Hybrid Generation Bioethanol Supply Chain
Vinay Gonela, Assistant Professor Of Management, Southwest Minnesota State University, CH 214, 1501 State Street, Marshall, MN, 56258, United States of America, vinay.gonela@smsu.edu, Atif Osmani, Jun Zhang, Joseph Szmerekovksy
This paper focuses on designing a new industrial symbiosis based hybrid generation bioethanol supply chain (ISHGBSC). A SMILP model is proposed to design the optimal ISHGBSC under different sustainability standards. The result provides guidelines for policy makers to determine the appropriate standard to use under different sustainable concerns. In addition, it provides investors a guideline to invest in different technologies under different sustainability standards.

TA78
78-Room 301, CC
Big Data and Energy
Contributed Session
Chair: Feng Gao, SGR1 North America, 5451 Great America Parkway, Santa Clara, CA, 95054, United States of America, feng.gao@sgrina.com
1 - Resilient Power System State Estimation using Compressive Sensing
Hamid Livani, Assistant Professor, University of Nevada Reno, Electrical & Computer Engineering, MC 0111, 1115 Perry St, / Room 302, Reno, NV, 89557, United States of America, hlivani@unr.edu
Phasor Measurement Units (PMU) have become widely used for power system monitoring and control. However, they are not installed on all the buses in a network. Therefore, PMU-only state estimation encounters problems arising from a limited number of installed PMUs and probable data losses as the results of congestion or disconnection in communications. In this study, we propose power system state estimation using Compressive Sensing (CS) algorithm which is resilient to loss of data.
2 - Data Exploration of Publicly Reported Power Outages to Assess Grid Reliability and Damages
Michael Sohn, Staff Scientist, Lawrence Berkeley National Laboratory, One Cyclotron Road, Mail Stop: 9OR2008, Berkeley, CA, 94720, United States of America, msohn@lbl.gov, Joseph Eto, Kristina Lacomare, Laurel Dunn
We have amassed a database of power outages, with high temporal resolution, from across the US. We present an analysis of the database, focusing on the distribution of outages by duration, customers affected, location, time, etc. We also link the data to orthogonal datasets to estimate the types of customers affected for a particular outage. Finally, we estimate the cost of power interruptions, and discuss implications on the reliability costs nationwide.

3 - Energy Disaggregation Based on Stochastic Dynamic Programming with Collocation Method
Feng Gao, SGRI North America, 5451 Great America Parkway, Santa Clara, CA, 95054, United States of America, feng.gao@sgrina.com, Chris Saunders, Yang Yu, Wendong Zhu, Guangyi Liu
The purpose of energy disaggregation is to separate energy consumption for a consumer into the energy data for individual appliances. The benefit lies in the promotion of improved consumption behaviors and adaptation of energy-efficient devices. The paper presents a dynamic model for devices power consumption; considers uncertainty of consumption; and proposes a fix-point iterative schema to efficiently resolve the stochastic problem. The paper demonstrates its result on a simulated data set.

4 - Transmission Planning with Renewable Distributed Generation Uncertainty
Fikri Kucuk sayacigil, Iowa State Uni. Industrial Engineering, 3004 Black Engineering, Ames, IA, 50011, United States of America, fk sayaci@iastate.edu, Kyung Jo Min
There have been substantial developments of distributed generation from renewable energy sources. This has created new challenges in transmission planning as distributed generation leads to uncertainties on the use of transmission lines. To address this uncertainties, we utilize a jump-diffusion demand process and binomial lattice to show how the best transmission is planned under the risk of self-supporting communities. From the resulting analysis, economic implication and managerial insights will be discussed.

TA79

79-Room 302, CC

Software Demonstration
Cluster: Software Demonstrations
Invited Session
1 - SigmaXL, Inc. - What's New in SigmaXL® Version 7
John Noguera, CTO & Co-founder, SigmaXL, Inc.
SigmaXL is a user friendly Excel Add-In tool for Process Improvement, Six Sigma Quality and Statistics. We introduce SigmaXL and the new features in Version 7: 'Traffic Light' Automatic Assumptions Check for T-tests and ANOVA, Automatic Normality Check for Pearson Correlation and Small Sample Exact Statistics for One-Way Chi-Square, Two-Way (Contingency) Table and Nonparametric Tests. Exact statistics are appropriate when the sample size is too small for a Chi-Square or Normal approximation to be valid.

2 - Mathworks - MATLAB: An Environment for Operations Research and Data Analytics
Seth DeLand, MathWorks, Data Analytics. Product Manager
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.

Tuesday, 11:00am - 12:30pm

TB01

01-Room 301, Marriott

Cyber and Logistics Applications
Sponsor: Military Applications
Sponsored Session
Chair: Natalie Scala, Assistant Professor, Towson University, Dept. of e-Business and Tech Management, 8000 York Road, Towson, MD, 21252, United States of America, nscala@towson.edu

1 - Operations Research Initiatives in Cyber Defense
Paul Goethals, Army Cyber Institute, United States Military Academy, West Point, NY, United States of America, paul.goethals@usma.edu
Despite the reduction in the total Army population, the cyber force structure continues to grow in strength and impact. This presentation describes a number of Operations Research initiatives that could benefit the cyber community. Research trends and areas of future work are also offered.

2 - Automated Identification Technology Devices for Naval Seabasing
Natalie Scala, Assistant Professor, Towson University, Dept. of e-Business and Tech Management, 8000 York Road, Towson, MD, 21252, United States of America, nscala@towson.edu, Jennifer Pawour
We present a value focused decision model for naval seabasing. We discuss automated identification technology devices as alternatives to a multi-objective decision model with the goal of selecting the preferred device for seabasing logistics support. Criteria for this model include metrics and associated measures related to seabasing.

3 - Logistics Engineering Solution for Reverse-engineering Topology
Alan Briggs, INFORMS Maryland, 8606 Aspen Grove Court, Odenton, MD, 21113, United States of America, avbriggs@gmail.com
Using monte carlo simulation, author uses proximate location data to reverse engineer network topology.

TA79

79-Room 302, CC

Software Demonstration
Cluster: Software Demonstrations
Invited Session
1 - SigmaXL, Inc. - What's New in SigmaXL® Version 7
John Noguera, CTO & Co-founder, SigmaXL, Inc.
SigmaXL is a user friendly Excel Add-In tool for Process Improvement, Six Sigma Quality and Statistics. We introduce SigmaXL and the new features in Version 7: 'Traffic Light' Automatic Assumptions Check for T-tests and ANOVA, Automatic Normality Check for Pearson Correlation and Small Sample Exact Statistics for One-Way Chi-Square, Two-Way (Contingency) Table and Nonparametric Tests. Exact statistics are appropriate when the sample size is too small for a Chi-Square or Normal approximation to be valid.

2 - Mathworks - MATLAB: An Environment for Operations Research and Data Analytics
Seth DeLand, MathWorks, Data Analytics. Product Manager
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.

Tuesday, 11:00am - 12:30pm

TB02

02-Room 302, Marriott

Homeland Security Decision Making
Cluster: Homeland Security
Invited Session
Chair: Jun Zhuang, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, 14221, United States of America, jzhuang@buffalo.edu
Co-Chair: Fei He, Assistant Professor, Texas A&M University-Kingsville, 700 University Blvd., Kingsville, TX, 78363, United States of America, fei.he@tamuk.edu

1 - Multi-Objective Optimization Models in Urban Security
Jose Emmanuel Ramirez-Marquez, Associate Professor, Stevens Institute of Technology, 1 Castle Point Rd, Hoboken, NJ, 07030, United States of America, jmarquez@stevens.edu, Mohammed Muaafa
The allocation of limited resources is a daily dilemma for police commanders. More than 50% of police department costs go into patrolling operations, which include responding to emergencies and maintaining police presence. This study aims to address the challenging tradeoff police face when designing patrolling strategies between lessening the economic burden of crime prevention and maintaining high levels of public safety.

2 - A Literature Review of Recent Attacker-defender Games
Fatemeh Mousapour, SUNY Buffalo, 338 Bell Hall, Buffalo, NY, United States of America, f.mousapoor@yahoo.com, Jun Zhuang
This research provides an extensive review of game-theoretic analysis of attacker-defender models. Those models are categorized according to different defense measures, attack tactics, system structures, game types, player rationality and risk preferences. Statistical charts and tables are presented to identify patterns and trends in this area. Through the content analysis framework, some research gaps and future research directions are identified.
3 - Protecting and Restoring Facilities from Intentional Attacks

Chi Zhang, Assistant Professor, Tsinghua University, 100084 Beijing, Department of Industrial Engineering, Beijing, China, czzhang@tsinghua.edu.cn, Saeidie Rao

Besides protecting facilities from intentional attacks, another paramount issue is taken into consideration—restoring destroyed facilities to optimal service level within a given time interval. The defender decides which facilities to protect before an attack, and resource allocation between improving capacities of operational facilities and rebuilding destroyed facilities after an attack, to maximize profit by satisfying customer demands. The problem is solved by an ant colony algorithm.

4 - Coordinating Pre- and Post-disaster Resource Allocation at Multiple Locations

Fei He, Assistant Professor, Texas A&M University-Kingsville, 700 University Blvd., Kingsville, TX, 78363, United States of America, fei.he@tamuk.edu, Jun Zhuang

Resource allocation in the face of disaster aims to improve the efficiency and effectiveness of disaster relief. In this research, disaster preparedness and relief at multiple locations are modeled in a two-stage stochastic programming framework with the objective of loss minimization. New insights of coordinating preparedness and relief at multiple locations are provided.

5 - Model Validation for a Public-private Partnerships Model in Disaster Management

Vineet Madasseri Payyappall, PhD Student, University at Buffalo, 305 Winspear Avenue (Upper), Buffalo, NY, 14215, United States of America, vineetma@buffalo.edu, Peilqi Guan, Jun Zhuang

This research designed and conducted an experiment to validate a public-private partnerships model in disaster management. A two-staged experiment was conducted in a computer simulated environment. The risk behaviors of the subjects were evaluated in the first stage, and the second stage collected the decision of the subjects, who played the role of the private sector, under different scenarios. The experiment shows that our model results are consistent with the experimental results.

■ TB03
03-Room 303, Marriott
New Topics in Scheduling
Cluster: Scheduling and Project Management
Invited Session
Chair: Rainer Kolisch, rainer.kolisch@wi.tum.de

1 - Coordinating Subcontractor Scheduling with Divisible Jobs
Behzad Hezarkhani, Assistant Professor, Nottingham University Business School, Jubilee Campus, Nottingham, United Kingdom, behzad.hezarkhani@nottingham.edu.cn; Wieslaw Kublak

We study a decentralized scheduling problem with a single subcontractor and several agents having divisible jobs. Under complete information, we design pricing schemes that always make the agents’ decisions coincide with efficient schedules. Under private information, we prove that the pivotal mechanism makes truth-telling the only optimal choice of the agents when announcing their processing times. We comment on the subcontractor’s revenue under complete and private information.

2 - Single Machine Scheduling via Decision Theory
J.J. Kanet, Department of MIS/OM/DSC, 300 College Park, University of Dayton, Dayton, OH, 45419-2130, United States of America, kanet@udayton.edu

We consider the following procedure for scheduling a single machine. At time $t$ the machine is free with a set $N$ of jobs ready to occupy it. Thus, we have to choose a job to occupy the machine starting at time $t$ with the remaining $n$-1 jobs completed later. Given that a job $k$ is tentatively chosen to next occupy the machine, we calculate its completion time and the expected value (E) of the completion times of the remaining $n$-1 jobs. We do this for each of the n choices, producing for each the set of completion times $C = (c_{ij})/N$. We then evaluate the objective $Z = E(c)$ choosing that job $k$ is minimum to next occupy the machine. We provide an unbiased estimator of the set $C$ and show that the procedure provides optimum results when the objective $Z$ is to minimize flow time or maximum tardiness.

3 - Scheduling on a Single Machine Under Time of Use Tariffs
Kan Fang, Tianjin University, No 92 Weijin Road, Nankai District, Tianjin, 300072, China, 2junhai@gmail.com, Nelson Tan

We consider the problem of scheduling jobs on a single machine to minimize the total electricity cost of processing these jobs under time-of-use electricity tariffs. We show the computational complexity of this problem for both the uniform speed and speed-scaling cases, present different approximation algorithms for the speed-scaling case and analyze their computational performance. We also show how to compute optimal schedules for the preemptive version of the problem in polynomial time.

4 - The Value of Flexibility and Shift Extensions in Physician Scheduling

Andreas Fuegener, University of Augsburg, Universitätstraße 16, Universität Augsburg, WWI, Augsburg, D, 86159, Germany, andreas.fuegener@unikat.uni-augsburg.de, Jens Brunner

Scheduling physicians is a relevant topic in hospitals. In the literature, demand is usually assumed to be deterministic. However, surgery durations and emergencies can disrupt the process. We model a stochastic physician demand using a scenario-based approach. We introduce flexible shift extensions, where physicians might have to work longer to match supply with demand and simultaneously increase predictability of working hours. We propose a mixed-integer model and a column generation heuristic to solve our problem.

■ TB04
04-Room 304, Marriott
The Business of Music and Emotion in Social Media
Cluster: Social Media Analytics
Invited Session
Chair: Chris Smith, TRAC-MTRY, 28 Lupin Lane, Carmel Valley, 93924, United States of America, cmsmith1@nps.edu

1 - Philippine Language and Emotion During Typhoon Haiyan/Yolanda
Amanda Andri, Graduate Student, Georgetown University, aa1436@georgetown.edu

An investigation of language and emotion in tweets from the Philippines before and after 2013 super typhoon Haiyan/Yolanda using Linguistic Inquiry and Word Count (LIWC), breakpoint analysis, and a computational clustering tool revealed differences in topics and emotions depending on whether messages were expressed in English or Filipino.

2 - Subscribe or Sell: Itunes vs. Google Play Music all Access
Hooman Hidayat, PhD Student, University of Alberta, #1604 8515 112 St. NW, Edmonton, AL, T6G1K7, Canada, hooman.hidayat@ualberta.ca

Recently, subscription has become a popular method of user monetization in online media business along with selling model. It is expected that firms utilize both approaches to cover as much demand as possible. However, pricing strategy of the firms is crucial in determining the demand for the two. In this study, using an economic model with endogenous demand, we set to model how the firm decides on the business model. Different user types and business model-dependent demand are considered.

3 - Stock Market Prediction using Disparate Data Sources
Bin Weng, Auburn University, 425 Opelika Rd Apt, 224, Auburn, AL, 36830, United States of America, bww0018@auburn.edu, Fadel Megahed

Stock market prediction has attracted much attention from academia as well as business. In recent years, social media is considered as a new source to affect human’s behavior and decision-making. In this paper, we will develop a new way to predict the movement of the stock market using disparate data source, social media data and market data. In order to predict the stock price more accurately, the model is developed using multivariate selection method and machine learning statistic methods.

■ TB05
05-Room 305, Marriott
Social Media in Business
Cluster: Social Media Analytics
Invited Session
Chair: Dokyun Lee, Carnegie Mellon University, Pittsburgh, PA, United States of America, fleedokyun@gmail.com

1 - Understanding the Impact of Discussions on Quality of Crowdsourced Content – The Case of Wikipedia
Srikar Velichety, PhD Student, Eller College of Management, University of Arizona, 1130 E Helen St, Tucson, AZ, 85719, United States of America, srikarv@email.arizona.edu, Jesse Bockstedt, Sudha Ram

We investigate the impact of discussions on the quality of crowdsourced content using a data science approach that involves conducting an exploratory study to uncover the associations among different discussion characteristics and article quality and building a prediction model. By identifying appropriate instruments to overcome selection, we build a model to quantify the impact of these characteristics. Our results show that most of these characteristics have a positive impact on quality.
2 - Toward Effective Information Diffusion on Social Media Platforms: An Analysis of Dyadic Relationship  
Jing Peng, The Wharton School, University of Pennsylvania, 3730 Walnut Street Suite 500, Philadelphia, PA, 19104, United States of America, jingpeng@wharton.upenn.edu, Ashish Agarwal, Kartik Hosanagar, Raghuram Iyengar

We investigate the impact of dyadic network characteristics on information diffusion in social media platforms with directed networks. We propose a novel hazard model to deal with the problem that a user may receive the information from multiple others. The model is estimated using diffusion of ads on Digg.com. We find that a non-reciprocal follower is more likely to adopt than a reciprocating follower and the effects of network embeddedness are more complicated than that in undirected networks.

3 - Monetizing Sharing Traffic through Incentive Design: A Randomized Field Experiment  
Tianshu Sun, University of Maryland Smith School of Business, 3330 Van Munching Hall, College Park, MD, 20740-2840, United States of America, tianshusun@rhsmith.umd.edu, Siva Viswanathan, Elena Zheleva

Customers share product information with each other everyday. While the share of a product indicates clear purchase intent of either sender or recipient, most of such sharing traffic does not lead to successful purchases. In collaboration with a daily deal platform, we conduct a large field experiment to study whether and how firms can monetize sharing traffic, targeting senders with incentive. Specifically, we examine the impact of incentive design on sender’s purchase as well as referrals.

4 - Founder and Funder, Just One Click Apart: How Social Media Facilitates Investor Entrepreneur Match  
Fujie Jin, the Wharton School, University of Pennsylvania, 50 Jon M Huntsman Hall, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, jinfujie@wharton.upenn.edu

This study examines how entrepreneurs’ social media presence facilitates the funding process across geographic regions. Comparison will be drawn between traditional angel investors or VCs and the new crowdfunding platform to show how entrepreneurs could optimally manage their social media profile to appeal to different investor groups.

3 - Trading a Portfolio of Pairs in the Presence of Transaction Costs  
James Primbs, Associate Professor, California State University Fullerton, 800 N. State College Blvd., Fullerton, CA, United States of America, jprimbs@fullerton.edu, Yuji Yamada

In this work we consider the problem of trading a portfolio of pairs when transaction costs are present. We develop a receding horizon approach based on a power utility function and proportional transaction costs. The resulting methodology is very computational tractable, even for a portfolio of many potentially correlated pairs. Backtested results on historical data are provided.

4 - Backtesting Simultaneous Long-short and Proportional-integral Investment Schemes  
Sean Warnick, Associate Professor, Brigham Young University, TMCB 2222, Provo, UT, 84602, United States of America, sean.warnick@gmail.com, Scott Condie, Nathan Woodbury

Simultaneous Long-Short is an investment strategy analyzed by Barmish and Primbs that uses feedback control techniques to make investment decisions. An extension of the technique uses proportional-integral control to make such decisions. Importantly, these methods use a feedback architecture—and no explicit market model—to manage investments. This study explores the performance of these methods compared to other methods that use some estimate of a market model through various backtests.

■ TB06  
06-Room 306, Marriott  
Engineering Approaches in Finance  
Sponsor: Financial Services  
Sponsored Session  
Chair: James Primbs, Associate Professor, California State University Fullerton, 800 N. State College Blvd., Fullerton, CA, United States of America, jprimbs@fullerton.edu

1 - On Feedback Control-based Stock Trading: Some Back Tests with High-frequency Data  
B. Ross Barmish, Professor, University of Wisconsin, ECE Department, Madison, WI, 53706, United States of America, barmish@engr.wisc.edu

The takeoff point for this paper is a new paradigm for stock trading involving adaptive feedback control loops. I will first overview the key elements of our theory with emphasis on “model-free” trading and money management. Subsequently, I will describe recent back tests of our trading algorithms using high-frequency data. Given that our underlying theory requires continuity of the stock price, it is natural to study whether performance improves as a function of the trading frequency.

2 - Construction of Nonlinear Simultaneous Equations Models for Electricity Supply and Demand Functions  
Yuji Yamada, Professor, University of Tsukuba, 3-29-1 Otsuka, Bunkyo-ku, Tokyo, 112-0012, Japan, yui@ssm.otsuka.tsukuba.ac.jp

In this work, we develop a new methodology for estimating supply and demand functions in the Japan Electric Power Exchange (JEPX) spot market. To this end, we generalize the standard simultaneous equations approach using linear regressions for nonlinear case and show that the nonlinear structural equations may be constructed based on the reduced equations of a nonparametric regressions model. Then, we demonstrate the proposed approach using empirical data.
**TB08**

08-Room 308, Marriott

**Sharing Economy and Peer-to-Peer Marketplaces**

Cluster: Business Model Innovation

Invited Session

Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, 94720-1900, United States of America, jguajardo@berkeley.edu

1 - The Efficacy of Incentives in Scaling up Marketplaces

Ashish Kabra, INSEAD, Boulevard de Constance, Fontainebleau, France, ashish.kabra@insead.edu, Elena Belavina, Karan Girotra

Achieving scale is key to the efficacy, survival and eventual domination of marketplaces. Marketplace operators often run aggressive promotions and incentive schemes to attract new users or increase the usage of existing users. Using detailed transaction and location data from a leading transportation marketplace, we estimate and compare the the short-term and long-term effects of incentives given to the “buyer” side and “seller” side of the marketplace.

2 - Business Models in the Sharing Economy: Manufacturing Durables in Presence of Peer-to-peer Markets

Zhe Zhang, PhD Student, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, zhezhang@cmu.edu, Jose Guajardo, Vibhanshu Abhishek

We investigate the interaction between a manufacturer of durable goods and a peer-to-peer marketplace where consumers trade the temporary use of the durable goods as a service. We analyze market outcomes under alternative business models and market structures.

3 - Outsourcing Tasks Online: Matching Supply and Demand on Peer-to-peer Internet Platforms

Chiara Farronato, Harvard Business School, Soldiers Field, Boston, United States of America, chiara.farronato@gmail.com, Zoe Cullen

We study a central problem for peer-to-peer markets: how to create matches between demand and supply that are highly variable. We develop a model of a matching market for services, and estimate it using data from TaskRabbit. We find that supply is highly elastic and estimate average gains from each trade to be $37. Because of the matching frictions, the ex-ante gains are more modest, but are maximized by the elastic supply. Finally, we explore heterogeneity of platform success across cities.

4 - First Ranked First to Serve: Strategic Agents in a Service Contest

Konstantinos Stouras, PhD Candidate, INSEAD, Bd. de Constance, Fontainebleau, 77305, France, Konstantinos.STOOURAS@insead.edu, Karon Girotra, Serguei Netessine

We develop a model of a virtual call center that pays its agents on-demand, by committing to a (relative) performance agent ranking prioritization scheme. We show that the optimal design of such a “service contest” is often coarse. Discarding available information about agents’ relative performance, or deploying coarser priority classes can paradoxically create higher incentives for agents to voluntarily participate and provide better service.

**TB09**

09-Room 309, Marriott

**Ecosystem Analytics & Visualization**

Sponsor: Technology, Innovation Management & Entrepreneurship

Sponsored Session

Chair: Rahul Basole, Associate Professor, Georgia Institute of Technology, 85 Fifth Street NW, Atlanta, GA, 30332, United States of America, basole@gatech.edu

1 - Integrated Analytics Framework for Business Ecosystem Dynamics

Hyunwoo Park, Georgia Institute of Technology, 85 5th St. NW Rm 339, Atlanta, GA, 30309, United States of America, hwpark@gatech.edu, Rahul Basole

We propose a computational framework and interactive prototype for specifying and analyzing business ecosystem dynamics. Our research fuses simulation with data/process mining and information visualization techniques, enabling decision makers to specify micro-behavior of firms, generate and test hypotheses, gain insights, and communicate results effectively. We illustrate our approach using real-world examples based on a unique curated dataset from multiple sources.

2 - Network Visualization Analysis of Main Paths and Directions of Firm Innovation

Jianxi Luo, Assistant Professor, Singapore University of Technology and Design, 8 Somapah Rd, Singapore, 487372, Singapore, luoj@sutd.edu.sg, Bowen Yan

We present a method to represent the technology space as a network of patent technology classes, and then overlay the network map to visualize firms’ technology capability positions and main paths of diversification over time. Based on a few case studies, we show this method can reveal the differences in innovation behaviours and strategies of different firms and aid in the assessment of the firm’s past and existing capability positions and the exploration of future innovation directions.

**TB10**

10-Room 310, Marriott

**Frontiers in IS Research**

Sponsor: E-Business

Sponsored Session

Chair: Min-Seok Pang, Assistant Professor, Temple University, 1810 N 13th St, Speakman 201e, Philadelphia, PA, 19122, United States of America, minspong@temple.edu

1 - Fundraising Patterns and Entrepreneurial Performance in Crowdfunding Platforms

Eun Ju Jung, George Mason University, Enterprise Hall, 4400 University Drive, School of Business, Fairfax, VA, 22030, United States of America, jej978@gmail.com, Vallabh Sambamurthy, Anjana Susarla

Crowdfunding provides entrepreneurs with new opportunities for funding and ultimately fosters entrepreneurship and new firm creation. However, there is a dearth of research on entrepreneurial performance after fundraising success. In this paper, we examine how the dynamics in fundraising processes are related to entrepreneurial performance. This study will contribute to crowdfunding and entrepreneurship literature and offer practical implications.

2 - It Security Effectiveness: Influence of Breach Type and Public Attention

John D’arcy, University of Delaware, 207A Purnell Hall, Newark, DE, 19716, United States of America, jdarcy@udel.edu, Asli Basoglu

This study explores factors that bias auditor judgments of companies’ information security effectiveness. We developed a dataset consisting of security breaches against publicly traded companies, public attention attributed to these breaches—in the form of abnormal Google search volume, and auditor evaluations of these companies’ IT internal controls. Our results suggest that breach source and abnormal public attention both contribute to biased evaluations of information security effectiveness.
3 - Studying Influence of Comments in Online News Papers
Iljoo Kim, Assistant Professor, Saint Joseph's University, 347 Mandeville Hall, 5600 City Avenue, Philadelphia, PA, 19131, United States of America, ikim@sju.edu, Gautam Pant
In this work, we study online comments and their influence in online news articles. Using text-mining techniques, we attempt to explain and/or predict influence of online newspaper comments on the context of the original article or even on creating a new agenda through the discussions among commenters. This is done based on the textual signals embedded within comments as well as news articles.

4 - Politics and Information Technology Investments in The United States Federal Government in 2003-2015
Min-Seok Pae, Assistant Professor, Temple University, 1810 N 13th St, Speakman 201e, Philadelphia, PA, 19122, United States of America, mspae@temple.edu
What makes some US federal agencies digitally advanced and others lagging? This study investigates how politics affects IT investment in federal agencies. With a panel dataset from 113 federal agencies, our empirical analyses produce several intriguing findings. A federal agency makes more capacity-building IT investments (i) when its head is appointed with legislative approval, (ii) when the federal government is less divided, and (iii) when it is neither too conservative nor too liberal.

Machine Learning under a Modern Optimization Lens
Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session
Chair: Dimitris Bertsimas, Professor, MIT, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, dbertsim@mit.edu

1 - Sparse Principal Component Analysis via a Modern Optimization Lens
Lauren Berk, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Boulder, MA, 02139, United States of America, lberman@mit.edu, Dimitris Bertsimas
We develop tractable algorithms that provide provably optimal solutions to the exact Sparse Principal Component problems of up to 1000 dimensions, using techniques from Mixed Integer Optimization and first order methods. Unlike earlier SCA methods, our approach retains complete control over the degree of sparsity of the components, and provides solutions with higher explained variance.

2 - Robust Support Vector Machines
Colin Pawlovski, MIT, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, cpawlowski@mit.edu, Dimitris Bertsimas
We consider a maximal-margin classifier which is the non-regularized formulation of SVM. Using Robust Optimization, we develop new, computationally tractable methods that are immunized against uncertainty in the features and labels of the training data. Experiments on real-world datasets from the UCI Machine Learning Repository show out-of-sample accuracy improvements for robust methods in a significant number of problems analyzed.

Optimal Trees
Jack Dunn, Operations Research Center, MIT, 77 Mass Ave, Bldg E40-130, Cambridge, MA, 02139, United States of America, jackdunn@mit.edu, Dimitris Bertsimas
Decision trees are widely used to solve the classical statistical problem of classification. We introduce a new method for constructing optimal decision trees using Mixed-Integer Optimization, and show using real data sets that these trees can offer significant increases in accuracy over current state-of-the-art decision tree methods. We also demonstrate the benefits of using Robust Optimization when constructing these trees.

Logistic Regression using Robust Optimization
Daisy Zhuo, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, zhoud@mit.edu, Dimitris Bertsimas
Logistic regression is one of the most commonly used classification methods, yet the solution can be sensitive to inaccuracy and noise in data. Here we propose an approach using Robust Optimization to find stable solutions under uncertainties in data features and labels. Using more than 80 real-world problems, we demonstrate that the robust logistic regression lower misclassification error significantly in the majority of the data sets.

Nonlinear Programming in Stochastic and Multilevel Problems
Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization
Sponsored Session
Chair: Alexander Vinel, Auburn University, 3301 Shelby Center, Auburn, AL, 36849-5346, United States of America, alexander.vinel@auburn.edu

1 - Branch-and-cut Algorithm for Integer Bilevel Linear Optimization Problems
Sahar Tahernejad, Graduate Student, Lehigh University, 12 Duh Drive, No. 132, Bethlehem, PA, 18015, United States of America, sat214@lehigh.edu, Ted Ralphs
We extend the branch-and-cut framework of Denegre and Ralphs for solving integer bilevel linear optimization problems (IBLPs). IBLPs differ from standard integer optimization problems in that there are solutions which are integer but not feasible and they should be removed from the feasible solution set. Our proposed algorithm applies a variety of cut generation techniques for removing such solutions. We report on numerical experiments on some benchmark IBLPs.

2 - On Pessimistic Versus Optimistic Bilevel Linear Programs
M. Hosein Zare, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, mohzare@pitt.edu, Osman Ozalpin, Oleg Prokopyev
We study the relationships between Pessimistic and Optimistic Bilevel Linear Programs. In particular, we focus on the case when the upper-level decision-maker (i.e., the leader) needs to consider the uncertain behavior of the lower-level decision maker (i.e., the follower). We derive some computational complexity properties, and illustrate our results using a defender-attacker application.

3 - Identifying Risk-averse Low-diameter Clusters in Graphs with Random Vertex Weights
Maciej Rysz, NRC-APRL, 1350 N. Piquito Road, Shalimar, FL, 32579, United States of America, mrysz@yahoo.com, Pavlo Krokhmal
We consider the problem of finding a k-clubs of minimum risk contained in a graph whose vertices have stochastic weights. A stochastic programming framework that is based on the formalism of coherent risk measures is used to find the corresponding subgraphs. A combinatorial branch-and-bound solution algorithm is proposed.

4 - Solution Procedures for a Class of Mixed-integer Nonlinear Programming Problems
Alexander Vinel, Auburn University, 3301 Shelby Center, Auburn, AL, 36849-5346, United States of America, alexander.vinel@auburn.edu, Pavlo Krokhmal
We study solution approaches for a class of mixed-integer non-linear programming problems with our interest stemming from recent developments in risk-averse stochastic programming. We explore possible applications of some of the solution techniques that have been successfully used in mixed-integer second-order conic programming and show how special structure of problems under consideration can be utilized.
2 - Optimal Averaging Schemes for Stochastic Approximation Methods
Farzad Pasupathy, Associate Professor, Rutgers University, New Brunswick, NJ, USA; Luiz Faes, University of Pennsylvania, USA

We propose a class of averaging schemes for solving stochastic optimization problems. The proposed schemes are based on the idea of averaging the iterates generated by a stochastic approximation algorithm, and we show that they can achieve optimal convergence rates under certain conditions. We illustrate the proposed schemes with an example from portfolio optimization.

3 - Adaptive Sampling Line Search for Local Simulation Optimization
Raghu Pasupathy, Associate Professor, Department of Statistics, Purdue University, USA; Fatemeh Hashemi, Associate Professor, Virginia Tech, USA

We present a new adaptive sampling line search algorithm for local simulation optimization problems. Our algorithm is based on a novel adaptive sampling technique that dynamically adjusts the sampling strategy based on the observed function values. We demonstrate the effectiveness of our algorithm through numerical experiments.

4 - Noisy Collective Nonconvex Optimization
Mengdi Wang, Assistant Professor, Princeton University, USA; Farzad Yousefian, Postdoctoral Researcher, Penn State, USA

We consider the problem of optimizing a nonconvex function in a network of agents, where each agent observes a noisy version of the function. We propose a new algorithm that allows for communication delays and noise in the observations, and we show that it converges to a stationary point with high probability.
2 - Computational Study of a Second Order Cone Relaxation for Binary Quadratic Polynomial Problems
Julio Goz, Postdoctoral Fellow, Ecole Polytechnique Montreal and GERAD, 2900 Boulevard Edouard-Montpetit, Montreal, QC, H3T 1J4, Canada, jgoz1@gmail.com, Miguel Anjos
This work presents a computational study of the second order cone relaxation for binary quadratic problems proposed by Ghaadz, Vera and Anjos (2011) who used a polynomial optimization approach. We explore how this relaxation can be strengthened using additional constraints, and also, we explore the relation of disjunctive conic cuts with this relaxation.

3 - Computational Approaches to Mixed Integer Second Order Cone Optimization
Aykut Bulut, PhD Candidate, Lehigh University, 200 W. Packer Ave., Bethlehem, PA, 18015, United States of America, aykut@lehigh.edu, Ted Ralphs
We introduce a open-source Mixed Integer Second Order Cone Optimization (MISOOCO) solver. We present computational experiments on various approaches to solve MISOOCO problem using outer approximation method to solve continuous relaxations. We also discuss using various valid inequalities to improve the continuous relaxations. We discuss computational performance of these approaches on conic benchmark library (CBLB 2014) problems.

4 - Solving Robust Portfolio Optimization Problems in Practice
Sarah Drewes, Senior Consultant, Dr., MathWorks, Adalpestr. 45, Ismaning, Germany, Sarah.Drewes@mathworks.de
Robust versions of the Markowitz mean-variance model can reduce the estimation risk induced by its sensitivity to changes in expected returns or the covariance matrix. Probabilistic versions of the classical model can be formulated as nonlinear and often second order cone programs. We study how to solve these problems also by general nonlinear solvers (MATLAB Optimization Toolbox) and in case of discrete variables. We evaluate both computational performance and complexity of implementation.

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4 - Network Design Problem for Battery Electric Bus
Yousuf Maknoon, EPFL, Route Cantonale, Lausanne, Switzerland, yousuf.maknoon@epfl.ch, Shadi Sharif Azadch, Michel Bierlaire
In electric bus planning, for battery installation, we need to investigate two points: (1) the type and location of charger stations (2) the capacity of battery of each bus. In this presentation, first we describe the problem and the design elements. Then, we present its mathematical form followed by the resolution approach. Finally, we demonstrate the computational results on our case study and discuss about the robustness of the plan.

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2 - The Classification Methodology of Chip Quality using Canonical Correlation Analysis
Ki-lyun Kim, Samsung Electronics Co., Canem-dong, Hwaseong-si, Gyeonggi-do, Korea, Republic of, bluenja@daum.net
In this study, we proposed classification methodology using a canonical correlation analysis as feature selection method at multi-dimensional chip level data generated in the semiconductor manufacturing industry. As the result of this research, we were able to extract important variables in the various PCM variables from the correlation of the multiple FBC variables and PCM variables. The proposed method was improved the accuracy of quality classification for a chip tested in the probe test.

3 - Multivariate Monitoring of Metal Fabrication Process in Mobile Devices Manufacturing
Seonghyeon Kang, M.S. Candidate, Korea University, Innovation Hall 817, Korea University, 145 Anam-ro, Seongbuk-gu, Seoul, 136-713, Korea, Republic of, sbkang@gmail.com, Seoung Bum Kim
In mobile industry, using metal case of devices is rapidly increased for thin and attractive design. However, fabricating metal is the difficult process because accurate control of equipment is required. In this study, we propose an efficient multivariate monitoring procedure to observe more than 40 parameters of metal fabrication equipment. The effectiveness of the proposed procedure is demonstrated by real data from the mobile plant in one of the leading mobile companies in South Korea.

4 - Multivariate Monitoring of Automated Material Handling Systems in Semiconductor Manufacturing
Sangmin Lee, Korea University, Innovation Hall 817, Korea University, 145 Anam-ro, Seongbuk-gu, Seoul, 136-713, Korea, Republic of, smlee679@gmail.com, Seoung Bum Kim
Monitoring all possible contingencies in automated material handling system (AMHS) of semiconductor manufacturing is a difficult task because tremendous hardware and software systems are involved. This study presents an efficient multivariate monitoring procedure to monitor more than 100 KPIs in AMHS. The effectiveness and applicability of the proposed procedure is demonstrated by real data from semiconductor fabrication plant in one of the leading semiconductor companies in South Korea.

5 - Quantifying the Level of Risk of Functional Chips in Semiconductor Wafers
Young-seon Jeong, Chonnam National University, Department of Industrial Engineering, Gwangju, Korea, Republic of, youngseonjeong@gmail.com, Byunghoon Kim, Seoung-hoon Tong, Inkap Chang, Myoung K (MK) Jeong
This talk presents the procedure to quantify the level of risk of functional chips in dynamic random access memory (DRAM) wafers. To screen risky functional chips, the risk level of each chip is estimated by the posterior probability for functional chips. The functional chips closer to the class of defective chips may have a higher probability of being failed in the near future. The experimental results by using real-life wafers show the effectiveness of the proposed method.

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2 - Statistical Guarantees for Individualized Rank Aggregation  
Sahand Negahban, Yale University, 24 Hillhouse Ave, New Haven, CT, 06510, United States of America,  
sahand.negahban@yale.edu

We study a version of rank aggregation known as collaborative ranking. In this problem we assume that individual users provide us with pairwise preferences and from those preferences we wish to obtain rankings on items that the users have not had an opportunity to explore. We provide a theoretical justification for a nuclear norm regularized optimization procedure.

3 - Inference in High-dimensional Varying Coefficient Models  
Mladen Kolar, Assistant Professor, Chicago Booth, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, mkol@chicagobooth.edu, Damin Kozbur

We focus on the high-dimensional linear varying-coefficient model and develop a novel procedure for estimating the coefficient functions. Our procedure works in a high-dimensional regime, under arbitrary heteroscedasticity in residuals, and is robust to model misspecification. We derive an asymptotic distribution for the normalized maximum deviation of the estimated coefficient function and demonstrate how these results can be used to make inference in high-dimensional dynamic graphical models.

4 - Elementary Estimators for High-dimensional Statistical Models  
Eunhoo Yang, IBM T.J. Watson, PO. Box 1128, Yorktown Heights, United States of America, eunhoo@cs.utexas.edu

We propose a class of closed-form estimators for sparsity-structured high-dimensional models. Our approach builds on observing the precise manner in which the classical MLE breaks down under high-dimensional settings. We provide a rigorous statistical analysis that shows that our simple estimators recover the same asymptotic convergence rates as those of computationally expensive L1-regularized MLEs. We corroborate statistical performance, as well as computational advantages via simulations.

2 - Level Scheduling in Automotive Assembly Lines and its Effect on the Consumption of Resources  
Heinrich Kuhn, Professor, Catholic University of Eichstaett-Ingolstadt, Supply Chain Management & Operations, Auf der Schanze 49, Ingolstadt, 85049, Germany, heinrich.kuhn@ku-eichstaett.de, Dominika Woterer

Level scheduling approaches in sequencing of assembly lines are used as substitutional model for the underlying economic and sustainable objectives since a leveled distribution of materials requirements does not necessarily contribute directly to these objectives. We conduct a case study at a major German automotive company selecting relevant part families whose consumption is currently unequal distributed by an extensive simulation study.

3 - A New Scenario Based Sales and Operations Planning Model  
Nico Vandeaele, Professor, KU Leuven, Naamsestraat 69 Box 3555, Leuven, 3000, Belgium, nico.vandeaele@kuleuven.be,  
Catherine Decouttere, Gerld Hahn, Torben Sens

We apply a scenario-based approach to the sales and operations planning process where both model-based and non-model based Key Performance Indicators are taken into account. This allows us to balance customer service, derived from aggregate order lead times, and relevant costs of operations when determining volume/mix decisions for internal and external production. An industry-derived case example with distinct outsourcing options is used to highlight the benefits of the approach.

1 - Coordinating Multi-product Manufacturing Systems: Modeling and Analysis  
Cong Zhao, Research Assistant, University of Wisconsin-Madison, 1513 University Ave, Room 3235, Madison, WI, 53706, United States of America, czhao27@wisc.edu, Ningxuan Kang, Li Zhang, Jingshan Li

Multi-product systems are common in today's manufacturing process. Effective coordination between products in such systems is important in operation. We study a two-product geometric manufacturing system and derive closed-form expressions of performance measures. An optimal allocation policy and buffer thresholds is developed, and the monotonicity of optimal buffer size with respect to machine parameters is investigated. The managerial insights to achieve optimal production control are discussed.
ow ners of those sites. However, past research has yet to account for this interface. While there is sufficient evidence of gains from mobile marketing in the same session, they may not, which has important implications for the experimental results show promise of the proposed methods.

1 - Exploiting Geographic Dependencies for Real Estate Ranking

Yanjie Fu, Rutgers University, 504 N 5th St, Harrison, NJ, 07029, United States of America, yanjie.fu@rutgers.edu, Hui Xiong, Hui Xiong

We propose a geographic method, named CuesRanking, for estate evaluation by leveraging the mutual enforcement of ranking and clustering power model the geographic dependencies of estates for enhancing estate ranking. Indeed, the geographic dependencies of the investment value of an estate can be from the characteristics of its own neighborhood (individual dependency), the values of its nearby estates (peer dependency), and the prosperity of the affiliated latent business area (zone dependency).

3 - A General Geographical Probabilistic Factor Model for Point of Interest Recommendation

Bin Liu, Rutgers University, 900 Davidson Road, 47 Nichols Apartment, Piscataway, NJ, 08854, United States of America, binben.liu@rutgers.edu

The problem of point of interest recommendation is to provide personalized places. The decision process for a user to choose a POI can be influenced by numerous factors, such as personal preferences, geographical considerations, and user mobility behaviors. We propose a general geographical probabilistic factor model framework which takes various factors into consideration. Extensive experimental results show promise of the proposed methods.

1 - Business Value of the Mobile Enterprise: An Empirical Study of Mobile Sales Force in Banking

Ajit Sharma, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, United States of America, asharmaz@umich.edu

The press and research on mobility has remained focused on the customer-firm interface. While there is sufficient evidence of gains from mobile marketing in better targeting and lift, the benefits of mobile-centric enterprise processes remain under-studied. In this paper, we empirically assess the reduction in process time and error rates by shifting from a traditional “sales person in the field-computer in the office” sales process to a “sales person in the field with a tablet” sales process.

2 - Lost in Cyberspace: An Investigation of Digital Borders, Location Recognition, and Experience Attribution

Brian Dunn, Assistant Professor, University of Oklahoma, 307 West Brooks St, 307D, Norman, OK, 73072, United States of America, bkdunn@ou.edu, Narayan Ramasubbu, Dennis Galletta, Paul Lowry

Do website users know where they are? Given that they may visit multiple sites in the same session, they may not, which has important implications for the owners of those sites. However, past research has yet to account for this possibility. To understand when users recognize where they are online and how they attribute credit to the sites that are helpful to them, we introduce the concepts of ‘digital borders’ and ‘border strength’ and use them in an experimental investigation.

3 - Design Control in Open Innovation: An Examination of Open Source Software Production

Shivendu Pratap Singh, University of Pittsburgh, Room 229, Mervis Hall, Pittsburgh, 15260, United States of America, shs161@pitt.edu

Firms are opting for co-creating software, by attracting developers on platforms like GitHub This shared model of development requires flexible software design controls to influence community engagement, which could result in proliferation of design options. Flexible design control policy could have side effects such as accumulation of technical debt and need to be judiciously managed. This paper examines the antecedents and consequences of design control policies in software production.

4 - Time-dependent Pricing for Mobile Data: Analysis, Systems, and Trial

Soumya Sen, sen@umn.edu, Carlee Joe-wong, Mung Chiang, Sangtae Ha

Dynamic pricing of mobile data traffic can alleviate network congestion by creating temporally-varying price discounts. But realizing it requires developing analytical models for price point computation, systems design, and field experiments to study user behavior. In this paper, we present the architecture, implementation, and a user trial of a day-ahead time-dependent pricing.
INFORMS Philadelphia – 2015

TB27
27-Room 404, Marriott
Multiple Criteria Decision Aiding
Sponsor: Multiple Criteria Decision Making
Sponsored Session
Chair: Roman Slowinski, Prof., Poznan University of Technology, Pl. Marii Sklodowskiej-Curie 5, Poznan, PL, 60-963, Poland, roman.slowinski@cs.put.poznan.pl
1 - FTTradeoff: Flexible and Interactive Tradeoff Elicitation Procedure
Adiel T. DeAlmeida, Professor, Universidade Federal de Pernambuco, Caixa Postal 7462, Recife, PE, 50630-971, Brazil, almeidaadt@gmail.com, Adiel De Almeida Filho, Jonatas Araujo, Cave Almeida, Ana Paula Costa
The FTTradeoff is a Flexible and Interactive Tradeoff elicitation procedure for multicriteria additive models in MAVT scope. The classical tradeoff procedure is one of the approaches with strongest theoretical foundation. However, behavioral studies have shown inconsistencies of DM during elicitation. The FTTradeoff reduces DM's effort in the process, by using partial information, thereby contributing to reduce inconsistencies. It is implemented in a DSS, which is illustrated by applications.

Jyrki Wallenius, Professor, Aalto University School of Business, Runneberginkatu 22-24, Helsinki, Finland, jyrki.wallenius@aalto.fi, Tommi Pajala, Akrham Dehnokhalaji, Pekka Korhonen, Pekka Malo, Ankur Sinha
Web-based questionnaires to match candidates' and voters' views play an important role in Finland. We have collaborated with Helsingin Sanomat, who runs the most influential of such questionnaires, to enhance and further develop it. Our algorithm was tested in last April's Parliamentary Elections. We describe our algorithm and the feedback.

3 - Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Context
Rodrigo J P Ferreira, Assistant Professor, Universidade Federal de Pernambuco, Av. Professor Morais Rego, 1235., Recife, PE, 50670-901, Brazil, rodjp@gmail.com, Adiel T De Almeida, Cristiano A V Cavalcante, Marcelo H Alencar, Adiel De Almeida Filho, Thalles V Garcez
The use of multiple criteria and multiobjective models in risk, reliability and maintenance research has increased in recent years. These models may affect the strategic results of any organization, as well as human life and the environment. In such situations, optimal solutions for one objective function cannot be suitable. These issues are presented according to the reference multicriteria and multiobjective models for risk, reliability and maintenance decision analysis.

4 - Constructive Preference Learning in Value-driven Multiple Criteria Sorting
Roman Slowinski, Prof., Poznan University of Technology, Pl. Marii Sklodowskiej-Curie 5, Poznan, PL, 60-963, Poland, roman.slowinski@cs.put.poznan.pl, Milosz Kadzinski, Krzysztof Ciomek
We present an interactive preference learning technique for multiple criteria sorting driven by a set of additive value functions compatible with a rich preference information acquired from the user. This information may include: (1) imprecise assignment examples, (2) desired class cardinalities, and (3) assignment-based pairwise comparisons. The output results are necessary and possible assignments, and extreme class cardinalities.

TB28
28-Room 405, Marriott
Empirical Market Design
Cluster: Auctions
Invited Session
Chair: Peng Shi, MIT Operations Research Center, 1 Amherst Street, E40-149, Cambridge, MA, 02139, United States of America, pengshi@mit.edu
1 - Market Congestion and Application Costs
John Horton, Assistant Professor, NYU Stern School of Business, 44 West Fourth Street, Kaufman Management Center, New York, NY, 10012, United States of America, John.Horton@stern.nyu.edu, Ramesh Johari, Dana Chandler
We report the results of an experimental intervention that increased the cost of applying to vacancies in an online labor market by requiring workers to answer questions about the job. Although the ordeal positively selected candidates, it was the information in the answers that mattered for match formation. Although the overall number of matches and speed to fill a vacancy was unchanged, employers engaged in less recruiting activities and formed higher quality matches.

TB29
29-Room 406, Marriott
Applications of Analytics II
Sponsor: Analytics
Sponsored Session
Chair: Tarun Mohan Lal, Mayo Clinic, mohanlal.tarun@mayo.edu
1 - Combating Attrition through New Developments in Transaction Analytics and Customer Dialogue
Gerald Fahner, Analytic Science Senior Director, FICO, 181 Metro Drive, San Jose, United States of America, geraldfahner@fico.com “Silent” attrition remains a costly problem requiring fast detection and insight to create effective retention offers. Our credit card case study shows how ensemble models instrumented with low-latency transaction features rapidly detect card-level and merchant category-level attrition. We explain our models and relate performance to profitability. We show how to boost persuasiveness of offers by customer dialogues to learn their preferences. Using a simulation we illustrate the value of dialogues.

2 - How Bringing Decision Optimization to the Cloud Will Democratize Optimization
Susara Van Den Heever, IBM France, 1681 Route des Dolines, France, svdheever@fr.ibm.com, Xavier Ceugnet, Alain Chabrier, Stéphane Michel
Even though Decision Optimization has been used effectively across industries for decades, it remains under-utilized. Complexity and cost are often cited as barriers to wider adoption. The emergence of cloud computing, as well as the renewed emphasis on cognitive analytics platforms, breaks down these barriers to bring the benefits of optimization to a wider audience. We will demonstrate this vision through a case study involving IBM Decision Optimization on Cloud, and IBM Watson Analytics.
3 - An Approach to Estimating Customer Lifetime Values for Apartment Tenants
Jian Wang, Vice President, Research & Development, The Rainmaker Group, 4530 North Point Parkway, Alpharetta, GA, 30022, United States of America, jwang@leittrain.com

Estimating tenant lifetime values is important for apartment revenue management. We propose a heuristic approach to predicting renewal likelihoods and estimating tenant lifetime values. We then present empirical results based on real apartment data.

TB30

30-Room 407, Marriott
Intelligent Agents and Systems
Contributed Session
Chair: Mohsen Moghaddam, PhD Candidate, Purdue University, 1155 Anthrop Dr., Apt. 9, West Lafayette, IN, 47906, United States of America, mmoghadd@purdue.edu

1 - Optimizing Physician to Patient Consults using Robot-based Virtual Systems
Henry Ibekeke, Post Doctoral Researcher, Independent, Richmond, United States of America, hibekeke1@gmail.com

The delivery of quality healthcare for chronically ill patients is burdened by the limited resources available to physicians and healthcare facilities. We propose the use of virtual-presence autonomous robot systems to optimize the physician to patient consultation by minimizing the patient wait-time and maximizing the number of physician consults given limited resources. We formulate a robot-patient interaction model as a stochastic process and solve using discrete-time dynamic programming.

2 - A Study on the Influence of Trust and Distrust Ratings in Social Networks on Cold Start Users
Sanjog Ray, Assistant Professor, Indian Institute of Management Indore, Rau Pithampur Road, Indore, 453331, India, sanjog@iimidr.ac.in

This study examines how cold start users get influenced by the trust and distrust scores of other users in a social network. We examine the users trusted by cold start users on the basis of critical parameters: number of trust statements, number of distrust statements, and number of items rated. We base our findings on our analysis of the real life Epinions dataset. Our analysis has implications for design of trust aware recommender systems for cold start users.

3 - Analyzing Inventory Policies in Multi-stage Automatic Manufacturing Systems
Barin Nag, Professor, Towson University, Department of E-Business & Technology Management, 800 W. College Pkwy, Towson, MD, 21252, United States of America, bna@towson.edu, Dong-qing Yao, Sungchul Hong

In a multi-stage manufacturing system each stage fills demand from a combination of buffer inventory or production. Lowest inventory levels may not be lowest cost, with contradictions arising from the costs of delays of physical production, backlogs, breakdowns, and bottlenecks. We study best performance inventory policies using varied production architectures.

4 - A Modeling Framework of Cyber-Physical Systems
Ashutosh Nayak, Student, Purdue University, 318 N Salisbury St, Apt. 8, West Lafayette, IN, 47906, United States of America, nayak2@purdue.edu, Shimon Y. Of, Seokcheon Lee, Rodrigo Levalle

Effective modelling of CPS is a big challenge. In this work, we propose a resource sharing based framework for CPS aimed at maximizing its utility. This framework represents CPS as a network of tasks and resources characterized by utility functions and overlapping resource communities. A distributed control approach backed by utility aggregation function is considered for optimality and stability. Its implementation is illustrated through two examples: Smart factory and multi-robot system.

5 - Collaborative Networked V-organizations: Design & Integration
Mohsen Moghaddam, PhD Candidate, Purdue University, 1155 Anthrop Dr., Apt. 9, West Lafayette, IN, 47906, United States of America, mmoghadd@purdue.edu, Shimon Y. Of

Modern distributed, networked, and collaborative organizations of humans/machines/firms enable systematic integration of distributed resources for processing dynamic/ diverse tasks. We design collaborative networked Vorganizations by integrating physical (location of resources) and virtual (allocation of tasks) dimensions, for higher service level, stability, and utilization. A mixed-integer program and a tabu search are developed for modeling and optimization purposes, respectively.

TB31

31-Room 408, Marriott
Connected Vehicle Analytics
Sponsor: Data Mining
Sponsored Session
Chair: Juan Li, Member of Research Staff, Xerox Innovation Group, 800 Phillips Road, 128-27E, Webster, NY, 14580, United States of America, Juan.Li@xerox.com

1 - A System for Estimating Traffic Congestion Measures in a Network using GPS Smartphone
Charles Chung, Vp Products, Brisk Synergies, 295 Hagey Blvd, 1st Flr, Waterloo, Canada, charles.chung@brisksynergies.com

A smartphone app is developed for logging route data. A platform is then built for mapping traffic congestion using speed indicators average speed and speed differential at the link level. The results demonstrate the feasibility and huge potential our data collection system that can be implemented in any city and sets the growth for real-time applications for connected vehicles.

2 - Online Travel Mode Identification with Smartphones
Qing Hc, Assistant Professor, SUNY Buffalo, 313 Bell Hall, Buffalo, NY, 14051, United States of America, qingle@buffalo.edu, Xing Su, Herman Caceres, Hanghang Tong

We propose an online classification algorithm to detect user's travel mode using mobile phone sensors. Our application is built on the latest Android smartphone with multimodality sensors. By applying a hierarchical classification method, we achieve high accuracy in a binary classification wheelers/non-wheelers travel mode, and all six travel modes.

3 - Locating Heterogeneous Traffic Sensors to Improve Network Surveillance Benefits
Xuechi Zhang, Graduate Research Assistant, University of Maryland, 0147C Eng Lab Blvd, University of Maryland, College Park, MD, 20742, United States of America, zhangxc90@gmail.com, Ali Haghani

Optimal placement of traffic sensors is significant to improve urban mobility. In this study, a mathematical optimization model of deploying heterogeneous sensors (i.e. Bluetooth sensor and loop detector) to large-scale traffic network is proposed. Maximizing real-time information report reliability and coverage are chosen as dual objectives. In addition, the effect of real-time GPS-based probe vehicle data is also considered. A case study in Washington D.C. area is conducted for demonstration.

4 - Inferring Trajectories for Partial Observations
Juan Li, Member of Research Staff, Xerox Innovation Group, 800 Phillips Road, 128-27E, Webster, NY, 14580, United States of America, Juan.Li@xerox.com, Moshe Lichman, Padhraic Smyth

The amount of spatial trajectory data is growing fast with the rapid increased availability of GPS-embedded vehicles. The trajectory data is mixed with high and low sampling rate with partial observations. In this study, we aim to build probabilistic models to infer possible traversed route for low sampling rate vehicle trajectory data.

TB32

32-Room 409, Marriott
Business Analytics in Higher Education Industry
Sponsor: Analytics
Sponsored Session
Chair: Roger Gung, Director, Business Analytics & Operations Research, University of Phoenix, 3137 E Elwood St, Phoenix, AZ, 85034, United States of America, roger.gung@phoenix.edu

1 - Marketing Mix Optimization
Roger Gung, Director, Business Analytics & Operations Research, University of Phoenix, 3137 E Elwood St, Phoenix, AZ, 85034, United States of America, roger.gung@phoenix.edu

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 - Contact Center Qualifying Transfer Rate Modeling and Analysis
Jie Yu, Operations Research Scientist, University of Phoenix, 3137 E Elwood St, Phoenix, AZ, 85034, United States of America, jie.yu@phoenix.edu, Roger Gun, Lin Wang
Impact analysis on transferring marketing inquiries to qualifying leads for potential enrollments and the performance of contact center agents are crucial to contact center and enrollment operations. An impact analysis was conducted on transfer rate with drivers including speed to lead, lead source, time of request as well as program level. A mixed effect logistic regression model was built to rank agents’ performance in terms of expected transfer rate with given marketing inquiries. The model was also employed to evaluate the impact of reducing contact center and enrollment operating hours.

3 - Enrollment Service Contact Strategy Optimization
Pan Hu, Operations Research Scientist, University of Phoenix, 3137 E Elwood St, Phoenix, AZ, 85034, United States of America, pan.hu@phoenix.edu, Yun Ouyang, Jie Yu, Lin Wang, Roger Gun
This project is to study how contact behaviors of enrollment representatives influence enrollment progression of higher education pursuer. To better serve the needs of potential students, it is critical to communicate effectively by bringing up right topics in the best timing. We examined a list of conversation topics suggested in the internal guideline of University of Phoenix for enrollment representatives, and identified the best contact strategy using statistical models.

3 - TB33
33-Room 410, Marriott
Joint Session HAS/MSOM-Healthcare: Modeling Applications for Emergency Departments
Sponsor: Health Applications
Sponsored Session
Chair: Sean Barnes, University of Maryland, 4352 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu

1 - Review of Queueing Theory Applied to Emergency Departments with Comparable Simulation Studies
Summer (Xia) Hu, PhD Student, University of Maryland, Department of Mathematics, College Park, United States of America, xhu64@umd.edu, Sean Barnes, Bruce Golden
Queueing Theory (QT) is an important tool for Emergency Department (ED) design and management. By reviewing all papers with ED QT analysis or applications since 1972, this survey examines the contributions of QT to modeling EDs and identify its benefits and limitations when compared to discrete-event simulation (DES) under similar ED operational settings. Our results indicate that the combination of queueing and DES methods can be a powerful approach to better ED modeling.

2 - Using Simulation to Assess the Impact of an Observation Unit in a Pediatric Emergency Department
Mark Grun, University of Michigan, 1205 Real Avenue, Ann Arbor, MI, 48109, United States of America, mgrun@umich.edu, Gabriel Zayas-Caban, Michelle Macy, Allison Cator, Amy Cohn
Observation units (OUs) provide an alternative disposition decision for ED patients who may benefit from further observation, such as those are not ill enough to be admitted, but not well enough to be discharged. Patients can be placed in an OU for monitoring, diagnostic evaluation, and/or treatment prior to disposition. In this talk, we discuss our approaches (e.g. simulation) for assessing the impact of an OU in the Pediatric ED at the University of Michigan.

3 - Operational Causes of Patients Leaving Before Treatment is Completed in Emergency Departments
David Anderson, Assistant Professor, Baruch, davidryberganderson@gmail.com, Bruce Golden, Edward Wasil, Laura Pimentel, Jon Mark Hirshon
Patients leaving before treatment (LBTC) is completed is an indicator of poor Emergency Department performance. Contrary to previous research, volume is not the main driver of patients leaving before treatment is complete. First provider time and lengths of treatment are much more strongly associated with LBTC rate. We show that operational factors such as treatment time and staffing decisions play a role in waiting time and, thus, in determining the LBTC rate.

4 - Strategies for Ebola Containment: A Biological-behavioral-operational Modeling Decision Framework
Eva Lee, Georgia Tech, Atlanta, GA, eva.lee@gatech.edu
This work is joint with CDC. We present a computational decision modeling framework that integrates an agent-based biological disease spread model, a dynamic network-based social-behavior model that captures human behavior and interaction, and a stochastic queueing model that describes treatment characteristics, day-to-day hospital and homecare processes, and resource usage. An optimization engine determines the minimum resource needed to contain the Ebola epidemic in W. Africa.

4 - TB34
34-Room 411, Marriott
Data-driven Modeling and Analysis of Health Care Systems
Sponsor: Health Applications
Sponsored Session
Chair: Anil Aswani, UC Berkeley, 4141 Etcheverry Hall, Berkeley, CA, 94720-1777, United States of America, aaswani@berkeley.edu

1 - Constructing Behavioral Models for Personalized Weight Loss Interventions using Integer Programming
Yonatan Mintz, Graduate Student, UC Berkeley, 1822 Francisco St., Apt. 10, Berkeley, CA, 94703, United States of America, ymintz@berkeley.edu, Phillip Kaminsky, Yoshimi Fukuoka, Anil Aswani, Elena Flowers
In this paper we describe two (a machine learning and a utility maximization) models for weight loss using clinical trial data. We believe these quantitative models of behavior change can be used to provide personalized interventions, improve adherence and lower costs of current weight loss programs. Given the high prevalence of obesity, these results provide significant insight into more effective approaches to implement weight loss programs.

2 - Modeling Treatment Adherence Behavior in the Treatment of Obstructive Sleep Apnea
Yunchoel Kang, Pennsylvania State University, 236 Leonhard Building, State College, 16801, United States of America, kang.yunchoel@gmail.com, Paul Griffin, Vittal Prabhur, Amy Sawyer
We target patients who suffered from Obstructive Sleep Apnea (OSA) and their treatment behaviors when using Continuous Positive Airway Pressure (CPAP) devices. We model underlying dynamics and patterns of patient treatment behavior using Markov models as a basis for designing effective and economical intervention. Also we suggest a guideline for designing a cost-effective intervention to economically treat the patients.

3 - Inverse Optimization with Noisy Data
Auyon Siddiq, UC Berkeley, 4141 Etcheverry Hall, University of California, Berkeley, 94720, United States of America, auyon.siddiq@berkeley.edu, Zuo-jun Max Shen, Anil Aswani
We present an approach for inverse parametric optimization with noisy solution data for convex forward problems. The proposed method yields well-behaved estimates that attain risk consistency or parameter estimation consistency under reasonable conditions. While the formulation is non-convex in general, we provide an approximation algorithm that yields consistent estimates for a class of quadratic programs. Numerical results show competitive performance with state-of-the-art techniques.

4 - Quantifying the Resilience of Hospital Unit Management under High Workloads
Mo Zhou, PhD Student, UC-Berkeley, 4470 Etcheverry Hall, Berkeley, CA, 94709, United States of America, mzhou@berkeley.edu, Anne Miller, Anil Aswani, Jason Slagle, Daniel France
Hospital unit shifts with high admissions/discharges (ADTs) and low nurse-to-patient ratios (NPRs) increase mortality. Nurse managers promote unit resilience, and we quantify this using time series and network analysis of hourly phone calls, ADTs, and NPRs over 2 years from an Intensive Care Unit. Statistical variable selection assessed variable dependency, and time-series estimation demonstrated the validity of phone calls as a resilience measure. Future studies will elucidate adaptive limits.
2 - Optimal Delivery and Pickup Planning for Patients with Chronic Diseases using Drones
Seon Jin Kim, University of Houston, Dept. of Industrial Engineering, Houston, TX, 77204, United States of America, sonjin64@gmail.com, Gino Lim, Jaeyoung Cho
Patients with chronic diseases are required to visit clinics for a routine health exam. The cost of chronic diseases has been increasing every year, which became a burden to patients, government, and health insurance companies. We present a robust optimization model to reduce healthcare costs and improve quality of healthcare service using drones. The model finds optimal routes of drones to deliver medicine and pickup necessary samples to analyze patients’ health.

3 - Application of Theory of Constraints in Blood Banking
Harshal Lowalekar, Assistant Professor, Indian Institute of Management Indore, Rau-Pithampur Road, Indore, MP, 453556, India, harshal@iimiddcr.ac.in
We discuss the application of the Theory of Constraints Thinking Processes (TOC/TP) methodology in managing inventory at blood banks. Using the Thinking Processes approach the root-cause behind the common inventory problems at blood banks like high shortage and wastage of blood products, high operating expenses and low revenue levels is identified. A TOC based solution is then proposed to address the root-cause.

4 - Study of Optimal Control Strategies for Visceral Leishmaniasis
Songnan Zhao, Student, Kansas State University, 1600 Hillcrest Dr., Apt 4, Manhattan, KS, 66502, United States of America, songnian@ksu.edu, Chih-hang Wu, Yan Kuang, David Ben-arieh
Visceral Leishmaniasis (VL) is a vector-borne disease which is transmitted by sandflies and it is the second-largest parasitic killer after Marilia. Mathematical models were proposed to assist in the control of spread of VL; however, quantitative conditions for the control of VL transmission are not studied. This paper develops a general mathematical model for VL disease transmission system, performs bifurcation analysis to discuss control conditions, and calculates optimal control strategies.
5 - The Advent of the Intelligent Electronic Health Record
John Glaser, Siemens Healthcare, Malvern, PA, United States of America, John.Glaser@Cerner.com
We’ve made great progress in embedding the Electronic Health Record (EHR) in our healthcare processes, with use reaching unprecedented rates. Now, we’re poised to take it the next level with the intelligent EHR. The intelligent EHR will look very similar to the traditional system – one can still look up patient results and history and write prescriptions but the application will move past transactional functions. The intelligent EHR will be characterized by sophisticated and flexible decision support, rules engines, process monitoring engines, intelligent displays of important patient data, access to knowledge resources, the ability to collect data from multiple care settings through a health information exchange, and tools that enable provider collaboration. The advent of the intelligent EHR will be necessary if healthcare is to effectively address challenges such as those generated by payment reform and managing the care of chronically ill populations.

2 - Nurse Allocation Policy Evaluation and Analysis of Admissions in an Intensive Care Unit
Osman Aydas, Instructor & PhD Candidate, University of Wisconsin-Milwaukee, 3202 N Maryland Ave., Milwaukee, WI 53211, United States of America, otaydas@uw.edu, Kaan Kuzu, Anthony Ross
Nurse staffing is a crucial step in providing quality healthcare. Many patient care units, including Intensive Care Units, have problems in accurately estimating the number of nurses to use on a daily basis. We evaluate the existing staff allocation system of an intensive care unit using clinical operational data and develop a prediction model for estimating the number of admissions to the unit.

3 - Coordinating Contracts for an Express Service Supply Chain
Juzhi Zhang, University of Science & Technology of China, No.96, JinZhai Road Baohu District, Hefei, 230026, China, jzjzhi@mail.ustc.edu.cn, Gou Qinglong, Xiaohang Yue
This paper studies the mismatch problem of an express service supply chain, in which the express company delivers the product from online retailer to consumers. We show that displaying information on delivery capacity can decrease consumers’ belief on delay risk and increase the centralized supply chain’s profit, but it may not be feasible because consumers may not believe it. We then design some contracts to make the supply chain achieve the profit under information display.

4 - Appraisal Viewpoint Disseminate and Evolution Analysis in Online Transaction
Xiening Wang, Associate Professor, Dongbei University of Finance and Economics, China, No 217, JianShan Street, Shahekou Distri, Dalian, LN, 116025, China, wangxiening@163.com
Through feature analysis and algorithm analysis, this paper researches the dissemination and evolution of online transaction appraisal view during consumption. The conversion rules of consumer view tendency is proposed, by describing the viewpoint tendency of network users and combining the clustering properties of the network transactions appraisal viewpoint. It analyzes the e-commerce transactions appraisal of the cellular migration model based on small world network effects.

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3 - Building Temperature Control with User Feedback and Energy Optimization

John Wen, Professor, Rensselaer Polytechnic Institute, CII 5015, 110 8th St., Troy, NY, 12180, United States of America, wenj@rpi.edu

Buildings are occupied by multiple occupants with different comfort preferences in a shared space. This paper proposes a distributed incentive based strategy to balance the user comfort feedback and building energy optimization. We establish the convergence of the proposed algorithm to the optimal temperature set-point that minimizes the total energy cost and the aggregate discomfort of all occupants.

4 - Green Technology Innovations, Adoption, and Regulation

Xin Wang, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, xinwang1@andrew.cmu.edu, Alan Scheller-wolf

When a government is considering tightening a standard on a pollutant, their decision often is influenced by the number of firms being able to meet the tightened standard, because a higher number indicates a more feasible standard. We study how such regulation may affect a firm’s incentive to develop a new technology to reduce a pollutant. We find that stricter regulation may discourage a firm to develop a new technology, but may encourage other firms to adopt the technology once it is invented.

3 TB41

41-Room 102A, CC
ED Operations Management
Sponsor: Manufacturing & Service Operation Mgmt/Healthcare Operations
Sponsored Session
Chair: Vedat Verter, James McGill Professor, Desautels Faculty of Management, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, vedat.verter@mcgill.ca

1 - Specialist Care in Rural Hospitals: from Emergency Department Consultation to Ward Discharge
Michael Klein, PhD Candidate, McGill University, Desautels Faculty of Management, Montreal, Canada, michael.klein20@mail.mcgill.ca, Vedat Verter, Brian G. Moses, Hughie P. Fraser

Patients often wait for admission to inpatient wards, boarding on stretchers in hallways. These delays are the key contributor to Emergency Department (ED) crowding, resulting in adverse effects including higher mortality. We consider the ED boarding problem from the perspective of specialists. We focus on Internal Medicine at two hospitals in Nova Scotia, Canada. We propose a stochastic dynamic programming model to analyze current practice and identify strategies for improvement.

2 - Impact of Coordination and Information Sharing in Urban Incident Response
Jonathan Helm, Indiana University Bloomington, 1309 E. Tenth Street, Bloomington, IN, United States of America, helmj@indiana.edu, Alex Mills, Andres Jola-sánchez, Mohan Tatikonda, Bobby Courtney

Following a disaster in an urban area, on-scene responders must decide how to distribute casualties among hospitals. This is typically done without information (real-time or otherwise) about hospital capacities, ED and inpatient. We study a new type of organization, called a healthcare coalition, and use real data to study what types of information this organization should share with responders after a multiple casualty incident to improve response.

3 - Optimal Admission/Discharge Criteria for Patients with Heart Failure in Observation Units
Sanket Bhat, McGill University, 1001 Sherbrooke Street West, Room 520, Montreal, QC, H3A 1G5, Canada, sanket.bhat@mcgill.ca, Beste Kucukyazici, Rick Mah

Although more than 80% of the patients presented to Emergency Departments with symptoms related to acute decompensated heart failure (ADHF) are hospitalized, the majority of patients are not in need of an acute intervention beyond decongestion. These patients could be managed in observation units and be discharged without hospitalization. We develop a stochastic model that dynamically assess the risk levels of ADHF patients, and determine criteria to optimally discharge, observe, or admit them.

4 - A Data-driven Stochastic Model of an Emergency Department
Xiaopel Zhang, Columbia University, 1 Morningside Drive, Apt. 1710, New York, NY, 10025, United States of America, xzz363@columbia.edu, Ward Whitt

We explore arrival and length-of-stay (LoS) data from an Israeli Emergency Department. We fit a time-varying two-class (hospitalized or not) infinite-server queueing model with nonhomogeneous Poisson arrivals, where the arrival rate/admission/LoS is periodic over a week/day/day. Departures after long LoS tend to occur at midnight.

3 TB42

42-Room 102B, CC
Joint Session MSOM-Health/HAS: Global Health Delivery
Sponsor: Manufacturing & Service Operation Mgmt/Healthcare Operations
Sponsored Session
Chair: Jonas Jonasson, Student, London Business School, Regent’s Park, London, NW1 4SA, United Kingdom, jjonasson@london.edu

1 - Demand vs. Supply-side Investment in Humanitarian Operations
Karthik V. Natarajan, Assistant Professor, University of Minnesota, 321 19th Avenue South, 3-150, Minneapolis, MN, United States of America, knataraj@umn.edu, Jayashankar Swaminathan

Both supply- and demand-side constraints impact program coverage in humanitarian settings. We first study the problem of identifying the optimal mix of supply- and demand-side investments faced by a budget-constrained organization in a centralized setting. We then consider a decentralized setting and identify the optimal performance-based contract to mobilize demand. In addition, we also compare the performance of the optimal contract against three contracts frequently used in practice.

2 - Assessing the Impact of U.S. Food Assistance Delivery Policies on Child Mortality in Sub-Saharan Africa
Alex Nikulkov, Stanford GSB, 655 Knight Way, Stanford, CA, 94305, United States of America, nikulkov@stanford.edu, Lawrence Wein

The U.S. is one of the few countries in the world that delivers its food assistance via transoceanic shipments of commodity-based in-kind food, which is more costly and less timely than cash-based assistance. Using household survey data, geospatial data and supply chain modeling, we estimate that child mortality in sub-Saharan Africa can be reduced by 16.2% if the U.S. switches entirely to cash-based interventions.

3 - How Good are Uniform Co-Payments in Increasing Market Consumption?
Gonzalo Romero, Rotman School of Management, 105 St. George Street, Toronto, Canada, Gonzalez.Romero@rotman.utoronto.ca, Retsef Levi, Georgia Perakis

We analyze the problem of a central planner allocating co-payment subsidies to competing heterogeneous firms, under an endogenous market response and a budget constraint. We present the first worst-case performance guarantees in maximizing market consumption for the frequently implemented policy of uniform co-payments. Namely, allocating the same co-payment to each firm is guaranteed to induce a significant fraction of the optimal market consumption, even if the firms are highly heterogeneous.

4 - Deployment Guidelines for Community Health Workers in Sub-Saharan Africa
Jonas Jonasson, Student, London Business School, Regent’s Park, London, NW1 4SA, United Kingdom, jjonasson@london.edu, Anne Liu, Sarang Deo, Jérémie Gallien, Carri Chan

Community health workers (CHWs) are increasingly important to the delivery of health care in many African countries. Leveraging an extensive dataset featuring time, clinical findings and GPS information for CHWs visits in Ghana, we develop a stochastic model describing the health dynamics of a population served by a time-constrained CHW. This model supports the design of managerial guidelines for the patient prioritization, catchment area assignment and task profile definition in a CHW operation.
2 - The Big Data Newsvendor: Practical Insights from Machine Learning
Gal- Bernt, Assistant Professor, London Business School, 77 Massachusetts Avenue, 44 West 120th Street, Mudd 315, New York, NY, 10027, United States of America, gavahn@london.edu, Cynthia Rudin
We study the newsvendor problem when one has n observations of p features related to the demand as well as demand data. Both low- and high-dimensional data are considered. We propose Machine Learning (ML) and Kernel Optimization (KO) approaches, and derive tight bounds on their performance. In a nurse staffing case study we find that the best KO and ML results beat best practice by 23% and 24% respectively.

3 - Applying Machine Learning to Revenue Management at Groupon
David Small, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dsmall@mit.edu, Alexander Weinstein, He Wang, Wang Chi Cheung
We propose a new data-driven pricing algorithm for online retailers, which learns customer demand from online transaction data. Our method first generates multiple demand functions using a clustering algorithm, and then learns on the fly which demand function is more likely to be correct. We will also discuss some field experiment result through collaborating with Groupon, a large daily deal website.

4 - Demand Forecasting when Customers Consider, Then Choose
Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-134, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu, Srikanth Jagabathula
We consider the problem of demand forecasting when customers choose by first forming a consideration set and then choosing the most preferred product from the consideration set. The consideration set is sampled from a general model over subsets. We propose techniques to estimate such models from purchase transaction data.

2 - Transaction Attributes and Customer Valuation
Michael Braun, Associate Professor Of Marketing, Southern Methodist University, 6212 Bishop Blvd., Fincher 309, Dallas, TX, 75275, United States of America, braumn@smu.edu, Eli Stein, David Schweidel
We propose a model of customer value and marketing ROI that incorporates transaction-specific attributes and unobserved heterogeneity. From this model, one can estimate an upper bound on the amount to invest in retaining a customer. This amount depends on the recency and frequency of past customer purchases. Using data from a B2B service provider, we estimate the revenue lost by the firm when it fails to deliver a customer’s requested level of service.

3 - Auctions with Dynamic Costly Information Acquisition
Negin Golrezaei, Auctions With Dynamic Costly Information Acquisition, University of Southern California, Bridge Memorial Hall, 3670 Trousdale Parkway, Los Angeles, CA, 90089, 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 encompases the optimal and the efficient mechanisms as special cases.

1 - Approximation Algorithms for Dynamic Assortment Optimization Models
Ali Anuar, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 44 West 120th Street, Mudd 315, New York, NY, 10027, United States of America, cya2114@cornell.edu, Danny Segev, Retsef Levi
We consider a capacity constrained assortment optimization problem under the Markov Chain based choice model proposed by Blanchet et al. We first show that even severely-restricted special cases are APX-hard. We then present a constant factor approximation for the general problem. Our algorithm is based on a “local-ratio” method that allows us to transform a non-linear revenue function into a linear function over appropriately modified item prices.

2 - Capacity Constrained Assortment Optimization under the Markov Chain Based Choice Model
Chun Ye, Columbia University IEOR department, 500 West 120th Street, Mudd 315, New York, NY, 10027, United States of America, cy2214@columbia.edu, Danny Segev, Viteet Goyal, Antoine Desir
We consider a capacity constrained assortment optimization problem under the Markov Chain based choice model proposed by Blanchet et al. We first show that even severely-restricted special cases are APX-hard. We then present a constant factor approximation for the general problem. Our algorithm is based on a “local-ratio” method that allows us to transform a non-linear revenue function into a linear function over appropriately modified item prices.

3 - Assortment Optimization under a Random Swap Based Distribution over Permutations Model
Antoine Desir, Columbia University IEOR department, 500 West 120th Street, Mudd 315, New York, NY, 10027, United States of America, ad2918@columbia.edu, Viteet Goyal, Danny Segev
We consider special class of distribution over permutations model based on modeling the consumer preferences by a random number of random swaps from a small set of fixed preference lists. This model is motivated from practical applications where preferences of “similar” consumers differ in a small number of products. We present polynomial time approximation schemes for capacity constrained assortment optimization problem under the random swap based distribution over permutation model.

4 - Design of an Optimal Membership Promotion Policy with Experiments
Spyros Zoumpoulis, Insead, spyros.zoumpoulis@insead.edu, Duncan Simester, Artem Timoshenko
Deciding what customer to target with what type of membership promotion is among the most important decisions that wholesale clubs face. We use the results of a large-scale membership promotion field experiment involving multiple types of membership promotions to propose various promotion policies, each relying on a different algorithm for customer segmentation. We then evaluate the performance of the proposed policies as implemented in a large-scale field test.

1 - Scheduling of Guaranteed Targeted Display Advertising under Reach and Frequency Requirements
Ali Højati, University of California Irvine, Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, alihojati@uci.edu, John Turner, Suleyman Cetinmaz, Jian Yang
We propose a novel mechanism for the scheduling of guaranteed targeted advertising in online media. We consider a new form of contract in which advertisers specify the number of unique individuals (reach) and the minimum number of times (frequency) each individual should be exposed. We further integrate a variety of new features such as desired diversity and pacing of ads over time or the number of competing brands seen by each individual. We perform extensive numerical tests on industry data.

1 - Prediction vs Prescription in Data-driven Pricing
United States of America, sjagabat@stern.nyu.edu
We study the joint assortment and inventory management problem, where demand consists in a random sequence of heterogeneous customers. Although the problem is hard in general, we provide the first polynomial time algorithms that attain constant approximations, for variants proposed in previous literature as well as more general choice models. In addition, our algorithms provide practical means for solving large-scale instances and for incorporating more realistic constraints.
4 - Learning, Revising, and Forgetting Multidimensional Contextual Features for Online Ad Selection

John Turner, Assistant Professor, University of California, Irvine, Room 122, The Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, j.turner@uci.edu, Tianbing Xu, Amelia Regan, Yaming Yu

We study how best to match ads to viewers using high-dimensional contextual features (demographic, browsing behavior) to predict click-through probability. Using Thompson Sampling in a Bayesian framework, our model learns the importance of contextual features while adapting/forgetting over time, capturing changing individuals’ tastes and shifts in the viewing population’s composition.

TB46

46-Room 104A, CC

Service Models in MSOM

Sponsor: Manufacturing & Service Op Mgmt/Service Operations

Sponsored Session

Chair: Opher Baron, University of Toronto, 105 St George St, Toronto, ON, Canada, opher.baron@rotman.utoronto.ca

1 - Worker Flexibility Training and Production Decision Rights

Gad Allon, Professor, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, g.allon@kellogg.northwestern.edu, Achal Bassamboo, Evan Barlow

We explore the interaction between production decision rights and workers’ decisions on training to become flexible resources. Research on flexible resources is prevalent in the operations management literature. Human resources, however, are decision makers and have rights to decide on their own training levels. Many firms, however, have also given workers some production decision rights. We show how the workers’ training decisions are affected by the identity of the production decision maker.

2 - Revenue Maximization for Cloud Computing Services

Cinar Klicioglu, Columbia Business School, New York, NY, 10027, United States of America, cklicioglu16@gsc.columbia.edu, Costis Maglaras

We study a stylized model of revenue maximization for cloud computing services, analyze price data traces from the biggest cloud service provider, Amazon, provide some possible explanation for price spikes based on intuitive asymptotic analysis arguments in systems with large scale capacity and large market potential, and ultimately study the revenue maximization problem faced by the service provider that operates in an infinite capacity system and in a market with multiple customer types.

3 - Admission and Discharge Decisions in Intensive Care Units

Huiyin Ouyang, UNC Department of Statistics & Operations Research, 318 Hanes Hall, CB# 3260, Chapel Hill, NC, 27599-3260, United States of America, ouyang5@live.unc.edu, Serhan Ziya, Nilay Argon

We formulate a MDP model for admission decisions in an ICU where patients’ health conditions change over time according to Markovian probabilities. We find that the optimal decision can depend on the mix of patients in the ICU and provide an analytic characterization of the optimal policy. We also identify conditions under which the optimal policy is state-independent.

4 - Tandem Queues with Reneging – Analysis and Insights

Jianfu Wang, Assistant Professor, Nanyang Business School, NTU, 50 Nanyang Avenue, NTU, Singapore, Singapore, wangjf@ntu.edu.sg, Opher Baron, Oded Berman, Hossein Aboue Mehri

This paper considers tandem queueing systems with reneging. We develop a new technique to solve two dimensional Markov Chains with non-repeating structure. Our technique can be applied to additional settings and used to derive different service level measures. We demonstrate this technique on a two-station tandem queueing model with reneging, which has been considered analytically intractable.
2 - Planning for Product Substitution in Seed Business
Saurabh Bansal, Assistant Professor, Penn State University, 405 Business Building, University Park, PA, 16802, United States of America, sub32@psu.edu

We present new analytical results to manage seed substitution in the agribusiness domain, and discuss results of an empirical case study in collaboration with an industry partner.

3 - Government Intervention and Crop Diversification in Agricultural Supply Chains
Duygu Gunaydin Akkaya, Stanford GSB, 655 Knight Way, Stanford, CA, 94305, United States of America, duygug@stanford.edu, Kostas Bimpikis, Hau Lee

Agricultural supply chains face immense risks including yield and market price uncertainty. In order to mitigate these risks, farmers can engage in crop diversification. Governments also take a role in supporting farmers’ income and implement various subsidies to alleviate poverty in the farmer population. We study how interventions and diversification practices impact the supply chain in the presence of random yield and endogenous market price.

4 - Corn or Soybean: Dynamic Farmland Allocation under Uncertainty
Onur Boybayballi, Assistant Professor of Operations Management, Singapore Management University, 50 Stamford Road 04-01, Lee Kong Chian School of Business, Singapore, 178899, Singapore, obboybayballi@smu.edu.sg, Javad Nasiry, Yangfang Zhou

This paper studies the farmland allocation decision of a farmer between two crops in a multi-period framework. In each period, the farmer chooses the allocation in the presence of revenue uncertainty, and crop rotation benefits across periods. We characterize the optimal policy and investigate the impact of revenue uncertainty. We propose a heuristic allocation policy which is near-optimal.

■ TB49
49-Room 105B, CC
Retail Operations
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Chris Parker, Penn State University, 411 Business Building, University Park, PA, 16802, United States of America, chris.parker@psu.edu

1 - Supply Chain Structure and Multimarket Competition
O. Cem Ozturk, Assistant Professor Of Marketing, Georgia Institute of Technology, 800 West Peachtree St. NW., Atlanta, GA, 30308, United States of America, oem.ozturk@scheller.gatech.edu, Necati Tereyagulu

We study the role of supply chain structure in determining competitive intensity when manufacturers and retailers encounter in multiple markets. Our theoretical model shows how the differences in supply network overlap across multiple markets lead to higher retail prices. Using an extensive scanner data set, we find empirical support for the analytical results. These findings show the importance of supply chain structure in assessing multimarket competition among firms.

2 - Value of Downward Substitution under Stochastic Prices
Fehimi Tanrisever, Bilkent University, Bilkent, Ankara, Turkey, tanrisever@bilkent.edu.tr, Zimbubu Atan, Junchi Tan

Downward substitution as a form of operational flexibility has received significant academic attention. The literature on downward substitution follows the main stream inventory literature and assumes uncertain demand and/or yield and explores the value of substitution flexibility. They, however, assume fixed prices which may distort the analysis in many industries where prices may fluctuate. In this paper, we explore the effect of price uncertainty on the value of downward substitution.

3 - Supply Chain Contracts that Prevent Information Leakage
Yiwei Chen, Assistant Professor, Renmin University of China, NO. 59 Zhongguancun Street, Beijing, China, chenyiwei@rbs.org.cn, Ozalp Ozer

We study a supply chain with one supplier and two competing retailers (incumbent and entrant). The incumbent has better but imprecise private forecast. We explore general conditions that a wide range of contracts need to satisfy to prevent the supplier from leaking the incumbent’s private forecast to the entrant. We define two groups of contracts based on how the supplier and retailers share inventory risks. We find only these two groups of contracts may avoid information leakage.

4 - Experience and Competition Effects in Penny Auctions
Chris Parker, Pennsylvania State University, 411 Business Building, University Park, PA, 16802, United States of America, chris.parker@psu.edu, Pranav Jindal, Tony Kwasnica, Peter Newberry

The internet has created many new online retail opportunities. One such model is the penny auction, an ascending first-price auction where bidders pay a fee to bid and increase the price by a nominal amount. The winning bidder pays the auction price and receives the item with all other bidders receiving nothing. We utilize a detailed dataset from a penny auction company to investigate the effects of experience and competition on bidding behavior and auction outcomes.

■ TB50
50-Room 106A, CC
Value Chain Innovations in Developing Economies
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Saibal Ray, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, saibal.ray@mcgill.ca
Co-Chair: Fei Qin, Post-doc Research Fellow, McGill University, Desautels Faculty of Management, Montreal, QC, Canada

1 - Milking the Quality Test: Improving the Milk Supply Chain under Competing Collection Intermediaries
Liyung Mu, Assistant Professor, University of Delaware, 20 Orchard Rd, Newark, 19716, United States of America, muilig@udel.edu, Milind Dawande, Xianjun Geng, Vijay Moukjerjee

We examine the quality issues of milk — via deliberate adulteration by milk farmers — acquired by competing collection intermediaries in developing countries. Interestingly, some intuitive interventions such as providing collection stations with better infrastructure (e.g., refrigerators) or subsidizing testing costs could hurt the quality of milk in the presence of competition. The goal of this study is to provide recommendations that address the quality problem with minimal testing.

2 - Low Cost Cataract Surgery in India: What Can Western Health Systems Learn from it?
Harish Krishnan, Sauder School of Business, University of British Columbia, Vancouver, Canada, Harish.Krishnan@sauder.ubc.ca

The Aravind Eye Care System (AECs) in India is known for its low-cost business model. However, few studies have done a detailed analysis of the cost structure of a cataract surgery at the AECs. This talk will present cost data from AECs and compare it to similar data at an eye hospital in Canada. The goal is to identify root causes of the cost differences between AECs and western health systems. The barriers to implementing AECs’ innovations in the west will also be discussed.

3 - Multi-treatment Inventory Allocation in Humanitarian Health Settings under Funding Constraints
Jayashankar Swaminathan, UNCH-Capel Hill, 300 Kenan Drive, Chapel Hill, NC, 27599, United States of America, Jay_Swaminathan@kenan-flagler.unc.edu, Karthik V. Natarajan

We study the problem of allocating inventory procured using donor funding to patients in different health states over a finite horizon with the objective of minimizing the number of disease-adjusted life periods lost. The optimal policy is state-dependent and hence, we develop two heuristics for the allocation problem. We also provide analytical results and computational insights regarding how the funding level and funding timing impact program performance.

4 - Micro-entrepreneurship in Agri-food Supply Chains in Developing Economies
Fei Qin, McGill University, Desautels Faculty of Management, Montreal, QC, H3A1GI, Canada, fei.qin@mcgill.ca, Mehmet Gumus, Saibal Ray

Motivated by Veggie-Kart direct farm-to-food initiative for marginal farmers and retailers in developing economies, we examine the impact of supply chain innovations involving micro-entrepreneurs at both upstream and downstream stages, which compete with the traditional spot-market based channel in presence of supply uncertainty.
1 - Distressed Selling by Farmers: Model, Analysis, and Use in Policy-Making
Shivam Gupta, PhD Candidate, UT Dallas, NJ School of Management, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, sxg104920@utdallas.edu

The surprising practice of distressed selling, where farmers sell to produce agents at prices much lower than the government’s guaranteed price, is common in developing countries. We build a tractable stochastic DP model that captures the ground realities – limited and uncertain procurement capacity, high holding costs, and lack of affordable credit – that lead to distressed sales. Using real procurement data, we establish the accuracy of our model and develop useful policy suggestions.

2 - Coordinating Procurement Decisions in Multi-division Firms
Fang Fang, Ph. D. Candidate, University of Miami, 5250 University Drive, Coral Gables, FL, 33124, United States of America, f.fang@umiami.edu, Hari Natarajan

Central procurement organizations (CPO) of large firms must coordinate firm-wide procurement to leverage volume discounts from suppliers. Facing such a procurement coordination problem, we examine how a CO can design internal prices to maximize firm-wide cost savings. Our analysis of commonly-used internal pricing rules shows interesting impacts on vendor selection, divisional participation, and gain allocation.

3 - Does Quality Knowledge Spillover at Shared Suppliers? – An Empirical Investigation
Suresh Muthulingam, Assistant Professor Of Supply Chain Management, Smeal College of Business, The Pennsylvania State University, 460 Business Building, State College, PA, 16802, United States of America, sxm184@psu.edu, Anupam Agrawal

We study the spillover of quality knowledge across supply chains. We observe the quality performance of 191 suppliers who use the same facilities to manufacture similar products for two distinct businesses. We find that quality knowledge spills over under three conditions: (i) When quality efforts focus on organizational members; (ii) When quality efforts focus on output activities of suppliers; and (iii) When quality knowledge is developed at suppliers with low complexity.

4 - Contracting Between a Blood Bank and Hospitals
Anand Paul, University of Florida, 351 Stuzin Hall, Gainesville, FL, United States of America, paulaa@ufl.edu, Tharanga Rajapakshe

The supply of blood at a regional blood bank (RBB) is uncertain and often insufficient to satisfy the total demand for it. The RBB typically does not observe the demand at each hospital before determining the allocation policy. Insufficient allocation leads to shortages at hospitals which necessitates reallocation of blood and significant blood outdated cost. We make an analytical study of socially optimal contracting decisions of an RBB serving multiple hospitals.

2 - Automatic Feedback Control for Shunt Drainage in Hydrocephalus Patients
Kalyan Raman, Professor, Northwestern University, Medill School, Evanston, IL, United States of America, kalyraman@gmail.com, Vijay Viswanathan

Excessive intracranial pressure (ICP) resulting from insufficient drainage of cerebrospinal fluid (CSF) leads to a neurological disorder called hydrocephalus, which is treated by implanting shunts to reduce ICP by draining excess CSF. We use non-linear control theory to develop a mathematical algorithm for a regulator to achieve shunt action that is significantly more sophisticated than that of a switch.

3 - Multiattribute Pricing
Thomas Weber, Associate Professor, EPLF, CDM-ODY 3.01, Station 5, Lausanne, VD, 1015, Switzerland, thomas.weber@epfl.ch

We provide a technique for constructing second-best multiattribute screening contracts in a general setting with one-dimensional types based on necessary optimality conditions. Our approach allows for type-dependent participation constraints and arbitrary risk profiles. As an example we discuss optimal insurance contracts.

4 - Dynamic Incentives in Sales Force Compensation
Olivier Rubel, UC Davis, Graduate School of Management, One Shields Avenue, Davis, CA, United States of America, orubel@ucdavis.edu, Ashutosh Prasad

We propose dynamic principal-agent model to investigate how to incentivize sales people when current selling efforts and carryover sales drive present sales. We show that the carryover effect increases not only expected sales, but also sales uncertainty. We then find that the manager incentivizes the high risk-aversion salesperson with a concave compensation and the low risk-aversion salesperson with a convex compensation.

1 - Pricing Cause Marketing Products in the Presence of Social Comparison
Paola Mallucci, Assistant Professor of Marketing, University of Wisconsin at Madison, 4261 Grainger Hall, 975 University Ave., Madison, WI, 53706, United States of America, pmallucci@bus.wisc.edu, Tony Haitao Cui, George John

The broad takeaway from the literature on cause marketing campaigns, where firms donate to charities with purchase, is that they generally work well, because of “warm glow.” We conjecture that far from creating only positive feelings, such firm donations can create discomfort by encouraging social comparison. We find that firms can find it profitable to exploit such discomfort even if it decreases consumers utility. Results apply in both monopoly and competition.

2 - Pricing and Quality Perception: Theory and Experiment
Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu, Rim Harits, Georgia Perakis, Wichinpong Sinchaistri

We study how a constant pricing strategy versus a markdown strategy may induce different perceptions of quality among consumers, and how a firm should take these quality perceptions into account when optimizing its pricing policy for competitive products. We empirically elicit the relationship between consumers’ perceived quality and prices under either pricing strategy, and incorporate these relationships into our consumer model to analyze the firm’s optimal pricing policy.

3 - Conflict of Interest and Market Structure in Multiplayer Games
Sung Ham, Assistant Professor of Marketing, George Washington University, 2201 G St. NW, Washington, DC, 20052, United States of America, sungham@gwu.edu, Jiaxin Wu, Noah Lim

When a firm serves customers who compete with one another, a conflict of interest may arise. We develop a multi-player game where firms serve competing customers, and examine how the market structure faced by the firms impacts the extent to which conflicts of interest affect behavior. We test our theory using an incentive-aligned experiment and find that the decisions are consistent with the model predictions.
4 - The Behavioral Cost of Quality Nonconformance: Risk-averse and Experience-sampling Customers

Jordan Tong, Assistant Professor, University of Wisconsin at Madison, WI, United States of America, jordan.tong@wisc.edu.
Greg Decroix

Why do customers purchase less when quality is inconsistent? A common explanation is that customers have risk-averse preferences: they inherently prefer less uncertainty. Another explanation, however, is that tendencies towards low-variance alternatives are due to a learning process from experience. We show that optimal pricing and promotion decisions can differ significantly depending on which explanation is modeled, thereby illuminating the costs of nonconformance and how to mitigate them.

■ TB54

54-Room 108A, CC

Approximations of Queueing Performance for Rapid Systems Design

Cluster: Tutorials

Invited Session

Chair: Ton Dieker, Columbia University, 500 W 120 St, New York, NY, United States of America, ton.dieker@iier.columbia.edu

1 - Tutorial: Approximations of Queueing Performance for Rapid Systems Design

Ton Dieker, Columbia University, 500 W 120 St, New York, NY, United States of America, ton.dieker@iier.columbia.edu, Steve Hackman

Recent advances in queueing analysis have yielded tractable approximations of performance metrics that can be used to quickly explore initial designs, to reduce computational burdens associated with simulation, or even to eliminate the need for simulation altogether. This TutOKal takes you on an accessible tour of these recent methods, shows you how to apply them using numerical examples drawn from real applications, and discusses implementation challenges and potential opportunities.

■ TB55

55-Room 108B, CC

Stochastic Methods in Efficiency Analysis

Cluster: Data Envelopment Analysis

Invited Session

Chair: Ole Olesen, Professor, University of Southern Denmark, Campusvej 55, Odense, 5230, Denmark, ole@sam.sdu.dk

1 - Estimating Production Functions and Frontiers using Stochastic DEA

John Ruggiero, Professor, University of Dayton, Dayton, OH, United States of America, jruggiero1@udayton.edu

In this paper, we present two methods to estimate production functions and frontiers (deterministic and stochastic). We constrain the technology using the Afriat conditions and consider minimizing the sum of absolute and/or squared errors. We extend this method using locally weighted least squares in the spirit of loess (local regression).

2 - Endogeneity in Stochastic Frontier Models

Artem Prokhorov, University of Sydney, CIREQ, St. Petersburg State U, Business School, Sydney, NS, 2006, Australia, artem.b.prokhorov@gmail.com, Peter Schmidt, Christine Amsler

Stochastic frontier models are typically estimated by MLE or corrected OLS. The consistency of either estimator depends on exogenity of the explanatory variables (inputs, in the production frontier setting). We will investigate the case that one or more of the inputs is endogenous, in the simultaneous equation sense of endogeneity. We will consider modifications of standard procedures under endogeneity for the stochastic frontier setting

3 - Shape Constrained Kernel Weighted Least Squares for the Estimation of Production Functions

Andrew Johnson, Texas A&M, College Station, TX, United States of America, ajohnson@tamu.edu, DaiSuke Yagi

This paper proposes a unifying model and estimator we call Shape Constrained Kernel-weighted Least Squares (SCKLS). We show the relationship between the SCKLS estimator and both the Convex Nonparametric Least Squares (CNLS) and Du's estimators. Specifically, the SCKLS estimator converges to the CNLS estimator as the bandwidth goes to zero. We compare the performance of the three estimators (SCKLS, CNLS, and Du's estimator) via Monte Carlo simulations.

4 - Two Different Approaches to Stochastic DEA

Ole Olesen, Professor, University of Southern Denmark, Campusvej 55, Odense, 5230, Denmark, ole@sam.sdu.dk, Niels Chr. Petersen

Focus is on different views on extending DEA to a stochastic setting. The management science framework does not focus to model performance using a statistical model based on a specific Data Generating Process (DGP). Some stochastic DEA models focus on replacing the observed input output observations with DMU specific distributions. The statistical framework insists on an axiomatic approach to a statistical model, including a specification of a DGP. We illustrate these differences.

■ TB56

56-Room 109A, CC

Multiple Stakeholders in NPD

Cluster: New Product Development

Invited Session

Chair: Niyazi Taneri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitaneri@sutd.edu.sg

1 - The Role of Decision Rights in Collaborative Development Initiatives

Nektarios Oraipoulos, Cambridge Judge Business School, University of Cambridge, Trumpington St., Cambridge, 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.

2 - Structuring New Product Development Partnerships

Niyazi Taneri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitaneri@sutd.edu.sg, Arnould De Meyer

New product development partnerships involve a high degree of risk, information and incentive problems across various stakeholders. Partners structure their alliances to address such concerns. We identify factors that affect the structure of the partnership and the performance of the partnership.

3 - The Impact of Continuous Product Development and Customer Feedback on Mobile App Performance

Nilam Kaushik, University College London, University College London, London, United Kingdom, nilam.kaushik.13@ucl.ac.uk, Bilal Gokpinar

Mobile application development differs from traditional product development owing to low barriers of entry, the ability to provide continuous software updates, and ease of access to customer feedback. Using a dataset from the App Store, and drawing from a combination of text mining techniques and econometric methods, we investigate the impact of incorporating customer feedback on mobile app performance.

■ TB57

57-Room 109B, CC

Assorted Topics in Renewable Energy

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Anthony Papavasiliiou, Université Catholique de Louvain, Voie du Roman Pays 34, Louvain la Neuve, Ou, 1348, Belgium, tppava@hotmail.com

1 - A Controlled Approximation Scheme for Managing Hydroelectric Generation with Multiple Reservoirs

Bernard Lamond, Professor, Universite Laval, Dep. Operations & Systems de Decision, 2325, Rue de la Terrasse #2620, Quebec, QC, G1V 0A6, Canada, Bernard.Lamond@lsa.ualaval.ca, Pascal Lang, Pascal Cote, Luckey Zephry

We present an approach for adaptive approximation of the value function in stochastic dynamic programming. We use a simplicial partition of the state space to construct a nonseparable piecewise affine approximation which is refined iteratively using lower and upper bounds on the value function. The proposed scheme is experimented numerically in the context of hydroelectric production across multiple reservoirs and power plants.
2 - Demand-side Power Procurement with Renewable Generation and Energy Storage
Soongceol Kwon, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, soongceol@tamu.edu, Natarajan Gautam

We consider operational decisions to satisfy power demand while minimizing purchase cost over time-varying electricity prices. In our scenario, consumers use renewable sources to serve power demand and operate energy storage. We propose a two-stage stochastic optimization problem to control purchase, consumption and operations based on day-ahead and real-time procurement while responding to variability and uncertainty in power demand, renewable sources and electricity prices.

3 - Wind Speed Forecasting for Wind Parks: A Sequential Modeling Approach
Vignesh Subramanian, Dept. of Industrial and Management Systems Engineering, University of South Florida, ENB118, Tampa, FL, United States of America, vigneshn@mail.usf.edu, Tapas K. Das

Inherently intermittent nature of wind energy makes it essential to accurately predict wind speed for reliable operation of power systems comprising wind generation. We propose a two-stage model. Stage I uses SVM to classify wind speed into three clusters: zero power, rated power, and continuous power. Stage II employs a Bayesian additive regression kernel (BARK) method to the continuous power cluster to estimate the wind speed. The model is tested on numerical weather prediction (NWP) data.

4 - Capacity Remuneration in the Belgian Electricity Market
Anthony Papavasiliou, Université Catholique de Louvain, Voie du Roman Pays 34, Louvain La Neuve, Oud, 1348, Belgium, tapav@hotmail.com

Belgium experienced a serious shortage in capacity recently due to the unplanned outage of nuclear capacity. This has motivated an investigation of Belgian capacity remuneration mechanisms. In this presentation we compare the existing fixed reserve requirements with the introduction of operating reserve demand curves in reserve auctions.

TB58

58-Room 110A, CC
Topics in Nuclear Energy
Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)
Sponsored Session
Chair: Alexandra Newman, Professor, Colorado School of Mines, Mechanical Engineering, Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Optimizing the Placement of Radioactive Isotope Measurement Devices in a Nuclear Fuel Cycle
Ben Johnson, PhD Student, Colorado School of Mines, Golden, CO, 80401, United States of America, bebjohns@nmmm.mines.edu, Alexandra Newman, Jeffrey King

The purpose of nuclear safeguards is to prevent proliferation of radioactive material. Enhancing methods to detect potential proliferation will help reduce the increasing threat of malicious entities successfully obtaining nuclear material. We create a mixed integer program to determine how many, where, and which types of radioactive isotope measurement devices should be used in the nuclear fuel cycle to minimize the weighted sum of Type I and Type II measurement errors.

2 - Modeling Societal Disruption from Nuclear Accidents to Inform Regulatory Decision-making
Vicki Bier, Professor, University of Wisconsin - Madison, 1513 University Avenue, 3270A Mechanical Engineering Building, Madison, WI, 53706, United States of America, vicki.bier@wisc.edu, Michael Corradini, Caleb Roh, Shuji Liu, Robert Youngblood

Nuclear regulation in the U.S. focuses on preventing radiation-related fatalities. However, recent experience shows that societal disruption from relocation can be considerable, arguably more significant than radiation-induced health effects. We have evaluated the population relocation that could occur after severe reactor accidents as a proxy for societal disruption, and argue that regulatory guidance should constrain societal disruption as well as radiation exposure.

3 - Economics of High-temperature Reactors for Industrial Cogeneration: A Utility’s Perspective
Reinhardt Madlener, R.Madlener@eonerc.rwth-aachen.de, Jona Hampe

This paper studies the economic potential of using HTRs for cogeneration of industrial process heat and electricity. We find that a reference case HTR can deliver cost-competitive process heat (at 200 °C), thus rendering the chemical and pulp & paper industries potential candidates. We use real options analysis to deal with uncertainty and the managerial flexibilities of the project. We also propose a model to calculate the option of switching between two different operation modes.

4 - Selecting the Optimum Nuclear Fuel Cycle Including Quasi-rational Opinions and Public Perception
Sama Bilbao Y León, Associate Professor, Virginia Commonwealth University, 401 W Main St, Richmond, VA, 23284, United States of America, sbilbao@vcu.edu, John Swanson, Ihsoc Salaam, Jonathan Hill

Although much work has been done to address the technological challenges associated with the management and ultimate disposal of used nuclear fuel, less attention has been given to public perception and acceptance of the selected fuel cycle. This work presents current progress in a decision making model based on Multi-Attribute Utility Theory that contains the fundamental objectives for both technical and non-technical factors.
2 - Measuring Interculture Competence Among Business, Education and Social Work Students
Amarpreet Kohli, Assistant Professor, Farmingdale State College, SUNY, Farmingdale, NY, United States of America, kohlias@farmingdale.edu, Hermeet Kohli, Cheng Peng

Purpose of this interdisciplinary research was to measure the level of multicultural awareness, sensitivity to, and understanding of difference, and intercultural competence when working in diverse environments in the undergraduate and graduate Business, Education and Human Development, and Social Work students using the UDO (MGUD-S Survey). Convenient purposive sampling was utilized to invite students enrolled in these three schools to participate in web based descriptive survey research.

3 - Redesigning Qatar University Class Meeting Pattern to Improve Performance
Omar Ben-ayed, Professor Of Management, Qatar University, Al Jamea Street, P.O. Box 2713, Doha, 2713, Qatar, omar.benayed@qu.edu.qa, Hiba Younis, Hend Hammad

This study examines the existing class meeting pattern at Qatar University based on the strategic plan of the University in addition to the perception of students and faculty members. The study shows that there is a need for a new class meeting pattern with two additional non-teaching half days. A capacity analysis proves the feasibility of such a pattern. Accordingly, alternative class meeting patterns are proposed and one is selected based on technical, academic and cultural perspectives.

4 - Inducing Environmental Disclosures: A Dynamic Mechanism Design Approach
Shouqiang Wang, Assistant Professor, Clemson University, 131D Srrine Hall, Clemson, SC, 29672, United States of America, shouqiw@clemson.edu, Peng Sun, Francis De Véricourt

This paper studies the design of voluntary disclosure regulations that jointly uses inspections and monetary rewards. We formulate this problem in a dynamic mechanism design framework with state verification and obtain complete analytical solution.

5 - Trade-Ins Versus Upgrades: A Behavioral Exploration
Mahdi Mahmoudzadeh, Georgia Institute of Technology, 800 W Peachtree St NW, Atlanta, GA, United States of America, Mahm.Mahmoudzadeh@scheller.gatech.edu, Beril Toktay, Basak Kalkanci

Understanding customers’ behavior in selling positions or exchanging their products would help better manage replacement purchases and product return streams. We study trade-ins and upgrades, which so far have been assumed to be equivalent. We find that customers perceive trade-ins and upgrades differently: perceived importance of the quoted price for current product is more salient in trade-ins than in upgrades. Our results are useful to find dominant replacement offers and pricing strategies.

6 - Design and Technology Choice for Recycling: The Value of Collaboration and Capacity Ownership
Luyi Gui, Assistant Professor, UC Irvine, United States of America, luyig@uci.edu, Morvarid Rahmani, Atalay Atasu

Efficient and effective treatment of end-of-life products requires not only product design improvements but also advancement in recycling technologies. We analyze how Extended Producer Responsibility (EPR) legislation would affect incentives for improving product recyclability and processing technology. In particular, we take into account the mutually reinforcing effect between product and process improvements and explore the implication of such complementarity in EPR implementation.

7 - Measuring Interculture Competence Among Business, Education and Social Work Students
Amarpreet Kohli, Assistant Professor, Farmingdale State College, SUNY, Farmingdale, NY, United States of America, kohlias@farmingdale.edu, Hermeet Kohli, Cheng Peng

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1 - The Need for a Sound Decision Making System

**Moderator:** Ali Abbas, Professor of Industrial And Systems Engineering And Public Policy And Director Of Create, University of Southern California, 3710 McClintock Avenue, RTH 314, Los Angeles, CA, United States of America, alibaba@price.usc.edu

This talk reflects on some widely used methods of multi-objective decision making in both public and private enterprises, and demonstrates the issues with their use and the need for a sound decision making system.

2 - Ethical Decision Analysis

**Ronald Howard, Professor, Stanford University, 646 Tennyson Avenue, Palo Alto, CA, 94301, United States of America, rhoward@stanford.edu**

Decision analysis is inherently amoral. Like fire or nuclear energy it can be used for good or ill. The decision analyst and the decision maker have the ethical responsibility for decisions. The decision maker for the choice of action and the decision analyst as a conspirator or accomplice in clarifying what is to be done. The daily news shows the consequences of abdicating ethical responsibility.

3 - There is No Rational Framework for Systems Engineering

**George Hazelrigg, Deputy Division Director, National Science Foundation, Civil, Mech. & Mfg Innovation, 4201 Wilson Boulevard, Arlington, VA, 22230, United States of America, ghazelr@nsf.gov**

Decision analysis for systems engineering is an oxymoron. Systems engineering requires teams of people, for which decision analysis does not apply. Failure to recognize this can lead to serious problems.

4 - Decision Analysis for Systems Engineering Trade-off Analyses

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

Critical systems decisions are made throughout the system life cycle. Decision analysis offers a sound foundation for developing a composite model of complex system alternatives, major uncertainties, and stakeholder values to provide insights to systems decision makers.

5 - Decision Analysis - Towards a Theoretical Foundation of Systems Engineering and Design

**Chris Pareidis, Program Director, National Science Foundation, 4201 Wilson Blvd, Arlington, VA, United States of America, cparedis@nsf.gov**

In a rapidly changing global context, out approach for engineering large-scale, complex engineered systems must also adapt quickly. A theoretical foundation for systems engineering and design is needed to help guide this adaptation in a rigorous, systematic fashion. Decision analysis is an important cornerstone of this foundation.

2 - How Little Do Models Tell Us?

**Eva Regnier, Associate Professor, Naval Postgraduate School, 699 Dyer Road, Monterey, CA, 93943, United States of America, erregnier@nps.edu, Erin Baker**

In arenas including weather forecasting and climate policy, simulation modeling is used to estimate uncertainty attributed to initial conditions. Model uncertainty (sometimes called structural uncertainty) is much harder to quantify. We outline a qualitative approach using Bayesian logic to answer the question: how much do model results tell us?

3 - Agile Modeling Focused on Decision Making

**Max Henrion, CEO, Lumina Decision Systems, Inc, 26010 Highland Way, Los Gatos, CA, 95033, United States of America, henhron@lumina.com**

Agile modeling borrows methods from agile software development, an alternative to the conventional approaches starting from formal requirements. Instead modelers start building a simple prototype, and refine it progressively, learning and improving as they go. Decision analysis and sensitivity analysis helps focus development on areas most decision-relevant.

2 - Examining the Robustness of Airline Operations under Weather Disruptions

**Donald Richardson, University of Michigan, Ann Arbor, MI, donalric@umich.edu, Luke Stumpos, George Tam, Amy Cohn, Chhavi Chaudhry**

We have compiled a database containing twelve years’ worth of flight data from the National Oceanic and Atmospheric Administration. By connecting this data with hourly weather reports from the National Weather Service, we are able to analyze how the weather affects the relationship between planned airline schedules and the actual flight performance. The purpose of this research is to provide a foundation for understanding the robustness of airline operations under weather disruptions.

3 - Data-driven Models for Robust Aircraft Routing

**Lavanya Marla, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Avenue, 216E, Urbana, IL, 61801, United States of America, lavanyam@illinois.edu, Vikrant Vaze**

We address the issue of pro-actively building robust aircraft routings that are less vulnerable to uncertainty, by focusing on reducing delay propagation. We present a series of data-driven models drawn from the classes of Robust Optimization and Chance-Constrained Programming that generate solutions that (i) are faithful to historical data and (ii) are less fragile to disruption. We conclude with results from a real-world airline network to provide proof-of-concept.
4 - Can Time Buffers Lead to Delays? The Role of Operational Flexibility  
Milind Sohoni, Associate Professor Of Operations Management  
And Sr. Associate Dean Of Programs, Indian School of Business,  
Gachibowli, Indian School of Business, Gachibowli, Hyderabad,  
Pl, 500032, India, milind_sohoni@ish.edu, Sanjiv Erat

In operating systems where the feasible start time of activities is uncertain, the actual buffers for conducting the activities are distinct from scheduled buffers. We study how, and why, do these buffers affect operating performance? We propose a theoretical model and evaluate its empirical content and predictions using airline industry data. Our main result shows that both buffers impact performance and their effects are moderated by flexibility. Thus ex-ante plans must consider flexibility.

■ TB67  
67-Room 201A, CC  
Advances in Vehicle Routing Problem and its Variants  
Sponsor: TSL/Freight Transportation & Logistics  
Sponsored Session  
Chair: Ibrahim Capar, The University of Alabama, Box 870226,  
Tuscaloosa, AL, United States of America, icapar@cba.ua.edu

1 - The Vehicle Routing Problem with Drones: A Worst-case Analysis  
Xingxin Wang, University of Maryland, Mathematics department,  
University of Maryland, College Park, MD, 20742, United States of  
America, wangxx@umd.edu, Stefan Polkoken, Bruce Golden  
We introduce the Vehicle Routing Problem with Drones (VRPD). A fleet of trucks  
equipped with drones delivers packages to customers. Drones can be dispatched  
from and picked up by the trucks at the depot or the customer locations. The  
objective is to minimize the maximum duration of the routes. We compare VRPD  
to the min-max Vehicle Routing Problem from a worst-case perspective and show  
that the maximum savings from using the drones depends on the number and  
the speed of the drones.

2 - Online and Open Vehicle Routing Problem with Split Delivery  
Ibrahim Capar, The University of Alabama, Box 870226,  
Tuscaloosa, AL, United States of America, icapar@cba.ua.edu,  
Burcu Keskin  
We consider an online, open vehicle routing problem with split deliveries. This  
type of problem is usual for companies that use common carriers with TL, LTL, or  
container services. We develop an integer programing model and propose a  
reduction technique to solve real life problem with commercial software. We  
investigate the effect of lead time on cost and outstanding orders and explore  
different policies to minimize total cost. We show more than eight percent savings  
compared to the literature.

3 - Distributionally Robust Adaptive Vehicle Routing  
Arthur Flajolet, MIT, Operations Research Center,  
77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA,  
02139, United States of America, flajolet@mit.edu, Patrick Jaillet,  
Sebastien Blandin  
We consider an adaptive solution to the vehicle routing problem with stochastic  
travel times with the objective of minimizing a risk function of the lateness. To  
mitigate the impact of the lack of information on the travel times, we develop a  
distributionally robust dynamic programming formulation for risk-averse travelers  
and illustrate the practicality of the approach with field data from the Singapore  
road network.

4 - A Metaheuristic for the Electric Vehicle Routing Problem with  
Recharging Stations and Time Windows  
Site Wang, Graduate Student, Clemson University, 854  
Issaquena Trail, APT908, Central, SC, 29630, United States of  
America, sitew@clemson.edu, Eric Huang, Scott Mason  
In this study, we consider electric vehicles and recharging stations in the vehicle  
routing problem with time windows. We examine two objectives for this problem,  
separately and in concert, to provide insights for the location-routing problem  
with time windows. Due to the problem’s complexity, we demonstrate the  
efficacy of our two-phase metaheuristic that combines variable neighborhood  
search and Tabu search for practical-sized problems.

■ TB68  
68-Room 201B, CC  
TSL Invited Cluster Keynote Address  
Sponsor: Transportation, Science and Logistics  
Sponsored Session  
Chair: Irina Dolinskaya, Northwestern University, 2145 Sheridan Road,  
Evanston, IL, 60208, United States of America, dolira@northwestern.edu

1 - Stochastic Vehicle Routing: An Overview and Some  
Research Directions  
Michel Gendreau, Full Professor, École Polytechnique de  
Montréal, P.O. Box 6128, Station Centre-ville, Montreal, QC, H3C  
3J7, Canada, michel.gendreau@cirrelt.ca  
While Vehicle Routing Problems have now been studied extensively for more  
than 50 years, those in which some parameters are uncertain at the time where  
the routes are made have received significantly less attention, in spite of the fact  
that there are many real-life settings where key parameters are not known with  
certainty. In this talk, we will examine the main classes of Stochastic Vehicle  
Routing Problems: problems with stochastic demands, stochastic customers, and  
stochastic service or travel times. We will emphasize the main approaches for  
modeling and tackling uncertainty: a priori models, a posteriori approaches,  
and chance-constrained models. The end of the talk will devoted to a brief  
presentation of some interesting research directions in this area.

■ TB69  
69-Room 201C, CC  
Joint Session TSL/Public Sector: Health-care,  
Education, and Emergency Applications of Logistics  
Sponsor: Transportation, Science and Logistics  
Sponsored Session  
Chair: Sung Hoon Chung, Binghamton University, P.O. Box 6000,  
Binghamton, NY, United States of America, schung@binghamton.edu

1 - Public Transportation Planning for Mass-Scale Evacuations  
Rahul Swamy, Graduate Research Assistant, University at Buffalo  
(SUNY), 412 Bell Hall, Buffalo, NY, Jee Eun Kang, Rajan Batta  
This research provides a public transportation planning strategy in an urban  
setting for evacuating population groups to safe locations before a mass-scale  
disaster. Under the objective of maximizing the number of evacuees, the proposed  
model first identifies pickup locations and then constructs special type of routing  
to serve a time-varying demand.

2 - Minimizing the Cost of Routing Blood Collection Vehicles  
Okan Orsan Ozener, Ozyegin University, Cekmekoy, Istanbul,  
Turkey, orsan.ozener@ozyegin.edu.tr  
We study the routing of blood collection vehicles to minimize the total routing  
costs. Donated blood has to be processed within a certain amount of time. We  
analyze the routing decisions and propose an integrated framework to minimize  
the total cost while collecting a pre-specified number of donations.

3 - A Heuristic for School Bus Routing of Special-education Students  
Hernan Caceres, SUNY Buffalo, 342 Bell Hall, Buffalo, NY, United  
States of America, hernanan@buffalo.edu, Rajan Batta, Qing He  
The problem of routing special-education students differs in many aspects with  
that of routing regular students. A bus can be configured to also support  
wheelchairs, students may be served differently depending on their disability,  
and they need to be picked up and dropped off in their homes. In our study we  
modeled a mixed integer program that accounts for these and other  
characteristics. We use column generation to find approximated solutions for real  
and benchmark instances.

4 - Disaster Relief Routing under Uncertainty: A Robust  
Optimization Approach  
Sung Hoon Chung, Binghamton University, P.O. Box 6000,  
Binghamton, NY, United States of America, schung@binghamton.edu, Yinglei Li  
We explicitly consider uncertainty in travel times when planning vehicle routes  
for delivering critical supplies to the affected population in need in the aftermath  
of a large disaster. In particular, we propose the robust optimization approach to  
minimize the impact of uncertainty and eventually to achieve enhanced resilience  
in the aftermath of disasters. We also explore several numerical methods and  
algorithms.
2 - Cooperative Unmanned Vehicles for Vision-based Detection and Real-world Localization of Human Crowds
Sara Minaieian, The University of Arizona, 1127 E James E. Rogers Way, Room 111, Tucson, AZ, 85716, United States of America, minaeian@email.arizona.edu, Young-jun Son, Jian Liu

In crowd control using unmanned vehicles (UVs), the crowd detection and real-world localization are required to perform key functions such as tracking and motion planning. In this work, a team of UVs cooperates under a DDAMS framework to detect the moving crowds by applying computer-vision techniques and to localize them using a new perspective transformation. A simulation model is also developed for validation, and the experimental results reveal the effectiveness of the proposed approach.

3 - Fault Identifiability Analysis of Beam Structures using Dynamic Data-driven Approaches
Yuhang Liu, Research Assistant, University of Wisconsin-Madison, 1513 University Ave, ME5255, Madison, WI, 53706, United States of America, yliu427@wisc.edu, Shiyu Zhou

In this research, we study the parameterization and localization identifiability of beam structures based on the dynamic response information. We show that the stiffness parameters can be locally identifiable in general cases for the colocated single input and single output system. The unique relationship between the damage location and the dynamic response are also investigated. The identifiable sensitivity is studied for practical damage identification.
4 - Wake Effect Characterization in Wind Power Systems
Mingdi You, PhD Candidate, University of Michigan, 1205 Beal Avenue, IOE 1773, Ann Arbor, MI, 48109, United States of America. mingdyou@umich.edu, Eunshin Byon, Jionghua (Judy) Jin
The rapid growth of wind power underscores the need to understand the dynamic characteristics of wind turbine operations. Wind turbines in a wind farm exhibit heterogeneous power generations due to the wake effect. This study provides a computational framework for characterizing the wake effects via a data-driven approach by extending the Gaussian Markov Random field framework. The computational results show that this approach improves the prediction capability over other methods.

TB75
75-Room 204B, CC
IBM Research Best Student Paper Award II
Sponsor: Service Science
Sponsored Session
Chair: Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmhi@ntu.edu.tw
1 - Best Student Paper Competitive Presentation
Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmhi@ntu.edu.tw
Finalists of the IBM Research Best Student Paper Award present their research findings in front of a panel of judges. The judging panel will decide the order of winners, which will be announced during the business meeting of the Service Science Section at the Annual Conference.

2 - Online Network Revenue Management using Thompson Sampling
He Wang, MIT, Cambridge, MA, United States of America, wanghe@mit.edu, Kris Johnson Ferreira, David Simchi-Levi
Mobile apps have great potential to provide promising services to improve consumers’ engagement and behaviors. Focusing on healthy eating, this study shows that an image-based professional support greatly improves consumer engagement and eating behaviors, while social media and a heuristic approach of self-management might have negative effects in some occasions. Mobile apps have great potential to provide promising services to improve consumers’ engagement and behaviors. Focusing on healthy eating, this study shows that an image-based professional support greatly improves consumer engagement and eating behaviors, while social media and a heuristic approach of self-management might have negative effects in some occasions.

3 - How Environmental Certification Can Affect Performance in the Service Industry: Evidence from the Adoption of LEED Standards in the U.S. Hotel Industry
Matthew Walsman, Cornell University, Ithaca, NY United States of America, mcv237@cornell.edu, Suresh Muthulingam, Rohit Verma
This study uses a mixed method approach (difference-in-differences and multi-level modeling) to measure the impact of environmental certification (i.e. LEED certification) on financial performance in the US hospitality industry. We find that certification does contribute to higher revenue for the certifying hotel, relative to its competitors.

4 - Optimal Coincurrence Rates for a Heterogeneous Population under Inequality and Resource Constraints
Gregory J. Schell, Center for Naval Analyses, 3003 Washington Blvd, Arlington, VA, United States of America, schellg@ana.org, Rodney A. Hayward, Mariel Lavieri, Jeremy B. Sussman
We derive prescription coincurrence rates which maximize the health of a heterogeneous patient population. We analyze the problem as a bilevel optimization model where the lower level is a Markov decision process and the upper level is a resource allocation problem with constraints on expenditures and coincurrence inequality.

5 - Managing Rentals with Usage-Based Loss
Vincent Slaug, Penn State University, University Park, PA, United States of America, vslaug@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 recirculation rule.
1 - A Set Approach to Simulation Optimization with Probabilistic Branch and Bound
Hao Huang, PhD Candidate, University of Washington, Industrial and Systems Engineering, Seattle, WA, 98195-2650, United States of America, hahuang@engr.washington.edu, Zelda Habibsky
Probabilistic Branch and Bound (PBBnB) is a partition-based random search simulation optimization algorithm for stochastic problems. PBBnB determines a set of solutions through an estimated bound on the performance. For single objective problems, PBBnB approximates a desirable level set with quantile estimation. In a multiple objective context, PBBnB considers a bound of the closeness to the efficient frontier and approximates the Pareto optimal set of solutions.

2 - A Model-based Approach to Multi-objective Optimization
Joshua Hale, Graduate Student, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, Atlanta, GA, 30332, United States of America, jha1332@gatech.edu, Enlu Zhou
We develop a model-based algorithm for the optimization of multiple objective functions that can only be assessed through black-box evaluation. The algorithm iteratively generates candidate solutions from a mixture distribution over the solution space and updates the mixture distribution based on the sampled solutions’ domination count such that the future search is biased towards the set of Pareto optimal solutions. We demonstrate the performance of the proposed algorithm on benchmark problems.

3 - Simulation Optimization: Review and Exploration
Chun-hung Chen, George Mason University, 4400 University Drive, MS 4A6, SEOR Dept, GMU, Fairfax, VA, 22030, United States of America, cchen9@gmu.edu, Edward Huang, Jie Xu, Loo Hay Lee
Recent advances in simulation optimization research and explosive growth in computing power have made it possible to optimize complex stochastic systems that are otherwise intractable. We will review some recent developments. We will also discuss how simulation optimization can benefit from cloud computing and high-performance computing, its integration with big data analytics, and the value of simulation optimization to help address challenges in engineering design of complex systems.

4 - MO-MO2TOS for Multi Objective Multi Fidelity Simulation Optimization
Loo Hay Lee, National University of Singapore, Department of Industrial & Systems, Engineering, Singapore, ischelell@nus.edu.sg, Giulia Pedrielli, Chun-hung Chen, Ek Peng Chew, Haobin Li
In simulation-optimization, low fidelity models can be particularly useful. However, we need to account for their inaccuracy while searching for the optimum. In 2015, Xu et al. proposed MO2TOS, which exploits multiple fidelities to improve the simulation optimization procedure. We extend the approach proposing MO-MO2TOS for the multi-objective case, using the concepts of non-dominated sorting and crowding distance. Several interesting insights specific to the multi-objective case are drawn.

2 - Flexibility Analysis on a Supply Chain Contract using a Parametric Linear Programming Model
Eric Longomo, PhD student, University of Portsmouth, Lighthouse Building, Lighthouse Terrace, Hampshire, Portsmouth, PO1 3HE, United Kingdom, eric.longomo@port.ac.uk, Xiang Song, Djamila Ouelhadj, Chengbin Chu
This study considers a multi-period Quantity Flexibility contract between a car manufacturer (buyer) and an external parts supplying company: The buyer-in-concert with the supplier- aims to develop a policy-at strategic level, that determines the optimal nominal order quantity and variation rate underlying the contract. The feasibility and convexity of the proposed LP model are examined. Simulations are carried out to evaluate the theoretical results.

3 - Assigning Non-Fixed Parts of a Delivery Area to Fixed Tours Serviced by Electric Vehicles
Sarah Ubber, RWTH Aachen University, Kackenstraße 7, Aachen, Germany, ubber@dpor.rwth-aachen.de
We consider last mile distribution where a delivery area is operated by different tours. Parts of this area are serviced by fixed tours in a fixed sequence every day. Other parts are not assigned to fixed tours. To respond e.g. to variable battery ranges or to fluctuations in demand, it is useful to reassign daily the non-fixed parts to the tours, whereby the assignment must not significantly alter the usual delivery sequence. We have developed a model and a heuristic for solving this problem.

4 - Asset Allocation in the Industrial Gas Bulk Supply Chain
Leily Farrokzhavar, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA, 24061, United States of America, leily@vt.edu, Kimberly Ellis
We study an asset allocation problem in a vendor managed inventory system of an industrial gas distribution network where customer demands vary over time. The objective is to determine the preferred size of bulk tanks to assign to customer sites to minimize recurring gas distribution costs and initial tank installation costs while accommodating customers’ time varying demand. The problem is modeled as a mixed-integer program and then solved using a periodically restricting heuristic approach.

310

2 - A Two-Echelon Wind Farm Layout Planning Model
Huan Long, City University of Hong Kong, Room 601, 78 -Room 301, CC

Planning and Scheduling in Energy Applications

Contributed Session

Chair: Yanyi He, Senior Scientist, IBM, 1001 E Hillside Blvd, Foster City, CA, 94404, United States of America, heyyanyidaodao@gmail.com

1 - Stochastic and Robust Optimization of the Scheduling and Market Involvement for an Energy Producer
Ricardo Lima, KAUST, Thuwal, Thuwal, Saudi Arabia, ricardo.lima@kaust.edu.sa, Sabigue Langodan, Ibrahim Hoteit, Antonio Conejo, Omar Knio
We will present three optimization methods based on stochastic programming, robust optimization, and a hybrid method for the scheduling and market involvement for an electricity producer. This producer operates a system with thermal, hydro, and wind sources. The wind power and the electricity prices are uncertain. The methods are implemented using parallel optimization runs. The computational performance, scheduling results, and the impact of risk management are presented and discussed.

2 - A Two-Echelon Wind Farm Layout Planning Model
Huan Long, City University of Hong Kong, Room 601, Nam Shan Estate, Hong Kong, China, hlong5-c@my.cityu.edu.hk, Zijun Zhang
In this paper, a two-echelon layout planning model is proposed to determine the optimal wind farm layout to maximize its expected power output. In the first echelon, a grid composed of identical cells is utilized to model the wind farm while the cell center is the potential slot. In the second echelon, the model for determining the optimal coordinate in a grid cell is formulated. The comparative analysis between the two-echelon planning model and the traditional grid-coordinate models is conducted.

3 - Demand Side Participation for a Major Consumer in a Co-optimized Electricity and Reserve Markets
Mahlubeh Habibian, Miss, University of Auckland, 6A-Short St, Auckland Central, Auckland, 1010, New Zealand, mhabib735@aucklanduni.ac.nz, Golbon Zakeri, Anthony Downdar
The paper probes demand side participation for a large consumer through demand response and offering in interruptible load reserve. Our model is a bi-level optimization problem that embeds the dispatch model, where electricity and reserve are co-optimized, as the lower level and the profit maximization problem for the consumer (over 2 sets of supply functions) as the upper level. The objective function is transformed into piecewise linear form via utilizing a new interpretation of offer stacks.
Chung-suk Cho, Assistant Professor, Khalifa University, Al Saada St. and Murroor Rd., Abu Dhabi, 127788, United Arab Emirates, chung.cho@kustar.acae, Young-ji Byon
Building energy performance modeling evaluates energy efficient design options. There are significant amount of missed opportunities of energy efficiency-related decisions that could be incorporated into the building design through quality building energy performance modeling. The best practice analysis will help optimize the building design and will allow the design team to prioritize investment in the strategies that will have the greatest impact on the building's energy use.

5 - Two-stage Optimal Demand Response with Battery Energy Storage Systems
Yanyi He, Senior Scientist, IBM, 1001 E Hillsdale Blvd, Foster City, CA, 94404, United States of America, heyanyi.dai@ao@gmail.com, Zhaoyu Wang
Proposes a two-stage co-optimization framework for the planning and energy management of a customer with battery energy storage systems (BESSs) and demand response (DR) programs. The first stage is to assist a customer to select multiple DR programs to participate and install batteries to coordinate with the demand side management. The second stage is to perform energy management according the planning decisions, including dispatches of batteries, loads, and DGs.

TB79
79-Room 302, CC
Software Demonstration
Cluster: Software Demonstrations
Invited Session
1 - Statistics.com - A Survey of Data Analytics Methods
Peter Bruce, Founder and President, The Institute for Statistics Education at Statistics.com
This workshop will survey the field of data analytics, reviewing both traditional statistical methods and machine learning methods, including predictive modeling, unsupervised learning, text mining, statistical inference, time series forecasting, recommender systems, network analytics, and more. It will be a broad brush treatment aimed at newcomers, as well as those with knowledge in one area who wish to understand where other analytic methods fit into the picture.

2 - River Logic - Code-free modeling for large-scale LP and MIP problems using Enterprise Optimizer
Eric Kelso, VP Product Management, River Logic
Enterprise Optimizer is a code-free, visual LP and MIP optimization modeling platform. Using EO’s intuitive drag-and-drop interface, learn how to rapidly create integrated process and financial models. Also learn about EO’s wizard-driven data integration, query designer, user-defined schema, dashboard builder, VBA integration, APIs and job automation component. Outputs demonstrated include detailed unit costs and audit-quality P&L, Balance Sheet and Cash Flow statements. The entire session will be spent discussing major features and showing real-world applications.

Tuesday, 12:30pm - 2:30pm
Exhibit Hall A
Tuesday Poster Session
Contributed Session
Chair: Min Wang, Drexel University, 3141 Chestnut Street, Philadelphia, PA, United States of America, mw638@drexel.edu
Co-Chair: Allen Holder, Rose-Hulman Mathematics, Terre Haute, IN, United States of America, holder@rose-hulman.edu
Co-Chair: Wenjing Shen, Drexel University, Philadelphia, PA, United States of America, ws84@drexel.edu

1 - Surgery Scheduling with Recovery Resources
Maya Bam, University of Michigan, Industrial and Operations Engineering, 1209 Beal Ave., Ann Arbor, MI, 48109, United States of America, mibam@umich.edu, Mark Van Oven, Mark Cowen, Brian Denton
Surgery scheduling is complicated by the post-anesthesia care unit, the typical recovery resource. Based on collaboration with a hospital, we present a novel, last 2-phase heuristic that considers both surgery and recovery resources. We show that each phase of the heuristic has a tight provable worst-case performance bound. Moreover, the heuristic performs well compared to optimization based methods when evaluated under uncertainty using a discrete event simulation model.

2 - Inventory Control with Unknown Demand and Nonperishable Product
Tingting Zhou, Rutgers University, 1 Washington Park, Newark, NJ, 07101, United States of America, tingzhou@rutgers.edu, Michael Katehakis, Jian Yang
We study an inventory control problem with unknown discrete demand distribution, focusing on the analysis of an adaptive algorithm based on empirical distributions and the newsvendor formula. When items are nonperishable, the algorithm can achieve a near square-root-of-T bound on its regret over the ideal case where demand distribution were known.

3 - Optimizing Information System Security Investments with Risk: Insights for Resource Allocation
Yueran Zhuo, PhD Candidate, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, yzhuo@som.umass.edu, Senay Solak
Information security has become an integral component of a firm’s business success, and thus investing on information security countermeasures is an important decision problem for many businesses. We use a portfolio approach to study the optimal investment decisions of a firm, where the uncertainty of information security environment is captured through a stochastic programming framework. Results cast managerial insights for information security investment planning by a firm.

4 - Adaptive Decision-Making of Breast Cancer Mammography Screening: A Heuristic-Based Regression Model
Fan Wang, University of Arkansas, Fayetteville, AR, United States of America, fxw005@uark.edu, Shenglan Zhang
The American Cancer Society currently recommends all U.S. women undergo routine mammography screenings beginning at age 40. However, due to the potential harms associated with screening mammography, such as overdiagnosis and unnecessary work-ups, the best strategy to design an appropriate breast cancer mammography screening schedule remains controversial. This study presents a mammography screening decision model that aims to identify an adaptive screening strategy while considering disadvantages of mammography. We present a two-stage decision framework: (1) age-specific breast cancer risk estimation, and (2) annual mammography screening decision-making based on the estimated risk. The results suggest that the optimal combinations of independent variables used in risk estimation are not the same across age groups. Our optimal decisions outperform the existing mammography screening guidelines in terms of the average loss of life expectancy. While most earlier studies improved the breast cancer screening decisions by offering lifetime screening schedules, our proposed model provides an adaptive screening decision aid by age. Since whether a woman should receive a mammogram is determined based on her breast cancer risk at her current age, our “on-line” screening policy is adaptive to a woman’s latest health status, which causes less bias in reflecting the individual risk of every woman.

5 - Optimization of Netting Scheme in Large-scale Payment Network
Shuzhen Chen, University of Science & Technology of China, No. 98, Jinzhai Road, Hefei, China, csz@mail.ustc.edu.cn
As netting becomes combined with real-time settlement, an efficient netting method is required to deal with the large-scale payment network. Network optimization may not be optimal due to repeated searching of shortest path. A new method is proposed to optimize the netting process by assembling payments in two specific routes. It can minimize the amount of total payments for the whole network and ensure unchanged net payment for each bank. Moreover, it has polynomial time-complexity.

6 - Wasserstein Metric and the Distributionally Robust TSP
Mehdi Behroz, University of Minnesota, Minneapolis, MN, United States of America, behro040@umn.edu, John Gunnar Carlson
Recent research on the robust and stochastic travelling salesman problem and the vehicle routing problem has seen many different approaches for describing the region of uncertainty, such as taking convex combinations of observed demand vectors or imposing constraints on the moments of the spatial demand distribution. One approach that has been used outside the transportation sector is the use of statistical metrics that describe a distance function between two probability distributions. In this paper, we consider a distributionally robust version of the Euclidean travelling salesman problem in which we compute the worst-case spatial distribution of demand against all distributions whose earth mover’s distance to an observed demand distribution is bounded from above. This constraint allows us to circumvent common overestimation that arises when other procedures are used, such as fixing the center of mass and the covariance matrix of the distribution.
7 - Intersection of a Tree Network for the Single Refueling Station Location Problem
Sanj Jin Kwak, PhD Student, The Pennsylvania State University, 310 Leonhard Building, State College, PA, 16802, United States of America, svk3333@psu.edu

An intersection is the vertex whose degree is greater than two in the network. In this talk, we consider intersections and develop the methodology that determines the continuous interval of the potential locations for a single alternative-fuel refueling station on a tree network, with an objective of maximizing the amount of traffic flows in round trips per time unit captured by the station.

8 - Intelligent Tutoring Systems: Future Paradigm of Educational Environments
Alireza Farasat, University at Buffalo (SUNY), 4433 Chestnut Ridge Rd Apt 7, Amherst, NY, 14228, United States of America, afarasat@buffalo.edu, Alexander Nikolaev

Educational systems have witnessed a substantial transition from traditional educational methods mainly using text books, lectures, etc. to newly developed systems which are artificial intelligent-based systems and personally tailored to the learners. We have developed a web-based tool, Crowdlearning which concentrates on creating an intelligent system that learns to interact with students and motivates them to more actively participate in the learning process by proposing their own problems.

9 - Optimized Scheduling of Sequential Resource Allocation Systems
Ra Li, PhD Student, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, rli63@gatech.edu, Spyros Reveliotis

We consider the scheduling problem of allocating finite reusable resources to concurrent sequential processes. This problem also involves the logical issue of deadlock avoidance. Our approach is based on the formal model of the generalized stochastic Petri-net. Special emphasis is placed on the representational and computational complexity of the proposed methods, which are controlled through (i) a stringent (re-)definition of the target policy spaces, and (ii) simulation optimization.

10 - Operation Research for Data Mining: An Application to Medical Diagnosis
Shahbab Derhami, Auburn University, 3301 Shelby Center, Auburn, GA, 36849, United States of America, sderhami@auburn.edu

Fuzzy rule based classification systems (FRBCSSs) have been successfully employed as a data mining technique where the goal is to discover the hidden knowledge in a data set and develop an accurate classification model. Despite various heuristic approaches that have been proposed to learn fuzzy rules for these systems, no exact optimization approach has been developed for this problem. We propose integer programming models to learn fuzzy rules for a FRBCS used for medical diagnosis purpose.

11 - Forecasting Surges in the Hospital Emergency Department (ED)
Alexander Gutfraind, Chief Healthcare Data Scientist, Uptake Technologies, 600 W. Chicago Avenue, Chicago, IL, 60654, United States of America, sasha.gutfraind@uptake.com, Nelson Bowers, Jim Herzog, Madeline Jannotta, Ilan Kaimont, Adam McElhinney

A major hospital system in the Chicago metro area experiences large unexpected surges in its Emergency Department (ED). Using five years of ED admissions we predict ED surges and improve scheduling of staff. Data indicates the time of arrival, rooming and discharge and acuity. Total arrivals per day cannot be predicted accurately with epidemiological climatological, calendar variables but the state of the ED could be predicted 1-4 hours in advance with high accuracy using VAR methods.

12 - A New Measure for Testing Independence
Qingcong Yuan, Graduate Student, University of Kentucky, 300 Alumni Drive Apt. 166, Lexington, KY, 40503, United States of America, qingcong.yuan@uky.edu, Xiangrong Yin

We introduce a new measure for testing independence between two random vectors. Our measure differs from that of distance covariances, by using expected conditional difference of characteristic functions. We propose one empirical version by slicing on one of the random vectors. This empirical measure is based on certain Euclidean distance. Its properties, asymptotics and applications in testing independence are discussed. Implementation and Monte Carlo results are also presented.

13 - Graph Based Non-isomeric Curve to Surface Matching for Local Calibration
Balab hads Parkash, PhD Student, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078-5016, United States of America, babak.farmanesh@okstate.edu, Balabhaskar Balasundaram, Arash Pourhabib

Calibration refers to the process of adjusting parameters of a computer simulation so that the simulation responses match the corresponding physical responses. Calibration can be interpreted as a curve to surface matching problem. We propose a graph-theoretic non-isometric matching approach to solve this problem using the graph shortest path algorithm in one-dimensional spaces. For higher dimensional spaces, we introduce the generalized shortest path concept to solve the matching problem.

14 - Location and Coverage Models for Preventing Attacks to Interurban Transportation Networks
Rameen Aazjad, Associate Professor, Universidad Católica del Norte, Of. 318, Bldg. Y1, 0610 Angamos Avenue, Antofagasta, 1240000, Chile, raaad@ucn.cl, Rajan Batta

We develop a binary integer programming model to solve this problem, whose objective is to maximize the expected vehicle coverage across the network over a time horizon, using decomposition heuristics. To introduce a measure of equity, we propose two sets of time constraints, considering total vehicle coverage, inequity and network coverage. We explore scalability of the model for excessively large instances. All of these features are applied to a case study in Northern Israel.

15 - An Information-based Framework for Incorporating Travel Time Uncertainty in Transportation Modeling
Jiangbo Yu, University of California, Irvine, 4101 Palo Verde Rd, Irvine, CA, 92617, United States of America, jiangby@uci.edu, Jay Jayakrishnan

This paper proposes a modeling framework aimed at systematically incorporating perceived uncertainty into decision making. The model uses theoretically sound concepts from information theory, communication, and cognitive science. Potential applications and implications are identified and demonstrated with examples.

16 - Database of Identified Poly and Mono ADP-ribosylated Proteins
Charul Agrawal, Undergraduate Student, Indian Institute of Technology (IIT) Delhi, Room No ED-16, Himadri Hostel, Hauz Khas, New Delhi, 110016, India, agrawalcharul09@gmail.com

Poly(ADP-ribose)polymerase (PARP) is a family of enzymes with 17 known members regulating post translational modification of proteins by attaching a single ADP ribose unit (MARylation) or a chain of ADP ribose (PARylation). In this study we have attempted to identify all proteins known to be modified by PARPs and the methods as well as drugs used in such studies. Our study aims to create the first ever tool for characterizing these modifications.

17 - Configuring Ecommerce Driven Supply Chains in the FMCG Sector
Stanley Lim, PhD Candidate, Cambridge University, Department of Engineering, 17 Charles Babbage Road, Cambridge, United Kingdom, wtsf2@cam.ac.uk

Omnichannel has become the engine of growth in retailing. However, it remains unclear as to how distribution networks should be configured. This research will shed light through a framework development, and by drawing theories from supply chain configuration, resource based view, and transaction cost economics. Case study approach is adopted to identify the critical factors driving operational choices and seeks to elaborate the relationships between configuration, capability and performance.

18 - Benchmarking Construction and Improvement Heuristics for Classification using Markov Blankets
Daniel Gartner, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu, Rema Padman

This study examines construction heuristics in connection with a tabu search-based improvement heuristic for classification in high dimensional data sets. Using the UCI machine learning data repository containing benchmark instances in e.g. health care, we evaluate computation times and information about the evolution of the Markov blanket graphical models in each phase of the heuristics. We compare the performance of the approaches using evaluation measures such as classification accuracy.

19 - A Sim-heuristic Algorithm for Robust Vehicle Routing Problems with Stochastic Demand
Abdulwahab Almutairi, Technology, 9 Horizon Building, Portsmouth, PO4 8EW, United Kingdom, abdulwahab.m.almutairi@gmail.com

We consider the VRPSD in which customers’ demands are stochastic. We propose to model and solve the VRPSD by developing a robust optimisation model with a sim-heuristic solution method to minimise the cost while satisfying all demands. The method combines MCS with CWS in order to efficiently solve the VRPSD combinatorial optimisation problem. The results are generating very good quality solutions compared to those in the literature.
20 - Rocket Stage Optimization in Kerbal Space Program
Nathan Arrowsmith, Rochester Institute of Technology, 2800 Butterntt Lane, Canandaigua, NY, 14424, United States of America, nea4309@rit.edu
Kerbal Space Program is a space exploration simulation game. Players design, launch, and fly multi-stage rockets using a variety of parts. The performance of these vehicles is governed by a realistic physics engine. A model was developed which minimizes the total mass of each rocket stage by choosing engine, motor and fuel tank combinations which accurately satisfy the Tsolovksky Rocket Equation. By iteratively solving this problem, the lowest mass or least expensive multi-stage rocket can be determined.

21 - Investigation of the Effect of Location, Built Environment and Urban Forms on Customer Satisfaction
Homa Atefyekta, Sharif University of Technology, No.14, 5th St., South Piruzan st, Tehran, 1466643479, Iran, homa.atefyekta@gmail.com, Hamed Ahangari, Hoda Atef Yekta
In this study we examine the effect of location factors, urban forms, transportation accessibility, and built environment on the customer satisfaction and business success in restaurant market. We investigated these relationships in two different geographical areas: the US and Iran by using Yelp and Fidilio data respectively. The results of this study could be helpful for urban policy makers to improve the urban livability and business entrepreneurs to enhance the odd of their success.

22 - What do Equity Hedge Funds Really do? Evidence in the QE Period
Geun Il Bae, KAIST, 291, Daechak-ro, Yuseong-gu, Daejeon, Korea, Republic of, gi_bae@kaist.ac.kr, Sun Young Park, Woo Chang Kim
We examine why the hedge fund industry has experienced a slump during the “Quantitative Easing (QE)” period. We analyze the risk-adjusted performances of equity hedge funds in the pre-crisis, crisis, and QE periods. We show that the disappeared alpha is the main reason for the inferior performance of hedge fund industry these days, and reduction in exposure to systematic risks further explains the underperformance of hedge funds in the QE period.

Rosemary T. Berger, University of Wisconsin - Madison, 330 N. Orchard St., Madison, WI, 53715, United States of America, rosemay1.berger@gmail.com, Michael Ferris, Jeff Linderoth
The NEOS Server is a free internet-based service for solving numerical optimization problems. Hosted by WID at the University of Wisconsin in Madison, the NEOS Server provides access to more than 60 state-of-the-art solvers in more than a dozen optimization categories. Solvers run on distributed high-performance machines enabled by the HTCondor software. We describe recent enhancements to the NEOS Server and highlight new interactive optimization cases studies available on the NEOS Guide.

24 - Provable Submodal Function Minimization via Wolfe’s Algorithm
Deeparnab Chakrabarty, Dr, Microsoft, 9 Lavelle Road, Bangalore, India, deeparnab@gmail.com
Submodal function minimization (SFM) is an essential paradigm which appears in many areas such as large scale learning and computer vision. The Fujisige-Wolfe Algorithm is agreed to be the fastest empirical SFM algorithm. Despite its great practical performance, very little is known about Wolfe’s minimum norm algorithm theoretically. In this paper we give the first polynomial time convergence analysis of Fujisige-Wolfe’s algorithm.

25 - Stochastic PDE-constrained Optimization of Vibrations of a Plate under a Piecewise-linear Current
Dmitry Chernikov, The University of Iowa, 1010 W Benton St. #208F, Iowa City, IA, 52246, United States of America, scher.de@gmail.com, Pavlo Krokhmal, Olesya Zhupanska
In this work a two-stage stochastic PDE-constrained optimization framework is applied to the problem of vibration control of a thin composite plate in the presence of electromagnetic field. The electric current is assumed to be of a piecewise-linear form. We compute the gradient of the objective function using adjoint numerical differentiation method. The value of the objective function is calculated by solving the governing PDEs, and a black-box approach is used for the minimization problem.

26 - Assessing Kernel-based Anomaly Detection Algorithms
Hyon-chang Cho, Seoul National University, Banpo-gu, Seocho-dong, Seoul, Korea, Republic of, hhcho@dm.snu.ac.kr, Sungwon Choi
Anomaly detection is the process of finding items which do not comply with the normal pattern of the data set. Although kernel-based approaches seem to be promising for detecting anomalies, they have not been compared in a systematic way in this study; we generated numerous well-calibrated benchmark data set and use them to evaluate the performance of various kernel-based anomaly detection algorithms. The effect of kernel parameters will also be empirically investigated.
34 - The Effect of High Socioeconomic Inequalities on Public Education Efficiency
Maria Cristina Gramani, Insper - Business Department, Rua Quitã, 304, Vila Olimpia, São Paulo, SP, 04546042, Brazil, maria@insper.edu.br

A model is proposed to capture the full picture of educational efficiency in an emerging country. Because of regional discrepancies, the model uses variables related to education and to socioeconomic inequalities. The empirical results are based on data from 5,129 Brazilian municipalities and the correlation factor between the HDI and the educational efficiency score indicates that the HDI-M index could not capture the discrepancies of a country with high levels of socioeconomic inequality.

35 - Improving Scheduling and Control of the OHTC Controller in Wafer Fab AMHS Systems
Shreya Gupta, Ms/phd Student And Graduate Research Assistant, University of Texas at Austin, Austin, TX, 78751, United States of America, shreya.gupta@utexas.edu, John Hasenbein

Automated Material Handling Systems (AMHS) in wafer fabs have complex requirements. Thus, a larger number of AMHS vehicles are now required to pick-up and transport these lots within the production facility. This has increased vehicular traffic jams and the wait time for lots requiring pick-up and delivery. Hence, to increase the system throughput, we present improved routing algorithms for the overhead transport control (OHTC) system.

36 - An Adaptive Large Neighborhood Search Heuristic for the Inventory Routing Problem with Time Windows
Mina Hadilanniar, University of Arkansas, 901 N Pollard Street, Arlington, VA, 22203, United States of America, mhadilanniar@uark.edu, Ashlea Milburn

This research models an integrated distribution and inventory control problem (IRP) which is faced by a retail chain in the US. Currently, a direct shipping policy with time window constraints is used for replenishing stores. This paper develops an Adaptive Large Neighborhood Search Heuristic to determine the optimal timing and magnitudes of deliveries to stores. The optimal plan considers direct shipping policy as well as options combining deliveries for multiple stores into a single route.

37 - Forecasting-based Truck Wait Time Reduction at Logistic Nodes
Alessandro Hill, Hamburg University of Technology, Am Schwarzenbergcampus 4, Hamburg, Germany, alessandro.hill@tuhh.de, Finn Meissner, Juergen Boese

Truck wait times at logistic nodes such as container depots, packing facilities or terminals cause delays in transport chains and traffic congestion. Truck companies and nodes experience economical losses due to vehicle idle times and a lack of planning reliability regarding routes, personnel or machinery, respectively. In this work we present a flexible forecasting-based real world approach using artificial neural networks to predict both, the truck wait times and the arrival rates at the nodes.

38 - Impact of Overbooking in Appointment Scheduling of Primary Care Services
Babak Hosini, PhD Candidate, New Jersey Institute of Technology, University Heights, Newark, NJ, 07102, United States of America, bb777@njit.edu, Wenbo Cai

No-shows and late cancellations not only reduce the providers’ utilization, but also result in long waiting times for other patients. Overbooking has the potential to mitigate these negative impacts. However, excess overbooking may lead to even longer waiting times for patients and prolonged working days for the care team. We use a mathematical model to evaluate the benefits of overbooking and develop a scheduling policy that reduces patients’ waiting time, and increase provider’s utility.

39 - Research on Combination of Container Yard Allocation and Automatic Lifted Vehicle Path Optimization
Hongtao Hu, Shanghai Maritime University, Room101, No 96, 355 Guozong Road, Shanghai, China, hu.hongtao@foxmail.cn

This paper brings in a new type of automatic transport machinery—automatic lifted vehicle which has the ability to lift container from the floor or put it down on the floor. Meanwhile, a mixed integer programming model is established to ensure that all the containers handled as far as possible in the time window. The model also considers the problem of allocating blocks to discharge containers and optimizing path of automatic lifted vehicle.

40 - Shipping Commodities Between a Container Terminal and Different Destination Zones using Heavy Trucks
Mazen Hussein, Assistant Professor, University of Wisconsin-Platteville, Platteville, WI, 53818, United States of America, Hussein@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 carriers 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 a container terminal and different facilities.

41 - Network Motif Analysis for an Infrastructure System Against Vulnerability
Jing Jiang, PhD, Shanghai Jiao Tong University, Shanghai, China, sjiangj@163.com, Xiao Liu

A motif-based evolutionary perspective is provided for infrastructure network design. First, a multi-objective vulnerability-cost model is proposed to optimize network structure. Second, an evolutionary algorithm is developed. Thirdly, a network is tested by structure analysis, and motifs are traced during the evolutionary process. Finally, Western States Power Grid is analyzed. Results have revealed some principles in network design towards lower cascading vulnerability and construction cost.

42 - Patient Reaction to Healthcare Data Breaches
Eric Johnson, Vanderbilt University, Owen School of Management, Nashville, TN, United States of America, eric.johnson@vanderbilt.edu, Juhee Kwon

We investigate consumer reaction to data breaches. Using a propensity score matching technique, we analyze a matched sample of U.S. hospitals. We investigate how breaches affect subsequent outpatient visits and admissions, accounting for geographically-based competition. We find that the cumulative effect of multiple breaches significantly decreases outpatient visits and admissions.

43 - Enhancing Distribution Performance through Improved Relationship Quality and Logistics Integration
Sung-tae Kim, Assistant Professor, SolBridge International School of Business, 128 Uam-ro, Dong-gu, Daejeon, Korea, Republic of, stkim1@solbridge.ac.kr, Moon-jung Yoo

Prior research has argued that business relationship quality mediated by logistics integration has shown positively related to distribution service performance. Hence, firms attempt to achieve higher levels of logistics service and distribution service performance through logistics integration. This study examines relationship quality and logistics integration to understand how the two factors are linked to distribution service performance.

44 - Smart Logistics: Distributed Control of On-demand Green Transportation Services
Seokgi Lee, Assistant Professor, University of Miami, 1251 Memorial Drive 281, Coral Gables, FL, 33146, United States of America, sgl14@miami.edu, Yuncheol Kang, Vittaldas V. Prabhut

We develop a strategic decision-making framework for on-demand delivery services, considering both operational and environmental performance explained by Just-In-Time delivery service, fuel consumption, and carbon emissions. The optimal policies based on the Markov decision process are established to make admission plans of delivery requests, and an integrated dynamic algorithm for admission control and route scheduling is developed.

45 - Extreme-point Search Heuristics for Interval-flow Generalized Network Problems
Angelilka Leskovskaya, Southern Methodist University, 3145 Dyer St., Suite 372, Dallas, TX, 75205, United States of America, alexkovs@smu.edu, Richard Barr

Interval-flow generalized networks are a new extension of the classic generalized network formulation that adds a conditional lower bound constraint on the arcs. An interval-pivoting heuristic that exploits the quasi-tree-forest basis structure to explore extreme points is developed and computational testing is presented.

46 - Hedge Fund Leverage Choice under Time-inconsistent Preference
Bo Liu, University of Electronic Science and Technology of China, No.2006, Xiuyan Ave, West Hi-Tech Zone, Chengdu, SC, 611731, China, bliu77@fulbrightmail.org

We show that time inconsistency preference discourages the manager from underinvesting because of the high liquidation risk. The payment of incentives may induce the irrational manager to be more aggressive and to overinvest. The naive manager is more conservative than the sophisticated manager and prefers a lower leverage level in normal times. Interestingly, investors are not sensitive to the manager’s irrational investment behavior.

47 - New Assay Implementation Planning at Clinical Laboratory
Wei Liu, Industrial Engineer, MD Anderson Cancer Center, 8513 Fannin St, Houston, TX, 77034, United States of America, wliu@mdanderson.org, Cindy Lewing, Bedia Barkoh, Pramod Mehta, Mark Rourtoub, Humin Lu, Justin Villarreal, Raja Luthra, Keyur Pravincha Patel, Geeta S Mantha, Mylene Bole, Haobo Yang, David Garcia, Zou Zhiung

Implementation of a new complex laboratory assay at our high-volume and high-complexity clinical Molecular Diagnostics Lab was facilitated by application of multiple engineering approaches including workflow assessment, historical volume-based demand prediction, IT solution, and resource allocation. The new assay implementation is expected to be successful with minimal workflow disruptions, no patient care interruptions, low implementation cost, and optimal resource utilization.
50 - Exploring the Multi-objective Portfolio Tradespace

Simon Miller, Graduate Student, Penn State Applied Research Lab, P.O. Box 30, State College, PA, 16804, United States of America, ses224@arl.psu.edu, Gary Stump, Sara Lego, Michael Yukish

We present a new version of the stable matching problem that uses an binary integer linear program to determine the minimum number of interviews that hospitals should conduct in order to still maximize the number of residents assigned.

51 - Experimental Designs for Metal Detectors at Large Venues

Christie Nelson, Rutgers University, CCIADA, 4th Floor, CoRE building, 96 Frelinghuyzen Rd, Piscataway, NJ, 08854, United States of America, christie.l.nelson.phd@gmail.com, Paul Kantor, John Edman, Vijay Chaudhary

Walk-through metal detectors (WTMDs) are being used increasingly more as a security measure at large events, particularly at stadiums. Currently, WTMDs are tested using a robotic tester which tests metallic objects at level heights by sending them straight through at a constant speed. However, this is not a proper representation of how a person would enter the WTMD. We will show that the way a person walks through the WTMD impacts detection rate through our experimental results.

52 - Leading Metrics for Progress Measurement and Performance Assessment in Construction Projects

Resulali Orgut, Graduate Research Assistant, North Carolina State University, Dept. of Civil, Cons. and Env. Eng., 2510 Stinson Dr., 222 Mann Hall, Raleigh, NC, 27695, United States of America, reorgut@ncsu.edu, Jin Zhu, Mostafa Batovali, Ali Mostafavi, Edward Jaselski

Progress measurement and performance assessment are critical to the management of construction projects. We perform statistical analyses to highlight key indicators for successful construction project controls by using data collected through an online survey from 27 companies. We analyze core metrics commonly used in the construction industry to develop guidelines for improving their reliability and recommend practices for interpreting metrics and indicators.

53 - Toward Consistent and Efficient Anomaly Detection in Hyperspectral Imagery

Todd Pacienza, USAF, AF/A9, Pentagon, Washington D.C., United States of America, todd.j.paciencia.mil@mail.mil

This research will showcase development of an approach to making an unsupervised anomaly detector for Hyperspectral Imagery (HSI). The algorithm is developed to be robust to different image scenes, different sensors, and noisy spectral bands. Specifically, fusion of spectral, spatial, and Signal-to-Noise information is used, in combination with a factor analysis approach, to identify anomalies. The algorithm is shown to be desirable when compared to current state-of-the-art techniques.

54 - Comprehensive Performance Evaluation of High-gravity Carbonation Process in the Steelmaking Industry

Shu-Yuan Pan, National Taiwan University, No. 71 Chou-Shan Rd., Taipei, 10675, Taiwan - ROC, d00341004@ntu.edu.tw, Pen-chi Chiang

An integrated portfolio of multi-waste treatment (steelmaking slag and wastewater) combined with CO2 capture in the steelmaking industry can be achieved by the high-gravity carbonation (HgCarb) process using a rotating packed bed (RPB). In this study, the HgCarb process was comprehensively evaluated according to engineering, environmental, and economic (3E) criteria using a cradle-to-gate life-cycle approach.

55 - Analysis on the Effect of Energy Efficient Technologies in Industry Sector using TIMES Model

Sang Yong Park, Senior Researcher, Korea Institute of Energy Research, Yuseong-gu, Gaeje-ro 152, Daejeon, 305-343, Korea, Republic of, gsped@kier.re.kr, Jong Chul Hong, Nyunbae Park, Boyeong Yun

The South Korea established energy policy which is focusing demand management rather than energy supply to secure a stable energy supply and to cope with climate change efficiently through 2nd national energy basic plan in 2014. This research developed energy system model which can analyze the effect of energy efficient technologies on demand management based on TIMES(The Integrated MARKAL-EFOM System) model and conducted case study on industry sector in Korea.
64 - Talk is Cheap - Action is Expensive
Simone Schmidt, University of Chemnitz, Houben Heinemannstrasse 24, Chemnitz, 09112, Germany, simone.schmidt@wirtschaft.tu-chemnitz.de, Peter Pawlowski

Adequate response to uncertain and unpredictable environmental changes requires innovative, agile, and adaptive team competencies. We use an interdisciplinary approach to assess and evaluate team competencies. From theory and previous research we derive indicators and test these by training teams accordingly. Experimental groups were given theoretical and practical trainings with regard to these team competencies. Control groups acted as usual. A succeeding standardized simulation in a high fidelity simulation environment showed significant effects with regard to team performance. From these results we propose behavioral markers for team competencies that can be used to assess team performance in critical situations.

65 - Euro/Roadef Challenge
Tejinder Singh, Air Liquide, 12800 W. Little York Rd, Houston, TX, United States of America, tejinder.singh@airliquide.com, Jean Andre, Michele Quattrom, Rodrigue Foskoup, Jeffrey Arboagut

The French OR Society (ROADEF) along with EURO, periodically organizes an OR challenge dedicated to industrial applications. This year, Air Liquide proposes the challenge problem concerning an IRP for the bulk distribution of liquefied gases. The challenge is open to everyone and will be presented during the EURO 2015 in Glasgow, Scotland in July 2015 and the results will be announced at EURO 2016 in Poznan, Poland. Prizes totaling 20,000 Euros will be awarded to the best teams.

66 - Usability Evaluation of a Mobile App to Reduce Congestive Heart Failure (CHF) Readmissions
Minal Singhee, Master’s Student, H. John Heinz III College, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, misinghee@andrew.cmu.edu, Daniel Gartner, Rerna Padman, Jina Lee, Srimat Iyenag

Congestive Heart Failure (CHF) is a major chronic condition affecting more than 5 million people in the US. CHF readmissions is one of the major contributors to the burgeoning healthcare cost. In our study, we evaluate factors associated with the usability and acceptability of a mobile application intended to reduce CHF readmissions. A fixed protocol was developed which included Think Aloud Protocol, Quiz and a Questionnaire. Qualitative and quantitative analyses were performed.

67 - An Optimization Approach to Warehouse Line Striping
Sudharshana Srinivasan, Research Scientist, Alitria Client Services, 601 E. Jackson St., Richmond, VA, 23219, United States of America, sanchdev@sushant@gmail.com, Rasmus Knyg, Anoop Rao

Given a directed acyclic graph G, and values y on the vertices, the Isotonic Regression of y is a vector s that respects the partial ordering given by G, and minimizes ∥x - y∥, for a given norm. We present improved algorithms for Isotonic Regression for all weighted Lp norms, with rigorous performance guarantees. Our algorithms combine interior point methods with provably fast solvers for the associated linear systems. The algorithms are practical and lend themselves to fast implementations.
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<th>Title</th>
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<tr>
<td>74 - Surgical Operations Scheduling with Machine Eligibility and Resource Constraint</td>
<td>Shan Wang, Shanghai Jiaotong University, 704 West 180th Street, First Floor, #4, New York City, NY, 10013, United States of America, <a href="mailto:wangshan_731@stju.edu">wangshan_731@stju.edu</a>, Guohua Wan, Huiqiao Su</td>
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<td>We study a problem in surgical operations scheduling and model it as a resource-constrained machine scheduling problem with eligibility restriction to minimize the makespan. By decomposing it into two subproblems, we develop effective heuristic algorithms to solve the problem. We test the proposed algorithms on randomly generated instances as well as real data set from a large hospital. The numerical results show the effectiveness and potential practical value of the models and the algorithms.</td>
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<td>75 - Optimizing System-Level Preventative Maintenance Cost of Multistate Series-Parallel Systems</td>
<td>Sallamar Worrell, The George Washington University, 3117 Icehouse Place, Bryans Road, MD, 20616, United States of America, <a href="mailto:skaw7@gwu.edu">skaw7@gwu.edu</a>, James Moreland Jr., Steve Doskey Maintenance costs for complex systems are often overpaid due to the lack of maintenance harmony within the individual subsystems. The research in this study proposes the use of a new meta-heuristic optimization method, the Grey Wolf Optimizer algorithm developed by Mirjalili and Lewis, to identify the optimal system-level maintenance strategy for multistate series-parallel systems and aims to produce better results than the methods previously applied to this problem in published literature.</td>
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<td>76 - Predicting Digital Currency Price from Social and Traditional Media</td>
<td>Peng Xie, Georgia Institute of Technology, Room 907, 100 10th Street, Atlanta, GA, 30309, United States of America, <a href="mailto:peng.xie@scheller.gatech.edu">peng.xie@scheller.gatech.edu</a></td>
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<td>Using daily Bitcoin price data and Bitcoin Forum discussion, we try to understand if social media can affect Bitcoin price and how long does it take. We use the percentage of negative words as the measure of the article sentiment. The results show that social media can affect price. However, for information sources focusing on speculation, the effects on prices are immediate. In contrast, information concerning fundamentals impacts prices in a longer holding period.</td>
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<td>77 - The Dimensions of Supervision-subordinate Relationship</td>
<td>Liiqing Yang, Xi’an Jiaotong University, No.28, Xianning West Road, Xi’an, China, <a href="mailto:yql2011@stu.xjtu.edu.cn">yql2011@stu.xjtu.edu.cn</a>, Qiaozhuan Liang Subordinate can form distinguishable social exchange relationships with their immediate supervisor. The exchange resources differ between organizational and personal. Based on the taxonomy, social exchange relationship can develop a construct of four dimensions: work, flatter, private, selfless. Various dimensions have different impact on performance as a mediator or intervening variable. The construct can explain the puzzle of relationship between social exchange relationship and performance.</td>
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<td>78 - Counterfeits, Anti-counterfeit Technology and Monitoring Strategy</td>
<td>Shiqing Yao, The Chinese University of Hong Kong, 9/F, Cheng Yu Tung Building, No.12 Chak Cheung Street, Shatin, N.T., Hong Kong, Hong Kong - PRC, <a href="mailto:sjyo@ust.hk">sjyo@ust.hk</a>, Kaljie Zhu</td>
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<td>We consider an authentic company that sells its products to a customer market. In the same market, a counterfeiter may sell its low-quality counterfeits. The authentic company can put effort into developing an anti-counterfeit technology to distinguish its products from counterfeits while the authority can monitor counterfeits and outlaw counterfeit locations. We derive the company’s optimal decision on its anti-counterfeit effort and highlight its difference from conventional wisdom.</td>
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<td>79 - Optimization of Area Traffic Control: A Binary Mixed Integer Linear Programming Approach</td>
<td>Zhao Zhang, Research Assistant, Tsinghua University, Room 615, Shunde Building, Haidian District, Beijing, 100084, China, <a href="mailto:zzxzx@tsinghua.edu.cn">zzxzx@tsinghua.edu.cn</a></td>
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<td>This paper proposes a model aimed at optimizing area traffic control. We use network total delay as the objective in the model. In this research, cell transmission model is used to discretize traffic time into many intervals and signal coordination, lane settings, phase, start of green and green split can be optimized simultaneously. The model is linear in nature and can be solved by standard branch and bound algorithm.</td>
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<td>80 - Identify Naturally Occurring Healthcare Provider Referral Networks for Diabetic Patients</td>
<td>Yuchen Zheng, PhD Student, Georgia Institute of Technology, Atlanta, GA, 30312, United States of America, <a href="mailto:richardz@gatech.edu">richardz@gatech.edu</a>, Kun Lin, Jeremy Pickreign, Thomas White, Gigi Yuen</td>
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<td>The pioneer Accountable Care Organizations (ACOs), where doctors voluntarily form groups to deliver coordinated quality care, saved Medicare $400 million in two years. To improve ACOs design, we utilize past care patterns and adopt modularity maximization to detect pre-existing referral networks for diabetic patients, within which doctors share patients frequently. We further identify the driving forces of the underlying community structures and understand the relation to cost and utilization.</td>
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**Tuesday, 1:30pm - 3:00pm**

**TC01**

**Logistics and Operations Research**

**Sponsor:** Military Applications

**Sponsored Session**

**Chair:** Andrew Hall, COL, U.S. Army, 4760 40th St N, Arlington, VA, United States of America, AndrewOscarH@aol.com

1. **Scheduling the Transition of the C-130 Aircraft Fleet to a New Maintenance Process**
   - Melissa Bowers, mrbowers@uktx.edu, Bogdan Bichescu, Kenneth Gilbert, Anurag Agarwal, Doug Keene
   - The US Air Force is tasked to increase aircraft availability through a new initiative, the High Velocity Maintenance program, which seeks to increase availability of aircraft to the US military through a reduction in the time an aircraft spends on the ground undergoing planned maintenance. The transition of a fleet of aircraft from the standard process to shorter HV M cycles is a complex task that requires careful planning. A mixed-integer programming approach is used to generate a schedule which maintains a constant annual workload and yields lower flow times and work-in-process levels.

2. **Learning and Bayesian Updating in Made-to-order (MTO) Production**
   - Keith Womer, Professor, University of Missouri - St. Louis, One University Blvd, St. Louis, MO, 63121, United States of America, womerk@umsl.edu, Jeffrey Camm, Haitao Li, Colin Osterman, Rajesh Radhakrishnan
   - The case of production planning for made-to-order (MTO) manufacturing. We minimize expected discounted cost by controlling production rate. A dynamic and adaptive mechanism to estimate the effects of learning and to optimize next period production is developed. This approach offers a closed-loop solution through stochastic dynamic programming. The approach is illustrated using data from the Black Hawk Helicopter Program.  

**INFORMS Philadelphia – 2015**
3 - Retail Inventory Optimization for the U.S. Navy
Javier Salmeron, Naval Postgraduate School, Operations Research Dept., GI-214, Monterey, CA, 93943, United States of America, jsalmeron@nps.edu, Emily Craparo

We present a mixed-integer linear model to guide retail (site-based demand level) inventory decisions for the Naval Supply Systems Command (NAVSSC), Weapons Systems Support. An (s,Q) model optimizes reorder points and order quantities for thousands of items in order to minimize deviations from target fill rates, with demand uncertainty; budget and order quantity constraints. We compare branch-and-bound with Lagrangean relaxation solutions, and our results with those from other NAVSSC tools.

TC02
02-Room 302, Marriott
Network Applications in Homeland Security
Cluster: Homeland Security
Invited Session
Chair: Thomas Sharkey, Rensselaer Polytechnic Institute, 110 8th Street, Center for Industrial Innovation, Troy, NY, 12180, United States of America, baycin@rpi.edu, Thomas Sharkey, Chase Rainwater

1 - Novel Bilevel Programming Approaches for Interdicting Multi-tiered Illegal Supply Chains
N. Orkun Baycin, Rensselaer Polytechnic Institute, 110 8th Street, Center for Industrial Innovation, Troy, NY, 12180, United States of America, baycin@rpi.edu, Thomas Sharkey, Chase Rainwater

We study a resource allocation problem faced by law enforcement in arresting criminals in the drug flow and information flow networks. The objective of law enforcement is to minimize the maximum amount of drugs reaching end users. There exist interdependencies between the networks which leads to a network interdiction problem with a discrete inner problem. We apply a novel dual-based reformulation technique to solve an equivalent single-level problem and present computational results.

2 - Bi-level Stochastic Network Interdiction Model for Deployment of Cyber-security Countermeasures
ApuRba Nandi, Mississippi State University, P.O. Box 9542, Mississippi State University, Mississippi State, MS, 39762, United States of America, akn77@msstate.edu, Hugh Medal

We study how best to deploy cyber-security countermeasures to protect a cyber-network against attacks. We propose a bi-level stochastic network interdiction model capturing the interaction between the attacker and the defender as a sequential stackelberg game played on an attack graph. We consider that the attacker's knowledge about the topology of the attack graph, and the attacker's and the defender's knowledge about each other's actions are uncertain. We develop algorithm to solve the model.

3 - Vitality Measures for Multigraphs with Applications to Communications Networks
Sarah Nurre, Assistant Professor, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Sarah.Nurre@affit.edu, Christopher Hergenreter

We consider the problem of determining the most vital arcs to protect within a multigraph, such as a communications network. Traditional vitality measures are insufficient as they often examine single arc failures which have no impact on multigraphs due to parallel arcs between pairs of nodes. Herein, we propose and examine set based vitality measures for multigraphs. We perform and present the results of promising computational results multi-mode military communications networks.

4 - Efficient Resilience Optimization of Interdependent Networks
Andres Gonzalez, Rice University, 6100 Main Street, MS-318, Ryon 203, Houston, TX, 77005, United States of America, andres.gonzalez@rice.edu, Leonardo Dueñas-Osorio, Andres Medaglia, Mauricio Sánchez-silva

MIP models of the Interdependent Network Design Problem (INDP) have proved to be effective tools to study and improve the resilience of systems of interdependent infrastructure networks. Nevertheless, these MIP models have limited scalability for large realistic systems. In this work, we present an enhanced methodology to optimize the resilience of interdependent networks, based on the joint use of decomposition techniques and efficient reformulations of the INDP models.

TC03
03-Room 303, Marriott
Inventory Management I
Contributed Session
Chair: Jun-yeon Lee, California State University, Northridge, 18111 Nordhoff St, Northridge, CA, 91330-8378, United States of America, junyeon.lee@csum.edu

1 - Forecasting of Demand Tail Distribution for Inventory Optimization
Antony Joseph, Staff Data Scientist, Walmart Labs, 1001 National Avenue, Apt. 107, San Bruno, CA, 94066, United States of America, AJoseph0@walmartlabs.com

We discuss a novel technique for forecasting demand tail distribution for items in the Walmart e-commerce inventory. The methodology first estimates the quantiles of the demand distribution, followed by fitting a parametric distribution using a suitable metric. The method is seen to be robust to high observed variability in demand. Performance of the proposed approach is assessed using Supply Chain metrics such as Weeks of Supply and Met Demand.

2 - Strategic Safety Stocks under Guaranteed Service and Constrained Service Models
Ton De Kok, TU Eindhoven, Paviljoen E.O4, P.O. Box 513, Eindhoven, Netherlands, a.g.d.kok@tue.nl

In this presentation we discuss our findings on a set of real-life supply chains concerning the positioning of safety stocks in the supply chain. We compare the results from models under the guaranteed service assumption and under the constrained service assumption. The latter assumption follows the classical Clark and Scarf model for serial multi-echelon systems. Furthermore, we discuss some implications of the guaranteed service assumption in case of a bounded demand formulation.

3 - Scarcity Effect on Dual-channel Supply Chain
Baoshan Liu, PhD Student, Huazhong University of Science and Technology, School of Management, 1037 Luoyu Road, Wuhan, China, liubaooshan@qq.com, Shihua Ma

We consider manufacturer’s dual-channel sale system where customers get the product the direct channel with limited quantity. The limited quantity of the direct channel releases a scarcity message that consumers will increase their purchasing desire. Both the manufacturer and the retailer choose their own decision variable to maximize their respective profits considering scarcity effect. We model the problem using Stackelberg games and try to find the best solution from different perspectives.

4 - An Optimal Inventory Replenishment Considering Product Life Cycle
Shunichi Ohmori, Assistant Professor, Waseda University, Room 51-15-05, Okubo 3-4-1, Shinjuku, Tokyo, 169-8555, Japan, ohmori0406@gmail.com, Kazuho Yoshimoto

We consider a problem of determining initial and replenishment order quantities that minimize the cost of lost sales, inventory holding cost, fixed ordering cost, and obsolete inventory subject to stochastic demands. We model this problem as a multi-stage problem where the demands and prices of products lie in some uncertainty set depending on their life cycle. We develop a dynamic programming method to solve this problem.

5 - Vendor-managed Inventory with a Time-dependent Stockout Penalty
Jun-yeon Lee, California State University, Northridge, 18111 Nordhoff St, Northridge, CA, 91330-8378, United States of America, junyeon.lee@csum.edu

We examine the problem of designing a vendor-managed inventory (VMI) contract with a time-dependent stockout penalty in a stochastic (Q, r) inventory system, in which the supplier is charged a stockout penalty that depends on the length of the time during which stockouts occur at the customer. The customer chooses the stockout penalty and offers the VMI contract to the supplier, and the supplier can accept or reject the contract. We examine the optimal behaviors of the two parties.
1 - Social Media Analytics: The Effectiveness of Marketing Strategies in Online Social Media

Vilma Todri, PhD Candidate In Information Systems, NYU, 44 W 4th St, KMC Room 8-181, New York, NY, 10012, United States of America, vtodri@stern.nyu.edu, Panagiotis Adamopoulos

This paper studies a novel social media venture and seeks to understand the effectiveness of marketing strategies in social media platforms by evaluating their impact on participating brands. We use a real-world data set and employ a promising research approach combining econometric with predictive modeling techniques.

2 - Predicting Crowd Behavior with Big Public Data

Nathan Kallus, MIT, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu

We present efforts to predict the occurrence, specific timeframe, and location of crowd actions before they occur based on public data collected from over 300,000 open content web sources in 7 languages, from all over the world, ranging from mainstream news to government publications to blogs and social media.

3 - Participation vs. Effectiveness of Paid Endorsers in Social Advertising Campaigns: A Field Experiment

Jing Peng, The Wharton School, University of Pennsylvania, 3730 Walnut Street Suite 500, Philadelphia, PA, 19104, United States of America, jingpeng@wharton.upenn.edu, Christophe Van den Bulte

We investigate the participation and effectiveness of paid endorsers in viral-for-hire social advertising. Specifically, we investigate (i) how financial incentives affect potential endorsers' participation and effectiveness in generating online engagements (likes, comments, and retweets), and (ii) which network characteristics and prior engagement characteristics are associated with participation and effectiveness. We conduct a large scale field experiment with an invitation design in which we manipulate both financial incentives and the soft eligibility requirement to participate in the campaign. The latter provides a strong invitation design in which we manipulate both financial incentives and the soft eligibility requirement to participate in the campaign. The latter provides a strong

4 - A Visual Monitoring Technique Based on Importance Score and Twitter Feeds

Zhenhuan Sui, Graduate Research Assistant, The Ohio State University, 2501 Gardenia Drive, Columbus, OH, 43235, United States of America, sui.19@osu.edu, David Milam, Theodore Allen

We propose a visual monitoring technique based on topic models, a point system, and Twitter feeds for monitoring. The method generates a chart showing the important and trending topics that are discussed over a given time period which is illustrated the methodology using cyber-security cases.

4 - Model Uncertainty in Commodity Markets

Sebastian Jaimungal, University of Toronto, Department of Statistical Sciences, Toronto, Canada, sebastian.jaimungal@utoronto.ca, ílvaro Cartea, Zhen Qin

This paper studies the effect that model ambiguity in commodities have on the value of derivative contracts. The base model consists of three drivers: a mean-reverting diffusion, a mean-reverting jump, and a stochastic volatility component. We allow the agent to consider a wide class of alternate models, and penalize the differing components of the model individually. We demonstrate how agents alter their behavior in the presence of ambiguity and how derivatives and spreads are affected by it.

2 - Index Tracking with Futures

Brian Ward, Columbia University, New York, NY, bhw2150@columbia.edu, Tim Leung

Exchange-Traded Funds (ETF) market continue to grow. Many ETFs are designed to track an index, and their leveraged benchmarks (2x, 3x, etc.) Since many of these indices are not directly traded, we consider tracking them using futures of various maturities. We do so both stochastically and dynamically, and backtest our strategies with empirical data.

3 - Investment in Commodities ETFs and Management of Contango

Andrew Papanicolaou, NYU Polytechnic, 6 Metrotech Center, Brooklyn, NY, 11201, United States of America, apapanic.brown@gmail.com

The last two decades have seen growing investment in commodities markets. Commodities ETFs are popular but not a passive investing strategy. They will post losses in contango markets. The focus of this talk will be storability commodities, where uncertainty in the convenience yield reduces the Sharpe ratios. Losses are seen as an information premium, which is quantified through a Merton-type control problem.
1 - Time-varying Systemic Risk: Evidence from a Dynamic Copula Model of CDS Spreads

Dong Bwan Oh, Economist, Federal Reserve Board, 20th Street and Constitution Avenue NW, Washington, DC, 20551, United States of America, d dongbwan.oh@frb.gov, Andrew Patton

This paper proposes a new class of copula-based dynamic models for high-dimensional conditional distributions, facilitating the estimation of a wide variety of measures of systemic risk. We use the proposed models to study a collection of daily credit default swap spreads on 100 U.S. firms. We find that while the probability of distress for individual firms has reduced since the financial crisis of 2008-09, the joint probability of distress is substantially higher now than in the pre-crisis.

2 - An Optimization View of Financial Systemic Risk Modeling

Nan Chen, Prof., Chinese University of Hong Kong, 709A William Engineering Building, Hong Kong, Hong Kong - PRC, nchen@sc.cuhk.edu.hk, Xin Liu, David D. Yao

We develop an optimization-based formulation of financial systemic risk. A partition algorithm is constructed to solve the problem. The sensitivity analysis helps us identify two multipliers to characterize the amplification effects caused by liability networks and market liquidity. The effects of policy intervention are also discussed in the paper.

3 - Optimal Capital Requirements in Interbank Networks with Fire Sales Externality

Jongsoo Hong, Duke University, 1 Towerview Rd, Durham, NC, 27707, United States of America, jongsoo.hong@duke.edu, David Brown

We consider an interbank network with fire sales externality and study the problem of optimally trading off between capital reserves and systemic risk. We find that the optimal capital requirements is a solution to a stochastic linear programming without fire sales externality and a stochastic mixed integer programming with fire sales externality. We offer an iterative algorithm that converges to the optimal. We demonstrate the methods on an example using data from a central bank.

4 - Free-Riding in Team Projects: The Role of the Leadership Style

Morvarid Rahmani, Assistant Professor, Georgia Tech, morvarid.rahmani@scheller.gatech.edu, Uday Karmarkar, Guillaume Roels

In order to remain innovative in today’s global market, firms are increasingly organizing work around teams. In this paper, we investigate the role of the leadership style (authoritarian or democratic) on free-riding in teams and characterize which leadership style is the most efficient depending on the project characteristics.

3 - Different Approaches to Crowdfunding: Kickstarter vs. Indiegogo

Simone Marini, Wharton, 562 Jon M. Huntsman Hall, 3730 Walnut St, Philadelphia, PA, 19104, United States of America, marini@wharton.upenn.edu, Karan Girotra

We compare the different modes of interaction between backers and creators offered in the two most famous crowdfunding platforms, and provide prescriptions on their implementation, taking the view of project creators.

4 - Are Good Idea Generators also Good at Evaluating Ideas

Otso Massala, INSEAD, 1 Ayer Rajah Avenue, Singapore, Otso.MASSALA@insead.edu

Using data collected from a series of innovation tournaments we relate different business opportunity generation skills with evaluation skills. We find that prolific generators are worse evaluators while generators that produce high quality ideas tend to also be good at evaluating. We provide implications for design of innovation tournaments and innovative organizations.
4 - Creativity under Fire: The Effects of Competition on Creative Production
Daniel P. Gross, Post-doctoral Fellow, NBER/Harvard Business School, Soldiers Field Road, Boston, MA, 02163,
United States of America, dgross@hbs.edu
This paper studies the incentive effects of competition on individuals’ creative production. Using a sample of commercial logo design competitions, and a novel, content-based measure of originality, I find that competition had an inverted-U effect on creativity. The results reconcile conflicting evidence from an extensive literature on the effects of competition on innovation, with implications for R&D policy, competition policy, and organizations in creative or research industries.

TC11
11-Franklin 1, Marriott
Advances in Discrete Optimization
Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session
Chair: Gustavo Angulo, Assistant Professor, Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Macul, Santiago, 7820436, Chile, gangulo@ing.puc.cl
1 - Optimization over Structured Subsets of Positive Semidefinite Matrices via Column Generation
Sanjeeb Dash, IBM Research, Yorktown Heights, NY, United States of America, sanjeebd@us.ibm.com, Amir Ali Ahmadi, Georgina Hall
We describe LP and SOCP algorithms that optimize over some structured subsets of the cone of positive semidefinite matrices (PSD cone) in an iterative fashion via column generation, starting with an initial linear approximation of the PSD cone given by Ahmadi and Majumdar (2014). We apply our techniques to sum-of-squares programming for nonconvex polynomial optimization problems, and to a copositive programming relaxation of the stable set problem.
2 - Cutting Planes from Extended LP Formulations
Merve Bodur, UW-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu, Sanjeeb Dash, Oktay Gunluk
For mixed-integer sets, we study extended formulations of their LP relaxations. We show that applying split cuts to such extended formulations can be more effective than applying split cuts to the original formulation. For any 0-1 mixed-integer set with n integer and k continuous variables, we construct an extended formulation with 2n+k-1 variables whose split closure is integral. We extend this to general mixed-integer sets and construct the best extended formulation with respect to split cuts.
3 - Robust (MONOTONE) Submodular Function Maximization
Rajan Udwani, ORC, MIT, 70 Pacific St, 324C, Cambridge, MA, 02139, United States of America, rudwani@mit.edu, James Orlin, Andreas Schulz
Consider two common instances of monotone submodular function maximization with cardinality constraint, feature selection (machine learning) and sensor placement. In both, it is often the case that out of the chosen set of features (sensors), some may be corrupt (may fail). Thus, we would like our chosen set to be robust to removal of some elements. We consider a previously known formulation of this problem and give the first constant factor approximation algorithms.
4 - On a Semicontinous Relaxation of Fixed-charging Network Flow Problems
Gustavo Angulo, Assistant Professor, Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Macul, Santiago, 7820436, Chile, gangulo@ing.puc.cl
Usual formulations of fixed-charge network flow problems make use of binary variables to indicate whether an arc is open or not, and to impose lower and upper bounds on the flow whenever an arc is used. We propose a relaxation where both binary and flow variables are treated as unbounded semicontinous variables. We derive a complete linear description of the convex hull of this relaxation and show the tractability of the associated separation problem.

TC12
12-Franklin 2, Marriott
Optimization Integer Programming I
Contributed Session
Chair: John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, ON, K1S5B6, Canada, chinneck@scce.carleton.ca
1 - School Districting Problem (SDP) Framed as a Spatial Optimization Model/mixed Integer Program
Shawn Helm, Senior Manager, Portland Public Schools, 501 North Dixon Street, Portland, OR, 97227-1807, United States of America, shelm@pps.net, Will Kearney, Saham Dissanayake
SDPs assign neighborhoods to schools given physical, demographic, and policy constraints. We control capacity; compactness; contiguity; amount of demographic change. Users specify class size; grade band; neighborhood capture assumptions; room uses; which current assignments are retained. The integrated framework uses real GIS data from Portland Public Schools and available solvers to identify best school-neighborhood assignments; solves model to display results and inform boundary decisions.
2 - Facility Location Problem with Appointment Scheduling in Healthcare

Mengnan Chen, University of Central Florida, Department of IEMS, Orlando, FL, 32816, United States of America, cmn891127@knights.ucf.edu, Qipeng Zheng

Facility location problem with appointment scheduling in healthcare is used to schedule elective surgeries for physician, as well as to provide multiple choices for patients. Facility location problem aims to improve the match between healthcare resources (physician, clinic location) and patient needs (preferences and types of diseases). By solving this problem, we can meet the minimum of loss for the hospital (the total travel time) and satisfied the each patient preference as much as possible.

3 - Exploiting Variability with Machine Learning Based Restart Strategies for MIP Solvers

Lars Beckmann, University of Paderborn, Warburger Straße 100, Paderborn, De, 33100, Germany, Lars.beckmann@gmail.com

Performance variability, a.k.a. the heavy-tail phenomenon, can greatly affect the solution time of combinatorial problems, especially mixed-integer programming (MIP) models. We present a machine learning based restart strategy that exploits variability for quickly solving MIP problems. We show that this approach is effective on a large dataset of MIP models. Our approach can be integrated in any MIP solver and can potentially be generalized for solving other combinatorial problems as well.

4 - Faster Infeasibility Analysis for Mixed Integer Linear Programming

John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, ON, K1S5B6, Canada, chinneck@se.carleton.ca, Andrew Scherr

Finding an Irreducible Infeasible Subset of Constraints in an infeasible mixed integer linear program is extremely time consuming due to the need to solve many different MILPs. We present a number of new algorithms that greatly speed the process of analyzing infeasibility by reducing the number and size of MILP subproblems solved.

5 - Algorithms for Determining Internal Credit Ratings

Srinivas Bollapragada, Chief Engineer, General Electric, 1 Research Circle, Niskayuna, NY, 12309, United States of America, bollapragada@ge.com, Xing Wang

Financial Institutions assign credit ratings to customers for managing risks. Underwriters use these ratings to determine risk-based pricing. We developed an efficient algorithm to assign credit ratings to customers. Our algorithm partitions the probability of defaults associated with customers into a specified number of risk classes to achieve a target mean probability of default for each class. GE Capital Services uses our algorithm for its risk management needs.

■ TC13

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2 - Facility Location Problem with Appointment Scheduling in Healthcare

Mengnan Chen, University of Central Florida, Department of IEMS, Orlando, FL, 32816, United States of America, cmn891127@knights.ucf.edu, Qipeng Zheng

Facility location problem with appointment scheduling in healthcare is used to schedule elective surgeries for physician, as well as to provide multiple choices for patients. Facility location problem aims to improve the match between healthcare resources (physician, clinic location) and patient needs (preferences and types of diseases). By solving this problem, we can meet the minimum of loss for the hospital (the total travel time) and satisfied the each patient preference as much as possible.

3 - Exploiting Variability with Machine Learning Based Restart Strategies for MIP Solvers

Lars Beckmann, University of Paderborn, Warburger Straße 100, Paderborn, De, 33100, Germany, Lars.beckmann@gmail.com

Performance variability, a.k.a. the heavy-tail phenomenon, can greatly affect the solution time of combinatorial problems, especially mixed-integer programming (MIP) models. We present a machine learning based restart strategy that exploits variability for quickly solving MIP problems. We show that this approach is effective on a large dataset of MIP models. Our approach can be integrated in any MIP solver and can potentially be generalized for solving other combinatorial problems as well.

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■ TC13

13-Franklin 3, Marriott

Stochastic Combinatorial Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Sean Skwerer, Yale, 300 George Street, Suite 523, New Haven, CT, United States of America, sean.skwerer@yale.edu

1 - Finite Horizon Markov Decision Problems and a Central Limit Theorem for Total Reward

Alessandro Arlotto, Duke University, Durham, NC, United States of America, aa249@duke.edu, J. Michael Steele

We prove a CLT for a class of additive processes that arise naturally in the theory of finite horizon Markov decision problems (MDPs). The theorem generalizes a result of Dobrushin for temporally non-homogeneous Markov chains. The innovation is that here the summands are permitted to depend on the current state and a bounded number of future states of the chain. We show through examples that this flexibility gives a direct path to asymptotic normality of the total reward of finite horizon MDPs.

2 - Simplifying Ensembles of Trees

Sean Skwerer, Yale, 300 George Street, Suite 523, New Haven, CT, United States of America, sean.skwerer@yale.edu

Recursive partition functions (RPFs) are used in a wide variety of statistical methods including classification and regression trees, regression splines, random forests and boosting. The focus of this research is to find a framework for aggregating an ensemble into a single tree or a small number of trees which have comparable predictive strength to the entire ensemble. I will discuss advances made in aggregating ensembles of recursive partition functions.

3 - Submatrix Detection in Gaussian Random Matrices

Quan Li, Massachusetts Institute of Technology, 550 Memorial Drive Apt. 12B4, Cambridge, MA, 62139, United States of America, qianli@mit.edu, David Gamarnik

Iterative Search Algorithm is widely used to find large average submatrices of a real-valued matrix in the exploratory analysis. It alternately updates rows and columns until no further improvement is obtained. We present first theoretical analysis of its performance in Gaussian random matrices. We show that the algorithm terminates within finite iterations w.h.p.. This result implies that it converges to a local maximum submatrix w.h.p., leading to a constant factor gap from the global maximum.

4 - Locality in Optimization

Patrick Rbeschinì, Yale University, New Haven, CT, United States of America, Patrick.rbeschini@yale.edu, Sekhar Tatikonda

How does the solution of a constrained network optimization problem behave under perturbations of the constraints with respect to the topology of the network? Typically, sensitivity results concern the objective function evaluated at the optimal point, not the optimal point itself. We develop a general theory for the local sensitivity of optimal points on networks. In the context of the network flow problem, this theory yields that local perturbations on the constraints have an impact on the components of the optimal point that decreases exponentially with the graph-theoretical distance. These results suggest a notion of decay of correlation for (non-random) optimization procedures. This notion can be used to develop local algorithms that can substantially reduce the computational complexity of canonical optimization procedures.

■ TC14

14-Franklin 4, Marriott

Stochastic Financial Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Miguel Lejeune, Associate Professor, The George Washington University, 2201 G Street, NW, Funger Hall, Suite 415, Washington, DC, 20052, United States of America, mlejeune@gwu.edu

1 - Scenario Decomposition for a Class of Risk-averse Stochastic Programs

Pavlo Krokhmal, University of Iowa, 2136 Seamans Center, Iowa City, IA, United States of America, krokhmal@engineering.uiowa.edu

We consider nonlinear convex stochastic optimization problems where objective or constraints involve downside coherent or convex risk measures of special form. A scenario decomposition algorithm that exploits the constraint structure induced by the corresponding risk measures is proposed. Numerical experiments on portfolio optimization problems illustrate the computational effectiveness of the developed procedure.

2 - Risk-budgeting Multi-portfolio Optimization with Portfolio and Marginal Risk Constraints

Ran Ji, PhD Candidate, The George Washington University, 2201 G St, NW, Funger 415H, Washington, DC, 20052, United States of America, jiran@gmail.gwu.edu, Miguel Lejeune

We propose several stochastic risk budgeting multi-portfolio optimization models with portfolio and marginal risk constraints. The models permit the simultaneous optimization of multiple sub-portfolios with a downside risk measure assigned to each asset and sub-portfolio. Each model includes a joint chance constraint with random technology matrix. We expand a combinatorial modeling framework to represent the feasible set of the chance constraint as a set of mixed-integer linear inequalities.

3 - Factor-based Robust Indexing

Roy Kwon, Associate Professor, University of Toronto, 5 King’s College Road, Toronto, Canada, rkwon@mie.utoronto.ca, Dexter Wu

We present an approach for tracking a benchmark index using robust factor models. Robust versions of the Fama-French 3 and 5 factor models are developed to construct uncertainty sets for a robust (non) integer program. Constraints limit risk, tracking error, and number of tickets. A Lagrangian-based strategy is developed and computational results in tracking the SP 100 and SP 500 show that robust indexing can offer enhanced indexation in turbulent market conditions.
1 - Tractable Approaches to Multiple-needle Radiofrequency Ablation
Shefali Kulkarni-thaker, Graduate Student, University of Toronto, 5 Kings College Road, Medical Operations Research Lab (RS304), Toronto, ON, (416) 978, Canada, shefali@mie.utoronto.ca, Dionne Almeida, Aaron Fenster
In radiofrequency ablation (RFA), needles are used to apply extreme heat to tumors, eradicating cancerous cells. To optimize multiple-needle RFA treatments, we first obtain needle trajectories and positions using minimum volume covering sphere and ellipse formulations. Then, we optimize the heat delivery duration for each needle using tractable approximations to several thermal damage models. We discuss resulting clinical treatment quality for four 3D patient models.

2 - Robotic Path Finding Techniques in Stereotactic Radiosurgery Treatment Optimization
Marlee Vandewouw, University of Toronto, 5 King's College Road, Toronto, Canada, marlee@mail.utoronto.ca, Kimia Ghobadi, Dionne Almeida, David Jaffray
We investigate applying robotic path finding techniques to develop treatment plans for Gamma Knife Perfexion where the radiation is delivered continuously. We explore the use of simultaneous localization and mapping, combined with heuristic exploration techniques, to generate a path. A mixed integer model is then used to find the beam times for this selected path. We discuss the advantages and challenges of this method in comparison to the conventional forward and inverse step-and-shoot plans.

3 - Adaptive and Robust Radiation Therapy in the Presence of Drift
Philip Allen Mar, Dept. of MIE, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, philip.mar@mail.utoronto.ca, Timothy Chan
We present our computational study of an adaptive and robust optimization radiation therapy (ART) method. Previously, it was shown that this ART method provides asymptotically optimal treatment plans for convergent sequences of tumor motion distributions. In this work, we generate simulated sequences of tumor motion distributions that exhibit baseline, amplitude and breathing phase drift, and show the effectiveness of the ART method applied to these sequences.

4 - VMT Radiation Therapy: Modeling Treatment Delivery Time Versus Plan Quality
David Craft, Massachusetts General Hospital, 30 Fruit St, Boston, MA, 02114, United States of America, dcraft@alum.mit.edu, Marleen Balvert
Volumetric modulated arc therapy is a radiation method where the gantry delivers dose continuously as it rotates around the patient. Metal leaves sweep across the field to modulate the intensity fields. In commercial software, leaf trajectories are solved by heuristics without any guarantee of an optimality gap. VMT is a large scale non-convex optimization problem with many local minima. We offer a solution approach and explore the tradeoff between treatment quality and delivery time.

5 - Optimizing Network Recovery Time under Uncertainty
Juan Borroto, University of Pittsburgh, 3700 O'Hara Street, Pittsburgh, PA, 15213, United States of America, jsb81@pitt.edu, Pavlo Krokhmal, Oleh Prokopyev
We consider a network under attack, where its nodes can recover either on their own, by receiving support from neighboring nodes, or by receiving support from outside the network. A decision maker has to determine how to invest his budget on these options in order to minimize recovery time. We propose a novel hierarchical and stochastic model to address the issue, derive closed form equations for the optimal resource allocation, and study its behavior as the number of nodes grows to infinity.

6 - When to Release Feedback in a Dynamic Tournament
Ruooyu Wang, PhD Candidate, Fuqua School of Business, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, rw120@duke.edu, Brendan Dailey
We study dynamic tournaments in which time is modeled explicitly, as opposed to with the abstract notion of periods. By doing so, we characterize the effects of the ex-ante-designated timing of an interim progress report. Whether a policy of reporting increases total expected effort does not depend on the release time. We find that total expected effort is single-peaked/single-troughed in the report's release time, with the peak/tough located at a time more than halfway through the tournament.

3 - Nash's Continuous Transformation and a Smooth Homotopy Method for Computing Nash Equilibrium
Yabin Sun, PhD, City University of Hong Kong, R5218, Academic Building 2, Tat Chee Avenue, Kowloon, Hong Kong, Rong-Hong PRC, yabin.sun@my.cityu.edu.hk, Chuanying Dang, Yin Chen
A different procedure often results in the different selection of Nash equilibrium. To prove the existence of Nash equilibrium, Nash defined a continuous transformation. This paper applies Nash's continuous transformation to develop a smooth homotopy method by introducing just one extra variable. Starting from any given totally mixed strategy profile, the method numerically follows a smooth path that ends at a Nash equilibrium. Extensive numerical results show that the method is very efficient.

2 - A Mixed Cooperative Dual to the Nash Equilibrium
Bill Corley, Professor, The University of Texas at Arlington, P.O. Box 19017, Arlington, TX, 76019, United States of America, corley@uta.edu
A mixed dual to the Nash equilibrium is defined for n-person games in strategic form. This dual extends theERGE equilibrium from pure to mixed strategies so that mutual cooperation is achieved for the expected payoffs. Conditions are established for the existence of a dual equilibrium. However, it is shown that for each n>2 there exists a game for which no dual equilibrium exists. This fact may be interpreted as there are mathematical as well as sociological obstacles to mutual cooperation.

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5 - Endgame Solving in Large Imperfect-information Games
Sam Ganzfried, Carnegie Mellon University, Computer Science Department, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, sam.ganzfried@gmail.com, Tuomas Sandholm
Sequential games of perfect information can be solved in linear time by a straightforward backward induction procedure; however, this procedure does not work in games with imperfect information since different endgames can contain nodes that belong to the same information set and cannot be treated independently. We present an efficient algorithm for performing endgame solving in large imperfect-information games and demonstrate its success experimentally in two-player no-limit Texas hold 'em.
2 - s-plex and s-defective Numbers of a Graph
Vladimir Stozhkov, University of Florida, 2330 SW Williston Rd Apt. 2826, Gainesville, FL, 32608, United States of America, vstozhkov@ufl.edu, Eduard Pasiliao, Jose Walteros, Vladimir Boginski

The presentation is dedicated to two clique relaxation models: s-plex and s-defective clique. Theoretical properties of the specified objects are investigated. Analytical and computational bounds for the related optimization problems are provided. The extensions of the Motzkin-Straus formulation for s-plex and s-defective clique are derived. The outline of the general procedure for solving the corresponding maximization problems is given.

3 - Minimum Edge Blocker Dominating Set Problem
Foad Mahdavi Pajouh, Assistant Professor, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Foad.Mahdavi@umb.edu, Eduard Pasiliao, Jose Walteros, Vladimir Boginski

Dominating sets are widely used in social and communication networks analysis. Given a weighted graph and r>0, we consider the problem of removing a minimum number of edges so that the weight of any dominating set in the remaining graph is at least r. Complexity results, polyhedral results, a linear 0-1 programming formulation, and an exact algorithm for solving this problem will be presented.

4 - Minimum Risk Network Covering Location Problem
Konstantin Pavlukov, University of Florida, 1350 N. Pquito Road, Shalimar, FL, 32579, United States of America, kpavlukov@ufl.edu, Alexander Veremiev, Vladimir Boginski, Eduard Pasiliao

The network coverage problem under uncertainty is considered. In this problem, components of the covering set and links connecting them to remaining nodes of the network are subject to random failures. The emphasis is put on minimizing the risk of losing coverage in presence of such failures. We formalize the model and discuss its connection to the maximum expected covering location model.

Informs Philadelphia 2015

TC19

- Modeling and Optimization for Sustainable Cloud Computing
Sponsor: Computing Society
Sponsored Session
Chair: Yunpeng Pan, South Dakota State University, Mathematics & Statistics, Box 2220, Brookings, SD, 57007, United States of America, yunpeng.pan@gmail.com

1 - Remote Sensing Data Mining for Extracting Data Center Site Characteristics
Yunpeng Pan, South Dakota State University, Mathematics & Statistics, Box 2220, Brookings, SD, 57007, United States of America, yunpeng.pan@gmail.com, Adam Buskirk

Data centers are powerhouses of cloud. Companies rush to build out their cloud infrastructure to meet fast growing demand. The environmental impact such as carbon footprint falls into the category of public good, and therefore, calls for appropriate public policy decisions, which in turn require good information. Our current work intends to achieve this by mining the Landsat remote sensing data to extract characteristics of data centers in operation and under construction at a global scale.

2 - A Dynamic Workflow Framework for Server Provisioning
Wei Lin, Software Engineering Researcher, IBM, 8 Dongbeiwan West Road, Haidian Dist, Beijing, China, linweilw@cn.ibm.com, Brian Peterson, Qinhua Wang, Zongyang Zheng, Christopher Young, Si Zeng

Cloud service providers support server provisioning to large number of enterprise customers, who have different functional, security and compliance requirements. We propose a framework which composes dynamic workflow at runtime to cater individualized provisioning procedures. In this framework, an onboarding module configures processes steps and dependencies for each customer, and a composition module dynamically composes execution workflow based on dependency validation and sequence calculating.

3 - Minimizing Costs in Distributed Cloud Resource Provisioning
Julio Goez, Postdoctoral Fellow, Ecole Polytechnique Montreal and GERAD, 2990 Boulevard Edouard-Montpetit, Montréal, QC, H3T 1J4, Canada, jgoez1@gmail.com, Juan F. Pérez

We consider the problem of minimizing the cost of provisioning resources at different cloud locations, constrained to satisfying a required service-level objective. We present a mixed integer non-linear optimization model for this problem and show an equivalent mixed integer second order cone formulation. We also show that a simple round-up provides an initial feasible solution for the problem. We use this property to design a heuristic procedure to improve the quality of the initial solution.

4 - Renewable Energy Prediction and Prescription in the Internet-of-things (IoT)
Hans Schlenker, IBM, Hollerithstr 1, Munich, 81829, Germany, hans.schlenker@de.ibm.com, Yianni Gamvros

The IoT connects all sorts of devices — from sensors to embedded devices to smartphones to laptops to servers. IBM connected 1600 solar fields to its Renewable Energy IoT. Sensor data is collected, combined in the cloud, and further analyzed by analytics services to generate accurate local energy production forecast. These predictions are then used by (prescriptive) meta-heuristics optimization in a network distribution model to balance under-runs and over-production in all connected areas.
2 - Optimizing Spatiotemporal Antiviral Release Schedules in a Pandemic Influenza

Bishnupriya Bandi, Kellogg School of Management, Northwestern University, Evanston, IL, United States of America, bandi@kellogg.northwestern.edu, Diwakar Gupta

To help the state of Texas plan influenza pandemic interventions, we build a stochastic MIP to compute time-based antiviral releases. We derive scenarios for the stochastic program from an epidemic simulator that accounts for the inherent amount of uncertainty in disease progression. We study the hardness of this problem, and present models and methods to solve it, even though a direct-solve is intractable because of the large number of scenarios.

3 - Online Scheduling of Operating Rooms

Chaitanya Bandi, Kellogg School of Management, Northwestern University, Evanston, IL, United States of America, c-bandi@kellogg.northwestern.edu, Diwakar Gupta

We consider the online operating room scheduling problem where we do not know the sequence of requests and associated surgery lengths beforehand. Given the uncertainty and the objective of feasible schedules, we model the uncertainty using a Robust Optimization (RO) approach, and utilize a RO framework to develop an interval-classification scheduling algorithm optimized under the RO framework. We obtain provable lower bounds on the performance and show promising results based on real data.

4 - Is Technology Eating Nurses? – Staffing Decisions in Nursing Homes

Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu, Huaxia Rui, Abraham Seidmann

We study the effect of IT-enabled automation on staffing decisions in healthcare facilities using a unique nursing home IT data from 2006 to 2012. We also develop a strategic staffing model that incorporates technology adoption.

2 - Control of Multiserver Energy-aware Queueing Systems

Vincent Macio, McMaster University, 1280 Main Street West, Hamilton, Canada, maccio@mcmaster.ca, Douglas Down

We study the problem of controlling a multiple server system, where servers may be turned on or off. The cost function of interest is a combination of holding costs and energy costs (and potentially switching costs). We provide several structural results on the optimal policy - these structural results are enough to allow for the derivation of the optimal policy for a wide range of systems. Finally, we discuss how these policies compare with those extant in the literature.

2 - The Snowball Effect of Customer Slowdown in Critical Many-server Systems

Jori Selen, PhD Candidate, Eindhoven University of Technology, De Zaal, Eindhoven, Netherlands, j.selen@tue.nl,

Johan Van Leeuwaarden, Vidyadharkulkarni, Ivo Adan

Customer slowdown describes the phenomenon that a customer's service requirement increases with experienced delay. In healthcare settings, there is substantial empirical evidence for slowdown, particularly when a patient's delay exceeds a certain threshold. For such threshold slowdown situations, we design and analyze a many-server system that leads to a two-dimensional Markov process. Analysis of this system leads to insights into the potentially detrimental effects of slowdown.

3 - Maximizing throughput in Non-collaborative Networks of Queues

Tugce Isik, Georgia Institute of Technology, 755 First Drive NW, Atlanta, GA, 30332-0120, United States of America, tugceisik@gatech.edu, Hayriye Ayhan, Sigrun Andradottir

We study queueing networks with flexible non-collaborative servers. We introduce a processor sharing (PS) scheme that yields maximal throughput when buffers are infinite. For systems where the servers cannot work together at a station, we develop non-collaborative round-robin policies that approximate PS as the rotation of the servers becomes more frequent. We evaluate the performance of these policies in queueing networks with tandem, merge, and split topologies for different buffer sizes.

4 - Optimal Assignment of Authentication Servers to Different Customer Classes

Daniel Silva, Georgia Tech, 755 First Drive, Atlanta, GA, United States of America, dsl3@gatech.edu, Hayriye Ayhan, Bo Zhang

Consider a system where user requests for authentication arrive from several classes of customers, following independent Poisson processes. Each arrival has a class-dependent probability of being an impostor. The system has several authentication methods; each one has a known service time distribution, and a Type I and II error probability. A controller assigns a method to each user request. We model the system as a queueing network and find the structure of a cost-optimal routing policy.

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4 - Is Technology Eating Nurses? – Staffing Decisions in Nursing Homes

Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu, Huaxia Rui, Abraham Seidmann

We study the effect of IT-enabled automation on staffing decisions in healthcare facilities using a unique nursing home IT data from 2006 to 2012. We also develop a strategic staffing model that incorporates technology adoption.
4 - Optimal Control of an Inventory System with Stochastic and Independent Leadtimes
Mohsen Elhafsi, Professor, University of California, School of Business Administration, 900 University Avenue, Riverside, CA, 92521, United States of America, mohsen.elhafsi@ucr.edu,
Sail Benjaafar, Rui Chen
We study a continuous review inventory system with stochastic independent leadtimes. Because orders may not be delivered in the same sequence in which they have been placed, characterizing the optimal policy is difficult and much of the available literature assumes a fixed base-stock policy which we show is suboptimal and can perform poorly. Instead, the optimal policy is state-dependent and specified in terms of an inventory-dependent threshold function characterized by at most m parameters.

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2 - The Effect of Rating System Design on Negativity Bias
Ying Liu, Arizona State University, 1201 S McClintock Dr, Apt 221, Tempe, AZ, 85281, United States of America, yingliu_is@asu.edu, Pei-yu Chen, Kevin Hong
Does rating system design affect consumers' negativity bias in reporting product ratings? We examine the effect with both observational and experimental study. Results suggest that consumers tend to reflect their experiences in the least satisfied dimension in single-dimensional rating systems, whereas the overall ratings in multi-dimensional systems tend to reflect consumers' average experience. The study suggests that multidimensional rating systems could mitigate consumers' negativity bias.

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3 - Predict Campaign Quality: An Empirical Analysis of the Value of Video in Crowdfunding Markets
Qiang Gao, University of Arizona, 3700 N 1st Ave. #1020, Tucson, AZ, 85719, United States of America, qiangg@email.arizona.edu, Mingfeng Lin
Videos are prevalent in crowdfunding campaigns where there is usually little verifiable information. Yet to date there is virtually no systematic study of its roles in this new context. We investigate how video features predict campaign quality using data from a leading rewards-based crowdfunding website by implementing both explanatory and predictive models.

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4 - Content Monetization in Social Media: Estimation of Demand and Supply for User Generated Content
Ruibin Geng, Zhejiang University, 388 Yuhangtang Road, Hangzhou, ZJ, 310058, China, grace.bin1207@gmail.com, Bin Zhang, Paulo Goes
Social networking is reaching a maturity stage with fewer new registrations but more user churning. Our study investigates how a new market mechanism, content monetization, reduces turnover rate by using data from the largest Chinese social network Sina Weibo. It examines the factors that affect both the demand and supply for user-generated content (UGC) in social media. Our results confirm that this nascent mechanism effectively motivates the supply for UGC and also improves its quality.

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1 - A Distant Supervision Approach for Social Media Pharmacovigilance
Xiao Liu, University of Arizona, 1130 E. Helen St., Room 430, Tucson, AZ, 85721, United States of America, xiaoliu@email.arizona.edu, Hsinchun Chen
Pharmacovigilance refers to the science relating to the detection, assessment, understanding, and prevention of adverse drug events. Prior studies showed social media can be used to identify adverse drug events with supervised learning approaches. However, they require expert annotation and are not scalable for large datasets. In this study, we develop a distant supervision framework for pharmacovigilance in social media using distant supervision. Our framework achieves competent performance without annotation.
3 - Online Vs. Traditional Education: A Competitive Framework.
Vashkar Ghosh, University of Florida, Department of ISOM, Gainesville, FL, 32611, United States of America, vashkar.ghosh@warrington.ufl.edu, Gulver Karamemis, Asoo Vakhrria

Innovation and technological advancement are eliminating a lot of constraints (eg. physical presence) bringing weaving changes to higher education. We examine how technology in education is likely to develop and what its impacts will be on existing institutions. We examine a university's incentive to offer online programs in addition to the traditional program in a competitive environment. We consider two different games: the simultaneous and the sequential leader/follower location game.

4 - The Diffusion of Product Generation of Auto Industry
Gary Chao, Kutztown University, P.O. Box 730, Kutztown, PA, 18031, United States of America, chao@kutztown.edu, Maxwell Hsu

Instead of a whole new model, every a few years, automakers introduce a new generation of their existing model to continue their success of old models or to correct the mistakes in the old models. Based on the Bass diffusion theory, we would like to study whether the different sales behavior among models and generations in US market.

[TC27]

Sponsored Session
Evolutionary Bilevel Optimization
Sponsor: Multiple Criteria Decision Making
Chair: Kalyanmoy Deb, Koenig Endowed Chair Professor, Michigan State University, 428 S. Shaw Lane, 2120 EB, East Lansing, MI, 48864, United States of America, kdeb@egr.msu.edu

-Pekka Malo, Assistant Professor, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, Finland, pekka.malo@aalto.fi, Ankur Sinha, Kalyanmoy Deb, Jyrki Wallenius, Pekka Korhonen

Bilevel decision making and optimization problems are commonly framed as leader-follower problems, where the leader desires to optimize his own decision while taking the decisions of the follower into account. In such cases, the Pareto-optimal frontier of the leader is influenced by the decision structure of the follower facing multiple objectives. In this paper, we analyze this effect by modeling the lower level decision maker using value functions.

2 - Handling Uncertainties in Decision Variables for Bilevel Optimization Problems
Kalyanmoy Deb, Koenig Endowed Chair Professor, Michigan State University, 428 S. Shaw Lane, 2120 EB, East Lansing, MI, 48864, United States of America, kdeb@egr.msu.edu, Zhichao Lu

Bilevel problems involve two optimization problems in hierarchy and are challenging problems often found in practice. In this talk, we present evolutionary optimization algorithms and results on test and practical bilevel problems with uncertainties in decision variables for finding robust and reliable solutions. Uncertainties are considered for both lower and upper level variables and problems with and without constraints.

3 - Expected Frontiers: Incorporating Weather Uncertainty into an Integrated Bilevel Optimization
Moriah Bostian, Assistant Professor, Lewis & Clark College, Department of Economics, 0615 SW Palatine Hill Rd, Portland, OR, 97219, United States of America, mbostian@lclark.edu, Gerald Whittaker, Bradley Barnhart, Rolf Fare, Shawna Grosskopf

Weather is a main driver of agricultural nutrient fate and transport in the environment. We use bilevel optimization and a time-series bootstrap to evaluate a water pollution policy subject to a distribution of weather outcomes. Our results show that the deterministic Pareto frontier is sensitive to climate variation. Some policy configurations that appear equally effective in a deterministic model setup are strongly differentiated when weather uncertainty is included in the policy evaluation.
**TC30**

**Decision Support Systems I**

**Contributed Session**

**Chair:** Mohamad Hasan, Associate Professor, Kuwait University, Department of Quantitative Methods 815, CBA, Kuwait University, Kuwait City, 13055, Kuwait, mkanal@cbu.edu.kw

1. **Review of Consistency Among Pairwise Comparisons: Relationship Between Indices and Human Perception**
   Yujio Sato, Graduate School of Management, Chukyo University, 101 Yagotohonmachii, Showa, Nagoya, 466-8666, Japan, ysatoh@1988.jukuin.keio.ac.jp

   This paper reviews the Consistency Index (CI) of AHP. Since AHP requires redundant pairwise comparisons, transitivity in judgment is often violated. The review focuses on the detection capability of CI, and the relationship between the size of CI and the goodness-of-fit of weight to decision maker’s perception. The results imply that CI may not distinguish the consistency of judgment nor the size may have no relation with the degree of goodness-of-fit of weight to decision maker’s perception.

2. **Transformations and Materializations of Uncertainty Sets in Robust Optimization**
   Abhilasha Aswal, International Institute of Information Technology, Bangalore, 26/C Electronics City, Bangalore, KA, 560100, India, abhilasha.aswal@iiit.ac.in, Prasanna Gop

   We present a polyhedral representation of uncertainty for robust optimization and a volume based uncertainty measure for it. Our decision support framework enables easy transformations and materializations of a given uncertainty set and also easy set-theoretic operations on alternative uncertainty sets. These operations are quite useful in practice and are more difficult with probabilistic representations of uncertainty and non-polyhedral robust uncertainty sets.

3. **Open Source or Proprietary? A Study on Software Diffusion in a Competitive Market**
   Chao Ding, Assistant Professor, University of Hong Kong, KKL 807, Hong Kong, Hong Kong - PRC, chao.ding@hku.hk

   When choosing between open source software and proprietary software, consumers will consider software quality, cost, consumer reviews, promotions, compatibility, technical support, ease of use, etc. In this paper, we consider three important decision making factors as identified in literature: external influence, internal influence and ownership cost and study their impact on consumers’ adoption decision.

4. **A Decision Support System for Predicting International Freight Flows for Trade**
   Mohamad Hasan, Associate Professor, Kuwait University, Department of Quantitative Methods 815, CBA, Kuwait City, 13055, Kuwait, mkanal@cbu.edu.kw

   A decision support system is developed that can help decision makers to take right decisions about the country international trade system. It helps them to evaluate different scenarios to improve the multimodal transport system and import, export, re-export, and transit operations. These improvements will enhance the competitiveness and integration of this system. The overall results will help in increasing the international trade share for the country.

**TC31**

**Joint Session DM/QSR: Quality and Statistical Decision Making in Health Care Applications**

**Sponsor:** Data Mining

**Sponsored Session**

**Chair:** Shuai Huang, University of Washington, Dept. of Industrial and Systems Eng., Seattle, WA, United States of America, shuai.huang.le@gmail.com

1. **Social Media Analytics for the Promotion of Mental Health**
   Qingseng Zhang, Assistant Professor, City University of Hong Kong, Kowloon, Hong Kong - PRC, qingseng.zhang@cityu.edu.hk

   The digital footprints of Web users left on social media present important mental health proxies. In this work, we aim to characterize the dynamics of the online social groups for the mutual help of people suffering from depression. We identified unique features in both language and social interaction patterns, and interesting relationship between the two, which could have important implications of the causes and factors of depression.

2. **Adaptive Cluster-based Oversampling Method: Application to Gynecological Surgery Failure Prediction**
   Iman Nekoeimehr, PhD Candidate, University of South Florida, 14304 Wedgewood Ct., Apt. 201, Tampa, FL, 33613, United States of America, nekoeimehr@mail.usf.edu, Stuart Hart, Allison Wyman, Susana Lai-yuen

   A new oversampling method called Adaptive Semi-Unsupervised Weighted Oversampling is presented for imbalanced dataset classification. It is adaptive, and avoids overgeneralization and overfitting. The method was used with Support Vector Machines to predict surgical failure after gynecological repair operations. Results show 76% weighted accuracy and improvement over other oversampling methods.

3. **Real-time Detection of System Change Points via Graph Theoretic Sensor Fusion**
   Prahalad Rao, SUNY Binghamton, 4400 Vestal Pkwy E, Binghamton, NY, United States of America, prao@binghamton.edu, Chou-An Chou, Samie Tooootomi

   We propose a novel graph theoretic approach for detection of system change points from multidimensional sensor data. The approach is based on transform time series data into an un-weighted and undirected planar graph, and subsequently extracting topological invariants. This approach outperforms conventional statistics-based monitoring techniques. We demonstrate the effectiveness of the approach based on experimentally acquired sensor data from advanced manufacturing processes and healthcare.

4. **High-throughput Screening for Rule Discovery from High-dimensional Datasets**
   Mona Haghighi, University of South Florida, 3202 E Fowler Avenue, Tampa, FL, 33620, United States of America, monahaghighi@mail.usf.edu, Shuai Huang, Xiaoning Qian, Bo Zeng

   We propose a rule-based methodology to identify risk-predictive baseline patterns of Alzheimer’s disease through a network-based mathematical model. We apply data-mining techniques to reduce dimensionality while taking care of synergistic interaction of variables. Selecting a set of rules to monitor the progression of the disease is the second part of this study.

**TC32**

**Decision Support Systems for Data Mining**

**Contributed Session**

**Chair:** Zhiguo Zhu, Associate Prof., Dongbei University of Finance and Economics, No. 217 JianShan St., Shaehekou District, Dalian, 110625, China, zhuguo2862@gmail.com

1. **A Mixture Method of Multivariate Time Series Clustering**
   Cheng-Bang Chen, Penn State University, 233 Leonard Building, University Park, PA, 16802, United States of America, cbc184@psu.edu, Soundur Kumara

   Time series clustering is widely used in different domains. Although much literature is available on time series clustering, only a few articles relate to multivariate time series clustering. This research developed a clustering methodology and applies different similarity/dissimilarity measures to multivariate time series datasets. It can reduce the data size and has good clustering performance.
2 - Mining Association between Promotions and Transactions to Find Optimum Time for Targeted Promotions
Hari Koduvule, Dr, Samsung, # 2870, Orion Building, Outer Ring Road, Bangalore, K, 560037, India, hari.koduvule@gmail.com, Roshni Mohandas

In the usual Targeted Promotion scenario one optimizes the promotion content tailored towards a consumer’s purchase interest to maximize response. However time of targeting a promotion also equally important. In this paper, we present a new method, based on the temporal association patterns between promotion and transaction events, to find the optimum time for targeted promotions. We validate our method against existing approaches on a real retail data set and show significantly better results.

3 - The Effect of Non-local Diversity in Dynamic Class Prediction
Senay Yasagil Saglam, PhD Student, University of Iowa, 108 Pappajohn Business Building, S210, Iowa City, IA, 52242, United States of America, senayyasagil@gmail.com, Nick Street

Classifiers’ agreement in the region where a new data instance resides in has been considered a major factor in dynamic ensembles. We hypothesize that in this region the agreement among classifiers that are different is more important than among the similar ones. In other words, high local accuracy and confidence, and high diversity in other regions, is desirable. In this study, we check the validity of this hypothesis and verify that diversity still plays a role in the dynamic class prediction.

4 - Measuring Influence in Online Social Network Based on the User-content Bipartite Graph
Zhiguo Zhu, Associate Prof., Dongbei University of Finance and Economics, No. 217 JianShan St., Shahekou District, Dalian, 110625, China, zhuzg0628@126.com

How to precisely identify and measure influence has been a hot research direction. Differentiating from existing researches, we are devoted to combining the status of users in the network and the contents generated from these users to synthetically measure the influence diffusion. In this paper, we firstly proposed a directed user-content bipartite graph model. Finally, the experiment results verify our proposed model can discover most influential users and popular broads effectively.

TC33

33-Room 410, Marriott
Appointment Scheduling in Healthcare
Sponsor: Health Applications
Sponsored Session
Chair: Armagan Bayram, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, abayram@northwestern.edu

1 - Ensuring Timely Access and Adequate Capacity for an Endocrinology Clinic
Moses Chan, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, mosesych@umich.edu, Amy Cohn, Amy Rothberg

The weight management program was designed to promote weight loss for morbidly obese patients. Program participation is associated with reductions in BMI and improvements in cardiovascular risk factors and quality of life. Providers are booked weeks out, posing a challenge to schedule consecutive weekly visits. Non-adherence to schedule undermines the effectiveness of the program. The purpose of this study is to improve patient compliance with the program and to increase program access.

2 - An Online Appointment Scheduling Model
Ali Kemal Dogru, Om PhD Student, University of Alabama, 315 Bidgood Hall, 361 Stadium Drive, Tuscaloosa, AL, 35487, United States of America, akdogru@crimson.ua.edu, Sharif Melouk

Incorporating patient centered medical home (PCMH) principles, we develop an online appointment scheduling system (OASS) for a primary care setting. We propose a simulation optimization solution approach that uses two models working in concert to provide high quality solutions (i.e., schedules) in short time. We aim to minimize: 1) weighted cost of expected patient waiting time and 2) doctor idle time and overtime. Key Words: Online Appointment Scheduling, Simulation Optimization, PCMH

3 - Managing Series Patients in a Healthcare Facility
Siuyin Yu, STOR Department, UNC-Chapel Hill, B26 Hanes Hall, Chapel Hill, NC, 27514, United States of America, yusiyin@live.unc.edu, Vidyadhar Kulkarni, Vinayak Deshpande

Series patients are scheduled for a series of appointments, such as patients in physical therapy clinic, dialysis center, etc. To balance the demands from different
1 - An Optimization Model for Seismic Hazard Loss Analysis for Spatially Distributed Infrastructure
Hasan Manzour, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, hmanzour@uw.edu, Rachel Davidson

The new Optimization-based Probabilistic Scenario method produces a small set of probabilistic ground motion maps to represent the seismic hazard for analysis of spatial distributed infrastructure. A set of just 124 ground motion maps were able to match the hazard curves based on a million-year Monte Carlo simulation. This enormous computational savings has substantial implications for regional-scale since it can allow many more downstream analyses.

2 - A Model of the Effect of Pandemic Influenza on the U.S. Blood Supply
Hussein Ezzeldin, FDA, CBER, 10903 New Hampshire Ave, Bldg 71 Rm 1009, Silver Spring, MD, 20993, United States of America, hussein.ezzeldin@fda.hhs.gov, Arianna Simonetti, Richard Forshee

We present the spatial and temporal impact of Pandemic Influenza (PI) on the US blood supply through an inter-regional blood transfer system. We utilize a hybrid optimization heuristic to enhance the global performance of the network. Using Neural Networks trained by Particle Swarm Optimization, we model a function of regional factors to optimize the daily blood transfers among US regions. We simulate the effect of PI on regional blood transfers and compare to those during normal operations.

3 - Agent-Based Modeling to Simulate Resilience of Water Systems for Healthy and Secure Communities
Emily Berglund, Associate Professor, North Carolina State University, CB 7908, Raleigh, NC, 27695, United States of America, emily.berglund@ncsu.edu, Jacob Monroe, Hayden Strickling, Michael Knepper, Elizabeth Ramsey, M. Elsah Shafiee

Civic water systems are vulnerable to attacks and disasters that threaten the health and security of communities. When water service is lost due to a water quality failure or an attack on critical infrastructure, the decision-making of perpetrators, security personnel, utility managers, and the public can influence event outcomes. An agent-based modeling approach is developed to simulate the impact of sensing, communication, security, and infrastructure management on community resilience.

4 - Decision Support to Air Rescue Unit Allocation in Disaster Management Operations
Sergio Reboucas, ITA, Rua H 9C, Apt. 302, São José Dos Campos, SP, 12228612, Brazil, reb@ita.br

After a disaster break up, rescue helicopters have a valuable role in response phase. The allocation of these air rescue units requires knowledge about certain conditions that are most of times uncertain and its analysis and trade-offs must be thoroughly done. This paper aims to suggest a methodology to support the air rescue unit allocation decision in a natural disaster response phase context.

5 - Modeling Housing Stock Recovery after a Catastrophic Storm Event
Rafael Diaz, Research Associate Professor, Old Dominion University, 1040 University Blvd, Suffolk, VA, 23435, United States of America, rdlaz@odu.edu, David Earnest, ManWo Ng, Joshua G. Behr

Severe catastrophic storm events adversely affect housing stock and regional capacity to build and repair houses. Rebuilding this capacity takes time while the region faces an unexpected surge in the demand. We present a simulation model that considers a supply chain perspective. The model provides significant insights for policy makers into how the production of permanent housing depends upon the uncertainties and feedback effects of material, labor, funds, and regulatory environments.

1 - Pre-disaster Unmanned Air Vehicle Base Location and Routing for Road Damage Assessment and Repair
Seyed Kian Farajkhal, Middle East Technical University, METU-Cankaya, Metu Campus Esiendilisi, Ankara, 06800, Turkey, kian.farajkhal@metu.edu.tr, Melih Celik

Following large-scale disasters, unmanned air vehicles (UAVs) can help efficiently gather data on the status of the roads in the network. Given a set of potential disaster scenarios, we address the problem of establishing connectivity between relief and damaged areas through road repair. A two-stage stochastic model is developed to determine a UAV base location and time-limited routes so that the expected shortest path length between the supply and demand nodes is minimized.

2 - Disaster Operations Management: Recovery Classification and Research Framework
Niratcha Grace Tungtisanont, PhD Candidate, Clemson University, 100 Regency Dr, #22, Central, SC, 29630, United States of America, ntungti@g.clemson.edu, Aleca Roth, Yann Ferrand

We propose a research framework for improving post-disaster phase recovery. We address what types of investments should be made and their relative allocations in the “pre” and “during” emergency phases to improve the effectiveness of the recovery process? We use the proposed framework to draw managerial and policy implications.

1 - The Dynamics of Kidney Exchange
John Dickerson, CMU, 9219 Gates-Hillman Center, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu, Tuomas Sandholm

We discuss analytic, optimization, and game-theoretic approaches to matching in dynamic kidney exchange. We consider dynamism (i) at the post-match pre-transplant stage (ii) as patients and donors arrive and depart over time, and (iii) as multiple exchanges compete for overlapping sets of participants. We empirically validate our models and theoretical results on over 150 match runs of the UNOS national kidney exchange.

2 - A New Model to Decide Kidney-Offer Admissibility Depending on Patients’ Lifetime Failure Rate
Michael Bendersky, Ben Gurion University of the Negev, Beersheba, Israel, michael.bendersky@gmail.com, Israel David

We propose a new model to decide kidney-offer admissibility depending on patient’s age, estimated lifetime probabilistic profile and prospects on the waiting list. We allow for a broad family of lifetime distributions - Gamma - thus enabling flexible modeling of one’s survival under dialysis. It yields the optimal critical times for acceptance of offers of different qualities and may serve the organizer of a donation program, the surgeon and the individual recipient practicing patient-choice.

3 - Preemptive Approach to Kidney Allocation in USA
Phillip Applatlak-Kubi, Ohio University, 14 Pine St, Apt. #1B, The Plains, OH, 43780, United States of America, pakk09911@ohio.edu

The new kidney allocation policy improves kidney utilization. However, the policy has no consideration for allocation of cadaveric kidneys under emergency situations; a problem observed by the National Kidney Foundation. This research evaluates a point scoring model with considerations for emergency allocation. Simulated results indicate that the model minimizes number of waitlist deaths by 2% while prioritizing sensitive candidates and waiting time.
4 - Optimal Integration of Kidney Exchange Programs with Antibody Reduction Therapy
Naoto Koiwai, Assoc Professor, GMU, 3351 N Fairfax Dr, Arlington, VA, 22203, United States of America, nkoiwai@gmu.edu, Monica Gentili, Keith Melcon
Kidney paired donation (KPD) allows incompatible pairs to exchange kidneys with other incompatible pairs. However, evidence suggests there stills exist barriers to KPD utilization, especially among difficult-to-match transplant candidates and positive actual or virtual crossmatches. Using mathematical models, we investigate how to optimally integrate antibody reduction therapy in KPD to increase successful living-donor kidney transplants among difficult to match candidates.

■ TC39
39-Room 100, CC
Distribution Channel Management
Cluster: Operations/Marketing Interface
Invited Session
Chair: Xiaowei Xu, Associate Professor, Rutgers Business School-New Brunswick, 100 Rockafeller Rd., Piscataway, NJ, 08854, United States of America, xiaowei@andromeda.rutgers.edu
1 - Co-Advertising and Channel Power in Distribution Channels
Xiaowei Xu, Associate Professor, Rutgers Business School-New Brunswick, 100 Rockafeller Rd., Piscataway, NJ, 08854, United States of America, xiaowei@andromeda.rutgers.edu
We study a manufacturer-retailer channel, in which the manufacturer decides wholesale price as the channel leader and the retailer decides the retail price as the channel follower. Besides the retail price, customer demand is influenced by non-price marketing instruments, such as advertising. We identify business scenarios, under which the manufacturer should not participate any co-advertising campaign even if it's free, since doing so will increase the channel power of the retailer.

2 - Effects of Channel Intermediaries on Quality-price Competition
S. Chan Choi, Rutgers Business School-New Brunswick, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, chanchoi@rci.rutgers.edu
We show that when products are vertically differentiated, the optimal channel structure depends on whether a company is a high- or low-quality producer. Either manufacturer benefits by channel integration while the competitor uses an intermediary, but this effect is stronger for the low-quality manufacturer. If an intermediary is to be used, the low-quality manufacturer has more incentive to use an exclusive dealer. But the total channel profit is higher with a common retailer.

3 - Fairness in Supply Chain Contracts with Sales Efforts
Jumyung Song, Rutgers Business School, Room 430, 1 Washington Park, Newark, NJ, 07102, United States of America, jumyung.song@rutgers.edu
Fairness is an important incentive for supply chain contract design. I consider a setting where a retailer chooses both retail price and sale effort to maximize profit, and analyze how fairness in a supply chain affects supplier and retailer’s behaviors and their expected profits.

4 - A Longitudinal Analysis of Supplier Working Relations in Component Markets
Sengun Yeniyurt, Associate Professor, Rutgers Business School, 100 Rockafeller Rd, Piscataway, NJ, 08854, United States of America, yeniyurt@business.rutgers.edu, Steven Carnovale, John W. Henke
This study utilizes a longitudinal dataset that includes information regarding supplier working relations and sourcing transactions in the North American Automotive industry. Econometric models are developed and estimated utilizing information provided by first tier component suppliers to major automotive manufacturers. The estimates reveal the interplay between past interactions, future expectations, and working relations and their effect on transactional decisions in component markets.

■ TC40
40- Room 101, CC
Marketing I
Contributed Session
Chair: Robert Bordley, Expert Systems Engr Professional, Booz-Allen-Hamilton, 525 Choice Court, Troy, MI, 48085, United States of America, bordley_Robert@bah.com
1 - How Cultural Difference Influences Consumer Behavior in Hypermarket Industry
Mei-Wei Chao, Assistant Professor, Kao Yuan University, 1821 Zhongshan Rd., Luzhu Dist., Kaohsiung, 82151, Taiwan - ROC, t80149@cc.kyu.edu.tw
No empirical research exists to discuss the issues of culture and consumer behavior in the hypermarket industry using the territory of Taiwan and the U.S. as the units of comparison. This paper attempted to explore grocery consumers’ inner world and how their shopping perceptions vary between Taiwanese and American cultures. The contexts of interviews are given and additional findings are also put forward. Salient results and practical issues are discussed in detail in this paper.
2 - The Effect of Price Ending on Consumer Behavior
Yoshiyuki Okuse, Professor, Senshu University, 2-1-1, Higashi-Mita, Taka-Ku, Kawasaki, 2148580, Japan, okuse@sc.senshu-u.ac.jp

In the area of pricing research, a lot of researches on price endings have been developed. The purpose of this research is to specify the effect of price endings on consumer behavior in Japan.

3 - I Like using My Mobile Apps But... A Study of Post-Consumption Appraisal
Amubha Mishra, Assistant Professor Of Marketing, University of Idaho, 875 Perimeter Dr, Moscow, ID, 83844, United States of America, amushra@uidaho.edu

The study of mobile app consumption suggested three distinct dimensions. Users' evaluation of control, freedom, newness, assimilation, and fulfillment of need from apps was captured by Perceived Benefits, Perceived Alleviation, perceived easiness, obsolesce, and creation of need and Perceived Obsecuity, examined comprehensively. Perceived usefulness positively influenced all dimensions indicating that while apps may be perceived as helpful, it can also cause isolation.

4 - Increasing User Engagement with Mobile Analytics
Chaitanya Sagar, Chief Executive Officer, Perceptive Analytics, 353 West 48th Street, New York, NY, 10036, United States of America, cs@perceptiveanalytics.com

Mobile represents a teotonic platform shift with great opportunities and challenges. 80% of users do not return to an app after the first day of downloading it. 80% of total app revenue is ‘in-app’ purchases - so unless an app can engage users, it cannot generate significant revenue. Add to that, top 20% apps generate 97% of the revenue making fierce competition among 1.2 million apps. I focus on the heart of this problem increasing engagement with users specifically using push-notifications.

5 - Maximum Entropy Models of Individual Choice
Robert Bordley, Expert Systems Engr Professional, Booz-Allen-Hamilton, 525 Choice Court, Troy, MI, 48085, United States of America, Bordley_Robert@bah.com, Elhsan Soofi

Many forecasts are based on economic models of individual choice. But these models assume actual individual choice is rational, an assumption which some viewed as having been refuted. To avoid making this assumption, this paper shows that maximum entropy models can approximate general discrete choice models. This paper also shows how to parameterize such models in order to use them for forecasting.

TC41 INFORMS Philadelphia – 2015

2 - Dynamic New Patient Consult Scheduling for Medical Oncology
Antoine Sauré, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, antoine.sauer@sauder.ubc.ca, Claire Mu, Jonathan Patrick, Martin Puterman

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 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.

4 - Optimal Issuing Policies for Hospital Blood Inventory
Amlara Sabori, Assistant Professor, Haskayne School of Business, University of Calgary, Calgary, AB, Canada, amlara.sabori@haskayne.ucalgary.ca, Steven Shechter, Tim Huh

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.

TC42
42-Room 102B, CC
Joint Session MSOM-Health/HAS: Workarounds, Errors and Interruptions in Healthcare

Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations

Sponsored Session
Chair: Anita Tucker, Associate Professor, Brandeis University, 415 South Street, Waltham, MA, 02453, United States of America, atucker@brandeis.edu

1 - Hospital Operations and Patient Satisfaction
Sarah Zheng, Doctoral Candidate, Boston University, 16 Gold Star Rd., CAMBRIDGE, MA, 02140, United States of America, xinzheng@bu.edu, Amy McLaughlin, Aubrey Poddell, Anita Tucker, Z. Justin Ren

We look at the impact of operations performance on service quality. Our study site is a nationally-ranked major hospital in the Boston area. Service quality is measured by both medical errors and patient satisfaction. Daily operations are measured by performance in about a dozen of its supporting services. We attempt to answer questions such as: What are the operational drivers of medical errors? To what extent does higher operations performance lead to higher patient satisfaction?

2 - Medical Errors in the Healthcare Delivery: An Econometric Analysis of the Operational Sources
Sriram Thirumalai, Associate Professor, Texas Christian University, Neely School of Business, TCU Box 298530, Fort Worth, TX, 76116, United States of America, s.thirumalai@tcu.edu

Medical errors in the delivery of care is a significant cause of concern in healthcare supply chains. Based on an econometric analysis of a panel dataset on medical errors, this study serves to examine the sources of medical errors and error mitigation in the delivery of care in hospitals.

3 - The Impact of Workarounds on Patient Falls and Pressure Ulcers
Anita Tucker, Associate Professor, Brandeis University, 415 South Street, Waltham, MA, 02453, United States of America, atucker@brandeis.edu

We present results from a survey of 100 medical/surgical nursing units that tests the impact of workarounds and operational failures on nursing sensitive patient outcomes, such as pressure ulcers, falls, patient satisfaction and infections.

4 - Batching of CSP Medication in In-Hospital Pharmacy
Vera Tilson, Simon School of Business, University of Rochester, Rochester, NY, 14627, United States of America, vera.tilson@simon.rochester.edu, Gregory Dobson, David Tilson

Hospital pharmacy departments batch production of Compounded Sterile Products (CSP). A change in a patient’s condition can lead to change or cancellation of physician’s orders. A very large proportion of orders are cancelled, which leads to waste custom compounded medication. We create an integer programming model to help pharmacies plan batch production trading off the cost of waste and the cost of employee labor.
operations. We present a model of incentive-compatible pricing for this setting.

Sponsor: Revenue Management and Pricing

Chair: Sumit Kunnumkal, Indian School of Business, Gachibowli, Hyderabad, India, Sumit_Kunnumkal@isb.edu

1 - Formulation, Motivation, and Estimation for the D-Level Nested Logit Model

Guang Li, University of Southern California, Bridge Hall 401, None, Los Angeles, CA, 90089-0809, United States of America, guangli@usc.edu, Huseyin Topaloglu, Paat Rustamvichentong

Using a tree of depth d, we provide a novel formulation for the d-level nested logit model. Our model is consistent with the random utility maximization principle and equivalent to the elimination by aspects model. Using new concavity results on the log-likelihood function, we develop an effective parameter estimation algorithm. Numerical results show that the prediction accuracy of the d-level nested logit model can be substantially improved by increasing the number of levels d in the tree.

2 - Assortment Optimization Over Time

James Davis, Cornell University, 290 Rhodes Hall, Ithaca, NY, United States of America, jamesmariodavis@gmail.com, Huseyin Topaloglu, David Williamson

Inspired by online retail we introduce a new type of assortment optimization problem: assortment optimization over time. In this problem the retailer must choose which products to display but must also choose an ordering for the product. This is a relevant problem when items are displayed as a list: this is common when returning results from a search query, for example. We provide a framework to analyze this problem, provide an approximation algorithm, and some hardness results.

3 - Tractable Bounds for Assortment Planning with Product Costs

Sumit Kunnumkal, Indian School of Business, Gachibowli, Hyderabad, India, Sumit_Kunnumkal@isb.edu, Victor Martinez-de-Albeniz

Assortment planning under a logit demand model is a difficult problem when there are product specific costs associated with including products into the assortment. In this paper, we describe a tractable method to obtain an upper bound on the optimal expected profit. We provide performance guarantees on the upper bound obtained. We describe how the method can be extended to incorporate additional constraints on the assortment or multiple customer segments.

4 - Clustering Consumers Based on Their Preferences

Ashvin Venkataraman, New York University, 715 Broadway, New York, NY, United States of America, ashvin.venkataraman@gmail.com, Srikant Jagabathula, Lakshminarayana Subramanian

Preference-based clustering is an important and challenging problem. We propose a non-parametric method to cluster consumers based on their preferences for a set of items. Our method combines the versatility of model-free clustering (such as k-means) with the flexibility and rigor of model-based clustering (based on EM algorithm). Our approach is fast, can handle missing data, identify general correlation patterns in consumer preferences, and has provable guarantees under reasonable assumptions.

2 - Mobile Technology in Retail: The Value of Location-based Information

Marcel Goic, Assistant Professor Or Marketing, University of Chile, Republica #701, Santiago, 8370438, Chile, mgoic@di.uchile.cl, Jose Guajardo

We analyze the value of location-based information in mobile retailing and the conditions under which incorporating geolocation information increase effectiveness metrics for retailers.

3 - Dynamic Pricing in Ride-Sharing Platforms

Siddhartha Banerjee, Postdoc, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, sidb@stanford.edu, Carlos Riquelme, Ramesh Johari

We develop a model for ride-share platforms, which combines a queueing model for the platform dynamics with strategic models for passenger and driver behavior. Using this, we study various aspects of this system - the value of dynamic pricing versus static pricing; the robustness of these policies; the effect of heterogeneous ride-request rates and traffic between different locations. Joint work with Ramesh Johari, Carlos Riquelme and the Data Science team at Lyft.

4 - Pricing with Limited Knowledge of Demand

Maxime Cohen, MIT, 70 Pacific Street, Apt. 737B, Cambridge, MA, 02139, United States of America, maxcohen@mit.edu, Georgia Perakis, Robert Pindyck

How should a firm price a new product with limited information on demand? We propose a simple pricing rule that can be used if the firm's marginal cost is constant: the firm estimates the maximum price it can charge and then sets price as if demand were linear. We develop bounds that show that if the true demand is one of many commonly used demand functions, the firm will do “very well” - its profit will be close to what it would earn if it knew the true demand.

3 - Tractable Bounds for Assortment Planning with Product Costs

Sumit Kunnumkal, Indian School of Business, Gachibowli, Hyderabad, India, Sumit_Kunnumkal@isb.edu, Victor Martinez-de-Albeniz

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Behavioral Issues in RM

Sponsor: Revenue Management and Pricing

Chair: Anton Ovchinnikov, Queen’s University, 143 Union St West, Kingston, Canada, anton.ovchinnikov@queensu.ca

1 - Should Consumers be Strategic?

Arian Allaki, Doctoral Student, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, arian.allaki@duke.edu, Robert Swinney, Prina Feldman

We consider whether strategic consumer behavior benefits consumers when they purchase from a rational, revenue-maximizing firm that sets prices over multiple periods. We show that strategic behavior does not benefit all consumers. Then, by studying a wide range of pricing and inventory strategies in a unified setting, we find that different strategies may induce different levels of interest in strategic behavior.

2 - Intertemporal Pricing under Minimax Regret

Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu, Rene Caldentey, Ilan Lobel

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.

3 - Behavioral Anomalies in Consumer Wait-or-Buy Decisions and the Implications for Markdown Management

Nikolay Osadchiy, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States of America, nikolay.osadchiy@emory.edu, Anton Ovchinnikov, Manel Baucells

A decision to buy at a target price or wait for a possible markdown involves a trade-off between the value, delay, risk and markdown magnitude. We build an axiomatic framework that accounts for three well-known behavioral anomalies along these dimensions and produces a parsimonious generalization of discounted expected utility. We consider a pricing/purchasing game and show that accounting for the behavioral anomalies results in substantially larger markdowns and leads to noticeable revenue gains.
We study a market where customers derive emotion 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.

### TC46
46-Room 104A, CC

**Issues Related to Supply Chain Management**

**Sponsor:** Manufacturing & Service Oper Mgmt/Service Operations

**Sponsored Session**

**Chair:** Achal Bassamboo, Professor, Kellogg School of Management, 2001 Sheridan Road, Evanston, IL, 60208, United States of America, a-bassamboo@kellogg.northwestern.edu

1 - **Worker Poaching in a Supply Chain: Enemy from Within?**

Evan Barlow, Northwestern University, Evanston, IL, United States of America, e-barlow@kellogg.northwestern.edu, Gad Allon, Achal Bassamboo

Poaching workers has became a universal practice. We explore worker poaching between firms linked in a supply chain. We show that the classical intuition from labor economics is insufficient in explaining poaching between supply chain partners. We also show how and under what conditions worker poaching can actually improve supply chain performance. Finally, we show how the equilibrium identity of the supply chain bottleneck depends on the interaction between hiring, poaching, and productivity.

2 - **Dynamic Clustering and Assortment Personalization: The Value of Information Pooling**

Sajad Modaresi, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, sajad.modaresi@duke.edu, Denis Saure, Fernando Bernstein

A retailer faces heterogeneous customers with initially unknown preferences. The retailer can personalize assortment offerings based on available profile information; however, users with different profiles may have similar preferences, suggesting that the retailer can benefit from pooling information among customers with similar preferences. We propose a dynamic clustering approach that adaptively adjusts customer segments and personalizes the assortment offerings to maximize cumulative profit.

3 - **Policing a Self-policing Firm: Incentives for Detection and Disclosure of Compliance Violations**

Sang Kim, Yale School of Management, New Haven, CT, United States of America, sang.kim@yale.edu

One of the challenges in enforcement of environmental regulations is designing an effective incentive mechanism that elicits firms’ voluntary detection and disclosure of compliance violations. With a right incentive, a firm self-polices its internal operations to detect random violations before a regulator does, and subsequently puts a remedial action in place. We study this incentive dynamic using a game-theoretic framework.

4 - **Reshoring Manufacturing: Supply Availability, Demand Updating, and Inventory Pooling**

Bin Hu, Assistant Professor, UNC Kenan-Flagler Business School, CB#3490 McColl Bldg, University of North Carolina, Chapel Hill, NC, 27519, United States of America, Bin_Hu@kenan-flagler.unc.edu, Li Chen

Reshoring shortens the distance from factory to market, however limited onshore supply availability may force reshoring manufacturers to remain dependent on offshore suppliers, leading to increased distance from supplier to factory. In this case, we show that manufacturers’ preferences toward reshoring boil down to trade-offs between operational flexibilities. We characterize when manufacturers prefer reshoring, and further identify operational strategies that can swing such preferences.
1 - Quality at the Source or Quality at the End? Managing Supplier’s Quality under Information Asymmetry
Mohammad Nikoofal, Católica Lisboa School of Business & Economics, UCP, Palma de Cima, Lisbon, 1649-023, Portugal, mohammad.nikoofal@ucp.pt

In this paper, we first develop and then compare two different mechanisms for the buyer in order to control quality improvement efforts exerted by the supplier when the supplier has private information about his/her reliability.

2 - Optimal Monitoring Decisions for Asset Based Lending
Nikolaos Trichakis, Harvard Business School, Boston, MA, United States of America, HBS, trrichakis@hbs.edu, Dan Iancu, Do Young Yoon

We consider a firm financing its operations by collateralizing its working assets, e.g., inventory. To mitigate the risk due to the assets’ uncertain valuation, the lender has a monitoring option entitling him to early repayment by liquidation. We derive the optimal liquidation policy, showing that it can have a non-threshold structure. We derive bounds on the optimal monitoring time, and leverage them to devise simple heuristics, which perform well in numerical studies.

3 - Capital Structure with Flexible Future Investments
Qi Wu, Case Western University, Cleveland, OH, United States of America, Weatherhead School of Management, CWRU, qxw132@case.edu, Peter Ritchken

We analyze the interaction between investment and financing decisions in a dynamic contingent claims model where the firm has the ability to dynamically control production decisions of assets in place and has growth options to invest in that can be financed with debt and equity. The fundamental question to be addressed is how investment timing and financing decisions are affected by the existing capital structure and the nature of the operating flexibility inherent in the growth options.

4 - Make-to-Order vs. Make-to-Stock when Firms Compete, Input Costs, and Demand are Stochastic
Danko Turcic, Associate Professor of Operations, Olin Business School, Washington University in St. Louis, St. Louis, MO, United States of America, turcic@wustl.edu, Guang Xiao, Panos Kouvelis

This paper provides a new rationale for why firms choose long and short production lead times that is based, in part, on non-competitive behavior in product markets. We identify a set of conditions, which imply that some, otherwise identical, production firms want to choose long production lead times, while others choose short production lead times. The conditions are: (i) stochastic production costs, (ii) price-dependent demand, and (iii) strategic inventory withholding.

TC49
49-Room 105B, CC
Multi-Echelon Inventory Modeling
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Sean Willems, University of Tennessee, 453 Haslam Business Building, Knoxville, TN, 37996, United States of America, willems@utk.edu

1 - Velocity-based Storage in a Semi-automated Order Fulfillment System
Stephen Graves, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, sgraves@mit.edu, Rong Yuan

Online retailers continue to invest in technology to improve the efficiency of order fulfillment. This technology creates new operating challenges and opportunities. We examine a semi-automated fulfillment system in which pickers andowers are stationary, and the inventory storage units are brought to them. We evaluate the effectiveness of velocity-based storage and consider how to deploy a velocity-based storage policy in light of picking, stowing and storage decisions.

2 - Incorporating an Operational Layer into the Guaranteed-service Inventory Optimization Approach
Steffen Klosterhalfen, University of Richmond, 1 Gateway Road, Richmond, VA, 23173, United States of America, steffenklosterhalfen@gmail.com, Daniel Dittmar

The existing guaranteed-service contributions assume bounded demand and do not explicitly model how excess demand is handled by some type of flexibility measure. The lack of a clear operational description leaves the material flow representation somewhat incomplete and renders the approach controversial. We incorporate operating flexibility in the form expediting. By doing so we can work directly with the external (unbounded) demand and the entire material flow is easy to trace and understand.

3 - Multi-item Spare Parts Inventory Planning with Selective use of Advance Demand Information
Geert-Jan Van Houtum, Full Professor, Eindhoven University of Technology, P.O. Box 513, Eindhoven, 5600MB, Netherlands, g.j.v.houtum@tue.nl, Tarkan Tan, Engin Topan

We propose a multi-item, spare parts inventory system model with a general representation of imperfect demand information. We determine which parts should be monitored and how much stock should be kept for each component so that a given aggregate system availability is maintained. Our model allows excess inventory on stock and on order to be returned to the central depot or external supplier at a certain return cost. We also characterize the optimal ordering and return policy.

TC50
50-Room 106A, CC
Operations Economics
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Terry Taylor, U.C. Berkeley, Haas School of Business, 2220 Piedmont Avenue, Berkeley, CA, United States of America, taylor@haas.berkeley.edu
Co-Chair: Wenyiqiang Xiao, Associate Professor, New York University, Stern School of Business, 44 West Fourth Street, 8-72, New York, NY, 10012, United States of America, wxiao@stern.nyu.edu

1 - Strategic Outsourcing under Competition and Asymmetric Information
Lusheng Shao, University of Melbourne, Melbourne, Australia,lusheng.shao@unimelb.edu.au, Xiaole Wu, Fuqiang Zhang

This paper studies two firms’ outsourcing strategies under competition and asymmetric cost information. We find that without asymmetric information, the firms will choose the supplier with smaller cost uncertainty. However, with information asymmetry, the supplier with greater cost uncertainty may be preferred.

2 - Information Preferences in the Supply Chain under Strategic Inventory
Ablish Roy, PhD Student, McCombs School of Business, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, ablishroy@utexas.edu, Steve Gilbert, Guoming Lai

We investigate how the possibility of strategic inventory influences the preferences for information sharing between supply chain partners. Among other results, we show that the presence of strategic inventory may alter traditional information preferences of the supply chain partners regarding the creation of a mechanism for sharing information about the retailer’s operation with the supplier.

3 - Product Quality in a Distribution Channel with Inventory Risk
Kimshuk Jerath, Columbia University, 521 Urus Hall, 3022 Broadway, New York, NY, 10027, United States of America, jerath@columbia.edu, Sang Kim, Robert Swinney

We analyze a situation in which a product has to be designed and sold under demand uncertainty. We consider the jointly optimal quality and inventory decision in both a centralized channel (a single firm determines both) and a decentralized channel (a manufacturer determines quality while a retailer determines inventory), and discuss how demand uncertainty impacts the optimal quality-inventory pair and how coordination of the decentralized channel may be achieved.

4 - Congested Platforms
Terry Taylor, U.C. Berkeley, Haas School of Business, 2220 Piedmont Avenue, Berkeley, CA, United States of America, taylor@haas.berkeley.edu

In a platform business model, the platform firm provides a per-service wage payment to independent agents (e.g., drivers in ride-sharing services (e.g., Uber), shoppers in delivery services (e.g., Instacart)) to motivate them to provide service to customers. This paper using a queuing model to examine the impact of congestion on the platform’s optimal price and wage.
1 - Counteracting Strategic Purchase Deferrals: The Impact of Online Retailers’ Return Policy Decisions

Toğra Aydınlıyim, Baruch College, One Bernard Baruch Way, Dept of Management Box B9-240, New York, United States of America, Toğra.Aydinaliyim@baruch.cuny.edu, Mehmet Sekip Altug

We study the impact of (i) forward-looking (i.e., discount-seeking) consumer behavior and (ii) consumers’ sensitivity to clearance. The data are from online retailers who offer returns management decisions and the ensuing demand segmentation and profit effects in both monopolistic and competitive settings.

2 - Replenishment under Uncertainty in Online Retailing

Jason Admovic, Penn State University, 462 Business Building, University Park, PA, 16802, United States of America, jaa268@psu.edu, Stephen Graves

Online retailers often may need to adjust inventory levels based on current demand. We solve an optimal experimentation problem as a dynamic pricing in marketing and econometrics using non-parametric approaches. The optimal experiment takes into account demand uncertainty, shipping costs, and estimated stockout costs. We show how this policy performs on realistic data.

3 - Optimal Spending for a Search Funnel

Shengqi Ye, The University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, 75080, United States of America, sxy143530@utdallas.edu, Goker Aydin, ShanShan Hu

Sponsored search marketing is a major advertising channel for online retailers. Recent observations indicate that not all customers utilize their purchase decision after their first search query. Instead, customers may take a path of keywords and clicks to a search funnel to complete a conversion. Our study, which investigates a retailer’s optimal advertising budget allocation across keywords in the search funnel, is based on bringing inventory up to a target level on the day inventory arrives. We calculate robust target levels, taking into account demand uncertainty, shipping costs, and estimated stockout costs. We show how this policy performs on realistic data.

4 - Omnicheck Inventory Management with Buy-On-and-Pickup-in-Store

Fei Gao, Wharton School, University of Pennsylvania, 3730 Walnut Street, 500 Jon M. Huntsman Hall, Philadelphia, PA, United States of America, feigao@wharton.upenn.edu, Xuanming Shen

Many retailers offer customers the option to buy online and pick up orders in-store. We study the impact of this omnicheck strategy on store operations and offer recommendations to retailers.

2 - Nonparametric Demand Predictions for New Products

Srikantan Jagabathula, NYU, 44 West Fourth Street, New York, NY, United States of America, sagarbat@stern.nyu.edu, Lakshminarayana Subramanian, Ashwin Venkataraman

Predicting demand for new products is important and challenging. Existing parametric approaches require selection of relevant features of products and specification of the parametric structures, both of which are challenging. We propose a non-parametric approach combining ideas from “Learning to Rank” in machine learning and “Choice Estimation” in operations and marketing. The resulting methods can be used out-of-the-box and allow us to predict the impact of changes in product features.

3 - A Structured Analysis of Unstructured Big Data Leveraging Cloud Computing

Xiao Liu, Assistant Professor Of Marketing, New York University, 44 West 4th Street, New York, NY, 10012, United States of America, xiaoliu@andrew.cmu.edu, Kamin Sinivasan, Param Vir Singh

In this study, we combine methods from cloud computing, machine learning and text mining to illustrate how content from social media can be effectively used for forecasting purposes. We conduct our analysis on a staggering volume of nearly two billion Tweets. Our main findings highlight that, in contrast to basic surface-level measures such as volume or sentiment, the information content improve forecasting accuracy significantly.

4 - Modeling Multi-taste Consumers

Liu Liu, NYU Stern School of Business, 40 West 4th Street, Tisch Hall, Room 829, New York, NY, 10012, United States of America, liu@stern.nyu.edu, Shengqi Ye, The University of Texas at Dallas, 800 West Campus, Richardson, TX, 75080, United States of America, sxy143530@utdallas.edu, Goker Aydin, Shanshan Hu

In many product categories where recommendation systems are used, a single consumer may have multiple different tastes. We propose a framework for modeling the choice behavior of a single multi-taste consumer and iteratively search for estimation. We test it in numerical studies and an empirical application (Allrecipes.com). Our results show that it has superior out-of-sample predictive performance than single-taste models and is able to accurately recover parameters in simulation studies.
4 - The Bright Side of Managerial Overconfidence
Juan Li, Assistant Professor, Nanjing University, No. 5 Ping Cang Xiang, Nanjing, China, juanli@nju.edu.cn, Baqun Jiang, Fugiang Zhang
Managers are often overconfident about the accuracy of their demand forecast. This paper shows that the firm may actually benefit from such overconfidence bias whether or not its competitor has such bias. Further, such bias can lead to a win-win situation for both competing firms.

■ TC54
54-Room 108A, CC
Discrete Optimization Models for Homeland Security and Disaster Management
Cluster: Tutorials
Invited Session
Chair: Laura McIay, Associate Professor, University of Wisconsin, 1513 University Ave, ISYE Department, Madison, WI, 53706, United States of America, lmclay@wisc.edu
1 - Discrete Optimization Models for Homeland Security and Disaster Management
Laura McIay, Associate Professor, University of Wisconsin, 1513 University Ave, ISYE Department, Madison, WI, 53706, United States of America, lmclay@wisc.edu
Preparing for and responding to disasters, including acts of terrorism, is an important issue of national and international concern. Recent disasters underscore the need to manage disasters to minimize their impact on critical infrastructure and human suffering. In this tutorial, we survey the operations research literature that develops, analyzes and applies discrete optimization models to effectively mitigate, prepare for, respond to and recover from a wide variety of disasters.

■ TC55
55-Room 108B, CC
Outsourcing I
Contributed Session
Chair: Ting Luo, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ting.luo@utdallas.edu
1 - Outsourcing Supplier Selection: Quality-driven Demand and Taguchi Loss Function
Yanni Ping, Drexel University, 3220 Market Street, Gerri C. LeBow Hall 310, Philadelphia, PA, 19104, United States of America, yp86@drexel.edu, Seung-lae Kim, Min Wang
Facing limited capacity, a manufacturer would often rely on external suppliers. How to select suppliers to work with becomes a strategic decision particularly when demand for the final product is quality driven. In this talk, we adopt a Taguchi loss function as a supplier’s quality measurement and present a dynamic programming model to explore how supplier quality affects manufacturer’s outsourcing strategy. We propose simple and efficient algorithms for supplier selection in a dynamic setting.
2 - Fixed Entry Cost Effect on Contract Length and Renewals in a Maintenance Service Contract Systems
Rodrigo Ulloa, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Santiago, Chile, rulloa@uc.cl, Alejandro Mac Cawley, Rodrigo Pascual, Gabriel Santelices
We analyze how the inclusion of a fixed entry cost will affect the decision making of a maintenance contract, using a model that evaluates the contract value for the vendor according to the contract duration and its renewals. The analysis considers different scenarios that show the existence of a relationship between the length of the contract and the amount of renewals from which the contract is valuable for the vendor.
3 - Long-term Outsourcing under Stochastic Learning and Information Asymmetry
Ting Luo, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ting.luo@utdallas.edu
Suppliers can reduce their cost through learning by doing, however their learning abilities and outcomes are kept as private information. When buyers design the procurement contract, they must consider the above effects. We study the interplay of stochastic learning and information asymmetry. We show that the stochastic learning has a profound impact on the optimal contract.

■ TC56
56-Room 109A, CC
Commercialization of New Technologies
Cluster: New Product Development
Invited Session
Chair: Karthik Ramachandran, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu
Co-Chair: Sreekumar Bhaskaran, SMU, Dallas, TX, United States of America, sbhaskar@cox.smu.edu
1 - Product Line Design for Strategic Customers
Saurabh Bansal, Assistant Professor, Penn State University, 405 Business Building, University Park, PA, 16802, United States of America, sub32@psu.edu, Karthik Ramachandran
We report results for optimal product line design when customers are strategic about uncertain quality of products. Our analysis explains evolution of product lines observed in practice.
2 - Licensing Contracts: Control Rights and Options
Niyazi Taneri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitaneri@sutd.edu.sg, Pascale Crama, Bert De Reyck
Research and development (R&D) collaborations, though common in high-tech industries, are challenging to manage due to technical and market risks as well as incentive problems. We investigate the impact of control rights, options, payment terms and timing decisions on R&D collaborations between an innovator and a marketer. We provide recommendations on the optimal contract structure and timing based on the R&D project characteristics.
3 - Does Equity Crowdfunding Improve Entrepreneurial Firm Performance?
Susanna Khavul, UTA/London School of Economics, London, United Kingdom, s.khavul@lse.ac.uk, Saul Estrin
As a fast moving financial innovation, equity crowdfunding may relax resource constraints for new ventures. Using four years of proprietary data, we model how information provision, generation, and exchange affects the supply of funds and likelihood of pitch funding. We evaluate this against the survival and performance of the firms that sought funding.
1 - Stochastic Model for Assessment of Thermoelectric Power Generation Drought Risk under Climate Change
Royce Francis, George Washington University, 800 22nd St. NW B1850, Washington, DC, 21212, United States of America, secd@gwu.edu, Behailu Bekera

The objective of this article is to propose a stochastic method for analyzing drought risk to the thermoelectric power generation infrastructure sector due to its heavy reliance on freshwater availability. In particular, this article proposes a thermoelectric drought characterization framework from which a stochastic drought risk assessment model is constructed from the thermoelectric power sector's operational perspective.

2 - Portfolio Approach for Optimal Rooftop Solar Arrays Selection for Distributed Generation
Olufemi Omitaomu, Senior Research Scientist, Oak Ridge National Laboratory, 1 Bethel Valley Road, MS-6017, Oak Ridge, TN, 37831, United States of America, omitaomuo@ornl.gov, Xueming Li

We present a portfolio selection approach that consider thousands of buildings with different solar energy potential and that are being considered for utility-scale distributed power generation. Our approach uses Markowitz mean-variance portfolio selection model to select suitable rooftops by identifying a combination of buildings that will maximize solar energy outputs and minimize system variability. Our approach is implemented using some real data-sets.
Strategies.

Protection against critical infrastructure systems disruption scenarios and facilitates effectiveness analysis of resilience visually exploration of critical infrastructure system resilience under point and

Assessment and Strategy Exploration, which together allow for statistically and

Scenario Generation, Vulnerability Analysis, Restoration Simulation, Resilience

infrastructures. This RDSS includes seven modules: Data Input, Property Statistics, different recovery policies of a supply chain after major disruption caused by
disasters and prepositioning of emergency inventory of product-specific parts

sourcing, improved suppliers visibility, protection of suppliers against natural
disasters and prepositioning of emergency inventory of product-specific parts

along a supply chain are considered and their impact on the recovery process is

analyzed.

It develops a framework of resilience decision support system RDSS for critical
infrastructures. This RDSS includes seven modules: Data Input, Property Statistics,
Scenario Generation, Vulnerability Analysis, Restoration Simulation, Resilience
Assessment and Strategy Exploration, which together allow for statistically and

visually exploration of critical infrastructure system resilience under point and

period disruption scenarios and facilitates effectiveness analysis of resilience

strategies.

Disruption

Contributed Session

Chair: Min Ouyang, Associate Professor, Huazhong University of Science and Technology, Room W308 in S1 Building, 1037 Luoyu Road, Wuhan, 430074, China, mousyang618@gmail.com

1 - Transportation Network Protection: A Model with Variable Flow Demand

Stefano Starita, PhD Researcher, Kent Business School, University of Kent, University of Kent, Canterbury, CT2 7PE, United Kingdom, s.starita@kent.ac.uk, Dr. Maria Paola Scutari

Different recovery policies of a supply chain after major disruption caused by natural disasters are presented. The Japan’s competitiveness-robustness dilemma is discussed against a resilient supply chain design strategy. Single, dual or multiple sourcing, improved suppliers visibility, protection of suppliers against natural disasters and prepositioning of emergency inventory of product-specific parts along a supply chain are considered and their impact on the recovery process is analyzed.

2 - Comparison of Supply Chain Recovery Policies After a Major Disruption

Jonna Marszewska, Assistant Professor, Jagiellonian University, Department of Japanology and Sinology, Krakow, 31 120, Poland, rokin@op.pl, Tadeusz Sawik

We propose a solution approach to reroute barges in case of an Inland waterway disruption. The first part of the solution uses an Analytic Hierarchical Process (AHP) to assign priority index to the barges. We formulate an Integer Linear Problem to assign the barges to the terminals where the cargo is offloaded to be transported by a different transportation mode. The AHP results are used to schedule the barges assigned to a terminal. A case example is presented to illustrate our results.

3 - Cargo Prioritization and Terminal Allocation in Case of Inland Waterway Disruption

Lillana Delgado Hidalgo, Graduate Student, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ldel002@uark.edu, Heather Nachtmann

We study two hypothesis to address a key legal question that e-tailers consider when opening up distribution centers: whether they should operate under the assumption that collecting state sales tax for all online transactions is inevitable or continue to strategically position themselves to minimize the tax burden where possible, even if it compromises supply chain strategic positioning. We also study the environmental implications of these e-tailer supply chain decisions.

4 - Resilient Design in Agribusiness Supply Chain under Supply Disruptions

Golnar Behzadi, PhD Student, University of Auckland, Level 2, Room 439-215.70 Symonds St, Auckland, 1010, New Zealand, gbeh681@aucklanduni.ac.nz, Abraham Zhang, Tava Olsen, Michael O’Sullivan

Agribusiness supply chains have limited lifecycle of products, seasonality of supply and demand, long lead time for production and delivery, and supply that is affected by climatic variability, which makes them especially vulnerable to supply disruptions. A special approach to risk management is required and here we consider resilience. Resilience incorporates concepts from vulnerability and risk management to address the recovery of a system from disruptions (rare high-impact risks).

5 - Decision Support for Critical Infrastructure Resilience Enhancement

Min Ouyang, Associate Professor, Huazhong University of Science and Technology, Room W308 in S1 Building, 1037 Luoyu Road, Wuhan, 430074, China, mousyang618@gmail.com

We find that environmental and social responsible activities have different impacts on different stages of supply chains. For manufacturers, positive social activities and negative environmental activities increase the return on assets for wholesalers, neither social nor environmental activities has significant impact; for retailers, negative environmental activities negatively affect the return on assets.

2 - The Amazon Tax and E-tailer Supply Chains

Trisha Anderson, Associate Professor, Texas Wesleyan University, 1201 Wesleyan Street, Fort Worth, TX, United States of America, trdanderson@txwes.edu, Kevin McGarry

We model a fortification problem on an all-pairs, flow-based network. To
determine the length of the shortest path available. We present an efficient heuristic solution approach and a case study on the London tube. 

3 - Social Responsibility Investments: Financial Networks, Transaction Cost, and Risk Effects

Jose Cruz, Associate Professor, University of Connecticut, 2100 Hillside Road, Storrs, CT, 06269, United States of America, Jose.Cruz@business.uconn.edu

This paper develops a network equilibrium model in conjunction with capital asset pricing model (CAPM) and the net present value (NPV) to determine the optimal portfolio, prices, profits, and equity values of financial network firms under financial risks and economic uncertainty. We investigate how social responsible financial investment decisions affect the values of interconnected financial firms from a network perspective.

4 - Green Building Decision-making using an Exploration and Exploitation Approach

John Dickson, Symphony Teleca Analytics, 5360, Legacy Drive, Plano, TX, United States of America, john.dickson@mavs.uta.edu, Jay Rosenberger, Victoria Chen

The experiments or simulations conducted by computers can be a tedious task, which require substantial computational time. This research focuses on developing a surrogate based optimization, in which we iteratively build a surrogate model, using few points and then optimize the model by adding more points until the best solution is found. A single story residential green building based in California is used as a case study.

Optimization in Bio-energy


Invited Session

Chair: Mohammad Marufuzzaman, Mississippi State University, Industrial & Systems Engineering, Starkville, MS, 32762, United States of America, mm20066@msstate.edu

1 - Designing a Dynamic Multimodal Transportation Network under Biomass Supply Uncertainty

Sushil Poudel, Mississippi State University, Starkville, MS, 32762, United States of America, srp224@msstate.edu, Mohammad Marufuzzaman, Linkan Bian, Hugh Medal

This study presents a two-stage stochastic programming model that assigns multi-modal facilities dynamically to design a biomass supply chain network under feedstock supply uncertainty. We develop algorithms combining sample average algorithm, progressive hedging algorithm, and rolling horizon algorithm to solve this challenging NP-hard problem.
2 - Designing a Reliable Bio-fuel Supply Chain Network Considering Link Failure Probabilities
Linkan Bian, Associate Professor, Mississippi State University, 260 McCain Building, Starkville, MS, 36792, United States of America, bian@ise.msstate.edu, Sushil Poudel, Mohammad Marufuzzaman
This study presents a pre-disaster planning model that seeks to strengthen the multi-modal facility links for a bio-fuel supply chain system under limited budget availability. The failure probability of the links are estimated using a spatial-statistical model. We developed a combinatorial Rends decomposition algorithm to solve this challenging NP-hard problem.

3 - Managing Congestion in a Multi-modal Facility Location Problem under Uncertainty
Mohammad Marufuzzaman, Mississippi State University, Industrial & Systems Engineering, Starkville, MS, 36792, United States of America, mm2006@msstate.edu
This paper presents a mathematical model that studies the impacts of the congestion effect in a multi-modal facility location design problem under feedstock supply uncertainty. The model is solved using a hybrid algorithm that integrates constraint generation, sample average approximation, progressive hedging and rolling horizon algorithm.

TC63
INFORMS Philadelphia – 2015

5 - Progressive Modeling: Towards a New Complex Systems Optimization Paradigm
Mohamed Ismail, Assistant Professor, University of Regina, 3737 Wascana Parkway, Regina, SK, S4S0A2, Canada, mohamed.ismail@uregina.ca
Progressive Modeling (PM) is a multidisciplinary forward-looking modeling approach that finds pragmatic solutions for many complex and large-scale industrial problems. Many related applications will presented to demonstrate the principles and the techniques adopted in this paradigm. The new modeling paradigm is expected to have many engineering applications and influence many disciplines such as systems optimization, Operations management, and system of systems engineering.

TC64

Panel Discussion: Analytics and Decision Analysis
Sponsor: Decision Analysis
Sponsored Session
Chair: Jeffrey Keisler, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Jeff.Keisler@umb.edu
1 - Analytics and Decision Analysis
Moderator: Jeffrey Keisler, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Jeff.Keisler@umb.edu, Panelists: Jeff Vales, Casey Lichtendahl, John Turner, Don Kleinmuntz, Max Henrion

TC65

65-Room 1103C, CC
Joint Session DAS/MAST: Game Theory, Decision Analysis, and Homeland Security, Part B
Sponsor: Decision Analysis
Sponsored Session
Chair: Jun Zhuang, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, 14221, United States of America, jzhuang@buffalo.edu
1 - Modeling A Multi-target Attacker-defender Resource Allocation Game Considering Risk Preferences
Jing Zhang, University at Buffalo, SUNY, 338 Bell Hall, Buffalo, NY, 14221, United States of America, jzhang42@buffalo.edu, Jun Zhuang, Victor Richmond Jose
Although evidence has been found that people often demonstrate risk preference when faced with risky decisions, the literature mostly assumed that adversaries are risk-neutral. This paper models a sequential attacker-defender game where the defender allocates defensive resources to multiple targets while considering the risk preferences of both the defender and attacker. We study the cases when the attacker could be either non-strategic, or strategic.

2 - Game Theoretic Analysis of Secret and Reliable Communication
Melike Baykal-gorsky, Rutgers, The State University of New Jersey, 96 Frelinghuysen Road, CoRE Building, Room 201, Piscataway, NJ, 08854, United States of America, gorsoy@rci.rutgers.edu
Secret and reliable communication presents a challenge involving a double dilemma for a user and an adversary. To get insight into this problem, we present two simple stochastic games. Explicit solutions are found. In addition, we show that under some conditions, incorporating in the transmission protocol a time slot dealing just with the detection of malicious threats can improve the secrecy and reliability of the communication without extra transmission delay.

3 - Optimal Cost-sharing in General Resource Selection Games
Konstantinos Kollias, Stanford University, 474 Gates Building, 353 Serra Mall, Stanford, CA, 94305, United States of America, kkollias@stanford.edu, Tim Roughgarden, Vasilis Gkatzelis
Resource selection games provide a model for a diverse collection of applications where a set of resources is matched to a set of demands. In reality, demands are often selfish and congestion on the resources results in negative externalities for their users. We consider a policy maker that can set a priori rules to minimize the inefficiencies induced by selfish behavior and we characterize the control methods that minimize the worst-case inefficiency of equilibria.
4 - Strategic Security Screening Queue with Abandonments
Ali Pala, PhD Student, University at Buffalo, 441 Delta Rd, Apt. 2, Amherst, NY, 14226, United States of America, alipala@buffalo.edu, Jun Zhuang

Risk of threats and congestion are the major problems in security screening procedures. Strict security screening policies help detect or deter the adversary applicants, but also lead to congestion which may discourage good applicants from applying or cause unnecessary abandonment from the screening queue. This research focuses on a novel strategic queueing system and proposes a data supported game-theoretical model to study this problem.

5 - When Security Games Go Green: Designing Defender Strategies to Prevent Poaching and Illegal Fishing
Fei Fang, University of Southern California, 941 Bloom Walk, SAIL 300, Los Angeles, CA, United States of America, fefang@usc.edu; Millind Tambe, Peter Stone

Building on the successful applications of Stackelberg Security Games (SSGs) to protect infrastructure, researchers have begun focusing on applying game theory to green security domains such as protection of endangered animals and fish stocks. We introduce Green Security Games (GSGs), a novel game model for green security domains and provide algorithms to plan effective sequential defender strategies and to learn adversary models that further improves defender performance.

TC66
66-Room 113C, CC

Managing Airport Arrival Flows
Sponsor: Aviation Applications
Sponsored Session
Chair: John-Paul Clarke, Georgia Tech, 270 Ferst Drive, N.W., Atlanta, GA, United States of America, johnpaul@gatech.edu

1 - Combining Control by CTA and Enroute Speed Adjustment to Improve Ground Delay Program Performance
James Jones, University of Maryland, 3117 A.V Williams, College Park, MD, 20742, United States of America, jonesjc1@umd.edu; Michael Ball, David Lovell

Over the past several years there have been proposals and discussions regarding a move from the use of controlled times of departure (CTDs) to controlled times of arrival (CTAs) for ground delay programs (GDPs) in the U.S. In this talk we show that, by combining control by CTA with the judicious use of en route speed control, significant improvements to GDP performance can be achieved.

2 - Robust Airport Gate Planning – First Order Stability Concept
Bruno Santos, Assistant Professor, TU Delft, Faculty of Aerospace Engineering, Delft, Netherlands, B.F.Santos@tudelft.nl; Dennis Buimtendijk, Joris De Kaey, John-Paul Clarke

We present a novel approach to the airport gate assignment problem entitled “First Order Stability” (FOS). The FOS has the goal of increasing gate plans robustness and uses two key concepts to achieve this: it postpones the gate scheduling to a moment when uncertainty is reduced significantly; and it uses “First Order Stability” (FOS). The FOS has the goal of increasing gate plans robustness and uses two key concepts to achieve this: it postpones the gate scheduling to a moment when uncertainty is reduced significantly; and it stabilizes the order of flights, minimizing the risk on disturbances. A real case study application showed that FOS provides more stable solutions that can make equal or higher usage of the capacity.

3 - Heuristic Gate Assignment Model for Airports with Multiple Parallel Concourses
Parth Shah, Graduate Research Assistant, Georgia Tech, 401 17th Street, Apt. 5205, Atlanta, GA, 30363, United States of America, parth.shah1053@gmail.com, John-Paul Clarke

Ramp operation model of Atlanta International airport is simulated to understand the characteristic of aircraft movement on ramp. A new heuristic approach is adopted in which aircraft are assigned gates based on their direction of ramp entry and exit points. The model is calibrated using ASPM traffic data. The results show that the proposed new method achieves 23% reduction in total ground delay by significantly reducing the gate wait, taxi blocking and pushback blocking time.

TC67
67-Room 201A, CC
Consolidation in Transport
Sponsor: TSL/Freight Transportation & Logistics
Sponsored Session
Chair: Wentao Zhang, University of Southern California, Los Angeles, CA, United States of America, wentao@usc.edu

1 - Frequency-Location Clustering for Efficient Inbound Routes to Consolidation Centers
Zhijie Dong, Cornell University, United States of America, zd57@cornell.edu; Mark A. Turnquist

An optimization model addresses joint decisions of frequency of pickup from individual suppliers and grouping suppliers into collection routes by clustering in both time and space. The objective is to minimize total logistics (transportation plus inventory) cost. The optimization problem is equivalent to a single-source fixed charge facility location problem, and near-optimal solutions are found using a very efficient heuristic algorithm. Results of numerical experiments show the effectiveness of both the model formulation and the heuristic solution method. A case study demonstrates that substantial total cost savings can be achieved in realistic applications using the combined frequency-location clustering method.

2 - A Lagrangian-based Strategy to Consolidate Freight of Perishable Products
Christine Nguyen, Northern Illinois University, DeKalb, IL, United States of America, Christine.Nguen@niu.edu; Alejandro Toriello, Maged Dessouky

Our research focuses on a supply chain of suppliers with low demand for perishable products, where consolidating their product would take advantage of better shipping FTL rates versus LTL or courier rates. We consider a Lagrangian Relaxation formulation that includes a capacity constraint for a shared consolidation center. We develop an LR-based heuristic that aims to balance the consolidated economical shipping cost and the inventory cost at the consolidation center.

3 - Cost Sharing Mechanism Design for Supply Chain Consolidation and Cooperation in Agriculture Industry
Wentao Zhang, University of Southern California, Los Angeles, CA, United States of America, United States of America, wentao@usc.edu; Nelson Uhan, Alejandro Toriello, Maged Dessouky

We design cost sharing mechanisms for a consolidation center where suppliers who need to ship products to a common destination can consolidate their shipments and save transportation costs. Using the Moulin mechanism framework, we propose cost sharing mechanisms that are group strategyproof and budget-balanced. By studying the efficiency of these mechanisms empirically and analytically, we show that the outcome of these mechanisms often closely resembles an optimal solution of a central planner.

TC68
68-Room 201B, CC

TSL Prize Session
Sponsor: Transportation, Science and Logistics
Sponsored Session
Chair: Barrett Thomas, Associate Professor, The University of Iowa, W272 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, barrett-thomas@uiowa.edu

1 - TSL Prize Winners
Barrett Thomas, Associate Professor, The University of Iowa, W272 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, barrett-thomas@uiowa.edu

The TSL 2015 Prize Session finalists will present their award-winning work in this session. Prize committee chairs will say a few words about the winning selections.
TC69
69-Room 201C, CC
Multimodal Traffic Signal Control in a Connected Vehicle Environment
Sponsor: TSL/Intelligent Transportation Systems (ITS)
Sponsored Session
Chair: K. Larry Head, University of Arizona, Tucson, AZ, United States of America, larry@sie.arizona.edu
1 - The Multi Modal Intelligent Traffic Signal Control System (MMITTSS)
K. Larry Head, University of Arizona, Tucson, AZ, United States of America, larry@sie.arizona.edu, Yiheng Feng, Mehdi Zamanipour, Shayan Khoshmagham, Byunho Beak, Sara Khosravi
The Multi Modal Intelligent Traffic Signal Control System (MMITTSS) is a Dynamic Mobility Application for connected vehicles in signalized networks. MMITTSS provides intelligent signal control, priority control for emergency vehicles, transit, trucks, and pedestrians, and performance observation. MMITTSS has been implemented in the Arizona Connected Vehicle Testbed in Anthem, AZ.
2 - Personalized Signaling for Connected Travelers in a Multi Modal Traffic Signal System
Sara Khosravi, University of Arizona, Tucson, AZ, United States of America, sarakhosravi@email.arizona.edu, Srilakshmi Mucheli, K. Larry Head
Smartphones have become standard equipment for almost all travelers. The smartphone can be used to provide personalized signaling information for multi modal travelers including pedestrians and bicycles at signalized intersections, transit riders, and automobile drivers using navigation applications. This talk will explore how smartphone applications can impact the transportation system.
3 - Multi-Modal Intelligent Traffic Signal System, Optimal Priority Control
Mehdi Zamanipour, University of Arizona, Yiheng Feng, K. Larry Head, Shayan Khoshmagham
A priority control algorithm is presented that simultaneously considers the needs of different modal users in a Connected Vehicle environment. A mathematical programming framework that allows multiple priority requests to be considered simultaneously based on a hierarchical control policy at the intersection level will be presented.
4 - Real-Time Performance Observation under Connected Vehicle Technology
Shayan Khoshmagham, University of Arizona, K. Larry Head, Yiheng Feng, Mehdi Zamanipour
This paper introduces an approach to observe the performance measures of a multi-modal transportation system in a connected vehicle environment. Different types of metrics including traffic-based, CV-based and signal-based measures are observed and estimated by mode by movement. Challenges regarding low market penetration rate and privacy of the road users are addressed respectively.

TC70
70-Room 202A, CC
Predictive Analytics in Railway – Practice
Sponsor: Railway Applications
Sponsored Session
Chair: Dharmendra Acharya, President, KOSU Services LLC, 241 Auburndale Dr., Ponte Vedra, FL, 32081, United States of America, acharya.dharmendra@gmail.com
1 - State of Railway Analytics
Dharmendra Acharya, President, KOSU Services LLC, 241 Auburndale Dr., Ponte Vedra, FL, 32081, United States of America, acharya.dharmendra@gmail.com
A brief overview of how the new emerging technology “Analytics” has been leveraged by railroads will be presented. Potential new areas where railways might be able to further utilize this new techniques to bring bottom line value to the company will also be discussed.
2 - Big Data Analytics for Optimized Track Maintenance and Renewal Management
Luca Ebreo, MERMEC Inc., 110 Queen Parkway, Columbia, NY, United States of America, Luca.ebreo@mermekgroup.com, Pietro Pace
Nowadays, track inspection technology allows railways to collect more and more data on track’s condition. These data are comparable to “big data” and require proper analysis in order to extract information for properly managing Track Maintenance and Renewals. Since railways need to make use as much as possible of the available data for optimizing their maintenance programs, the required analytics to support key decisions in an efficient and effective manner will be illustrated and discussed.

TC71
71-Room 202B, CC
Transportation Planning I
Contributed Session
Chair: Antonio Antunes, Professor, University of Coimbra, Dept. of Civil Engineering, Coimbra, Portugal, antunes@dec.uc.pt
1 - Plug-in Electric Vehicle Charging Infrastructure Planning using Cellular Network Data
Jing Dong, Assistant Professor, Iowa State University, 350 Town Engineering Building, Ames, IA, 50011, United States of America, jingdong@iastate.edu, Luning Zhang
This paper presents a method to identify activity-travel patterns, in terms of timing and duration at home, work, and other major destinations, using midday cell phone records. A Hidden Markov Model (HMM) is built to link traveler’s activity transitions to the observed cell tower locations. The probabilistic parameters of HMM are estimated using the Baum–Welch algorithm. The derived travel distances and dwell times are key inputs for plug-in electric vehicle charging infrastructure planning.
2 - The Barriers of Electric Vehicles Spread Adoption in China
Faping Wang, Ph.d Candidate, Tsinghua University, Shenzhen Graduate School of Tsinghua, Shenzhen, GD, 518100, China, wpf3@mails.tsinghua.edu.cn
This paper presents a survey research about barriers of electric vehicle spread adoption in China. 1000 questionnaire was designed and send to participants which come from Beijing, Shanghai, Guangzhou and Shenzhen, all of which are large city in China. Majority of participants have EVs driving experience or owner of EV or PEV. The demographic data was analyzed by statistic methods which reveal that more different choice behavior exit between western consumer and Chinese in EVs consumption.
3 - Strategic Infrastructure Development for Alternative Fuel Vehicles with Routing Considerations
Seong Wook Hwang, PhD Student, The Pennsylvania State University, 232 Leonhard Building, The Pennsylvania State University, University Park, PA, 16802, United States of America, swh5223@psu.edu, Sang Jin Kweon, Jose A. Ventura
This research considers decisions on the siting of alternative fuel (AF) refueling stations and on the routing of AF vehicles when drivers take a detour to refuel. Supposing that a driver takes any path whose distance is less than or equals to a detour distance, we provide an algorithm that finds feasible paths between origins and destinations. Then, a mathematical model is proposed to determine the locations of AF refueling stations with the objective of maximizing the covered flows.
4 - Optimization Model for Floating Carsharing System Planning
Antonio Antunes, Professor, University of Coimbra, Dept. of Civil Engineering, Coimbra, Portugal, antunes@dec.uc.pt

The focus of this presentation is an optimization model aimed to assist a floating carsharing company in the making of its key planning decisions – the area to be operated by the company (called home area), the price rate or rates to be charged to customers, the relocation operations to perform across zones of the home area, and, indirectly, the size of the fleet to be used by the company. The results that can be obtained through the model are exemplified for a real-world setting.

■ TC72
72-Room 203A, CC

DDDAS for Industrial and System Engineering Applications III
Sponsor: Quality, Statistics and Reliability
Sponsored Session

Chair: Shiyou Zhou, Professor, University of Wisconsin-Madison, Department of Industrial and Systems Eng, 1513 University Avenue, Madison, WI, 53706, United States of America, shiyzhou@wisc.edu
Co-Chair: Yu Ding, Professor, Texas A&M University, ETB 4016, MS 3131, College Station, TX, United States of America, yuding@leemall.tamu.edu

1 - The Predict Project: Enhancing DDDAS/Infosymbiotics with Privacy and Security
Vaidy Sunderam, Emory University, 400 Dowman Dr #W-401, Math & CS, Atlanta, GA, 30322, United States of America, vs@emory.edu, Li Xiong

The ubiquity of mobile devices will greatly expand the applicability of DDDAS, provided privacy and security issues are addressed. The PREDICT project is developing: (1) approaches to assign data-targets to participants with privacy protection; (2) methods for aggregating and fusing data that quantify veracity of the data sources and maintain high fidelity; and (3) secure distributed computation for field- and region-level deployment of the DDDAS paradigm with adaptation and feedback.

2 - Securing Industrial Control Systems with Software-defined Networking
Dong Jin, Assistant Professor, Illinois Institute of Technology, 10 W 31st Street, Stuart Building 226E, Chicago, IL, 60614, United States of America, dong.jin@iit.edu

Modern industrial control systems (IC Ses) are increasingly adopting Internet technology to boost control efficiency, which unfortunately opens up a new frontier for cyber-security. With the goal of safely incorporating existing networking technologies in IC Ses, we design a novel software-defined networking (SDN) architecture for IC Ses, with innovative security applications (e.g., network verification and intrusion detection) and rigorous evaluation using IIT’s campus microgrid.

3 - A DDDAS Approach to Distributed Control in Computationally Constrained Environments (UAV Swarms)
Vijay Gupta, Univ. of Notre Dame, 273 Fitzpatrick Hl Engnrg, Notre Dame, IN, 46556, United States of America, vgupta2@nd.edu, Greg Madey, Daniel Quevedo, Wann-juan Ma

In modern applications of distributed control, the traditional assumption of ample processing power at every time step at each agent can be challenged by use of processor intensive sensors such as cameras. Inspired by the Dynamic Data Driven Application System approach, we present an algorithm that shifts computational loads among the agents to guarantee performance in spite of reduced average processor availability. Analytical results and numerical simulations illustrate the approach.

■ TC73
73-Room 203B, CC

Quality Monitoring and Analysis in Complex Manufacturing Processes
Sponsor: Quality, Statistics and Reliability
Sponsored Session

Chair: Li Zeng, Assistant Professor, Texas A&M University, Industrial and Systems Engineering, College Station, TX, 77843, United States of America, lizeng@tamu.edu
Co-Chair: Qiang Zhou, Assistant Professor, City Univ of Hong Kong, Kowloon, Hong Kong, China, q.zhou@cityu.edu.hk

1 - Monitoring Uniformity of Particle Distributions in Manufacturing Processes using the K Function
Xiaohu Huang, Graduate Student, City University of Hong Kong, 106B, Hall B, Student Residence, CityU, Hong Kong, China, xhhuang6-c@my.cityu.edu.hk, Qiang Zhou

Data in the form of spatial point patterns are frequently encountered in manufacturing processes. The distributional characteristics of a spatial point pattern can be summarized by functional profiles like K function. In this study, a Gaussian process is designed to characterize its behaviour under complete spatial randomness. A T2 control chart is proposed to monitor the uniformity of point patterns.

2 - Bayesian Hierarchical Linear Modeling of Profile Data with Apps to Quality Control of Nanomaterials
Jianguo Wu, Assistant Professor, University of Texas-El Paso, El Paso, TX, United States of America, jwu2@utep.edu, Yuhang Liu, Shiyou Zhou

To achieve a highly automatic quality control, simultaneous profile monitoring and diagnosis is often required. This paper presents a general framework by using a hierarchical linear model to connect profiles with both explanatory variables and intrinsic processing or product parameters for simultaneous monitoring and diagnosis. The effectiveness is illustrated through numerical studies and applications to NDE profiles for quality control of nanocomposites manufacturing.

3 - Modeling of Optical Profiles in Low-E Glass Manufacturing
Qian Wu, Graduate Student, Texas A&M University, Industrial and Systems Engineering, College Station, TX, 77843, United States of America, hi.wuqian@gmail.com, Li Zeng

Quality of low-E glass is measured by optical profiles. This study considers modeling of the optical profile data in Phase 1 analysis.

4 - Wafer Yield Prediction Based on Virtual Metrology-generated Parameters
Wan Sik Nam, Seoung Bum Kim/Korea University, Korea University, 145 Anam-ro, Seongbuk-, Seoul, Korea, Republic of, wansiknam@korea.ac.kr

Yield prediction is one of the most important issues in semiconductor manufacturing. Especially, for a fast-changing environment of the semiconductor industry, accurate and reliable prediction techniques are required. In this study, we propose a procedure to predict wafer yield using process parameters generated from the virtual metrology of the semiconductor fabrication, which is based on a variety of regression and classification algorithms.

■ TC74
74-Room 204A, CC

Innovative Methods for System Informatics
Sponsor: Quality, Statistics and Reliability
Sponsored Session

Chair: Peihua Qiu, Professor, University of Florida, 2004 Mowry Road, Gainesville, FL, 32610, United States of America, pqiu@phhp.ufl.edu

1 - When Importance Sampling Meets Stochastic Simulation Models
Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu, Youngjin Choe, Nan Chen

Importance sampling has been used to improve the efficiency of simulations where the simulation output is uniquely determined, given a fixed input. We extend the theory of importance sampling to estimate a system’s reliability with stochastic simulations where a simulator generates stochastic outputs. Given a budget constraint on total simulation replications, we derive the optimal importance sampling density that minimizes the variance of an estimator.

2 - QQ Models: Joint Modeling for Quantitative and Qualitative Quality Responses in Manufacturing System
Ran Jin, Virginia Tech., Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Xinwei Deng

A manufacturing system with both quantitative and qualitative (QQ) responses is widely encountered. The QQ responses are closely associated with each other, but current methodologies often model them separately. This paper presents a novel modeling approach, called “QQ models”, to jointly model the QQ responses through a constrained likelihood estimation. Both simulation studies and a case study are used to evaluate the performance of the proposed method.
3 - Discussant's Presentation
Yu Ding, Professor, Texas A&M University, ETB 4016, MS 3131, College Station, TX, United States of America, yuding@email.tamu.edu

As a discussant in this Technometrics special issue on system informatics, I will present my understanding of strengths and weaknesses of the two papers selected by Technometrics editor for this session. I will also discuss other related research problems on the similar topics.

TC75
75-Room 204B, CC
IBM Research Best Student Paper Award III
Sponsor: Service Science
Sponsored Session
Chair: Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmh@ntu.edu.tw

Finalists of the IBM Research Best Student Paper Award present their research findings in front of a panel of judges. The judging panel will decide the order of winners, which will be announced during the business meeting of the Service Science Section at the Annual Conference.

2 - Efficient Information Heterogeneity in a Queue
Yang Li, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto ON M5S3E6, Canada, Yang.L110@Rotman.UToronto.ca, Ming Hu

How would the growing prevalence of real-time delay information affect a service system? We consider an M/M/1 queueing system in which only a fraction of customers are informed about real-time delay. Surprisingly, we find that system throughput and social welfare can be unimodal in the fraction of informed customers.

3 - Scheduling and Pricing Services for Online Electric Vehicle Charging
Mark Nejad, Assistant Professor, University of Oklahoma, Industrial and Systems Engineering, Norman OK, United States of America, mark.nejad@ou.edu, Ratna Babu Chinnam, Daniel Grosu, Lena Mashayekhy

We design mechanisms for EV charging services in online settings. We prove that our proposed mechanisms are incentive compatible, that is, truthful reporting of price and the amount of charging is a dominant strategy for self-interested EV drivers. Our preemption-aware charging mechanisms allow providers to manage fluctuations in renewable energy production.

4 - Scheduling with Testing
Thomas Magnanti, Institute Professor, MIT, 77 Massachusetts Avenue, 32-D784, Cambridge MA 02139, United States of America, magnanti@mit.edu, Retsef Levi, Yaron Shaposhnik

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.

5 - Trading Time in a Congested Environment
Luyi Yang, Doctoral Student, University of Chicago Booth School of Business, Chicago, IL, United States of America, luyi.yang@chicagobooth.edu, Laurens Debo, Varun Gupta

We propose a time-trading mechanism, mediated by a revenue maximizing broker, in which customers privately informed about their waiting costs mutually agree on the ordering in a queue via trading positions. To that end, we show that the broker can implement an auction with a trade-participation fee and two trade restriction prices on customer bids. Under the optimal auction, there is partial pooling in the bidding strategies and therefore customers are not strictly prioritized.

Advances in Stochastic Simulation
Sponsor: Simulation
Sponsored Session
Chair: Henry Lam, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, United States of America

1 - Risk Assessment for Input Uncertainty
Helen Zhu, School of Industrial and Systems Engineering, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, hzhu66@gatech.edu, Enlu Zhou

When simulating a complex stochastic system, the behavior of the output response depends on the input parameter estimated from finite real-world data, and the finiteness of data brings input uncertainty to the output response. Risk assessment for input certainty, which quantifies the extreme behavior of the mean output response, is extremely important. In the present paper, we introduce the risk measures for input uncertainty and study the corresponding estimators.

2 - Projected Directional Derivatives for High Dimensional Gradient Estimation
Raghu Pasupathy, Associate Professor, Department of Statistics, Purdue University, 250 N University Street, West Lafayette, IN, 47907, United States of America, pasupath@purdue.edu, Baojian Zhang

We present a method to estimate gradients in high dimensions by projecting randomly generated directional derivatives onto the various axes. We discuss theoretical properties and sampling measures that minimize the resulting estimator's error norm. The method appears particularly relevant in high dimensions since only two observations are needed for a complete gradient estimator.

3 - Perfect Sampling of GI/GI/C Queue
Yanan Pei, Columbia University, 500 W. 120th St, Mudd 313, New York, NY, 10027, United States of America, yyp2342@columbia.edu, Jose Blanchet, Jing Dong

We introduce the first class of perfect sampling algorithms for the steady-state distribution of multi-server queues with general inter-arrival time and service time distributions. Our algorithm is built on the classical dominated coupling from the past protocol using a coupled multi-server vacation system as the upper bound process. The algorithm has finite expected termination time with mild moment assumptions on the inter-arrival time and service time distributions.

4 - Rare Event Simulation in the Neighborhood of a Rest Point
Konstantinos Spiliopoulos, Assistant Professor, Boston University, Department of Mathematics and Statistics, 111 Cummington Mall, Boston, MA, 02215, United States of America, kspiliop@math.bu.edu

We construct efficient importance sampling Monte Carlo schemes for finite time exit probabilities in the presence of rest points. The main novelty of the work is the inclusion of rest points in the domain of interest. We motivate the construction of schemes that perform well both asymptotically and non-asymptotically. We concentrate on the regime where the noise is small and the time horizon is large. Examples and simulation results are provided. Joint work with Paul Dupuis and Xiang Zhou.

TC77
77-Room 300, CC
Logistics II
Contributed Session
Chair: Fateme Fotuhiardakani, Data Scientist, TMW Systems, 6085 Parkland Blvd, Mayfield Heights, OH, 44124, United States of America, fateme.fotuhi@gmail.com

1 - Using Heuristics to Solve the Container Loading Problem
Crystal Wilson, Clemson University, 6 Natalie Ct., Greer, SC, 29651, United States of America, crysta3@clemson.edu, Mary Beth Kurz

Just-in-time manufacturers need the parts to arrive to the facility by a scheduled time to keep the assembly line moving smoothly. How small containers, such as parts, are loaded onto a larger container is a special type of packing problem. This research will focus on creating a heuristic that creates loading patterns that balance priorities level, while also maximizing the utilization of the container with respect to the weight and cube.
2 - Bundling and Pricing Truckload and Less-than-truckload Services with Stochastic Demand
Rodrigo Mesa Arango, Assistant Professor, Florida Institute of Technology, 150 W. University Blvd, Melbourne, FL, 32901.
United States of America, rmesaara@purdue.edu, Satish V. Ukkusuri

Algorithms to bundle and price Truckload (TL) and Less-than-truckload (LTL) services are proposed considering stochastic demand, value-based pricing, and demand segmentation. A two-stage min-cost flow problem accounts for uncertain demand. Its deterministic equivalent is formulated as a regular min-cost flow problem and efficiently solved. Deterministic models overestimate benefits. Numerical experiments reveal the cost of uncertainty and demonstrate improvements in bundle quality.

3 - Stochastic Models for Optimal Reusable Pallets Management and Sustainable Supply Chain Configuration
Xiangxiang Fan, Huazhong University of Science and Technology, Wuhan, China, goodman432708@163.com, Yemin Gong, Xianhao Xu

This paper compares the impact of supply chain configuration and operating rules on the management of reusable pallets in closed-loop supply chains. We evaluate how pallet management strategy could affect the whole performance of a supply chain in terms of minimizing the number of pallets and the cycle time and propose semi-open queue network models to analyze four different alternatives which could provide an effective tool for optimal pallet management.

4 - Iterative Mechanisms for Shippers’ Collaboration in Production-Shipping Schedule Planning
Minghui Lai, Assistant Professor, Southeast University, Economics and Management Building, Jiujianghu Campus, Nanjing City, China, laimh@seu.edu.cn

We study the collaborative distribution problem of the shippers with sensitive private information. We propose iterative mechanisms that are convergent, strategy-proof, individually rational, and budget balanced in most cases. The mechanisms are implemented by efficiently computable distributive algorithms. Extensive simulations show that the mechanisms converges fast and have high efficiency.

5 - Dynamic Capacitated Intermodal Terminal Location Problem
Fateme Fotuliardakani, Data Scientist, TMW Systems, 6085 Parkland Blvd. Mayfield Heights, OH, 44124, United States of America, fateme.fotuli@gmail.com, Nathan Huynh

In this paper we introduce a dynamic intermodal terminal location problem which intends to locate new intermodal terminals to dynamically meet fluctuations in customers’ demands. The planning horizon is partitioned into multiple consecutive time periods with a given budget for network configuration in each time period. A lagrangian relaxation approach embedded with a heuristic algorithm for upper bound computation is developed to solve this NP-hard problem.

TC79
79-Room 302, CC
Software Demonstration
Cluster: Software Demonstrations
Invited Session
1 - Syncopation Software - DPL Portfolio and DPMX™: A Decision Analysis Based System for Better Portfolio Decisions
Chris Dalton, Syncopation Software, 6 State Street, Suite 308, Bangor, ME, 04401, United States of America, cdalton@syncopation.com

This demonstration will show how the DPMX® System can serve as the analytical backbone for an effective portfolio analysis process. We’ll start with an overview of DPL Professional, a proven modelling environment for decision analysis, risk analysis and Monte Carlo simulation. Next, we’ll cover DPL Portfolio, the modelling environment for portfolio analysis, visualization and prioritization. Finally we’ll show DPMX®, a web-based based system for managing project data and presenting portfolio results in attractive, management-friendly charts. The motivating examples will be drawn from the prioritization of an R&D portfolio in the pharmaceutical industry.

2 - Frontline Systems, Inc. – Analytic Solver® Platform: Integrated Data Mining, Simulation and Optimization in Microsoft Excel
Frontline Systems

Analytic Solver Platform in Microsoft Excel has everything you need for forecasting and data mining. Monte Carlo simulation and risk analysis, conventional and stochastic optimization – with data from Apache Spark and visualization of results in Excel, Tableau and Power BI. 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.
Tuesday, 4:30pm - 6:00pm

TD01 01-Room 301, Marriott

Optimizing Decisions in Conflict, Deterrence, and Peace

Sponsor: Military Applications
Sponsored Session

Chair: Brian Lunady, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, Brian.Lunday@afit.edu

1 - Active Target Defense Cooperative Differential Game
David Casbeer, Dr., Air Force Research Laboratory, 2210 8th Street, B20146 R300, Wright Patterson AFB, OH, 45433, United States of America, david.casbeer@us.af.mil, Meir Pachter, Eloy Garcia

This work addresses an active target defense differential game where an Attacker pursues a Target. The Target cooperatively teams with a Defender, to maximize the distance between the Target and the point where the Attacker is intercepted by the Defender, while the Attacker tries to minimize said distance. The solution to this differential game provides the min-max optimal heading angles for the Target and the Defender team, as well as the Attacker.

2 - Approximate Dynamic Programming for the Military Inventory Routing Problem with Direct Delivery
Matthew Robbins, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, matthew.robbins@afit.edu, Brian Lunady, Ian McCormack, Rebeka McKenna

The military inventory routing problem (IRP) with direct delivery is formulated to model resupply decisions concerning a set of geographically dispersed brigade combat team elements operating in an austere combat situation. We construct a Markov decision process model of the military IRP and obtain solutions via approximate dynamic programming. Designed computer experiments are conducted to determine how problem features and algorithmic features affect the solution quality of our policies.

3 - Improving Chemotherapy Delivery through the Simulation of Scheduling Heuristics
Ryan Slocum, Instructor, Department of Mathematical Sciences, Building 601, United States Military Academy, West Point, NY, 10996, United States of America, ryan.slocum@usma.edu, Javad Taheri, Thom Hodgson

In the last decade, chemotherapy delivery has largely become an outpatient service. This has challenged clinics to administer complex treatments to as many patients as possible within a fixed period of time. We apply selected scheduling heuristics to reduce patient waiting times and minimize nurse overtime hours. We present the results of a case study for which our heuristics found two solutions that respectively reduce the average patient's waiting time by 20% and annual overtime by 60%.

4 - A Game Theoretic Model for the Optimal Disposition of Integrated Air Defense Missile Batteries
Brian Lunady, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, Brian.Lunday@afit.edu, Chan Han, Matthew Robbins

We examine the allocation of air defense batteries to protect a country's population as a three-stage sequential, perfect information, zero-sum game between two opponents. We formulate a trilevel nonlinear integer program, but instead apply both an enumeration algorithm and a customized heuristic to search the game tree. We test both on small instances to assess the efficacy of the heuristic, and we demonstrate the computational efficiency of the heuristic on realistic-sized instances.

TD02 02-Room 302, Marriott

Military Applications
Contributed Session

Chair: Irene Gerlovin, PhD Candidate/ Part Time Lecturer, Rutgers Business School, 1 Washington Pl, Newark, NJ, 07102, United States of America, irene.gerlovin@gmail.com

1 - Modeling Disease Mortality in The National Operational Environment Model (NOEM)
Venkat Venkateswaran, Rensselaer Polytechnic Institute, 273 Windsor St., Hartford, CT, 06033, United States of America, venva3@rpi.edu, John Schaefer

The National Operational Environment Model (NOEM) is a large scale stochastic model that can be used to simulate the operational environment of a nation-state. Effects of various action alternatives can then be studied through simulations. In this work we describe the methodology developed to estimate disease mortality. Extensive V&V tests show that estimated disease death rates compare well with published values, year by year, for several countries tested.

2 - Optimization of The Canadian Armed Forces Domestic Transportation Network
Raman Pall, Defence Scientist, Department of National Defence, 1600 Star Top Road, Ottawa, ON, K1B 3W6, Canada, raman.pall@forces.gc.ca, Abdelsem Boukhouta

The Canadian Armed Forces domestic transportation network transports goods between military bases and depots throughout Canada using a combination of military transport assets and commercial carriers. In this presentation, we provide an overview of the network, describing it as a directed graph and analyzing its efficiency. Recommendations are made on how utilization of the military resources can be maximized through improvements to the route scheduling.

3 - Supply Chain Program Management (SCPM) to the Rescue! F-35 Program
Irene Gerlovin, PhD Candidate/ Part Time Lecturer, Rutgers Business School, 1 Washington Pl, Newark, NJ, 07102, United States of America, irene.gerlovin@gmail.com, Yao Zhao

F-35 program had a number of technical challenges. Since its inception in 2001, the program is seven years behind the schedule and 70% over initial budget. We review its key SCPM practices to identify root causes for the delays and to enhance the chance of success for future DOD acquisitions.

TD03 03-Room 303, Marriott

Inventory Management II
Contributed Session

Chair: Ruiqi Hou, University of Science and Technology of China, East Campus USTC, No. 96 Jinzhai Road, Room 367-414, Hefei, 230026, China, ruiqi@ustc.edu.cn

1 - A Continuous Formulation for a Location-Inventory Problem Considering Demand Uncertainty
Matias Schuster Puga, Université Catholique de Louvain, Chausée de binche,151, Mons, 7000, Belgium, matias.schuster@uclouvain.be, Jean-sébastien Tancrez

We propose a location-inventory model that can be applied to design large supply chain networks. We address a continuous non-linear formulation that minimizes transportation, inventory, order, safety stock and facility opening costs. We solve the non-linear model with an heuristic algorithm that relies on the fact that the model simplifies to a continuous linear program when two auxiliary variables are fixed. We show the efficiency of the algorithm with the computation of numerical experiments.

2 - SQRTN and Portfolio Effect Inventory Models: Notes on Practical Use and Accuracy for Practitioners
Tan Miller, Director Global Supply Chain Management Program, Rider University, 12 Winding Way, Morris Plains, NJ, 07950, United States of America, tanjean@verizon.net, Renato De Matta, Minghong Xu

We conduct simulations of alternative logistics network inventory stocking strategies. We then evaluate the accuracy and practical utility to network planners of using multiple portfolio effect models and the SQRTN model to predict changes in inventory investment requirements under alternative inventory network strategies and configurations.
Daesung Ha, Professor, Marshall University, 415 Corbyl Hall, 1 John Marshall Drive, Huntington, WV, 25755, United States of America, ha@marshall.edu

In this study, we discuss the estimation errors and the model specification problem of the existing studies which investigated the relationship between inventory productivity and firm performance in U.S. manufacturing industry. Using the panel data of U.S. manufacturing firms over the period of 1980–2014 collected from the Compustat database, we provide the corrected estimation results.

4 - The Effect on Inventories/Assets Turnover Change Ratio by Firm Characteristics
Jiyou Lee, Kyungpook National University, Sangyo 3-Don Buk-Gu, Daegu, Korea, Daegu, Korea, Republic of, ji208@gmail.com, Pansoo Kim

This study analyzed the effect on ratio of change of inventories turnover by firm characteristics using panel data targeting manufacturing companies listed on the Korea Stock Exchange securities market since January 1, 1999 to December 31, 2012. Firm size, sales growth rate, ROA (return on assets), leverage ratio, credit rating, age of firm were used as 6 important firm characteristic variables.

5 - Service Management in Dynamic Online Markets with Positive and Negative Word of Mouth
Ruigui Hou, University of Science and Technology of China, East CampusUSTC, No. 96 Jinzhai Road, Room 367-414, Heifei, 230006, China, ruijinmath@gmail.com

We consider that comments online may lead to customers’ leaving the market. We use the effect that value for money level may have on market size to measure the economic effect. The model considers both single and two-firm model and the decision is setting investment cost. Customers are distinguished by their types which induce heterogeneous rates of adoption information. The information of value for money level diffuses and affects the transitions of consumers. We establish conditions for a Nash equilibrium policy.

- TD05

05-Room 305, Marriott
Social Media Engagement
Cluster: Social Media Analytics
Invited Session
Chair: Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, United States of America, Iservi@mitre.org

1 - Development and Evaluation of Tagalog LIWC Dictionaries for Negative and Positive Emotion
Amanda Andre, Graduate Student, Georgetown University, Washington, DC, United States of America, aa1436@georgetown.edu

Developing non-English sentiment analysis tools can ensure that data is not lost due to language. A proof-of-concept Tagalog Linguistic Inquiry and Word Count (LIWC) dictionary for positive and negative emotion was developed for use in analyzing mixed language Twitter data from the Philippines and evaluated against human-annotated sentiment for Twitter, referred to as groundtruth.

2 - Consumer Engagement with Green Brands on Facebook as Revealed in Refined Sentiment Analysis
Tiffany Ting-Yu Wang, Associate Professor, College of Informatics, KNU, 70-7 Xianyuan Rd. Lane 16, Taipei, No. 1, 11688, Taiwan - ROC, Tiffany.tingyu@knu.edu

The fast-growing number of social media users together with inundating user generated content has posed significant challenges to firms trying to detect consumers’ attitudes. This research aims to uncover consumer experiences with two green brands in the cosmetics industry through collecting and analyzing public Facebook posts. We refine sentiment analysis by applying the Tetraclasse model to identify social media context and/or green product attributes as satisfaction determinants.

3 - Tailored Incentives and Least Cost Influence Maximization on Social Networks
Rui Zhang, University of Maryland, College Park, MD, United States of America, rui.zhang@rhsmith.umd.edu, S. Raghavan

We wish to promote a product over a social network and attain 100% adoption. We study a cost minimization problem where incentives can be tailored to each individual. A totally unimodular formulation is proposed for trees. Observing that the influence propagation network is acyclic, we apply this formulation (along with an exponential set of anti-cycle inequalities) to general networks. Next, a branch-and-cut approach is developed and used to solve problems on real-world graphs with 5000 nodes.

4 - Large-scale Bid Optimization in Online Advertising Auctions
Mustafa Sahin, University of Maryland, Van Munching Hall 3330, College Park, MD, 20742, United States of America, mustafa.sahint@rhsmith.umd.edu, Abhishek Pani, S. Raghavan

In sponsored search ads, the search operator collects bids for a given keyword and determines whose ad will be displayed in what position. The advertisers have to decide on keywords and positions to bid on given a budget, which can be modeled as a Multiple Choice Knapsack Problem. The number of keywords and positions considered can be in the order of hundreds of millions for this application. We offer an algorithm that is both time and memory efficient and present results on hard instances.
in the rational expected utility framework.

3 - Sequential Monte Carlo with Parameter Learning for Long-memory Processes
Konstantinos Spiliopoulos, Assistant Professor, Boston University, Department of Mathematics and Statistics, 111 Cummington Mall, Boston, MA, 02215, United States of America, kspilop@math.bu.edu

We consider state-space models specified up to an unknown vector of parameters and in which the unobserved state process exhibits long-memory. We estimate both the state process and the parameter vector and propose a sequential Monte Carlo method that is based on smoothing of the sample points of model parameters. We establish a central limit theorem for the state and parameter filter. We apply the approach to S&P 500 data in the context of a stochastic volatility model with long memory.

4 - Leveraged ETF Portfolios with Delta-vega Control
Zheng Wang, Columbia University, 116th Street, New York, NY, 10027, United States of America, zwx2192@columbia.edu, Tim Leung

We analyze a collection of static portfolio strategies that allow an investor to control portfolio sensitivity with respect to the short-term return and realized volatility of a reference asset. This is done by choosing appropriate weights of each constituent in a portfolio of leveraged ETFs. We backtest our proposed strategies using empirical data of major equity leveraged ETFs and illustrate the efficacy of our methodology.

■ TD09

09-Room 309, Marriott

Collaborative R&D
Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session
Chair: Niyazi Tameri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitaneri@sutd.edu.sg

1 - Incentivizing External Experts in New Product Development
Shantanu Bhattacharya, Singapore Management University, Lee Kong Chain School of Business, Grange Heights, Singapore, 238145, Singapore, shantanu@smu.edu.sg, Sameer Hasija

We create a model of new product development where information on external factors like market potential and technology feasibility is sought from external experts. The firm has to adequately incentivize these experts to truly reflect their judgment. Contracts are presented to alleviate the resulting adverse selection problem.

2 - Supplier Incentives in Collaborative Product Development with Internal Competition
Timofey Shalpegin, Lecturer, University of Auckland, 12 Grafton Road, Auckland, 1010, New Zealand, t.shalpegin@auckland.ac.nz

Internal competition in new product development has a profound, yet unexplored effect on the incentives of the suppliers involved in a development project through collaboration with the manufacturer's competing development teams. We study the optimal assignment of development teams to different suppliers. We find that due to the effect of competition on supplier incentives, the manufacturer may find it optimal to allocate more development teams to a supplier with lower capabilities.
3 - Dynamic Delegated Search
Morvairid Rahmani, Assistant Professor, Georgia Tech, Atlanta, GA, morvairid.rahmani@scheller.gatech.edu,
Karthik Ramachandran

Firms often delegate the search for solution of their innovative problems to third parties (e.g., search for designs, advertisements, executive leaders, etc.) In this paper we study how the client’s choice of search process (i.e., defined or open-ended) depends on the strategic behavior of the provider. Taking the client’s and provider’s perspective, we identify conditions for which a defined search is preferred to an open-ended search.

4 - The Impact of Health Information Technology Bundles on Hospital Performance: An Econometric Study
Aravind Chandrasekaran, Associate Professor, The Ohio State University, 2100 Neil Avenue, Columbus, OH, 43210, United States of America, chandrasekaran.24@osu.edu, Luv Sharma

We examine how two HIT bundles: Clinical (used for patient data collection, diagnosis and treatment) and Augmented Clinical (used for integrating patient information and decision making) jointly impact operating cost and process quality. Results suggest complementarities between these bundles with respect to process quality but not cost. A posthoc analyses offers additional explanation on the lack of association with cost.

12-Franklin 2, Mariott
Sponsor: Military Applications
Sponsored Session
Chair: 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.

14-Franklin 4, Mariott
Engineering Systems Applications
Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session
Chair: Honggang Wang, Assistant Professor, Rutgers University, 96 Frelinghuysen Rd, 201 CoRE, Piscataway, NJ, 08854, United States of America, honggang.w@rutgers.edu

Optimal development of shale gas involves determining the most-productive fracturing network via hydraulic stimulation processes in shale reservoirs. Shale gas development projects can be formulated with mixed-integer optimization models. We apply a simplex interpolation based optimization method to solve mixed integer optimization problems associated with shale gas production projects. The optimization performance is demonstrated with the example case of developing the Barnett shale field.

3 - Resource Abstraction in Planning and Design of Virtual Data Centers
Dimitri Papadimitriou, Copernicuslaan 50, 2018, Antwerp, 2018, Belgium, dimitri.papadimitriou@alcatel-lucent.com

Virtual data centers enable flexible allocation of capacity to customer demands by aggregating physical resources taken out of a subset of data centers (facilities) to satisfy customer demands. The goal is to determine the capacity to be provisioned on opened facilities and the assignment that minimize the cost of opening, supplying demands and connecting each customer to a subset of facilities. We compare the resulting cost against the corresponding capacitated facility location problem.
We propose several natural specializations of the framework that evaluate techniques to the recovery of transportation and production cost parameters in unobservable parameters in competitive markets. In particular, we apply these three models to healthcare settings.

3 - Three Newsvendor Models for Capacity Allocation
Sam Choi, Assistant Professor, Shenandoah University, 1460 University Dr., Winchester, VA, 22601, United States of America, schoi@su.edu

We propose three newsvendor models to allocate capacity under uncertainty: inverse newsvendor, sequential newsvendor, and inverse sequential newsvendor. The inverse newsvendor model tries to find optimal demand size under capacitated environment. The sequential newsvendor model deals with optimal time durations given that demand sizes. Lastly, the inverse sequential newsvendor model determines optimal demand sizes given that time durations. We apply three models to healthcare settings.

3 - Three Newsvendor Models for Capacity Allocation
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2 - Non-aggressive Adaptive Traffic Routing
Madhushini Narayana Prasad, Graduate Research Assistant, Cockrell School of Engineering, University of Texas at Austin, Austin, TX, 78712, United States of America. madhushini@utexas.edu, Nedialko Dimitrov
Routing a person through a traffic network presents a dilemma to choose between fixed route which is an easier to navigate route and adaptive route which minimizes the travel time by adjusting to the traffic conditions. We investigate methods for non-aggressive, adaptive routing that is middle-ground seeking the best of both these extremes, i.e. adaptive routes restricted in number of route shifts allowed at a critical juncture, and investigate the trade-offs between the extremes.

3 - Social Network Echo Chambers and Popularity
Yinhua Liu, University of Texas Austin, 1901 Crossing Place #3301, Austin, TX, 78741, United States of America, yinhua.liu@utexas.edu, Nedialko Dimitrov
Social network users often have the goal of building a large follower base. Some users are members of what we term echo chambers, a small group of users that re-share each other's messages. We present an empirical study on the impact of echo chambers on the popularity of users using historical data from Twitter. Specific questions we address are: Does echo chamber membership increase follower base?

1 - Success Drivers of Online Equity Crowdfunding Campaigns for Unaccredited Investors
Anna Lukkarinen, Aalto University, P.O. Box 21220, Helsinki, 00076, Finland, anna.lukkarinen@aalto.fi, Jeffrey Teich, Hannele Wallenius, Jyrki Wallenius
Using data from a leading equity crowdfunding platform in Northern Europe, we explore success factors of campaigns. The results suggest that the investment criteria traditionally used by professional investors are not of prime importance for success in equity crowdfunding. Instead, success is related to pre-selected crowdfunding campaign characteristics and networks. Understanding the success factors of online equity crowdfunding campaigns is important to the design of online platforms.

2 - The Mover-Stayer Process for the Credit Data
Anna Matuszczak, Assistant Professor, Warsaw School of Economics, Niepodleglosci 162, Warsaw, 02-554, Poland, amatuszczak@matuszczak.com, Halina Frydman
Using the credit data set, coming from the European bank, we estimate the mover-stayer model, which is an extension of the Markov chain. This model assumes that the population is heterogeneous: there are “stayers” and “movers”, “Movers” evolve according to a Markov Chain with the one-step transition matrix, while “stayers” never leave their initial states. The probability of a customer being a stayer in a paid up state is modeled using the logistic regression.

3 - Monopolistic Dealer Versus Broker: Impact of Proprietary Trading with Transaction Fees
Yuan Tian, Ryukoku University, 67 Tsukamoto-cho, Fukakusa, Fushimi-ku, Kyoto, Japan, tian@econ.ryukoku.ac.jp, Katsumasa Nishide
We consider a one-period financial market with a monopolistic dealer/broker and an infinite number of investors. While the dealer (with proprietary trading) simultaneously sets both the transaction fee and the asset price, the broker (with no proprietary trading) sets only the transaction fee, given that the price is determined according to the market-clearing condition among investors. We effectively demonstrate how proprietary trading affects market equilibrium and welfare of investors.

4 - A Data Analytics Based Approach for Building 360 View of Banking Customer
Tianzhai Zhao, IBM, Diamond Blvd, ZGC Software Park, Beijing, China, zhaotzhi@cn.ibm.com, Zhen Huang, Ming Xie, Bing Shao, Yuhang Liu, Jian Xu, Wenjun Yin, Yuhan Fu
Banks today are experiencing transformation from product-centricity to customer-centricity. With advent of big data, it enables banks to fully and deeply understand customers by building 360 degree customer view. In this paper, a data analytics based approach for 360 degree view of banking customer is proposed. It can help banks quick build customer centricity for customer segments, targeted marketing, personalized recommend, etc.
5 - Credit Scoring using Dynamic State Space Model under Statistical Volatility
Linna Du, Data Scientist, CACS, 2259 Adam Clayton Powell, New York, NY, 10027, United States of America, linna.du@gmail.com

In emerging market where the credit score and credit history are not trustworthy, the estimation and prediction of the credit score and prepayment risks are very important. In the paper, we propose a dynamic state space model considering the volatility and dynamic feature of the lending market. We found that the time varying volatility model provides better prediction than other time series models. We also identify the key factors that drive the lending risks.

TD21

21-Franklin 11, Marriott

Disease Modeling in OR
Sponsor: Health Applications
Sponsored Session

Chair: Emine Yayıllı, Senior Service Fellow, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA, 30333, United States of America, wq3@cdc.gov

1 - The Potential Impact of Reducing Indoor Tanning on Melanoma Prevention in the United States
Yuanhui Zhang, CDC, Chamblee GA 30341, United States of America, yhp3@cdc.gov, Donatus Ekuweme, Sun Hee Rim, Meg Watson, Gery Gay

More than 700,000 adults in the United States are treated for melanoma each year, resulting in annual direct medical costs of $3.3 billion dollars and 9,000 deaths. We developed a Markov model to estimate the health and economic impacts of reducing indoor tanning for melanoma prevention in the United States under certain assumptions. According to this model, reducing indoor tanning may result in favorable savings in medical costs and life-years, comparable to other national prevention efforts.

2 - Estimating the Impact of HIV Care Continuum Interventions on the Reproduction Number
Yao-Hsuan Chen, CDC, Chamblee GA 30341, United States of America, xjh1@cdc.gov, Andrew Hill, Paul G. Farnham, Stephanie L. Sansom

We used a compartmental model to study HIV transmission in the United States from 2006 through 2020 among heterosexuals, men who have sex with men, including bisexual men, and injection drug users. We analyzed the impact of interventions to improve HIV diagnosis, care, and treatment on the reproduction number. Analyses using this model can provide insights into the long-term effectiveness of HIV prevention strategies.

3 - Stratifying Risk Groups in Compartamental Epidemic Models: Where to Draw the Line?
Margaret L. Brandeau, Professor, Stanford University, M5E Department, Stanford, CA, 94305, United States of America, brandeau@stanford.edu, Jeremy D. Goldhaber-Fiebert

Disease models used to support cost-effectiveness analyses of health interventions are often stratified to reflect population heterogeneity (e.g., age, gender, risk behaviors). We examine the impact of population stratification in dynamic disease transmission models: specifically, the impact of different divisions of a population into a low-risk and a high-risk group. We show that the way in which the population is stratified can significantly affect cost-effectiveness estimates.

4 - Developing a Dynamic Compartmental Model of HIV in the United States
Emine Yayıllı, Senior Fellow, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA, 30333, United States of America, wq3@cdc.gov, Paul G. Farnham, Stephanie L. Sansom, Katherine A. Hicks, Emily L. Tucker, Amanda Honeycutt

Over 1 million people in the US are living with HIV. To observe trends in HIV and evaluate the effectiveness of prevention interventions, we developed a dynamic compartmental model of disease progression and transmission. The population was stratified by age, sex, circumcision status, race/ethnicity, transmission group, and risk level. People progressed between compartments defined by disease status and care and treatment stage. Outcomes included HIV incidence, prevalence, and care status.
3 - Replenishment and Fulfillment Based Aggregation for General Assemble-to-Order Systems
Enre Nadar, Assistant Professor, Bilkent University, Department of Industrial Engineering, Bilkent University, Ankara, Turkey, emre.nadar@bilkent.edu.tr, Alp Scheller-wolf, Alp Akcay, Mustafa Akan
We present an approximate dynamic programming method to optimizing Markovian assemble-to-order systems. We alleviate the computational burden by reducing the large state space of the problem via a novel aggregation method that builds upon certain component and product characteristics. We show the optimality of a lattice-dependent base-stock and rationing policy for the aggregate problem. We also derive finite error bound for the cost function of the aggregate problem under a mild condition.

4 - Optimal Manufacturing Policies for Engineer-to-Order Proteins
Tugce Martagan, Eindhoven University of Technology, 5600 MB Eindhoven, Eindhoven, Netherlands, T.G.Martagan@tue.nl, Ananth Krishnamurthy
We develop continuous state Markov decision models to optimize design processes related to protein purification operations. We focus on engineer-to-order proteins with strict production requirements on quality and yield. We present a state aggregation mechanism to solve industry-size problems. Our models and insights are implemented in practice.

**TD24**

24-Room 401, Marriott
Social Network Analytics
Sponsor: Artificial Intelligence
Sponsored Session
Chair: Xi Wang, The University of Iowa, S343 PBB, Iowa City, IA, 52242, United States of America, xi-wang@uiowa.edu

1 - Optimizing Hurricane Warning Dissemination Problem for Evacuation Decision Making
Dian Sun, Harbin Engineering University, 172 Princeton Ave. Apt 1, Buffalo, NY, 14226, United States of America, sundian@hrbeu.edu.cn, Yan Song, Zifeng Su
Individual make evacuation decisions based on risk perception which can be socially influenced as evacuation warnings spread through social networks. In this study a formal model for evacuation warning dissemination in social networks through time is presented to characterize the social influence of the risk perception in the evacuation decision making process. Simulation models are developed to investigate the effects of community mixing patterns and the strength of ties on evacuation decision.

2 - Inferring User Location from Geographic and Social Network
Da Xu, PhD Student, University of Utah, 1032 E 400 S, Apt 504B, Salt Lake City, UT, 84102, United States of America, Da.Xu@business.utah.edu, Xiao Fang
The lack of tools to monitor the time-resolved locations of individuals constrains us to gain a deep understanding of human mobility. While, despite the diversity of people’s travel history, human mobility follows a high of temporal and spatial regularity. In this paper, we study the human mobility through social and geographic networks, give a deep insight to how individual mobility pattern and social network impact with each other, and build a probabilistic model to depict human mobility.

3 - Concurrent Diffusions of Information and Behaviors in Online Social Networks
Shiyao Wang, University of Iowa, 634 Westgate St. Apt, 55, Iowa City, IA, 52246, United States of America, shiyao-wang@uiowa.edu, Kang Zhao
Using the spread of the Ice Bucket Challenge (IBC) on Twitter as a case study, this research compared the concurrent diffusion patterns of both information and behaviors in online social networks. Individual behaviors related to IBC were detected by text mining techniques. Comparison between diffusion dynamics of information and behaviors at different levels revealed interesting differences and interactions between the two diffusion processes and laid foundations for future analyses.

**TD25**

25-Room 402, Marriott
Economic Models and Analysis of Networks and Platforms
Sponsor: Information Systems
Sponsored Session
Chair: Soumya Sen, University of Minnesota, Minneapolis, MN, United States of America, ssen@umn.edu

1 - Payments for Transactions Versus Payments for Discoveries: Theoretical Analyses
Karthis Kannan, Purdue University, 403 W State Street, West Lafayette, IN, 47907, United States of America, kkarthik@purdue.edu, Rajib Saha
eBay.com in the U.S. charges payments for transactions but Taobao.com in China charges for discoveries. We theoretically study such payment schemes used by the platforms. We surprisingly find that when payments are for discoveries, the platform has an incentive to make welfare-decreasing matches between sellers and buyers. Similarly, in order for payments for transactions to be sustained, buyers and sellers should sufficiently value factors such as trust provided by the platform.

2 - The Impact of Online Word of Month on Channel Disintermediation for Information Goods
Brian Lee, University of Connecticut, 2100 Hillside Road Unit 1041, Storrs, CT, 06268, United States of America, brian.lee@business.uconn.edu, Xinxin Li
With the advance in digital technology, creators of intellectual products can sell their work directly to consumers without the help of publishers. In this study, we construct an analytical model to examine the role of online word-of-mouth (eWOM) in this trend of disintermediation. We find that eWOM may encourage creators to reintermediate publishers for high quality work. Our model makes predictions on when eWOM benefits publishers and for what types of products/creators it has the most impact.

3 - Electric Vehicle Power Plants: Carsharing Optimization with Smart Electricity Markets
Micha Kahnlen, Erasmus University Rotterdam, Burgemeester Oudlaan 50, Rotterdam, Netherlands, kahlen@rsm.nl, Wolf Ketten
We study electric vehicles as power plants to bridge weather dependent energy shortages from wind and solar energy. Particularly, we are interested in the allocation of electric vehicles by making a trade-off between driving and storing electricity. This allocation is optimized in a first-price sealed bid auction with pricing signals from smart electricity markets and the availability of electric vehicles. Results show positive effects for drivers, carsharing operators, and the environment.

4 - Should You Go with “Pay as You Go”?: Optimal Design of Bucket Plans for Multi-unit Goods
Manish Gangwar, Assistant Professor, ISB, ISB Campus, Gachibowli, Hyderabad, India, manish_gangwar@isb.edu, Hemant Bhargava
Among the class of nonlinear tariffs, “Three Part Tariff” is the most general tariff but it tends to focus on heavy users. Given the evident optimality of a bucket plan, we ask what are the pros and cons of alternative pricing models? We derive the closed-form expressions for commonly used demand function and specify a system of equations with economic interpretation for the general problem. We also examine the properties of optimal “Three Part Tariff” in the presence of a per-unit plan.
1 - A Hybrid Decision Making Approach for Multi-Objective Infrastructure Planning
Hana Chmielewski, North Carolina State University, Campus Box 7908, Raleigh, NC, 27695, United States of America, h_matchiel@ncsu.ed, Ranji Ranjithan

A hybrid approach using evolutionary computation and dynamic programming is used to optimize investments and operational decisions in a water supply case study system. Solutions are categorized by network centralization metrics, and analyzed with respect to multiple planning objectives.

2 - Evaluating Lignocellulosic Biomass Supply Chains Considering a Multi-objective of Optimizing Cost
Burton English, Professor, The University of Tennessee, 2621 Morgan Hall, Knoxville, TN, 37922, United States of America, benglish@utk.edu, James Larson, Edward Yu, Jia Zhong

A switchgrass supply chain that considers the optimization of cost, GHG emissions and soil erosion for a cellulose biofuel plant is developed. Using an augmented epsilon constraint multi-objective optimization model and a compromise solution method, along with high-resolution spatial data the optimal placement of feedstock supply chains can be estimated. Spatial characteristics, including land coverage and infrastructure availability, are crucial to both the cost and the environmental results.

3 - The Impact of Postponement Practices on the Lot-sizing Decisions of a Wine Bottling Plant
Sergio Maturana, Professor, Pontificia Universidad Católica de Chile, Vicuna Mackenna 4860, Santiago, Chile, smaturan@ing.puc.cl, Mauricio Varas

Export-focused wineries face a difficult problem when planning their bottling lines due to the number of different products they have to bottle and label. A way of reducing misallocation due to demand variability is by postponing the labeling process. We propose two MILP planning models that support tactical lot-sizing decisions. We tested both models in a rolling horizon framework, under different conditions of capacity tightness, horizon length, and demand uncertainty and we report the results.

4 - Scheduling of Maximizing Total Job Value with Machine Availability Constraint
Eun-Seok Kim, Middlesex University, The Burroughs, London, NW4 4BT, United Kingdom, e.kim@mdx.ac.uk, Joonyup Eun

We study a single machine scheduling problem of maximizing total job value with machine availability constraint. The value of each job is given as a non-increasing step function of its completion time. We develop a branch-and-bound algorithm and a heuristic algorithm for the problem. Finally, we perform computational experiments showing that the developed algorithms provide efficient and effective solutions.

26-Room 403, Marriott

Production and Scheduling I
Contributed Session
Chair: Strimathy Mohan, Associate Professor, Arizona State University, Department of Supply Chain Management, Tempe, AZ, United States of America, strimathy@asu.edu

1 - Weekly Production Planning on the Basis of Average Value-at-Risk by Shapley Value
Nobuyuki Ueno, Hiroshima University of Economics, 5-37-1 Gion Asaminami-ku, Hiroshima, Japan, ueno@pu-hiroshima.ac.jp, Hiroshi Morita, Koji Okuhara

Under demand uncertainty, they used stock-out ratio for estimating the risk. In this presentation, we propose a formulation for weekly production planning problem that reflects the AVaR (Average value-at-risk) for weighing tail risk and a solution by Shapley value. The characteristics of the solution procedure is proved. It has the features that it does not require strict probability distribution of stock-out and it enables an extension to the case where demand for each period is correlated.

2 - A Generalized Dantzig-Wolfe Decomposition Algorithm for Mixed Integer Programming Problems
Xue Lu, London School of Economics and Political Science, Houghton Street, London, WC2A 2AE, United Kingdom, X.Lu@lse.ac.uk, Zeger Degraeve

We propose a generalized Dantzig-Wolfe decomposition algorithm for mixed integer programming. By generating copy variables, we can reformulate the original problem to have a diagonal structure which is amenable to the Dantzig-Wolfe decomposition. We apply the proposed algorithm to multi-level capacitated lot sizing problem and production routing problem. Rigorous computational results show that our algorithm provides a tighter bound of the optimal solution than all the existing methods.

3 - A Hybrid Decision Making Approach for Multi-Objective Infrastructure Planning
Hana Chmielewski, North Carolina State University, Campus Box 7908, Raleigh, NC, 27695, United States of America, h_matchiel@ncsu.ed, Ranji Ranjithan

A hybrid approach using evolutionary computation and dynamic programming is used to optimize investments and operational decisions in a water supply case study system. Solutions are categorized by network centralization metrics, and analyzed with respect to multiple planning objectives.

28-Room 405, Marriott

Dynamic Matching Markets
Cluster: Auctions
Invited Session
Chair: John Dickerson, CMU, 9219 Gates-Hillman Center, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu

1 - Global Kidney Exchange
Afshin Nikzad, Stanford University, 37 Angell Court, Apt 116, Stanford, CA, 94305, United States of America, afshin.nikzad@gmail.com, Mohammad Akbarpour, Alvin Roth

In some countries, many patients die after a few weeks of diagnosis mainly because the costs of kidney transplantation and dialysis are beyond the reach of most citizens. We analyze the two proposals in which patients with financial restrictions who have willing donors participate in kidney exchange without paying for surgery. Our proposals can save thousands of patients, while substantially decreasing the average dialysis costs; in particular, we prove that they are "self-financing"

2 - Matching with Stochastic Arrival
Neil Thakral, Harvard, 1805 Cambridge Street, Cambridge, MA, United States of America, nthakral@fas.harvard.edu

We study matching in a dynamic setting, with applications to public-housing allocation. Objects of different types that arrive stochastically over time must be allocated to agents in a queue. When objects share priorities over agents, we propose an efficient, envy-free, and strategy-proof mechanism. The mechanism continues to satisfy these properties if and only if the priority relations are acyclic. Estimated welfare gains over existing housing-allocation procedures exceed $5000 per applicant.

3 - Dynamic Kidney Exchange with Heterogeneous Types
Maximilien Burg, Student, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, mburg@mit.edu, Itai Ashlagi, Vahideh Manshadi, Patrick Jaillet

Kidney exchange programs face growing number of highly sensitized patients. We develop an online model that models such heterogeneity, and we prove that finding some easy-to-match patients in the pool greatly reduces waiting times both in the presence of bilateral matching and chain matching. We provide simulations showing that some prioritizing leads to improved overall efficiency.

4 - Competing Dynamic Matching Markets
Sanmay Das, WUSTL, One Brookings Dr, CB 1045, St. Louis, MO, 63130, United States of America, sanmay@wustl.edu, John Dickerson, Zhoushu Li, Tuomas Sandholm

We extend a framework of dynamic matching due to Akkarpour et al. to characterize outcomes in cases where two rival matching markets compete. One market matches quickly while the other builds up the matching slowly. We present analytical and simulation results, both in general and for kidney exchange, demonstrating that rival markets increase overall loss compared to a single market that builds thickness.
A pplication to a m ajor regional schools investment and rationalization program is 
achieve both a higher level of sensitivity and specificity. Therefore; reducing both 
false and non-actionable alarm s. O ur goal is ignite the talk  on alarm  fatigue, begin 
to define algorithm s for sm arter actionable alarm s and provide a safer health care 
calls. A fter validating the predictive m odel, w e develop a forecast for the 
develop and validate a predictive m odel for the various types of visits and phone 
work load. W e evaluate the effect of w alk -in hours on the practice work load, then 
competition from  urgent care clinics and has ask ed to determ ine the effect on staff 
m spollen01@ qub.ac.uk 
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INFORMS Philadelphia – 2015
TD29
29-Room 406, Marriott
Joint Session Analytics/HAS:The Emerging Role of 
Health Systems Engineering and its Impact on 
Clinical Informatics and Analytics
Sponsor: Analytics
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 - How to Make Clinically Actionable Alarms 
Jeanne Venella Dnp, Chief Nursing Officer, Nuvon, 
4801 S Broad St, Philadelphia, PA, 19112, 
United States of America, jvenella@nuvon.com
How to Make Clinically Actionable Alarms The very alarm systems that were 
created to enhance patient safety have themselves become an urgent patient 
safety concern. We need to fix our current state of alarm systems. We must 
achieve both a higher level of sensitivity and specificity. Therefore; reducing both 
false and non-actionable alarms. Our goal is ignite the talk on alarm fatigue, begin 
to define algorithms for smarter actionable alarms and provide a safer health care 
environment.
2 - The Kalman Filter and its Application to Real-time Physiologic 
Monitoring of High-acuity Patients 
John Zaleski, Chief Informatics Officer, Nuvon, Inc., 
4801 S Broad Street, Suite 120, Philadelphia, PA, 19112, 
United States of America, jzaleski@nuvon.com
The Kalman Filter (KF) has seen application in many fields owing to its rapid 
computational framework and intrinsic optimality in tracking time-series. In this 
presentation, the KF is used to optimally track and smooth signal artifact 
associated with patient physiologic monitoring.
3 - Predicting the Effect of Introducing Walk in Hours on Staff 
Workload at a Pediatrics Practice 
Saurabh Jhia, University of Pittsburgh, 1048 Benedum Hall, 
Department of Industrial Engineering, Pittsburgh, PA, 15261, 
United States of America, saj79@pitt.edu, Louis Luangkeshorn, 
Diana Hoang, Lindsey Jones, Tricia Pil
A local pediatrics practice has introduced patient walk-in hours in response to 
competition from urgent care clinics and has asked to determine the effect on staff 
workload. We evaluate the effect of walk-in hours on the practice workload, then 
develop and validate a predictive model for the various types of visits and phone 
calls. After validating the predictive model, we develop a forecast for the 
remainder of the 12 months period following the introduction of all-day walk-ins.

TD30
30-Room 407, Marriott
Decision Support Systems II
Contributed Session
Chair: Rohit Nishant, Assistant Professor, ESC Rennes School of 
Business, 2 Rue Robert d’Arbrissel CS 76522, Rennes, 35065, France, 
rohit.nishant@esc-rennes.com
1 - Routing Recommendation System for Uber 
Yuhan Wang, University of California Irvine, 6478 Adobe Cir, 
Irvine, CA, 92617, United States of America, 
wangyuhuan101@gmail.com
Paper not available at this time.
2 - Optimising Allocation of Investor Funds in Multi-objective Public 
Infrastructure Investment Programs 
Martin Spollen, Queens University Belfast, David Bates Building, 
University Road, Belfast, BT7 1NN, United Kingdom, 
mspollen01@qub.ac.uk
This session will examine the development and application of Strategic 
Infrastructure Planning Models (SIPMs) as an emerging class of investment 
appraisal techniques for public investment management. The techniques focus 
attention on the network effects of investment on total portfolio performance. 
Application to a major regional schools investment and rationalization program is 
demonstrated.
3 - A Decision Support System for Traffic Diversion around 
Construction Closures 
Arezo Memarian, Graduate Research Assistant, University of Texas at Arlington, 425 Nedderman Hall, 416 Yates St., 
Box 19308, Arlington, TX, 76019, United States of America, 
arezo.memarian@navs.uta.edu, Siamak Ardekani
The objective of this study is to develop a PC-based decision support tool with a 
user-friendly graphical interface to allow development of optimal traffic 
management plans around highway construction sites. In addition to the 
capability to identify optimum traffic diversion routes, such a tool would also 
allow simulation of various traffic management plan scenarios envisioned by 
exerts.
4 - Can Virtualization Maturity Impact Software Development Project 
Performance: An Empirical Study 
Rohit Nishant, Assistant Professor, ESC Rennes School of 
Business, 2 Rue Robert d’Arbrissel CS 76522, Rennes, 35065, 
France, rohit.nishant@esc-rennes.com, Bouchal Bahl
In this article we invoke IT asset classes’ taxonomy and IT capability maturity 
model to examine the impact of virtualization maturity on software development 
project performance. Our findings suggest that virtualization capability has a 
distinct impact on software development project and process performance.
Finally, this study extends virtualization maturity model’s validity. Implications 
for research and practice are discussed.

TD31
31-Room 408, Marriott
Time Series Data Mining
Sponsor: Data Mining
Sponsored Session
Chair: Mustafa Gokce Baydogan, Assistant Professor, Bogazici University, Department of Industrial Engineering, Bebek, Istanbul, 
34342, Turkey, mustafa.baydogan@boun.edu.tr
1 - On the Parameter Identification of a New Knot Selection 
Procedure in Mars 
Cem iyigun, Associate Professor, Middle East Technical 
University, ODITU Kampusu Endustri Muhendisligi Bolum, 
Oda 331 Cankaya, Ankara, 06801, Turkey, iyigun@metu.edu.tr, 
Elcin Kartal Koc
Multivariate Adaptive Regression Splines (MARS) is a popular nonparametric 
regression for estimating the nonlinear relationship within data via piecewise 
functions. A clustering based knot selection method has been proposed to the 
literature recently. This study proposes a parameter selection criteria based on 
Schwarz’s Bayesian Information for determining the optimum grid size and 
threshold value of this new procedure. Numerical studies are conducted via 
artificial and real datasets.
2 - Discovering Interpretable Nonlinear Variation Patterns in 
High-Dimensional Data over Spatial Domains 
Phillip Howard, Arizona State University, 699 S Mill Ave, Tempe, 
AZ, 85281, United States of America, phoward@asu.edu, 
Daniel Apley, George Rung
The objective of this research is the identification of distinct and interpretable 
nonlinear variation patterns in high-dimensional data through dimensionality 
reduction. We present a new method for learning reduced dimension 
representations which characterize interpretable variation sources when mapped to 
the original feature space. A new metric for measuring how well the solution 
can be interpreted is also proposed. We compare our work to alternative methods 
using several examples.
3 - EEG Signal Classification using Functional Principal 
Component Analysis 
Wo-Sik Choi, Mr., Korea University, 145, Anam-Ro, Seongbuk-Gu, 
Innovation Hall, 816, Korea University, Seoul, Korea, 
Republic of, etpist@korea.ac.kr, Seoung Bum Kim
Electroencephalogram (EEG) is recordings of the electrical potentials of the brain. 
Identifying human activities from EEG is the main goal of brain computer 
interface area. To analyze events, selecting important features is a crucial step. 
In this study, we propose a feature extraction using functional principal component 
analysis with general classification methods. The effectiveness of the proposed 
method is demonstrated through a real data from the brain computer interface 
competition 2003.
4 - Modeling Time-varying Autocorrelation for Time Series Classification
Mustafa Gokce Baydogan, Assistant Professor, Bogazici University, Department of Industrial Engineering, Bebek, Istanbul, 34342, Turkey, mustafa.baydogan@boun.edu.tr,
George Runger
We introduce a novel approach to model the dependency structure in time series (TS) that generalizes the concept of autoregression to local auto-patterns. A learning strategy that is fast and insensitive to parameter settings is the basis for the approach. This unsupervised approach to represent TS generally applies to a number of data mining tasks. We provide a research direction that breaks from the linear dependency models to potentially foster other promising nonlinear approaches.

5 - Enterprise Social Networking and Firm Creativity
Donghyun Kim, Delta State University, 1003 West Sunflower Road, Cleveland, MS, 38733, United States of America,
dkim@deltastate.edu, Jaemin Kim
This study examines the influence of firm’s IT social networking (SN) capacity on the firm’s creativity and innovation. Analyzing data on utility patents of 7 firms using enterprise SN, we tested our predictions on a balanced panel of the firms’ data. The results illustrate how IT SN capacity can aid in the generation of an idea.

■ TD32
32-Room 409, Marriott
Data Mining
Contributed Session
Chair: Gustavo Lujan- Moreno, Arizona State University, Tempe, AZ, United States of America, glujannmo@asu.edu
1 - Open-source Statistical Packages: The True Cost of “Free” Software
Ronald Klimberg, Saint Joseph’s University, 35 Moorlinch Blvd., Medford, NJ, 08055, United States of America, klimberg@sju.edu, Rick Pollack, Susan Folz Boklage
Open source software is typically free and widely accessible to the public. In the statistical realm, R is the dominant open-source player. Is it really free? Where do you go for support? Are their possible significant costs associated with using R? Further, to what degree should open-source statistical software be used and taught in academia? This article will explore these questions, as well as others, in discussing what are often the hidden costs of using open-source statistical software.
2 - Study on Effects on Emotional Intensities of Negative Online Reviews on its Usefulness
Cuiping Li, Huazhong University of Science and Technology, 1037 Luoyu Rd, Hongshan District, Wuhan, Hubei, 430074, China, 412543536@qq.com, Qian Yuan, Shuqin Cai
Aimed at recognizing high quality reviews from mass data, this paper explores how reviews’ negative emotions influence the usefulness of negative online reviews by using data mining technology and regression analysis. The result reveals that strong negative emotions reduce negative reviews’ usefulness and moderate negative emotions have opposite effect. Results also show that different intensities of negative emotions have significant interactions on reviews’ usefulness.
3 - Impact of Library Online Resource use on Students Academic Outcome
Fan Zhang, University of Pittsburgh, 1048 Benedum Hall, Department of Industrial Engineering, Pittsburgh, PA, 15261, United States of America, f2331@pitt.edu, Louis Luangkesorn, Ziyl Kang, Yunjie Zhang, Shi Tang
University libraries have a need to demonstrate the impact of their resources on the University mission: academics and research. However, for electronic resources, research has shown that students often do not recognize they are using library resources, making surveys and other assessments not useful. We use undergraduate demographic and academic outcome data along with logs of online library resource access to determine if relationship exists between online resource use and academic outcome.
4 - A Case-Crossover Study to Evaluate the Effect of Player Affective State on Performance in Video Game
Gustavo Lujan- Moreno, Arizona State University, Tempe, AZ, United States of America, glujannmo@asu.edu
Using an electroencephalogram (EEG) headset we examined whether there was a significant change in the affective state reported by the EEG when a participant made a mistake while playing a popular video game. There were five affective constructs that were examined: engagement, frustration, meditation, short and long term excitement. We propose a case-crossover methodology to analyze this type of events. Results show that there is a significant difference in three affective states.

■ TD33
33-Room 410, Marriott
Decision and Prediction Models in Healthcare
Sponsor: Health Applications
Sponsored Session
Chair: Jakob Kotas, University of Washington, Dept. of Applied Mathematics, Box 353925, Seattle, WA, 98195, United States of America, jkotas@uw.edu
1 - A Stochastic Program with Chance-constrained Recourse for Surgery Scheduling and Rescheduling
Gabriel Zenarosa, PhD Candidate, University of Pittsburgh, 3700 O’Hara Street, Benedum Hall 1048, Pittsburgh, PA, 15261-3048, United States of America, glz5@pitt.edu, Andrew J. Schaefer, Oleg Prokopiev
Aggregate surgical expenditures in the US amount to a significant percentage of GDP. About 42% of hospital revenues are generated by operating rooms (ORs), yet ORs run at only 68% capacity on average. The most important issues in OR management are centered on scheduling. Advance schedules improve OR efficiency; however, surgeries are rescheduled in practice as they rarely go as planned. We present a stochastic program with chance-constrained recourse for surgery scheduling and rescheduling.
2 - Dynamic Scheduling of a Post-discharge Follow-up Organization to Reduce Readmissions
Sean Yu, Indiana University-Bloomington, 1275 E. Tenth Street, Bloomington, IN, 47405, United States of America, xy9@indiana.edu, Shanshan Hu, Jonathan Helm
Hospital readmissions are a growing problem. Many readmissions are preventable by properly monitoring patients post-discharge. We consider an organization that dynamically will schedule and staff post-discharge monitoring schedules for a cohort of patients being randomly discharged from client hospitals. We formulate this problem as an infinite horizon dynamic program that can be solved using approximate dynamic programming.
3 - Predictive Capabilities in Hierarchical Node-based Clustering of Time Series
Hootan Kamran, PhD Candidate, University of Toronto, 12 Rodney Blvd., North York, ON, M2N4B6, Canada, hootan@mie.utoronto.ca, Dionne Aleman, Kieran Moore, Mike Carter
Flu activity is shown to be affected by local variables such as climate. Therefore, localized activity must be monitored to study spatiotemporal spread patterns of the disease. Using a 10-year flu dataset from 103 hospitals in Ontario, we compare predictive capabilities extracted from existing aggregation scheme (LHIN) with those extracted from the novel hierarchical node-based clustering scheme and show that the new method will extract more statistically significant predictive capabilities.
4 - A Stochastic Dynamic Programming Model for Response-guided Dosing
Jakob Kotas, University of Washington, Dept. of Applied Mathematics, Box 353925, Seattle, WA, 98195, United States of America, jkotas@uw.edu, Archis Ghate
We discuss a stochastic dynamic programming (DP) model to assist with dosing decisions in response-guided dosing (RGG). The goal in this framework is to deliver the right dose to the right patient at the right time. We present robust, optimal learning, and optimal stopping variants of this problem. The structure of optimal policies in these problems will be explored both analytically and numerically.
Two mathematical models are developed with different objectives. The models are scheduled in order to reach a set of critical nodes such as schools and hospitals. The performance, we combine and utilize several real dataset from the healthcare sector.

2 - The Impacts of Healthcare Information Exchanges: An Empirical Investigation
Emre Demirezen, Assistant Professor, Binghamton University
SUNY, 4400 Vestal Parkway East, AA-242, Binghamton, NY, 13902, United States of America, edemirezen@binghamton.edu, Subodha Kumar, Ramkumar Janakiraman

In the last decade, the U.S. government has been aggressively promoting the use of electronic health records and the establishment of regional healthcare information exchanges (HIEs). HIEs facilitate electronic health information exchange among healthcare providers that is considered to be beneficial for the society. However, the real benefits of HIEs are not well understood. Hence, in this study, we work with an HIE provider based in the state of New York to investigate the benefits of HIEs.

3 - Chance Constrained Operating Room Scheduling with Uncertain and Ambiguous Information
Zheng Zhang, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48105, United States of America, zzhang0409@gmail.com, Brian Denton, Xiaolan Xie

We describe stochastic programming and distributionally robust optimization models that allow for uncertain or ambiguous surgery duration data, respectively. Each of the models considers surgery-to-OR allocation decisions in the context of probabilistic constraints on completion time that vary by OR. We describe column generation approaches that are tailored to these two model formulations. Results are presented to illustrate the potential use of these models in practice.

4 - Bundled Payments for Healthcare Services: A Framework for the Healthcare Provider Selection Problem
Seokjun Youn, PhD Student, Research Assistant, Mays Business School, Texas A&M University, 320R Wehner Building, 4217 Texas A&M University, College Station, TX, 77843, United States of America, syoun@mays.tamu.edu, Chelliah Sriskandarajah, Subodha Kumar

Identifying competitive healthcare providers is an important issue for the successful operation of bundled payments. We develop a selection framework via data envelopment analysis and combinatorial auction (CA). Based on efficiency and effectiveness measures, outstanding performers are pre-selected. Finally, CA determines winners. To evaluate the impact of design issues on the CA performance, we combine and utilize several real dataset from the healthcare sector.

1 - Solution Methodologies for Debris Removal in Disaster Response
Bahar Y. Kara, Associate Professor, Bilkent University, Industrial Engineering, Ankara, Turkey, bkara@bilkent.edu.tr, Oya E. Karasan, Nihal Berktaş

In this study we provide solution methodologies for debris removal problem in the response phase. Debris removal activities on certain blocked arcs have to be scheduled in order to reach a set of critical nodes such as schools and hospitals. Two mathematical models are developed with different objectives. The models are tested over real data from districts of Istanbul.
1 - Assessment of a Novel Device for Elbow Rehabilitation in Humans
Aline Callegaro, Researcher, UFRGS, 99 Osvaldo Aranha Avenue, 5 Floor, Porto Alegre, RS, 90035190, Brazil, nimacall@gmail.com, Carlos Fernando Jung, Clarissa Brusco, Marcelo Gava Poppermayer, Márcia Elisa Echeveste, Carla Schwenger ten Caten.

This study aimed to assess a novel device for elbow rehabilitation in humans. The functional prototype assessment was based on data collection in two stages: application of local muscle vibration; and its association with Continuous Passive Motion. Two way ANOVA was used to analyse the main factors. An average increase of the muscle electrical activation resulted in first stage. The main factors (frequency, sex, and treatment) had significant effect, as well as few interactions.

2 - Minimizing Metastatic Risk in Radiotherapy
Fractionation Schedules
Hamidreza Badri, Graduate Student, University of Minnesota, ISYE Department, 111 Church Street S.E., Minneapolis, MN, 55455, United States of America, badr019@umn.edu, Jagdish Ramakrishnan, Kevin Leder.

The treatment of metastatic cancer remains an extremely challenging problem. Here we consider the problem of developing fractionated irradiation schedules that minimize production of metastatic cancer cells. We observe that the resulting fractionation schedules are different than those that result from more standard objectives such as minimization of final primary tumor volume. Delivering large doses in small fractions is suggested even in cases when a/b value of the tumor is large.

3 - Customized 3D Printed Implants with Internal Channels for Intracavitary High Dose Rate Brachytherapy
Animesh Garg, PhD Student, UC Berkeley, 4141 Etcheverry Hall, Berkeley, CA, 94720-1777, United States of America, garg.animesh@gmail.com, Jean Pouliot, Gregory Tonkay, Robert Storer, Randy Robinson, Bemidji State University, Bemidji, MN, robinson@bemidjistate.edu

High-Dose Rate Brachytherapy is an internal radiation therapy frequently used for cancer treatment. Radioactive sources are briefly placed proximal to tumors. Current methods for intracavitary HDR-BT use generic templates which limits dose distribution to a small set of linear channels. We propose the use of algorithmically customized 3D Printed implants with curved internal channels that fit cavities without tissue puncture and aim to improve dose distribution and treatment quality.

4 - Surgery Sequencing and Scheduling in Multiple ORs with PACU Constraints
Miao Bai, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, mb411@lehigh.edu, Gregory Tonkay, Robert Storer

We study a multiple-OR surgery sequencing and scheduling problem with PACU constraints. To minimize the cost incurred by waiting, idleness, OR blocking and overtime, a two-stage solution scheme is proposed. In the first stage, a time-indexed integer program is formulated and solved by Lagrangian relaxation and dynamic programming to determine surgery sequences. Given surgery sequences in all ORs, scheduled times of patients are found in the second stage by a sample-gradient-based algorithm.

1 - Fluctuation Analysis and the Marked Poisson Process
Randy Robinson, Bemidji State University, Bemidji, MN, United States of America, rrobinson@bemidjistate.edu

This presentation studies the marked point process with position dependent marking. The focus was on predicting the first passage time of the marked random walk when exiting a given rectangular set and the value of the process upon exit. A new density function for the related processes has been obtained: a product of a negative exponential and modified Bessel functions.
3 - Supply Chain Power and Store Brand
Jun Ru, Assistant Professor, University at Buffalo, 326D Jacobs, Buffalo, NY, 14260, United States of America, junru@buffalo.edu, Ruixia Shi, Jun Zhang

This paper relates a retailer’s store brand strategy to the relative powers of channel members and offers a new explanation for the differences in retailers’ store brand strategies. Our analysis shows that store brands become less appealing to a retailer as it becomes more powerful.

4 - Consumer Preference Mismatch and Channel Choice Decisions under Competition
Kunpeng Li, Utah State University, 3555 Old Main Hill, Logan, UT, United States of America, kunpeng.li@usu.edu, Suman Mallick, Dilip Chhajed

We consider a product consisting of two components sold by two firms. A product/firm is integrated when both components are designed by a single firm, and is non-integrated otherwise. The consumers choose to purchase a product that better matches the specifications of their ideal product. Using a duopoly model, we study the effects of consumer preference mismatch on channel integration strategies.

5 - An Empirical Study to Examine Consumer Behavior towards Luxury Brands in Pakistan
Faryal Salman, Assistant Professor, SZABIST, 90 Clifton, Karachi, Karachi, Pakistan, faryal.sinam@szabist.edu.pk, Usman Warraich

Current study seeks to expand an understanding of consumer behavior towards branded goods. The data for this exploratory study was collected from urban youth of Pakistan. The study postulates significant relationship between consumer behavior and the predictors for various product categories. Regression analysis shows that these variables pose the positive impact on the buying behavior (p value (0.05) and this model shows R2 of 0.73.

**TD41**

Healthcare Supply Chain Decision Making
Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations
Sponsored Session

Chair: Xinghao Yan, Assistant Professor, Ivey Business School, Western University, 1255 Western Road, London, ON, N6G0N1, Canada, xyan@ivey.uwo.ca

1 - Determinants of Distribution Channel Choice in Pharmaceutical Industry – Specialty Drugs
Liang (Leon) Xu, University of Missouri-St. Louis, St. Louis, MO, United States of America, lpx2@umsl.edu, Vidya Mani, Hui Zhao

We use privately collected multi-year transaction data to study determinants of the choice of distribution channels for specialty and non-specialty drugs. Further, we explore how this channel choice explains observed variations in supply chain metrics in this industry.

2 - Transforming Drug Development via System Computational Modeling
Jinha Lee, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, United States of America, jlee68@gatech.edu, Eva Lee

We describe the first in-silico drug design system model to accelerate drug discovery. The model spans preclinical, clinical, IND and NDA tasks; and allows global risk analysis. It identifies bottlenecks, and performs system optimization that offers a holistic view of discovery pathways. Rapid development is achieved through parallel processes that shorten critical paths from start to registration of a new drug. The generalizable design allows rapid testing, and minimizes risk, cost, and time.

3 - Operational Performance Evaluation of Reverse Referral Partnership in the Chinese Healthcare System
Nan Kong, Associate Professor, Purdue University, 206 S. Martin Jischke Dr., West Lafayette, IN, United States of America, nkong@purdue.edu, Quanlin Li, Na Li, Zhibin Jiang

Reverse referral of patients from upper-level hospitals to lower-level hospitals after their acute care, has been promoted in the tiered Chinese care system to alleviate resource pressure at high-level hospitals and balance utilizations throughout the system. However, it remains unclear how to implement reverse referral partnerships given the conflicting interests. We develop a two-level queueing network model to capture patient flows and derive analytical results on queuing performance measures. Our work is expected to guide the establishment of hospital alliances in China.

4 - Influenza Vaccine Supply Chain with Vaccination Promotion Effort and its Coordination
Xinghao Yan, Assistant Professor, Ivey Business School, Western University, 1235 Western Road, London, ON, N6G0N1, Canada, xyan@ivey.uwo.ca, Gregory Zaric

We develop an influenza vaccine supply chain model consisting of a health authority, a vaccine manufacturer, and population. The health authority decides order quantity and effort exerted to increase vaccination demand; the manufacturer decides production effort; and population decides the vaccination probability. We find that the three parties’ decisions at equilibrium and different coordinating contract formats, such as a contract with payment linear/ piecewise linear w. r. t. order quantity.
the K-shortest paths algorithm, able to find an optimal K products’ configuration

2 - Dynamic Pricing for Mobile Apps
Kejia Hu, Kellogg School of Management, Northwestern University, 2169 Campus Drive, Evanston, IL, United States of America, k-hu@ Kellogg.northwestern.edu, Chaitanya Bandli, Srikanth Jagabathula
Mobile apps is special in the following aspects. It has no inventory constraint, almost zero marginal cost and free version updates. In our research, we will model these features and show the dynamic pricing for mobile apps.

2 - Optimal Pricing for a Multinomial Logit Choice Model with Network Effects
Chenhao Du, Student, University of Minnesota, 425 13th Ave SE, Apt. 1502, Minneapolis, MN, 55414, United States of America, duxxx181@umn.edu, William Cooper, Zhihuo Wang
We consider a seller’s problem of determining revenue-maximizing prices for an assortment of products that exhibit network effects. Customers make purchase decisions according to a modified MNL choice model. We show that the optimal strategy is either to maintain a semblance of balanced sales among all product or to boost the sales of exactly one product. We also show the importance of taking the network effects into consideration.

3 - Pricing Ancillary Service Subscriptions
Ruxian Wang, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu, Maqbool Dada, Ozge Sahin
We investigate customer choice behavior in the presence of main products, ancillary services with options of pay-per-use and subscription, as well as the outside option. Analytical results and numerical experiments show that offering service subscriptions may result in “win-win-win” “win-win-lose” “lose-lose-win” and other situations for the firm, competitors and customers in the monopolistic and competitive scenarios.
Yelp.com and quantify the value of social network knowledge empirically. We find that the optimal strategy is non-network structure, customer characteristics, and information structure, and comparison. We build a stylized game-theoretic model of strategically interacting the service qualities from the social network. We study the interplay among strategy for a firm selling to socially connected customers engaged in social opening up new opportunities for businesses. We identify an optimal distribution algorithm to optimize the regret.

When demand function is known. We study the asymptotic near-optimal policy when demand function is known. We study the asymptotic near-optimal algorithms to optimize the regret.

We investigate whether organizations can create value by introducing visual transparency between consumers and producers. Two field and three laboratory experiments in food service settings suggest that transparency that 1) allows customers to observe operational processes and 2) allows employees to observe customers not only improves customer perceptions, but also increases service quality and efficiency.

We consider the classic joint pricing and inventory control problem with lost-sales and censored demand in which the demand distribution is not known to the firm a priori. Conventional learning algorithms are not applicable as the firm can observe neither the realized value nor any derivative information of the true objective function, and the estimate of the expected profit function from data is not unimodal. We develop a data-driven algorithm which converges and provide its convergence rate.

We analyze price recommendations with a large dataset of mobile money agent transactions in an East African country.

In a supply chain, consisting of a buyer and a supplier, this study analyzes the effect of relative bargaining power and technology uncertainty on the supplier's decision to invest in energy efficiency (EE) measures. We analyze price commitment and shared investment contracts and compare the two mechanisms in their ability to boost EE investment when the buyer's high bargaining power in addition to high technology uncertainty prevent the supplier from investing in EE.

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" and demonstrate its many interesting properties. We then discuss the technology-and-market equilibrium under different structural assumptions.

When firms can choose from a set of potential production technologies and offshore facilities hold a production cost advantage, I show that carbon leakage due to offshoring and/or foreign entry can result despite the implementation of a carbon tariff. However, in such a setting, carbon leakage is shown to conditionally decrease global emissions, contradicting prevailing popular opinion and widely reported results that do not account for technology choice or foreign production cost advantage.

Kotsas Bimpikis, Stanford GSB, 653 Knight Way, Stanford, CA, 94305, United States of America, kotsasb@stanford.edu, Ozan Candogan, Shayan Elsah We investigate whether organizations can create value by introducing visual transparency between consumers and producers. Two field and three laboratory experiments in food service settings suggest that transparency that 1) allows customers to observe operational processes and 2) allows employees to observe customers not only improves customer perceptions, but also increases service quality and efficiency.
New Directions at the Interface of Finance, Operations, and Risk Management

Sponsor: Manufacturing & Service Oper Mgmt/IFORM

Sponsored Session

Chair: Gerry Tsoukalas, Assistant Professor, Wharton, 3730 Walnut street, Philadelphia, PA, 19104, United States of America, gtsouk@wharton.upenn.edu

Co-Chair: Vlad Babich, Georgetown University, Washington, D.C., volodymyr.babich@georgetown.edu

1 - Supply Chain Contract Design under Financial Constraints and Bankruptcy Costs

Panos Kouvelis, Professor, Olin Business School, Washington University in St. Louis, St. Louis, MO, United States of America, kouvelis@wustl.edu, Wenhui Zhao

We study contract design in a supply chain of two capital constrained firms in need of short-term financing. The failure of loan repayment leads to bankruptcy with fixed and variable default costs. With only variable default costs, buyback contracts remain equivalent to revenue-sharing contracts, which coordinate with working capital adjustments. With fixed default costs, a revenue-sharing contract with working capital coordination might have higher expected profit than the one-firm system.

2 - Network Recovery using Transactional Information

John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

Firms operate as components of complex networks of physical and financial flows. The structure of these networks is however not easily observed. This talk will discuss methodologies to uncover such hidden structure using inverse optimization techniques.

3 - Does Operational Investment Vary with Capital Structure?

Vishal Gaur, Cornell University, 321 Sage Hall, Ithaca, NY, 14850, United States of America, vg77@cornell.edu, Yasin Alan

We investigate the relationship between the operational investment of firms and their capital structure choices using data for U.S. manufacturing and retail trade sectors.

4 - Entrepreneurial Finance: Crowdfunding, Venture Capital, and Bank Financing

Vlad Babich, Georgetown University, Washington, DC, United States of America, Volodymyr.Babich@georgetown.edu, Gerry Tsoukalas

We study the interplay between bank financing, venture capital and crowdfunding, in a multi-stage bargaining game, with double-sided moral hazard. We find that while crowdfunding usually serves a positive role, enabling funding for good projects, and avoiding investments in bad projects, it may also hurt VCs, entrepreneur, and the society.

5 - A Manufacturer's Outlet Decision: The Impact of Quality, Innovation and Market Awareness

Jennifer Ryan, RPI, ISE, CIL, Troy, NY, 12180, United States of America, ryanj6@rpi.edu, Daewon Sun

We consider a manufacturer of a luxury good who must determine whether to sell products only through a manufacturer-owned retail store, or to also sell products through the factory outlet store. We study how this decision depends on the relative qualities of the products offered on the two channels, as well as the manufacturer's ability to innovate and introduce new product lines. In addition, our multi-period model captures the impact of market share on the manufacturer's brand awareness.
2 - Long-Term Partnership for Achieving Efficient Capacity Allocation
Fang Liu, Assistant Professor, Nanyang Business School, Nanyang Technological University, 50 Nanyang Avenue, South Spine S3-B2A-13, Singapore, 639798, Singapore, liu_fang@ntu.edu.sg,
Tracy Lewis, Tatiana Kurihiko, Jeanette Song

We consider a manufacturer and a group of buyers who share a scarce but expensive-to-build capacity over a finite period. Each member has private history-dependent demand information and makes unverifiable investments. Because of the high uncertainty, achieving supply chain efficiency while sustaining under a dynamic environment is challenging for the partnership. We construct a membership agreement that enforces efficient capacity allocation and investments by introducing a novel breach remedy.

3 - The Perils of Sharing Information in a Trade-association
Noam Shami, Assistant Professor, Tel-Aviv University, Haïm Levanon, Tel-Aviv, Israel, nshamir@post.tau.ac.il, Hyoduk Shin

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.

4 - Aligning Incentives in Omni-channel Sale
Elnaz Jallipour Alishtah, PhD Candidate, University of Washington, Seattle, Foster School of Business, Mackenzie Hall 358, Seattle, WA, 98195-3200, United States of America, jallipo@uw.edu, Yong-Pin Zhou, Jingqi Wang

We consider a retailer with both online and offline channels. While the online store exerts costly effort to attract customers, the offline store handles inventory for both locations – including fulfillment of online orders. We study how the retailer should appropriately credit both channels to align their incentives.

4 - Selling Fashionable Products: Change Price or Facilitate Learning?
Yufei Huang, PhD Student, University College London, Gower Street, London, United Kingdom, yufel.huang.10@ucl.ac.uk,
Onesun Steve Yoo, Bilal Gokpinar, Chris Tang

Firms selling new fashionable products are shifting their focus away from pricing and towards facilitating the learning process for customers. To understand this phenomenon, we present an applied model with relationship among channels through which customers learn. We find that for new fashionable products, facilitating learning can lead to greater profit than variable pricing. Moreover when firms facilitate learning, variable pricing has only a marginal effect on firm profits.

TD52
52-Room 107A, OC
Social Media and Internet Marketing
Sponsor: Marketing Science
Sponsored Session
Chair: Michael Trusov, University of Maryland, 3454 Van Munching Hall, College Park, MD, United States of America, mtrusov@rhsmith.umd.edu

1 - Attribution Metrics and Return on Keyword Investment in Paid Search Advertising
Hongshuang Li, Indiana University, Bloomington, IN, United States of America, lhshruc@gmail.com, Siva Viswanathan, Ablishek Pani, P.K. Kannan

In this paper, we analyze the impact of the attribution metric used for imputing conversion credit to search keywords on the overall effectiveness of keyword investment. We present a stylized model with relationship among channels of the advertiser’s bidding decision for keywords, the search engine’s ranking decision for these keywords, and the consumer’s click-through rate and conversion rate on each keyword, and analyze the impact of the attribution metric used on the overall return-on-investment of paid search advertising.

2 - Controlling for Self Selection Bias in Customer Reviews
Leif Brandes, University of Warwick, Coventry, CV4 7AL, United Kingdom, Leif.Brandes@wbs.ac.uk, David Godes, Dina Mayzlin

Customers frequently use user online reviews as a valuable information resource before making a purchase. This observation has motivated a large number of empirical studies, and it is now a well-established finding that customer online reviews impact product sales. However, one possible criticism of online user reviews as a source of information is the self-selection inherent in the review process. That is, consumers self-select into choosing whether to review a product, which suggests that reviews may be prone to the extremity bias: the distribution of reviews may be more polarized than the true preference distribution. This of course implies that posted review valence may not always provide an unbiased representation of customers’ true product experiences. We provide survey evidence that demonstrates that customers who post an online review tend to have more extreme opinions than customers who never post a review. We hypothesize that the consumers who have more extreme opinions post their reviews quicker, while the consumers with more moderate opinions may take longer to post a review, which implies that in the limit some consumers with moderate opinions may never post a review. One implication of this is that reviews that arrive after a long time lapse are more similar to the opinions of the non-responders. Hence, a firm that is able to observe the time lapse between the experience and the review should be able to calculate the valence of reviews in a way that corrects for the non-response bias. That is, we suggest how to correct for the extremity bias by taking into account the latency of response data. To test our hypotheses, we use a new dataset from a large online travel portal. Overall, we have detailed information on 1.26 million bookings and 2.75 million reviews over the complete history of the firm (twelve years). Because we observe hotel bookings and review provision behavior at the individual customer level, we know for each customer the exact duration between her last travel day and the day that she provided the review. Based on our empirical results, we show how customer self-selection across time impacts her review behavior and suggest a method for controlling for this bias.
3 - Deal or No Deal? The Quality Implications of Online Daily Deals and Competition
Jorge Mejia, University of Maryland, Robert H. Smith School of Business, College Park, MD, United States of America, jmjeia@rhsmith.umd.edu, Anand Gopal, Michael Trusov

Consumers use online reviews to inform purchasing decisions about many products/services. Moreover, online daily deals have become an important part of the marketing mix for merchants. The objective of this study is to understand the effect of daily deals on consumers’ quality perceptions, expressed through online reviews and investigate potential moderators for this effect, such as merchant characteristics and competition. We combine online reviews for restaurants from Yelp with data from online deals in a major American metropolitan area. We find that online deals have a significant negative effect on online reviews. Additionally, this effect is moderated by certain merchant characteristics such as price point and restaurant age. We also find that the reviews of merchants who do not offer deals are affected by nearby deal competition. We replicate our empirical findings by conducting three lab studies using subjects from MTurk and find consistent results, thus showing robustness.

4 - Swayed by the Numbers: The Consequences of Displaying Review Counts in Purchase Decisions
Jared Watson, University of Maryland, College Park, MD, United States of America, jwatson@rhsmith.umd.edu, Michael Trusov, Anastasiya Pocheptsova

Online retailers often display consumers’ review to aid consumers‘ decision-making. While prior literature postulates that an increase in review counts leads to an increase in consumers’ purchase intentions, the authors find an important corollary: holding purchase intentions constant, revealing a small review count systematically biases consumers’ preferences between choice options. Further, withholding review count information increases purchase intention relative to a small review count. These findings are contrasted with current retailer practices of revealing small review count information.

■ TD53
53-Room 107B, CC
Inventory and Information Sharing
Sponsor: Behavioral Operations Management
Sponsored Session
Chair: Ennio Siemsen, Associate Professor, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu

1 - Decision Dependent Bounded Rationality in Dual Sales Channel Management
Ozalp Ozer, The University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, United States of America, ozeruz@utdallas.edu, Kay-Yut Chen

We experimentally study behaviors in a dual sales channel in which a manufacturer sells through his direct channel and an independent retailer. The channels compete on demand. The manufacturer sets the wholesale price for the retailer, and also delivery times for customers in his direct channel. The retailer decides on its inventory level. We show and discuss why bounded rationality differs, in the same subject pool, across three decisions and model the behavior as quantal response equilibrium.

2 - Behavioral Inventory Sharing
Ennio Siemsen, Associate Professor, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu, Hui Zhao

The benefits of aggregating demand for reducing required safety stock investments in supply chains are well known. Yet, if decision makers are decentralized and keep separate stockpiles of inventory, these benefits can only be reaped if they agree to transship their inventory to others. We find effective communication strategies can significantly improve performance and such improvements are more significant under higher critical ratios.

3 - Communication Strategies in Assembly Systems: An Experimental Investigation
Jud Kenney, McGill University, Bronfman Building, Montreal, Canada, jud.kenney@mail.mcgill.ca, Jim Engle-Warnick, Saibal Ray

This study investigates how supply chain partners in an assembly system react to three different strategies of communicating supply risk. Our behavioral experiment uses a minimum game to model suppliers deciding on the amount of capacity to build when facing certain end customer demand, but uncertain supply from their peers. We find effective communication strategies can significantly improve performance and such improvements are more significant under higher critical ratios.

4 - Is Non-linear Pricing Contract Always Better than Linear Pricing Contract?
Guangwen Kong, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55414, United States of America, gkong@umn.edu, Tony Haitao Cui

We study supply chain contracts with consideration of information sharing and bounded rationality. We examine a dyadic supply chain where a supplier with more accurate demand information sells products to a bounded rational retailer. The research suggests that the supplier can be better-off by using a linear pricing contract than adopting a buy-back contract. The supplier either shares information with the retailer or help improve the retailer’s bounded rationality but not both in equilibrium.

■ TD54
54-Room 108A, CC
Meta-algorithms: From Algorithm Tuning and Configuration to Algorithm Portfolios
Cluster: Tutorials
Invited Session
Chair: Meinoll Sellmann, IBM, Yorktown Heights, NY, United States of America

1 - Meta-algorithms: from Algorithm Tuning and Configuration to Algorithm Portfolios
Meinoll Sellmann, IBM, Yorktown Heights, NY, United States of America

Efficiency and accuracy are of primary concern when developing analytics solutions in OR. Typically, there is more than one possible algorithmic approach and none dominates the others. Moreover, algorithms usually have implicit or explicit parameters that greatly affect performance. Meta-algorithms focuses on the development of effective automatic tools that tune algorithm parameters and, at runtime, choose the approach best suited for the given input. Here we summarize the lessons learned when devising such tools.

■ TD55
55-Room 108B, CC
Data Envelopment Analysis (DEA)
Contributed Session
Chair: Samir Srairi, Ministry of Higher Education and Scientific Research, 14 Avenue de Tunis, Ariana, 2080, Tunisia, srairisamir3@gmail.com

1 - Combination of Hybrid Two Level DEA with SVM for Indicator Weighting in Financial Failure Prediction
Chao Huang, Southeast University, Xuan Wu District, Sipailou No.2, Nanjing, 210096, China, huangchao@seu.edu.cn

A new WPF two level DEA is proposed to identify the bankruptcy firms by constructing a worst-practice frontier. Combining traditional BPF two level DEA and WPF two level DEA, a hybrid model is put forward as a tool for cooperates financial failure prediction. To improve the accuracy, a new indicator weighting method based on SVM is also proposed. The empirical results show that the proposed hybrid method has excellent bankruptcy prediction ability.

2 - A Cross-Dynamic Evaluation of Warehouse Operations
Jose Humberto Ablanedo Rosas, Associate Professor, University of Texas at El Paso, 500 W University Avenue, Marketing & Management Department, El Paso, TX, 79968, United States of America, jablanedorosas2@utep.edu, Faruk Arslan

We report a cross-dynamic comparison of distribution centers worldwide. This problem has been analyzed with the Malmquist productivity index; we introduce an approach based on cross-efficiency assessment which eliminates the drawbacks of tradiotional cross-efficiency methods. A comparison between both approaches is discussed and managerial recommendations for decision makers are derived.

3 - Performance Evaluation of Dynamic Supply Chain using Dea
Somayeh Mamizadeh-Chaghcheyeh, Asia Business Clusters & Networks Development (ABCD) Foundation Cooperation, moreiran, Tehran, Iran, somayeh_mamizadeh@yahoo.com, Abbas Ali Noura

One of the main researches in supply chain management is to improve the overall efficiency based on dynamic performance of supply chain. In this paper, by developing the basic dynamic model, different methods for evaluating the supply chain are studied. Dynamic Data Evolution Analysis as an efficient tool is new research focus in supply chain benchmarking. We develop DDEA models that can be evaluating the overall efficiency of supply chains and subsystems.
4 - On Integrating DEA and AHP for the Facility Layout Design in Manufacturing Systems
Toloo Mehdi, Technical University of Ostrava, Ostravec, Czech Republic, mtech.tolo@vsb.cz

Analytic hierarchy process (AHP) is a decomposition multiple-attribute decision making (MADM) method, which can represent human decision making process and help to achieve better judgments based on hierarchy, pair-wise comparisons, judgment scales, allocation of criteria weights and selection of the best alternative from a finite number of variants by calculation of their utility functions. Data envelopment analysis (DEA) is a well-known non-parametric method to evaluate the performance of a set of homogenous decision making units (DMUs) with multiple inputs and multiple outputs.

5 - The Efficiency of Tunisian Universities: An Application of a Two-Stage DEA Approach
Samir Srairi, Ministry of Higher Education and Scientific Research, 14 Avenue de Tunis, Arian, 2080, Tunisia, srairisamir3@gmail.com

This paper examines the efficiency of eleven universities in Tunisia during the period 2009-2013. Regression analysis suggests that a higher share of professors, a higher number of women in academic staff and a better quality of student in secondary education improve the efficiency of the university.

■ TD56
56-Room 109A, CC
Project Selection, Evaluation and Collaboration
Cluster: New Product Development
Invited Session
Chair: Yaozhong Wu, National University of Singapore, NUS Business School, Singapore, yaozhong.wu@nus.edu.sg

1 - An Experimental Study of Idea Selection Process
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, Shijith Payyadak, Dinney Goncalves

In this study, we design several online experiments to compares the efficacy of two commonly observed processes of idea selection: scoring vs. ranking. In scoring process, subjects are asked to evaluate the quality of each idea and give a score while in ranking process, subjects are asked to only rank the ideas according to their preferences. We find that the choice of idea selection process depends on some contextual factors.

2 - Overvaluation of Process Innovation Ideas
Fabian Sting, Erasmus University Rotterdam, Rotterdam, Netherlands, fabian.sting@rsm.nl, Christoph Fuchs, Maik Schlickel

Ideas by employees are a vital source for innovation. But are such ideas overvalued by their creators? If so, which ideas in particular? Drawing on a unique data set that comprises the generation, election, and implementation of process improvement ideas of an automotive supplier, we identify antecedents of overvalued ideas. Overvaluation is greater for ideas generated by higher-level employees, collaboratively versus individually, and by employees with previously lower ideation success.

3 - Project Evaluation and Selection via Risk-adjusted Net Present Value
Nicholas G. Hall, The Ohio State University, Fisher College of Business, Columbus, OH, United States of America, hall.336@osu.edu, Zhixin Liu, Wenhui Zhao

We consider a project with risk that declines over time as its tasks are completed, as reflected in a declining discount rate. The objective is to maximize the NPV of the project. This problem is highly nonlinear, since the discount rate at any point in time is a function of previous scheduling decisions. We solve this model and show that risk-adjusted NPV varies significantly from traditional NPV, and that the use of the risk-adjusted measure significantly improves project selection decisions.

4 - Resource Competitions for Research Projects
Pascale Crama, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, pcrama@smu.edu.sg, Anand Nandkumar, Reddi Kotha

Academic research is funded by governments, but is often seeded through grants from university administered research funds (UARF) and other charitable institutions. We compare the effectiveness of UARF and other sources of funding in obtaining subsequent federal funding and value creation. We build a parsimonious model that can explain the superior productivity of UARF funding and make recommendations on the ideal way to organize UARF funding.

■ TD57
57-Room 109B, CC
Modeling the Economics of Low-Carbon Power Systems
Sponsor: ENRE – Energy I – Electricity
Sponsored Session
Chair: Todd Levin, Energy Systems Engineer, Argonne National Laboratory, 9700 S Cass Ave, Lemont, IL, 60439, United States of America, tlevin@anl.gov

1 - Revenue Sufficiency and Resource Adequacy in Systems with Variable Generation Resources
Todd Levin, Energy Systems Engineer, Argonne National Laboratory, 9700 S Cass Ave, Lemont, IL, 60439, United States of America, tlevin@anl.gov, Aidan Botterud

An efficient MIP framework is applied to analyze the impact of increasing wind power capacity on generator profitability. The model is executed with hourly time steps on a test case that approximates the ERCOT system for a range of wind capacity levels. We analyze three market policies that support resource adequacy and find that some additional market incentives may be required to ensure long term revenue sufficiency and resource adequacy in systems with significant variable energy resources.

2 - An Approximate Model for Scheduling Energy and Reserve in Renewable-Dominated Power Systems
Miguel Carrion, Universidad de Castilla - La Mancha, Av. Carlos III, s/n, Toledo, Spain, miguel.carrion@uclm.es, Rafael Zarate-mihan

Since most of renewable energies are non-dispatchable, an appropriate schedule of reserves in renewable-dominated power systems is crucial. We propose an alternative formulation that co-optimizes energy and reserve considering the uncertainty involved in demand and renewable production. This formulation requires a significantly smaller number of variables and constraints than the classical stochastic economic dispatch problem. The proposed formulation is tested in a realistic case study.

3 - Hydroelectric Bid Optimization under Uncertainty
Andy Philpott, University of Auckland, Engineering Science Department, Private Bag 92019, Auckland, 1025, New Zealand, a.philpott@auckland.ac.nz, Faisal Wahid, Frederic Bonnans, Cedric Gouvernet

We consider the problem faced by the operator of a cascade of hydroelectric generating plants offering energy to a wholesale electricity pool market to maximize revenue. Both energy prices and uncontrolled inflows to the reservoirs of the cascade are assumed to be stochastic. We describe a stochastic dynamic programming model that generates an optimal offer for the next period given current observed prices. This is solved using SDDP when value functions are concave or MIDAS when they are not.

4 - Optimal Timing to Invest, Mothball, Reactivate, and Decommission a Coal Power Plant
Paul Rebeiz, Doctoral Candidate In Operations Mangement, UCLA Anderson School of Management, 110 Westwood Plaza, Los Angeles, CA, 90025, United States of America, paul.rebeiz.1@anderson.ucla.edu, Christian Blanco

Transitioning to a low-carbon economy will require most coal power plants to be replaced by other sources of generation such as wind and solar. We present a dynamic program to solve for the optimal price signals to invest, mothball, reactivate, and decommission a coal power plant. We find that our results are consistent with current industry trends. We conclude with some insights on the effect of renewable energy policy on mothballing and retiring a coal plant.
Natural disasters such as Hurricane Sandy have seriously disrupted the power grids. To increase the resilience of a distribution system under natural disaster attacks, we propose a resilient distribution network design model considering hardening and distributed generation unit placement to minimize the load shedding under worst-case natural disaster attacks.

2 - Electric Resource Optimization with High Penetration Renewables and Varying Reliability Measures
Cynthia Bothwell, Student, Johns Hopkins University, 117 Meridian Lane, Towson, MD, 21286, United States of America, cbothwell@gmail.com, Calvin Wood
As intermittent wind and solar energy resources increase in use throughout the electricity sector, techniques to assess system reliability are evolving. The optimization of investment in new capacity resources changes as a result of the reliability criteria applied to the system. This work overviews for policy and decision makers the tradeoffs between reliability criteria and generation investment with high penetrations of intermittent renewables for capacity planning and market design.

3 - Scheduling Energy Storage Resources to Provide Multiple Services
Johanna Mathieu, Assistant Professor, University of Michigan, 1301 Beal Ave, Ann Arbor, MI, 48109, United States of America, jmathi@umich.edu, Goran Andersson, Olivier Megel

Most energy storage devices in power systems are only partially used most of the time, and so they could also be used to help balance electricity supply and demand. The challenge is how to allocate their energy and power capacities to different services given uncertainty from multiple sources. We formulate the scheduling problem and apply both stochastic dynamic programming and stochastic dual dynamic programming to several case studies, and compare performance and computational complexity.

4 - Bidding Models for Price-responsive Loads in Electricity Markets
Javier Saez-gallego, PhD Candidate, Technical University of Denmark, Matematikorvet Building 303B, 019, Kgs. Lyngby, 2800, Denmark, jsga@dtu.dk, Juan M. Morales, Marco Zugno
This paper presents a data-driven approach to estimate the parameters of the market bid that best represents the stochastic and dynamic behavior of a pool of price-responsive consumers. The proposed methodology is based on inverse optimization and is able to leverage exogenous information, besides the electricity price, to partly explain the parameters of the bid. We use data relative to the Olympic Peninsula project to assess the performance of the proposed method.

Chair: Juan M. Morales, Associate Professor, Technical University of Denmark, Matematikorvet, Building 303b, 008, Kgs. Lyngby, 2800, Denmark, jmmgo@dtu.dk, Salvador Pineda, Marco Zugno
We consider the continuous version of an unit commitment problem with wind penetration, and subject to ramping constraints. The optimization problem assumes that ramping providers are priced at opportunity cost. We explore the scheduling problem and apply both stochastic dynamic programming and stochastic dual dynamic programming to several case studies, and compare performance and computational complexity.
4 - A New Framework for Sustainability Measurement
Anthony Afuf-Dadzie, University of Ghana, P.O. Box LG 78, Legon, Accra, Ghana, atosasarh@gmail.com
This presentation explores a new sustainability measurement and scoring system for assessing the efforts of organizations at meeting sustainability targets. Based on TOPSIS, the proposed measurement and scoring system incorporates all three sustainability dimensions and enables the establishment of a threshold below which an organization is considered to have failed a sustainability test. A time-independent threshold is also introduced to help compare performance over time.

5 - Government Intervention and Technovation Performance: An Empirical Study of Soes from Mainland China
Huan Liu, PhD, Xi’an Jiaotong University, 28B Xianning West Road, Shaanxi Province, Xi’an, 710049, China, liuhanlook@163.com, Jiannan Wu
We use a comprehensive provincial-level panel data set of 30 provinces during 2005-2012. Our results show that project funding and tax break at the provincial level have no impact on new products sales. Project funding has a negative impact on invention patents, by contrast, tax break has a positive impact on invention patents. The interaction term of project funding and tax break has an inverted U-shaped relationship with new products sales, but it has no impact on invention patent.

■ TD61
61-Room 111B, CC
Environmentally Responsible Operations Management
Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session
Chair: Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, COBA 2224, Statesboro, GA, 30460, United States of America, arda@georgiasouthern.edu
1 - Competitive Positioning and Pricing of Green Products with Multiple Environmental Attributes
Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, COBA 2224, Statesboro, GA, 30460, United States of America, arda@georgiasouthern.edu
To address consumers’ sustainability-related product concerns, a thorough approach to improving the environmental profile of one’s products is required. Using one dimension of green may hide possible trade-offs and overlook the fact that consumers’ preferences exhibit different orders in different green attributes. We study a duopoly model that explicitly incorporates multiple environmental attributes into the green product positioning and pricing, along with the trade-offs among them.

2 - Product Line Design: The Impact of Consumers’ Varied Perceptions of Recycled Content
Monire Jalili, University of Oregon, 1208 University of Oregon, Eugene, OR, United States of America, mjalili@uoregon.edu, Nagesh Murthy, Tolga Aydinliyim
We consider a monopolist selling ordinary and green product versions 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 in the green version.) We discuss how the optimal quality and pricing decisions drive demand and profit and whether it is optimal for the firm to only offer the green version (go completely green).

3 - Replenishment Decisions of Perishable Products under Price and Emissions Sensitive Demand
Goke Palak, Assistant Professor Of Operations Management, Shenandoah University, Harry F. Byrd, Jr. School of Business, Winchester, VA, 22601, United States of America, gpalak@su.edu
We extend economic lot sizing models for age dependent perishable products to maximize profit and minimize emissions. This model captures the tradeoffs between supplier and mode selection decisions, profits and emissions, and transportation lead time and remaining shelf life of products. We analyze impacts of price and emissions sensitive demand on the replenishment decisions.

4 - Maximizing Sustainability of Ecosystem Model through Socio-economic Policies
Urmila Diwekar, President, Vishwamitra Research Institute, 2714 Crystal Way, Crystal Lake, IL, 60012, United States of America, urmila@vri-custom.org, Kiriti Yenkie, Rohan Doshi, Pahlola Benevides, Heriberto Cabez
Current practices in natural resources consumption are unsustainable and may eventually lead to ecosystem extinction. This paper uses a simple mathematical model of an integrated ecological and economic system representing our planet’s sectors. The aim of the project is to maximize the sustainability of this system, using Fisher Information as a measure of sustainability, and derive socio-economic policies using multivariable optimal control techniques.

■ TD62
62-Room 112A, CC
Optimization on Power Grid Application
Invited Session
Chair: Chaoyue Zhao, Oklahoma State University, 322G Engineering North, Stillwater, OK, United States of America, chaoyue.zhao@okstate.edu
1 - Risk-based Admissibility Assessment of Wind Generation Integrated into a Bulk Power System
Cheng Wang, Tsinghua University, 3-211, West Main Building, Beijing, China, shiwangcheng2008@163.com, Feng Liu, Wei Wei, Jianhui Wang, Shengwei Mei
In this talk, a risk-based admissibility assessment approach is proposed to quantitatively evaluate how much wind generation can be accommodated by the bulk power system under a given UC strategy. Firstly, the operational risk brought by wind generation is developed as an admissibility measure. Then a risk-minimization model is established to mathematically characterize the admissible region. Simulations demonstrate the effectiveness and efficiency of the proposed methodology.

2 - Strong Formulations for Unit Commitment Problem
Kai Pan, PhD Student, University of Florida, 411 Well Hall, Gainesville, FL, 32608, United States of America, kpan@ufl.edu, Yongpei Guan
In this talk, we will present the strong formulations for unit commitment problem under different settings. Technical proofs are provided accordingly. Our computational experiments verify the effectiveness of proposed strong formulations.

3 - A Scalable Decomposition Method for the Two-Stage Stochastic Unit Commitment Problem
Farzad Yousefian, Postdoctoral Research Associate, Penn State, 333 Logan Ave., Apt. 307, State College, PA, 16801, United States of America, szy9@psu.edu, Wendian Wan, Uday Shanbhag
We consider a two-stage stochastic unit commitment problem modeled as a large-scale mixed integer nonlinear optimization problem. The state-of-the-art commercial packages, e.g. CPLEX, do not scale with the number of the units and scenarios. Motivated by the structure of the KKT system and employing the ideas of Schur complements, we propose a multithread primal-dual algorithm that scales with the size of the scenarios. Preliminary simulation results are presented.

■ TD63
63-Room 112B, CC
Operations Management II
Contributed Session
Chair: Xiaoyan Qian, PhD. The University of Auckland, 486 Parnell Road, Auckland, New Zealand, x.qian@auckland.ac.nz
1 - Flexible Commitment Contract in the Presence of Goodwill-sensitive Customers
Xiaoya Han, University of Science and Technology of China, No. 96, Jinzhai Road, Hefei, China, x.yhan@mail.ustc.edu.cn, Yujing Yu
This paper focuses on a retailer's dynamic decision problem: how to determine a minimum commitment at the beginning of the planning horizon and periodically variable order quantities to maximize its profit when facing goodwill-sensitive customers. We obtain that the next-period goodwill decreases in the current-period one, and the goodwill monotonically converges to a constant steady-state one over time. Moreover, we find that the steady-state goodwill may decrease in minimum commitment.
2 - Flexible Capacity Management with Advanced Information
Julian Kurz, Chair of Logistics and Quantitative Methods in Business Administration, University of Wuerzburg, Stephanstrasse 1, Wuerzburg, 97070, Germany, julian.kurz1@uni-wuerzburg.de

We consider a maintenance service provider that overhauls technical equipment for customers in a central facility. A flexible capacity control policy is developed such that capacity costs and queue length-related holding costs are minimized. We investigate three operating modes, each taking into account a different amount of information (reactive/single-/multi-stage proactive modes). In the proactive modes, advanced information regarding future jobs is utilized.

3 - How to Take Advantage of Crowdsourcing to Collect New Ideas about Product Innovation?
Wanjiang Deng, Huazhong University of Science and Technology, School of Management, Luoyu Road 1037, Hongshan District, Wuhan, 430074, China, dengwj01@foxmail.com, Shihua Ma
Crowdsourcing is gaining more and more attention in both practice and research field. We stand on the position of the company who is going to propose a task about product innovation on one online crowdsourcing platform, and investigate its best strategies of both choice of platform and reward setting. We derive solutions of the base model and then extend it to some detail aspects. Finally, we discuss the managerial insights of our research.

4 - A Heuristic for Hospital Operating Theatre Scheduling under Uncertainty
Milad Zalar Nezhad, Wayne State University, Industrial and Systems Engineering Dep, Detroit, MI, 48202, United States of America, fq3963@wayne.edu, Hossein Badri, Kai Yang
Resource planning is one of the most important issues in healthcare operating management. In this research a heuristic solution algorithm based on the shifting bottleneck method is developed for hospital operating theatre scheduling when some parameters are not deterministic. The developed algorithm is applied on several instances to evaluate its applicability and performance.

5 - Contractual Coordination of Agricultural Cooperatives with Quality Specifications
Xiaoyan Qian, PhD, The University of Auckland, 486 Parnell Road, Auckland, New Zealand, x.qian@auckland.ac.nz
This talk examines how agricultural cooperatives can motivate farmers’ effort when the market price depends on the quantity of high quality produce. We assume that a quality premium is offered to farmers and that their pay-outs are made progressively. We propose a two-stage stochastic model. The main findings are conditions for when the supply chain can be coordinated, that effort is motivated by the quality requirement, and that the progressive payment is needed for coordination.

3 - Modeling Reference Dependence using One-switch Independence
David Vairo, Virginia Commonwealth University, 2415 Krossridge Road, N. Chesterfield, VA, 23236, United States of America, vairodl@vcu.edu, Jason Merrick
We present an application of multi-attribute one-switch independence to single attribute gainables by modeling chance as an attribute, which models reference dependence, and shows it is equivalent to one-switch independence. The resulting form obeys stochastic dominance while incorporating probabilistic sensitivity, utility curvature, reference dependence, and loss aversion. The approach connects single-attribute behavioral and multi-attribute prescriptive decision analysis.

4 - Multiobjective Network Resilience Model with Parallel Component Recovery
Nazanin Morshedlou, Phd Student, University of Oklahoma, 202 W. Boyd St., Room 424, Norman, OK, 73071, United States of America, nazanin.morsshedlou@ou.edu, Kash Barker
This work introduces a multiobjective formulation that trades off investments to enhance network resilience in the form of (i) strengthening link capacity following a disruptive event to decrease vulnerability, and (ii) introducing “parallel component at a time” recovery scheduling to improve recoverability. Given the uncertainty associated with critical infrastructures, robust interval optimization is used to solve the multiobjective formulation.
1 - An Economic Analysis of the Air Cargo Problems in an Integrated Supply Chain

Kwon Gi Mun, PhD Candidate, Rutgers University, SCM, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, kwongimun@gmail.com,

Yudong Li, Yao Zhao, Endre Boros, Ariz Park

In this model, we demonstrate an integrated forecasting approach to coordinate ground and air transportation for a Korean air cargo company. Therefore, we present expected benefits of this integrated approach compared to current practice.

2 - A Multi-Stage Air Service Network Design Problem for an Express Carrier

Yusuf Secerdin, University of Miami, 1251 Memorial Drive, Department of Industrial Engineering, Coral Gables, FL, 33146, United States of America, yusufsecerdin@miami.edu,

Murat Erkoc

We study the air service network configuration problem for a global express carrier. We propose a multi-stage modeling framework for the company's Central and South America region by incorporating multiple service types in terms of time commitments for the air network. The proposed approach consists of three phases in which we formulate a hub location problem, generate feasible pick-up and delivery routes and formulate the service network design problem using the composite variable formulation.

3 - An Adaptive Search Network for the Pickup and Delivery Problem with Time Windows

Ferdinand Kiemerai, TU Munich, Arcistr. 21, Munich, Germany, Ferdin.Kiemerai@googlemail.com, Jonathan Bard, Markus M. Frey

We present an innovative “out-of-the-box” algorithmic framework coupling existing heuristics with a learning-based network structure applicable to many variants of the Pick-Up and Delivery Problem with Time-Windows (PDPTW) and, thus, for the Vehicle Routing Problem with Time-Windows. We show an application to a real-world airport baggage and cargo transportation problem and prove the effectiveness of our new approach by a comparison with state-of-the-art solution algorithms for the PDPTW.

4 - Express Air Network Design with Multi-Hub Flexible Connections

Jose Quesada, Université Catholique de Louvain, Chausée de Binche, 151, Mons, 7000, Belgium, jose.quesada@uclouvain-mons.be, Jean-sébastien Tantczer, Jean-charles Lange

We present a model for the Air Network Design for the next day delivery within an Express company. Most of the existing models rely on a pre-definition of connections for each commodity through a specific hub. We present a model in which we integrate the decision of connectivity simultaneously with the network design. When two hubs are so close from each other that they can serve (almost) the same nodes, the results show that savings can be obtained by taking both decisions at the same time.

2 - Designing a Biorefinery Supply Chain: A Real Case in Navarre (Spain)

Adrian Serrano, Public University of Navarra, Pamplona, Spain, adrian.serrano@unavarra.es, Javier Belloso, Javier Faulin, Alejandro G. del Valle

New alternative energy sources are spreading around the world to reduce greenhouse gas emissions and oil dependence. Our paper proposes a procedure to manage a biorefinery supply chain in Navarre (Spain) which involves, among others, which farms are going to be harvested, when they are going to be collected, and the storage levels. Moreover, a Facility Location Problem is solved inside a MILP model. Promising results are obtained at both levels: strategic (location) and operational (SCM).

3 - Train Dispatching Problem under Exact Travel Time Estimation for a Double Track Rail System

Lance Fu, University of Southern California, Los Angeles, CA, United States of America, luncefu@usc.edu, Maged Dessouky

We consider the problem of dispatching trains through double track railway system, where track segments have different speed limits. We take the train's dynamics into consideration, which differentiates our model from the previous literature. The objective is to minimize the traveling time under no-deadlock and no-collision constraints. We give a mixed integer programming (MIP) formulation for the train dispatching problem. Also we provide certain conditions which can ensure that there exists an optimal integer solution to relaxation of the MIP. A local search based heuristic is also proposed to solve the problem. Simulation on the railway system in Los Angeles County is conducted to verify the efficiency of the proposed algorithms.

4 - A Stochastic Programming Approach for Truckload Relay Network Design under Demand Uncertainty

Zahra Mokhtari, Oregon State University, Corvallis, OR, 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 and proposes a stochastic programming model and solution algorithm. The solution methodology uses Sample Average Approximation (SAA) to address a very large number of scenarios of demand realization. The examined number of scenarios determines the trade-off between optimality of the solutions obtained for the stochastic programming model and its computational complexity. Numerical results on a set of instances of this problem are presented along with areas for future research.

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3 - A Decentralized Decision Making System to Enable Resilient Microgrid Clusters
Yong Fu, Associate Professor, Mississippi State University,
Starkville, MS, United States of America, fu@ece.msstate.edu
Microgrid has been proposed to ensure resilience in power systems. The microgrid can treat connected neighboring microgrids as local energy buffers thus freely forming a cluster to share, exchange, and aggregate site-generated energy. This research proposes a decentralized decision making system to improve the microgrid clusters’ resilience capability to power disturbances and extreme events, consequently minimizing down-time for both consumers and the grid.

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1 - Markov Switching Autoregressive Models with Applications in Cell Biology
Ying Hung, Rutgers University, Piscataway, NJ, United States of America, yhung@stat.rutgers.edu

We will introduce a new framework based on Markov switching autoregressive models for the analysis of experiments in cell biology.

2 - Sparse Particle Filtering
Yun Chen, University of South Florida, 4202 E. Fowler Ave., ENB118, Tampa, FL, 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. Distributed sensing gives rise to spatially-temporally big data. Realizing the full potentials of distributed sensing calls upon the development of space-time modeling of measured signals in dynamically-evolving physical environment. This paper will present a new approach of sparse particle filtering to model spatiotemporal dynamics of big data in distributed sensor network.

3 - Graphical Modeling with Functional Variables
Ran Jin, Virginia Tech., Grado Department of Industrial and, Systems Engineering, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Hongyue Sun, Shuai Huang

Graphical models are widely used to model variable relationship. Traditional graphical models are mainly used to model scalar variables. In this paper, a graphical model with functional variables is proposed. Functional regression models, combined with sparsity-inducing norms, are applied for the graphical modeling. A case study and simulation will be used to evaluate the proposed method.

4 - Optimal Design of Experiments for Generalized Linear Models
Abyudday Mandal, University of Georgia, Department of Statistics, 101 Cedar Street, Athens, GA, 30602-7952, United States of America, amandal@stat.uga.edu, Liping Tong, Jie Yang, Dibyen Majumdar

Generalized linear models have been used widely for modeling the mean response both for discrete and continuous random variables with an emphasis on categorical response. Here we find efficient designs in the context of several optimality criteria, namely D-optimality, EWW-optimality and Bayesian optimality. Regular fractional factorial designs with uniform replications are often used in practice. We show that these popular designs are often not optimal for binomial, Poisson and multinomial cases.

1 - Generating and Comparing Pareto Fronts of Experiment Designs to Account for Multiple Objectives
Byran Smucker, Assistant Professor, Miami University, 100 Bishop Circle, 311 Upham Hall, Oxford, OH, 45056, United States of America, smuckerb@miamiOH.edu, Yongtao Cao, Tim Robinson

In many design scenarios the experimenter entertains multiple, conflicting objectives. The Pareto approach to experiment design is to construct a set of designs while explicitly considering trade-offs between criteria. The true Pareto front is not known, which creates problems in assessing front quality, and existing algorithms are inefficient, ineffective, or both. Here, we introduce an improved measure of front assessment, and present a new algorithm to generate Pareto fronts of designs.

3 - Cost Constrained ALT with Exponentially Changing Stress Durations
David Han, University of Texas, One UTSR Circle, San Antonio, TX, United States of America, David.Han@utsa.edu

When designing ALT, several variables such as the allocation proportions and stress durations must be determined carefully because of constrained resources. This talk discusses the optimal decision variables based on the popular optimality criteria under the constraint that the total cost does not exceed a pre-specified budget. A general scale family of distributions is considered to accommodate different lifetime models for flexible modeling with exponentially decreasing stress durations.

4 - Integration of Computer and Physical Experiments for Improving Predictive Inference
Arda Vani, Associate Professor, Florida State University, Tallahassee, FL, avani@fsu.edu, Spandan Mishra

A Bayesian predictive approach is developed to combine data from designed experiments on physical process and computer predictions. Predictive distribution of a regression model is used for inference on the outcome variable and issues including predictive capability, model adequacy and sensitivity to prior specifications are discussed. Applications from structural loss prediction and quality control are presented for illustrations.

2 - What do Coin Tosses, Vessel Traffic Risk Assessment and Return Time Uncertainty Have in Common?
Johan Rene Van Dorp, Professor, The George Washington University, 800 22nd Street NW, Suite 2800, Washington, DC, United States of America, dorpjr@gwu.edu, Jason Merrick

Via a coin toss argument we will advocate decision making under uncertainty in vessel traffic risk assessment to be informed by relative risk comparisons by highlighting the analogy of an accident potentially occurring in a traffic situation with the toss of a biased coin. That same analogy is next used to demonstrate the large uncertainty bands that result for average return times of accidents in this context.

2 - Integrating Expert Judgement and Bayesian Analysis
Thomas A. Mazuuchi, Professor And Chairman, George Washington University, Washington DC, DC, 20052, United States of America, mazu@gwu.edu

There is a growing need for marrying the fields of expert judgement and Bayesian Analysis that is, using the Expert Judgement approach to define prior distributions and for understanding the effects of the elicitation, codification and combination on the prior distribution and subsequent posterior analysis. This paper presents an investigation of the above for a simple model using the Classical Model for Expert Judgement by Cooke (2001).

3 - An Augmented Simulation Approach for Bayesian Design of Life Tests
Refik Soyer, The George Washington University, 2201 G St NW, Washington, DC, United States of America, soyer@gwu.edu

In this talk we consider a Bayesian decision theoretic setup for optimal design of life tests. More specifically, we consider use of augmented probability simulation with a conjugate class of utility functions for design of life tests. We illustrate the implementation of the approach in one and two stage designs.
5 - Dynamic Personalized Monitoring and Treatment Control of Glaucoma
Pooyan Kazemian, PhD Candidate, University of Michigan-Ann Arbor, 1205 Beal Ave., Ann Arbor MI 48105, United States of America, pooyan@umich.edu, Jonathan Helm, Mariel Lavieri, Joshua Stein, Mark Van Oyen,
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.

4 - Evaluating Consumer m-Health Services for Promoting Healthy Eating: A Randomized Field Experiment
Yi-Chin Lin, CMU, 5000 Forbes Avenue, Pittsburgh PA 15213, United States of America, yichin@cmu.edu, Vibhash Shabhishek, Julie Downs, Rema Padman
Mobile apps have great potential to provide promising services to improve consumers’ engagement and behaviors. Focusing on healthy eating, this study shows that an image-based professional support greatly improves consumer engagement and eating behaviors, while social media and a heuristic approach of self-management might have negative effects in some occasions.

5 - Dynamic Matching in a Two-Sided Market
Yun Zhou, University of Toronto, 105 St. George Street, Toronto, ON, Canada, Yun.Zhou13@Rotman.utoronto.ca, Ming Hu
A two-sided market often shares a common structure that engages three parties: the supply side, the demand side and an intermediate firm facing intertemporal uncertainty on both supply/demand sides. We propose a general framework of dynamically matching supply with demand of heterogeneous types (with horizontally or vertically differentiated types as special cases) by the intermediary firm and explore the optimal and heuristic matching policies.

4 - Bayesian Updating of Dirichlet Process Prior via Kernel Estimate
Ehsan Soofi, University of Wisconsin, Lubar School of Business, Milwaukee, WI, United States of America, esoofi@uwm.edu, Neshat Behshil, Jeffrey Racine
The standard nonparametric Bayesian approach uses multinomial proportions to update the Dirichlet Process Prior (DPP). We use kernel-smoothed CDF instead of the multinomial proportions for updating DPP. Applications include Bayesian measures and inferences for distributional fit and for dependence of random variables via the information measure of copula. The posterior mean of the quantized entropy provides a Bayes estimate of the dependence.

2 - Green Simulation Designs for Repeated Experiments
Mingbin Feng, PhD Candidate, Northwestern University, 2145 Sheridan Rd, Rm C210, Evanston, IL, 60208, United States of America, benfeng@u.northwestern.edu, Jeremy Staum
In many applications of simulation, such as in financial risk management, experiments are usually repeated with similar inputs. In these cases simulation outputs should be viewed as useful resource that should be recycled and reused to improve the efficiency of subsequent experiments. We consider a periodic credit risk evaluation problem in the KMV model and the numerical results show improving accuracy over time, measured by mean squared error, as more and more outputs are recycled.

3 - A General Golf Course Simulation Tool: Keeping Delays Down and Throughput Up
Moomoo Choi, Columbia University, Department of Industrial Engineering, New York, NY, 10027, United States of America, mc3983@columbia.edu, Qi Fu, Ward Whitt
We describe a simulation tool for designing and managing golf courses. Group play is represented by eighteen queues with precedence constraints, in series, where the primitives are the random group playing times on each stage of a hole. We characterize balanced courses and show the advantages over unbalanced courses.

1 - Rare-event Simulation for Queues with Time-varying Arrivals
Ni Ma, Columbia University, 500 West 120th Street, Room 345, New York, NY, 10027, United States of America, nmn2692@columbia.edu, Ward Whitt
We show that the exponential tilting approach for rare-event simulation in theGI/GI/1 queue can also be applied to efficiently estimate the time-varying periodic-steady-state probability of large delays in a M/GI/1 single-server queue with periodic arrival rate function.

2 - Rare-event Simulation for Queues with Tim e-varying Arrivals
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4 - Rare-event Simulation for Vulnerability Analysis of Power Grids
John Shortle, George Mason University, 4400 University Dr., MSN 4A4, Fairfax, VA, United States of America, jshortle@gmu.edu, Jie Xu, Chun-hung Chen
Vulnerability of a power grid can be evaluated by systematically considering failures of individual elements and estimating the likelihood of a large-scale blackout following these initial failures. This talk presents a method for identifying vulnerable links by using a low-fidelity model of the power system to guide simulation of a higher-fidelity model. Numerical examples using real power systems are given.
2 - A Branch-and-Price Algorithm for Switchgrass Logistic Supply Chain Design  
Maichel M. Aguayo Bustos, Virginia Tech, 250 Durham Hall, 1145 Perry Street, MC 0118, Blacksburg, VA, 24061, United States of America, maiaaguay@vt.edu, Subhash C. Sarin, John S. Cundiff 

Given the locations of a bio-energy plant and storage facilities for a switchgrass-based bio-ethanol supply chain, we introduce a multi-period mixed integer programming model to determine both strategic and tactical decisions. A novel branch-and-price approach is used to obtain near-optimal solutions for large-sized problem instances. Results of its implementation to a case study are also presented.

3 - A Newsvendor Problem with Multiple, Capacitated Suppliers and Marginal Quantity Discounts  
Roshanak Mohammadirovjdan, PhD Student, University of Florida, 305 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611, United States of America, rmohammadirovjdan@ufl.edu, Joseph Geunes  

We consider a newsvendor who may order stock from multiple, capacitated suppliers, each of which offers a marginal quantity discount pricing structure. The newsvendor seeks to minimize its total procurement plus expected overstock and understock costs, resulting in an objective function consisting of a sum of convex and concave terms. We provide an algorithmic approach that permits solving this non-convex problem in pseudopolynomial time by solving a set of 0-1 knapsack subproblems.

4 - An Integrated Model for Supplier Selection and Optimal Order Allocation Considering Uncertainty  
Majid Hooshmandi Malek, Allameh Tabatabaie University, Faculty of Management & Accounting, Hennmat Exp, Tehran, Iran, majidhooshmandi@gmail.com  

This paper first presents an approach for supplier evaluation based on integrated multiple criteria decision making model and then proposes a mathematical model to optimize the order allocation in a supply chain considering uncertainty in different parameters. An Iranian automobile company is utilized as a case study. The mathematical model is solved by genetic algorithm and the performance of the model is verified using other optimization approaches.

5 - The Production Routing Problem with Vehicle Costs  
Robert Russell, Professor of Operations Management, Univ. of Tulsa, 800 S Tucker Drive, College of Business, Tulsa, OK, 74104, United States of America, rrussell@utulsa.edu  

This paper addresses the integration of production, inventory, distribution, and vehicle costs for supplying retail demand locations from a production facility. A mixed integer model is used to determine an approximate solution to the production routing problem with vehicle costs and a vehicle routing metaheuristic is used to sequence routes for each time period. Computational results are reported and compared to results from the traditional production routing problem.

78-Room 301, CC  
Electricity Markets and Utilities  
Contributed Session  
Chair: Chung-Hsiao Wang, LG&E and KU, 102 Spruce Ln, Louisville, KY, United States of America, chunghsiao@hotmail.com

1 - Analysis of Consumer Behavior Towards Dynamic Residential Electricity Pricing  
Prajwal Khadgi, PhD Candidate, University of Louisville, Speed School of Engineering, Louisville, KY, 40219. United States of America, p0khadg01@louisville.edu, Lihui Bai  

Variable electricity pricing for the control of residential load has attracted much interest in the field of demand response, and static variable pricing such as time of use rates has had successful applications in the US as an optional service. However, dynamic variable pricing remains an open question, due to lack of understanding on consumer behavior. We study consumer behavior against two dynamic rates, i.e. demand charge and load-following rates, using utility functions and simulation.

2 - A Dynamic Garch Model for Energy Portfolio Allocation in Electricity Markets  
Reinaldo Garcia, Associate Professor, University of Brasilia - UnB, Faculty of Technology, Industrial Engineering Department, Brasilia, 70904-970, Brazil, rgarcia@unb.br, Javier Contrasera, Virginia Gonzalez, Janiele E. S. C. Custodio  

In the deregulated electricity markets, a Generation Company (Genco) has to optimally allocate their energy portfolio. Modern Portfolio Theory (MPT) allows a Genco to maximize their profit and decrease their associated risk. This paper proposes a model where MPT is combined with a Generalized Autoregressive Conditional Heteroskedastic (GARCH) prediction model for a Genco to optimally diversify their energy portfolio. The model is applied to the PJM electricity market showing its capabilities.

3 - Intraday Electricity Load Forecasting using Rule-based Model  
Myung Suk Kim, Professor, Sogang University, #1 Shinshu-Gu, Mapo-Gu, Seoul, Korea, Republic of, myungsuk@sogang.ac.kr  

A rule-based model selection methodology incorporating a multiplicative seasonal autoregressive with exogenous variables (ARX) model and a support vector machine (SVM) is provided and applied to Korean hourly electricity load data. We set up a rule that determines which of the SVM and ARX models should be applied to forecasting a specific hour within a day. The proposed rule-based model selection methodology outperforms its benchmarks.

4 - Modeling Grid Operations in China’s Partially-Restructured Electricity Market  
Michael Davidson, Massachusetts Institute of Technology, 400 Main Street, E19-411, Cambridge, MA, 02139, United States of America, michd@mit.edu, Valerie Karplus, Ignacio Perez Arriaga  

Long transitions of restructuring vertically-integrated electric utilities can affect interim market operations and assumptions underlying tools for policy assessment. We developed a mixed integer unit commitment model of China’s northeast region with several legacy central planning mechanisms modeled as regulatory constraints and penalties. We analyze their influence on system operation, test tractability of formulations and validate with actual operational outcomes.

5 - Fuel Hedging Strategy for Electric Power Utilities  
Chung-Hsiao Wang, LG&E and KU, 102 Spruce Ln, Louisville, KY, United States of America, chunghsiao@hotmail.com, Kyung Jo Min  

In recent years, natural gas combined cycle power plants have started to replace aging and less efficient coal power plants. Because fuel costs represent the majority of total costs for an electric power utility, how to manage volume and price risks for coal and natural gas fuel is critically important. In this paper, we develop mathematical models for structured and analytical guidelines on fuel hedging strategies for a utility owning both types of generation units.

Software Demonstration  
Cluster: Software Demonstrations  
Invited Session  
1 - SAS - Building and Solving Optimization Models with SAS  
Ed Hughes, Principal Product Manager, SAS, Rob Pratt, David Kraay  

SAS provides a broad spectrum of data and analytic capabilities, including statistics, data and text mining, econometrics and forecasting, and operations research-optimization, 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 - Responsive Learning Technologies - Online Games to Teach Operations and Supply Chain Management  
Sam Wood, President, Responsive Learning Technologies  

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.