

The Tenth POMS-HK International Conference
Operations Excellence for a Better World

City University of Hong Kong
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Abstract Summary

Online risk-aware resource allocation for improving quality of service in queueing networks under uncertainty

Guodong Yu
Shandong University
William B. Haskell
National University of Singapore

We are interested in managing the risk in performance of controlled queueing networks to minimize the total costs while guarantee the quality of service under ambiguity both in statistical uncertainty and risk preference. Instead of focusing on long-term average performance in classical models, we take a different approach and emphasize the steady state distribution of network performance. We show that the proposed model naturally leads to stochastic dominance constraints on queueing performance, and provide more reliable control policies than classical models on reducing the delay. As our another main contribution, we develop an online primal-dual algorithm that dynamically allocates resources in a controlled queueing network while simultaneously respecting stochastic dominance based constraints on system risks, achieving a regret bound of $o\left(\frac{1}{\sqrt{T}}\right)$ with high probability. The proposed algorithm allows the ambiguity of the distribution probability and risk preference in real-time resource allocation in a queueing system. We also extend the model to a more general case where the endogenous arrival rate and the network commodity generation problem are considered. The results show that the proposed method outperforms classical models in providing the lower average delay under uncertainty.

Keywords: queueing networks, resource allocation, risk-aware; stochastic dominance, online primal-dual algorithm

The online reservation problem with set-up cost

Wenqiang Dai, Yuqi Jiang
University of Electronic Science and Technology of China

Recent years have witnessed the rise of many successful sharing platforms like Airbnb and Uber, where the manager needs to properly match resources from real-time demand information. Motivated by these platforms, Goyal and Gupta (2018) formulate an online problem that they termed Online Reservation Problem. This work extends their work with set-up cost setting. We formulate models and derive lower bound on the Competitive Ratio (CR) of any algorithm. We then analyze CR of fair algorithms in the sense that no proposal is declined whenever resources are available. Finally, numerical simulation is carried out to prove the effectiveness of our strategy.

Keywords: Sharing platform, online reservation problem, set-up cost, online optimization; competitive analysis

Double Dipping of Two-Sided Platform Economy

Satyanath Bhat, Jussi Keppo, Chung-Piaw Teo
National University of Singapore

The role of platforms in breaking traditional monopolies, creating new markets, and resulting increase in net social welfare is overwhelmingly positive. We examine a two-sided platform economy against a more stricter benchmark — an open platform that discloses its proprietary information. That is, platforms know now or eventually discover ways to monetize the big proprietary data they control. We show that these monetizing strategies can be detrimental to both sides of the market resulting social welfare losses compared to the benign open platform.

Session 1B: Behavioral Operations Management I
Chair: Brent Moritz (Pennsylvania State University)

Sat 10:30 – 12:00
Room 5-205

Workshop on Behavioral Operations

Brent Moritz
Pennsylvania State University

This workshop will discuss research in behavioral operations management (BOM) and the state of the field. As behavioral economics is to traditional economics, BOM is a cross-disciplinary approach that moves from normative theories of decision making to descriptive theories of decision making. We will discuss topics, questions and methods well-suited to BOM, and how these fit with other domains. We will offer guidance for conducting experimental and non-experimental research.

Session 1C: Healthcare Operations Management I
Chair: Fei Yang (Southwest Jiaotong University)

Sat 10:30 – 12:00
Room 5-206

Developing a New Framework to Improve Emergency Departments' Performance: A New Zealand Perspective

Neda Pourreza
University of Auckland

In most countries, New Zealand in particular, the current situation of health care providers is no longer an all-time feasible solution necessitating decision making in operational and tactical levels to cope with different sources of uncertainty. We provided a structural literature review to investigate research stream on emergency departments' studies to develop a new framework for improving their productivity and performance from New Zealand healthcare industry perspective.

The new approach aims to incorporate fuzzy data sets in the operations management concept to integrate operational decisions.

Keywords: Health Care Centers, Emergency Departments, Fuzzy Data Sets, Productivity

A Surrogate-Model-Based Evolutionary Algorithm for Medical Staff Configuration at Emergency Department

Haobin Gu, Hainan Guo, Yu Zhou
Shenzhen University

In this paper, we aim to optimize medical staff configuration to alleviate overcrowding a emergency department (ED) in Hong Kong. We formulate the problem as minimizing the proportion of patients who cannot meet the service requirements of Categories IV while satisfying the requirements of the other Categories. To address such a time-consuming problem, we propose an evolutionary algorithm assisted by a surrogate model to replace simulation optimization and generate the elite population. Subsequently, we exploit optimal computing budget allocation method to find the best solution in the elite population. Some experiments are carried out to validate and verify our study.

Keywords: surrogate model, evolutionary algorithm, optimal computing budget allocation, medical staff configuration

Clinic Scheduling with Patient Re-entrant: Slot Model

Haolin Feng
Sun Yat-Sen University
Michelle Alvarado
University of Florida
Mark Lawley
Texas A&M University

Mohs Micrographic Surgery (MMS) is a surgical method for skin cancers. It sequentially removes and examines one skin layer at a time until a cancer free layer is obtained. This results in patients re-entering the service queue on the same day in a stochastic manner. To improve patient experience and clinic revenues, we develop a slot model for MMS clinic scheduling. The model captures the key characteristics of the surgery-pathology and stochastic re-entrants. Theoretical properties of the scheme are provided. Numerical studies using real data from MMS clinics are conducted to demonstrate the benefit of the method.

Keywords: Healthcare Operations Management, Mohs Micrographic Surgery, Outpatient Clinic Scheduling, Patient Re-entrant.

Analysis of a blood component preparation-inventory system with production alternatives and demand substitution

Fei Yang, Ying Dai, Zu-Jun Ma
Southwest Jiaotong University

Blood component therapy, as the major form of clinical transfusion, relies primarily on the components that are separated from whole blood (WB) by several common preparation methods. Each method outputs a particular combination of blood components, of which some are congeneric products with different degrees of separation, and the purer ones may be used as downward substitutes. Furthermore, clinical transfusion requires appropriate blood types for patients, in which definite compatibility relations are applied to demand fulfillment when necessary. In this paper, a dynamic programming model with proactive production alternatives and proactive demand substitution (PPA&PDS) is first proposed to optimize the integrated component preparation-inventory system, comprehensively considering the stochastic supply of WB, the stochastic demand of components, the output dependence in the component preparation process, the production alternatives incorporating downward component substitution, and the demand substitution among different blood types. Due to the curse of dimensionality, the approximate dynamic programming (ADP) approach is used to solve the problem; however, this approach usually overestimates the value of superior alternatives. Therefore, another model with proactive production alternatives and reactive demand substitution (PPA&RDS) is proposed to overcome the potential excessive substitution under certain special conditions, such as an adequate supply or a partial-type shortage. The PPA&PDS model is validated as useful in reducing shortage; however, increasing supply will result in more demand substitution than the PPA&RDS model for certain blood types and components. Managerial implications based on the case study with specific blood supply-demand situations are provided.

Session ID: OM-Marketing Interface I
Chair: Haoyu Liu (HKUST Business School)

Sat 10:30 – 12:00
Room 5-207

Vertical Probabilistic Selling under Competition: The Role of Consumer Anticipated Regret

Dongyuan Zhan
University College London
Yong Chao
University of Louisville
Lin Liu
University of Central Florida

Consumers are likely to regret purchasing random products, because less desirable alternative might be obtained due to the hidden features at purchase. When consumers can anticipate such potential postpurchase regret, the attractiveness of random products is lowered. However, we

show that this anticipated regret works to the advantage of merchants that offer a random product. Under competition, anticipated regret increases product differentiation at the competition margin while leaving the product sufficiently attractive to infra-marginal consumers. Thus, probabilistic selling can be more profitable and is more likely to occur in the presence than in the absence of anticipated regret.

Discount, Coupon, or Both? An Empirical Data-Based Analysis for Online Garment Retailers' Optimal Promotion Strategies

Yang Liu, Mingming Leng, Ling Peng
Lingnan University

We investigate an online retailer's optimal strategies for her promotion of the garments that are classified based on their price levels and life cycle stages. In general, the promotion with discount is optimal for the garments at the introduction and decline stages, whereas that with a coupon is optimal for the garments at the maturity stage. The most profitable garments are the high-priced garments at the introduction stage; but, the best sales garments are the low-priced garments at the maturity stage. We also test the influence on promotion effect of other factors such as seasonality, holiday, and time limit.

Inducing Supply Chain Transparency through Supplier Encroachment

Xu Guan
Wuhan University
Baoshan Liu
China University of Geoscience
Ying-Ju Chen
Hong Kong University of Science and Technology

This paper investigates the supplier's voluntary disclosure strategy when he can encroach on the retailer's operations by selling directly to consumers. Encroachment expands the market potential, induces the supplier to adopt disclosure strategy more frequently, and leads to a higher level of information transparency in the supply chain. The retailer can free ride on the supplier's disclosure to create a higher ex-ante payoff in face of the supplier's encroachment. While the supplier can no longer hide that negative quality information due to the change of channel structure, so that his ex-ante payoff may become lower with encroachment.

Opaque Selling and Clearance Sales under Demand Learning

Haoyu Liu
Hong Kong University of Science and Technology
Qing Li
The Ohio State University

We compare two selling strategies, clearance sales and opaque selling, when customer valuation is unknown. The firm sets higher prices for each product in the first period under opaque selling because introducing opaque goods in the second period reduces the need for learning. Demand learning requires decreasing prices over time. The profit of the firm is always higher under opaque selling since it allows the firm to charge higher prices. When customers are very strategic, demand learning no longer pays and the optimal strategy for the firm is to sell only opaque good in the second period.

Session 1E: Interface of Operations and Finance I
Chair: Xiaole Wu (Fudan University)

Sat 10:30 – 12:00
Room 6-207

Crowdfunding, Signaling, and Venture Capital

Yannan Jin
Shanghai University of Finance and Economics
Ming Hu
University of Toronto
Jussi Keppo
National University of Singapore

Motivated by the empirical observation of the relation between crowdfunding and Venture Capital (VC) investment, we build a theoretical model to study how crowdfunding, as a public information source, affect the competing VCs' investment strategies. Our economy consists of one startup, one crowdfunding platform, and two VCs with heterogeneous prior beliefs of the startup's probability of success. We find that with crowdfunding, the startup is more likely to get VC investment and the expected investment level is higher. Further, the value of crowdfunding for the VCs rises in the downside risk of the startup and falls in the VCs' prior beliefs. However, the impact of the information accuracy is not always positive.

A New Firm Entry under Capital Constraint

Wenhui Zhao, Guanmei Liu
Shanghai Jiao Tong University
Xuan Zhao
Wilfrid Laurier University

This study examines whether and how an entrant (she) could enter a market by competing with a dominating incumbent (he). Both firms may be capital constrained and need to borrow loans

from the credit market, and thus the success of the entrant depends on her relative operational competence over the incumbent and the competition level of the credit market. While in a perfectly competitive credit market, the successful entry of the entrant depends on her operational competence and reserved return on investment (RROI), in a monopolistic credit market, it depends on the working capital levels of the entrant and incumbent in addition. Interestingly, the entrant is not always beneficial to prepare higher working capital level: there is a range of medium level of working capital which is not enough for the entrant to meet her RROI, but she cannot access bank credit since the amount she borrows is too small for the bank to make enough profit in the case that the market is switched from monopoly into duopoly. In such a case, the competition of the credit market mitigates the entry barrier of the entrant. Unexpectedly, the competition of the credit market does not always help the entrant: if the operational competence of the entrant is not that high, her entry may fail in a competitive credit market but succeed in a monopolistic credit market, since the monopoly bank rate may erode the incumbent's competitiveness. Our work presents a unified explanation for the conflicting empirical findings in finance literature on which type of the credit market, competitive or monopolistic, may facilitate the successful entry of an entrant.

Equity or Debt? Financing the Capital-constrained Supply Chain with Risk-Averse Participants

Nina Yan
Central University of Finance and Economics
Xun Xu
California State University

This study compares the role of an internal and external financing scheme: equity and debt financing in the influence of manufacturer and retailer operational decisions with various risk attitudes. Via a game theory approach, we used the conditional value-at-risk (CVaR) criterion and took profit maximization and risk measurement into consideration in a two-level supply chain. We examined the condition that the manufacturer and retailer prefer choosing equity or debt financing by finding the value-added zone for both of them. Additionally, we validated our modeling results through empirical studies using 237 samples from the automobile and retail industries.

Keywords: supply chain finance; risk aversion; equity financing; debt financing; CVaR

Random Yield, Forward Market and Price Formation

Xiaole Wu
Fudan University
Lusheng Shao
University of Melbourne

Many agricultural commodities are traded in both forward and spot markets. Yet, at the time of signing forward contracts, firms (i.e., agricultural producers) face significant yield risk. This paper studies the interplay of random yield and forward market in a market with spot and forward transactions. Specifically, we examine two main questions: (a) how yield uncertainty affects the equilibrium outcome in such a hybrid market; and (b) how yield uncertainty mediates the role of forward market. It is found that as yield risk increases, firms sell less in the forward market, and counterintuitively, higher yield risk may benefit firms and make the spot price less volatile. The existence of a forward market leads to greater spot price volatility; that is, a forward market destabilizes spot price. There is a mitigating effect of yield uncertainty on the role of the forward market. Finally, the forward ratio can be influenced by yield risk in multiple directions.

Keywords: Random yield, forward market, spot market, price formation, market equilibrium

Session 1F: Applications of Distributionally Robust Optimization *Sat 10:30 – 12:00*
Methods in Operations

Chair: Karthik Natarajan (Singapore University of Technology and Design) *Room 6-208*

Distributionally Robust Multi-period Inventory Management with Bank Finance

Zhenzhen Yan
Nanyang Technological University

In this paper, we study a stochastic dynamic inventory management problem faced by a capital constrained firm who periodically replenishes its inventory from a supplier. The goal is to determine the optimal joint inventory and financing decisions to maximize the firm's expected terminal cash flow. We consider two types of financing strategies: Unsecured financing strategy and Asset based financing strategy. We model the problem from the distributionally robust perspective, assuming only information of the mean and covariance of demand is available. We provide a convex conic reformulation to the problem, which can be approximated by solving a semidefinite program. By conducting a sensitivity analysis on the conic program, we study how the initial capital and initial inventory affect the terminal cash flow. We also conduct extensive numerical studies to compare the two financing strategies under different market conditions.

Exploiting correlations in distributionally robust optimization

Divya Padmanabhan
Singapore University of Technology and Design

We aim to identify partial covariance information structures that allow polynomial-time solvable tight reformulations for evaluating the worst-case expected value of mixed integer linear programs whose objective coefficients are uncertain. To this end, assuming only the knowledge

of the mean and covariance matrix entries restricted to block-diagonal patterns, we develop a reduced semidefinite programming formulation whose complexity is characterized by a suitable projection of the convex hull of $\{(\mathbf{x}, \mathbf{x}\mathbf{x}'): \mathbf{x} \in \mathcal{X}\}$ where \mathcal{X} is the feasible region. These projected constraints lend themselves to efficient representations that result in polynomial-time solvable instances most notably for the appointment scheduling problem as well as for computing tight bounds in PERT networks and linear assignment problems. The partial correlation model we consider is the first example of a distributionally robust optimization approach towards appointment scheduling that permits a polynomial-time solvable tight reformulation in the presence of correlation information between uncertain processing times of the jobs to be scheduled.

Robust probability bounds: a linear optimization approach

Arjun Ramachandra
Singapore University of Technology and Design

Sums of random variables have been interesting objects of study in probability and applied fields such as quantitative risk measurement in finance and insurance. A relevant problem is to determine sharp bounds for the tail distribution function of sums of random variables. With independence and arbitrary support, it is known that computing tail probabilities of sums of random variables is NP-hard, except in special cases when the random variables are Bernoulli. In this paper, we show that for Bernoulli random variables with extreme dependence, the worst case bound is efficiently computable by modeling it as a linear optimization problem. We exploit the LP primal-dual structure, suitably transforming an exponential size primal to a polynomial size one. We also will try and discuss extensions to more general objective functions that arise in networks.

Distributionally Robust Linear and Discrete Optimization with Marginals

Karthik Natarajan
Singapore University of Technology and Design

In this paper, we study the class of linear and discrete optimization problems in which the objective coefficients are chosen randomly from a distribution, and the goal is to evaluate robust bounds on the expected optimal value as well as the marginal distribution of the optimal solution. The set of joint distributions is assumed to be specified up to only the marginal distributions. We generalize the primaldual formulations for this problem from the set of joint distributions with absolutely continuous marginal distributions to arbitrary marginal distributions using techniques from optimal transport theory. While the robust bound is shown to be NP-hard to compute for linear optimization problems, we identify a sufficient condition for polynomial time solvability using extended formulations. This generalizes the known tractability results under marginal information from 0-1 polytopes to a class of integral polytopes and has implications on the

solvability of distributionally robust optimization problems in areas such as scheduling which we discuss.

Session 1G: New Optimization Methods for Logistics Challenges
Chair: Shuai Jia, Zhou Xu (Hong Kong Polytechnic University)

Sat 10:30 – 12:00
Room 6-209

Bulk Ship Scheduling in Industrial Shipping with Stochastic Backhaul Canvassing Demand

Lingxiao Wu, Kai Pan, Shuaian Wang, Dong Yang
Hong Kong Polytechnic University

In this talk, we are going to present a ship scheduling problem for an industrial organization. The considered problem is an integration of three interconnected sub-problems from different planning levels: the strategic fleet sizing and mix problem, the tactical voyage planning problem, and the operational stochastic backhaul cargo canvassing problem. To obtain the optimal schedule for the problem, we developed a two-step solution scheme which combines a Dynamic Programming Algorithm and a Benders Decomposition Algorithm. A series of numerical tests are conducted, and the computational results demonstrate the applicability and efficiency of the solution method.

Fast Algorithm for the Urban Truck Routing and Scheduling

Hu Qin
Huazhong University of Science and Technology
Zhixing Luo
Nanjing University

As people and enterprises come under more pressure in a fast moving and highly connected world, smart logistics play an increasingly important role in improving operational efficiency and enhancing the consumer experience. Reducing costs and increasing logistics efficiency is critical. In this study, we focus on designing a fast algorithm to solve large-scale electric vehicle routing problems that involve more than 1000 customers in a short computation time (e.g., 5 minutes).

New Algorithms for Production and Transportation Integration with General Shipping Costs and Partial Deliveries

Zhou Xu

Hong Kong Polytechnic University
Feng Li
Huazhong University of Science and Technology
Zhi-Long Chen
University of Maryland

In this talk, we are going to present our newly developed algorithms to solve an integrated production and transportation problem, for the commit-to-delivery business mode of a make-to-order manufacturing company that uses third party logistics service providers to deliver products to customers, where partial deliveries are allowed, and general shipping cost functions are considered. The development of the algorithms hinges on a newly discovered property for minimizing the sum of two general piecewise linear functions, as well as on some nontrivial tractable cases. Results from computational experiments demonstrate that our algorithms can find near optimal solutions in short running time.

Managing Navigation Channel Traffic and Anchorage Area Utilization of a Container Port

Shuai Jia, Chung-Lun Li, Zhou Xu
Hong Kong Polytechnic University

Traffic congestion in seaports can lead to uncontrolled execution of berth plans, causing severe vessel delays and long waiting times. In this paper, we schedule the vessel traffic of a seaport by optimizing the utilization of the navigation channel and the anchorage areas in the terminal basin. We provide a mixed integer program of the problem, analyze its complexity, and propose a Lagrangian relaxation heuristic in which the relaxed problem is decomposed into two asymmetric assignment problems. Computational performance of the Lagrangian relaxation heuristic is tested on problem instances generated based on the operational data of a port in Shanghai.

Session 1H: Supply Chain Management I Sat 10:30 – 12:00

Chair: Huan Zheng (Shanghai Jiao Tong University)

Room 6-211

Homeland Security Games: The Value of Flexible Redeployment

Yini Gao
Singapore Management University
Chung-Piaw Teo
National University of Singapore
Huan Zheng
Shanghai Jiao Tong University

The classical Colonel Blotto game is one of the earliest games to model conflicts in multiple battlefields. In this paper, we extend the Colonel Blotto game to model homeland security game between a defender and an attacker where the defender can redeploy its resources after observing the attacker's deployment. This asymmetry reflects the locational advantage of the defender who has more time to prepare the battlegrounds. Our goal is to understand the value of this redeployment option in such games, and understand its impact on the attacker's and defender's strategy.

In general, finding an equilibrium strategy in this game is challenging. We show the redeployment problem with classic auction contest success function is, in general, NP hard. For a simplified contest success function, when the redeployment structure has a nice form, such as "k-chain" structure, we obtain closed-form equilibria to these problems. For the game under a general redeployment network structure, we obtain an equivalent reformulation of the game using a conic program. This extends recent LP based approach to characterize the equilibrium strategies in the classical Blotto game.

By analyzing this equivalent conic reformulation, we obtained many interesting properties of the game, i.e. value of the game, defender's strategy, and the marginal moments of attacker's mixed strategy, directly from the conic program. We further explored how the redeployment network structure affects the game, showing that a sparse redeployment network structure can already capture the value of redeployment for the defender.

Managing a Hybrid RDC-DC Inventory System

Tong Wang
Shanghai Jiao Tong University
Chaolin Yang, Xiaoyue Yan
Shanghai University of Finance and Economic

In this paper, we study a hybrid RDC-DC serial inventory system where the RDC replenishes its stock from an outside supplier, while the DC faces random demand and replenishes its stock from the RDC. However, unlike in the traditional serial system, the DC itself can replenish its inventory from the outside supplier as well. We propose two simple and easy-to-implement heuristic policies for the system. The first heuristic policy, which we call the three-index policy, combines the characteristics of the echelon-base-stock policy for the serial system (Clark and Scarf 1960) and the dual-index policy for the dual-sourcing system (Veeraraghavan and Scheller 2008). We show that the order-up-to level of the DC from the RDC can be computed by a newsboy fractile. A simulation-based optimization procedure for the policy is provided. We then develop another heuristic policy (the ALP policy) based on the three-index policy and the multimodularity of the problem proved by Sapra (2017). The policy applies the linear programming approach to approximately solve the value function of the dynamic programming formulation of the problem. Our numerical results show that the ALP policy and the three-index policy are comparable, and that the former performs slightly better. Moreover, by considering the optimal costs in the classic two-stage system as the benchmark, we demonstrate that the outside supply option of the DC can draw considerable cost savings under both policies.

Strategic Benefit of Request for Quotation

Leon Chu
University of Southern California
Ying Rong, Huan Zheng
Shanghai Jiao Tong University

Inspired by prescription drug affordability practices, we study how a buyer may achieve cost reduction by combining a procurement process with (the threat of) exclusion clauses, the latter of which has been commonly adopted in contracting but rarely executed. We analyze the equilibrium outcomes when the buyer simultaneously or sequentially negotiates with imperfectly substitutable suppliers under a dual-sourcing setting. We show that quantity-dependent pricing contracts coordinate the supply chain, and introducing exclusion clauses leads to various equilibrium profit allocations. Surprisingly, the buyer can benefit from a request for quotation (RFQ) stage that precedes the negotiation stage even under a full information setting. Specifically, by endogenizing the sequence of negotiations via the quotations submitted in the RFQ stage, the buyer's equilibrium profit with an RFQ is (weakly) higher than the profit without an RFQ. The insights extend to an uncertain demand setting, in which the buyer first negotiates contracts with suppliers and then decides order quantities after demand realization.

Mergers between On-Demand Service Platforms: The Impact on Consumer Surplus and Labor Welfare

Tao Lu
Erasmus University
Chung Yee Lee
Xiaogang Lin
South China University of Technology
Xin Wang
Hong Kong University of Hong Kong

This paper studies the impact of mergers between on-demand service platforms on consumer surplus and labor welfare. We employ a game-theoretical model in which customers choose between platforms based on prices and expected waiting times, and agents base decisions about which platform to work for on wages and the probability of getting jobs. Driven by these two features, we find that mergers between on-demand service platforms have several welfare implications that have not been documented by previous research. While a merger reduces competition, we show that customers may benefit from a merger due to the risk-pooling effect and reduced waiting times; moreover, if customers are sufficiently sensitive to delay, this benefit can spill over to the labor force via cross-side network externalities. We further establish that a win-win-win outcome, in which merging firms, customers and agents are all better off, can

always be achieved if the merged platform commits to certain ratios between prices and wages. This implies that antitrust agencies can enforce restrictions on the payout ratios to protect both consumers and agents. Finally, we illustrate our main insights by implementing our model in numerical experiments calibrated using real data from large on-demand ride-hailing platforms.

Talent Crowd Sourcing via Stochastic Sequential Assignments

Xuhan Tian, Xiangtong Qi
Hong Kong University of Science and Technology
Jumin (Jim) Shi
New Jersey Institute of Technology

Talent outsourcing, as a form of sharing economy, has gained growing popularity with numerous innovative market places. In this paper we study a stochastic assignment problem pertaining to talent crowd sourcing motivated by designer crowd sourcing, which has not been studied or even remains untapped in the OM literature. In the context of talent crowd sourcing, a platform has a pool of registered talents (e.g., designers) who provide customized intelligent service (e.g., design) for its clients. Due to the subjectivity in evaluating an intelligent service, the platform needs to present to a client multiple designs, though only one, or even none, will be selected at the end. This leads to a challenging resources allocation problem faced by the crowd sourcing platform. We tackle the problem via a stochastic sequential assignment model where a crowd sourcing platform assigns available talent to a stochastic project process. We show the optimal policy follows a staircase functional structure, and provide a sufficient condition under which more designers need to be assigned for the current project with a higher value. Furthermore, we show that the impact of the market volatility might be in an opposite way, determined by the structure of the reward function. Some algorithms have been developed to compute the optimal policy, which can be implemented for the pertaining automatization purpose, e.g., smart contract. Finally, an extensive computational study has been performed with rich and useful managerial insights. For example, it is shown that the developed strategic decision of stochastic sequential assignment can improve the expected reward or expected amount of successful projects while the market volatility becomes large, especially facing sparse resources. In addition, the merging and polling effect becomes fairly notable when the two sub-markets have a heterogeneous resource-demand structure.

Session II: Emerging Topics in OM

Sat 10:30 – 12:00

Chair: Xuan Wang (Hong Kong University of Science and Technology)

Room 6-212

The Value of Price Discrimination in Large Random Networks

Zizhuo Wang
University of Minnesota and CUHK-SZ

Jiali Huang, Ankur Mani
University of Minnesota

In this talk, we study the value of price discrimination in large random networks. Recent research has focused on the computation of optimal prices in deterministic networks under positive externalities. We would like to answer the question: how valuable is such discriminative pricing? We find, surprisingly, that the value of such pricing policies (increase in profits due to price discrimination) in very large random networks are often not significant. We provide the exact rates at which this value grows in the size of the random networks for different ranges of network densities.

Keywords: Random network, pricing, asymptotic analysis

Competition and Coopetition for Two-sided Platform

Renyu Zhang
New York University Shanghai
Maxime Cohen
New York University

We study the two-sided competition between online service platforms. We develop a new approach to characterize the existence and uniqueness of equilibrium when platforms compete for both demand and supply. Armed with this result, we then investigate coopetition between different ride-sharing platforms by introducing new joint services. The coopetition between different platforms is through profit sharing contracts. Interestingly, we show that a well-designed profit-sharing contract can will benefit both platforms. In addition, we find that one can design a profit-sharing contract that also benefits riders and drivers.

Keywords: platforms, two-sided competition, MNL choice model, coopetition, ride-sharing

Recommender Systems on Platforms

Xuan Wang
Hong Kong University of Science and Technology
Dennis Zhang
Washington University in St. Louis
Renyu Zhang
New York University Shanghai

We study the optimal recommender system design for a two-sided platform. The platform recommends producers to consumers to maximize the number of successful matches between consumers and producers. Consumers select a producer from the recommendation list according to an MNL model. Producers may be either capacitated or with unlimited capacity. We show that,

although only recommending high-quality producers to consumers is optimal when producers have unlimited capacity, such recommender system may result in substantial optimality losses in the presence of producer capacity constraints. If, in addition, the quality of a producer improves if s/he has the opportunity to work, the platform should recommend high-quality producers with an even lower probability.

Keywords: Recommender systems, labor platforms, platform operations, network externality

Managing Outpatient Care Services Under Strategic Walk-in Patients

Shan Wang
Shanghai Jiao Tong University
Nan Liu, Willem van Jaarsveld, Guanlian Xiao
Eindhoven University of Technology

Outpatient care providers often accept both scheduled patients and walk-in patients without appointments. Patients may choose to book an appointment or to walk in directly, depending on their health condition and the utility of each option. In this talk, we discuss how an outpatient care provider should manage her capacity taking into account such strategic behavior of patients.

Keywords: Appointment scheduling; Queueing Game; Walk-ins; Healthcare

Session 1J: Empirical Operations Management I
Chair: Zi'ang Wang (City University of Hong Kong)

Sat 10:30 – 12:00
Room 6-213

Digital Transformation in Retail Banking and the role of digital service development

Ting Cao, Murat Kristal
York University
Larry Menor
University of Western Ontario

We empirically examine the impact of digital transformation on digital service performance in retail banking. A multi-dimensional construct, digital service development (DSD), is developed to capture firms' efforts in generating digital service options through the integration of digital technologies into the operational system.

Keywords: Service Innovation; Service Operations Management; Digital Transformation; New Service Development.

Collateral-based Financing and Inventory Theory

Jing Wu
City University of Hong Kong
Vernon Hsu
CUHK Business School

Inventory can be pledged as collateral to gain financing for high-returns investment. In this research, we develop a parsimonious theoretical model on the inventory stock level and find that the optimal inventory is positively associated with expected risk-adjusted investment returns. Using China commodity data, we empirically confirm that the inventory levels of copper, zinc, and aluminum are positively related with net investment returns after controlling for exchange rate, price, as well as macro proxies for industrial demand and economic uncertainty. We further show that the economic impact of inventory as collateral is non-trivial compared to other factors. This suggests that the traditional inventory theory should further incorporate the financing collateral role in making the optimal decision.

Keywords: Inventory Theory, Collateral-based Financing, Commodity

The Evolving Role of AI and Robotics in Services Insights from the Hospitality Industry

Rohit Verma
Cornell University
Lina Zhong
Beijing International Studies University

The hospitality industry is trying to achieve customer satisfaction by using AI. In order to better understand the future trend of robot application in service industry, this project designed a series of researches to explore more from technology, customer and management in the hospitality industry. The research explored the customer demand and satisfaction, gathered technology acceptance perceptions of robots using TAM model, and analyzed the managers' understanding through deep interviews and the log data of robots in hotels. In the end, this research project discussed the possibility that robot could change the hospitality and service industry in the future.

Keywords: Artificial Intelligence; Robot application; Hospitality Industry

Social Interaction in Massive Open Online Courses: The Mediating Effects of Psychological Needs Satisfaction

Jiaming Fang, Lixue Hu, Jingjing Yang

University of Electronic Science and Technology of China

This study proposes a model to reveal the underlying mechanism how social interaction shapes learning engagement in massive open online courses (MOOCs), which are a new service delivery channel with universal access at reduced, if not zero, cost. This study uses survey data from MOOC learners to assess the proposed model. The results show that psychological needs satisfaction (i.e., competence, relatedness, and autonomy needs) fully mediate the effect of social interaction on MOOC learning engagement. Furthermore, peer learning group identification strengthens the effect of social interaction on psychological needs satisfaction. The finding has important managerial implications for MOOC platform design and operation in order to facilitate MOOC engagement.

Keywords: MOOC operation; psychological needs satisfaction; immersive experience; self-determination theory

The endemic population-trust and supply chain networks

Zi'ang Wang, Jing Wu
City University of Hong Kong
Volodymyr Babich, Gilles Hillary
George Washington University

We find that endemic population-trust matters in the formation and maintenance of supply chain links. County trust score is gathered from GSS survey data and combined with FactSet supply chain data. It is shown that endemic population-trust distance has significant negative relationship with supply chain formation, consistent with the matching theorem, implying high trust is not always beneficial. We also test the trust impact on supply chain stability when encountering both exogenous (hurricanes) and endogenous (class action events) shocks. It can be concluded that when facing outside or inside shocks, trust distance no longer matters, but trust level will.

Keywords: Supply Chains, Endemic population-trust, Social capital, Matching theorem

Session 1K: Policy and Quality

Sat 10:30 – 12:00

Chair: Guanlian Xiao (Eindhoven University of Technology)

Room 6-214

Denuclearization or Not: A Multiple-player Sequential Game Model

Puyu Ye
Nanjing University
Jun Zhuang
University at Buffalo

The Democratic People's Republic of Korea (DPRK) nuclear crisis is a complex international issue which relates to the security and geopolitics of many countries such as North Korea, United States, China, Russia, Japan and South Korea. In this paper, we use a multiple-player sequential game model to analyze the strategic interactions of these players. A multi-attribute (politics, economy, military) utility model is used for each player. To our best knowledge, this is the first game-theoretic study for modelling denuclearization decisions in a complex multiple-player scenario. Based on inputs from subject matter experts, we find that denuclearization is an optimal choice for North Korea, followed by the aids from United States, Japan, South Korea, China and Russia. The developed framework provides novel insights to decision making in this complex and important multilateral issue of denuclearization.

Jointly optimizing dwell point and boundary of 2-class-based storage in AS/RSs with input and output at opposite ends-of-the-aisle

Yuyu Liu, Hu Yu, Yugang Yu
University of Science and Technology of China

Class-based storage policy can significantly affect the performance of AS/RSs. However, as far as we know, class-based storage policy has not been studied in one of the typical AS/RS, in which Input and Output stations are at opposite ends-of-the-aisle. In this paper, we aim to optimize the boundary of this typical AS/RS with 2-class. We derive formulas for the expected travel time, with the help of a specific dwell point policy. We jointly optimize the boundary and dwell point with the objective of minimizing the expected travel time. Numerical experiments are performed to test the effectiveness of our results.

Keywords: AS/RS; input and output stations at opposite ends-of-the-aisle; two-class-based storage policy; dwell point policy

Temporal Aggregation Effects on Statistical Process Monitoring – A Review and Perspective

Inez Zwetsloot
City University of Hong Kong
W.H. Woodall
Virginia Tech

In monitoring applications data are always indexed in some way by time. One could have individual observations or samples collected at specific times, but aggregating data over time is very common. We review the literature on the effect of such aggregation on process monitoring performance and provide our perspective. We offer some practical advice and some directions for future research.

Keywords: Public Health Surveillance; Social Network Monitoring; Temporal Aggregation; Time-between-events Control Chart.

A Comparison of EWMA Control Charts for Dispersion based on Estimated Parameters

Jimoh Olawale Ajadi, Inez Maria Zwetsloot
City University of Hong Kong

In practical applications, parameter estimates are needed to set up the chart before monitoring can start. It is well known that using so-called Phase I estimates affect the performance of control charts. We compare three EWMA dispersion charts based on Phase I estimates. We compare the conditional performance under normally distributed data as well as non- normally distributed data. We show that the chart based on the sample variance is least influenced by estimation error under normally distributed data and the logarithm of the variance shows the most constant performance under deviations from the normality assumption.

Keywords: Dispersion; Estimation Effect; Exponentially Weighted Moving Average (EWMA); Standard Deviation of the Average Run Length (SDARL); Statistical Process Monitoring (SPM)

Opportunistic maintenance under Imperfect Failure Predictions

Guanlian Xiao, Alp Akcay, Lisa M. Maillart, Geert-jan van houtum
Eindhoven University of Technology

We study a two-component system which is continuously monitored by remote monitoring center. The component deteriorates according to a three-state discrete time Markov chain, with two unobservable operational states, (i.e., good and defect state) and a self-announcing failed state. We build an infinite horizon discounted total cost partially observable Markov decision process that takes imperfect signal information as input, and minimize the total sampling cost and maintenance costs. We proved the structural property of the optimal policy for general setting of two-component system. Based on the structural properties, we propose an efficient algorithm to get a solution for multicomponent case.

Keywords: Remote Monitoring; Imperfect Prediction; Multi-component; Partially Observed Markov Decision Process

Session 2A: Sharing Economy, Customer Behavior, and System Design

Sat 14:40 – 16:10

Chair: Yulan Wang, Yanli Tang (The Hong Kong Polytechnic University)

Room 5-203

Follow the Crowd to Avoid Congestion with Unknown Service Rate

Liu Yang,
Lingnan University
Weixin Shang
Tsinghua University

This paper investigates the impact of unknown service rate on customers' joining behavior in service systems. In a single-server queue with known service rate, customers always prefer the shorter-queue strategy when multiple joining equilibria exist. When the service rate is unknown to customers, we identify the follow the crowd (FTC) behavior and show that there exist at least one joining equilibria and that all of them have a threshold structure; when multiple equilibria exist, customers prefer the longer-queue strategy when the realizations of service rate differ significantly. In a two-server two queue system with random assignment of one faster server and one slower server, we show that the shorter-queue strategy (with random tie breaking for identical queue lengths) is always an equilibrium; when the faster and slower servers differ significantly in speed, a pure strategy in which customers sometimes join the longer queue is an equilibrium and dominates the shorter-queue strategy in terms of expected customer utility.

Efficient Incentives via Supply Re-usability

Shumin Ma, Qi Wu
City University of Hong Kong
Daniel Zhuoyu Long
The Chinese University of Hong Kong
Rowan Wang
Singapore Management University

In this paper, we study taxi platform where trip information is disclosed to drivers and number of drivers is fixed. Drivers are strategic and make the decision on whether to accept current trip request, which is known as cherry picking. We investigate the mechanism consisting of two incentives (ride fare sharing and subsidy) to manipulate drivers' cherry-picking behavior. With a queueing model, we study how drivers' choice and platform's performance are affected by the two incentives. Also, we explore the optimal design of incentive policy under different platform objectives.

Pricing and Service Level Competition with Variety-Seeking and Brand-Awareness Consumers

Ying Wei, Liyang Xiong
Jinan University

Yulan Wang
The Hong Kong Polytechnic University

In this paper, we consider that a portion of consumers are variety seeking and investigate the firms' pricing and service strategies when consumers also exhibit brand awareness. When firms are equally known, consumer variety seeking intensifies the competition in the sense that both firms adopt the same strategy by setting up the same price and service levels. However, when firms are unequally known, consumer variety seeking softens the competition in the sense that two firms differentiate their pricing and service levels. Variety seeking always harms the less known firm but may benefit the better-known firm when its brand advantage is sufficiently high.

The Effects of Overconfidence on a Competitive Supply Chain Members' Decisions

Juan Li, Jinling Cai
Nanjing University

The overconfidence of decision-makers manifests that managers over accurately estimate distributions of uncertainty, Intuitively, overconfidence bias is a negative force for decision-makers' profits, this paper intends to analyze the influence of deviation from overconfidence behavior of managers in a supply chain with two retailers and one capacity constrained supplier, and shows the bright side of overconfidence on members' profits.

Gender-Based Operational Issues Arising from On-Demand Ride-Hailing Platforms: Safety Concerns, Service Systems, and Pricing and Wage Policy

Yanli Tang, Pengfei Guo, Yulan Wang
The Hong Kong Polytechnic University
Christopher S. Tang,
The University of California, Los Angeles

Motivated by the recent development of “women only” ride-hailing platforms that aim to address the safety concerns raised by female riders and drivers, we examine whether a platform such as Didi should offer gender specific services (i.e., a “dedicated” system in which riders are matched with drivers of the same gender) instead of the current gender-neutral services (i.e., a “pooling” system in which riders are matched with drivers randomly without taking their gender into consideration). We make an initial attempt to examine if and when gender-specific services can enable the platform to address female safety concerns and improve its profitability.

Session 2B: Behavioral Operations Management II
Chair: Jussi Keppo (National University of Singapore)

Sat 14:40 – 16:10
Room 5-205

An Analysis of “Buy X, Get One Free” Reward Programs

Yan Liu, Yacheng Sun
Tianjin University

Our research context is “buy X, get one free” (BXGO) reward programs, which incorporate a redemption threshold (X purchases are required for a free product) and an expiry policy (unused points are lost after T periods of inactivity). Our analysis leads to the following results. First, an incremental purchase becomes more valuable as a consumer's reward points approach the redemption threshold or the expiration date. Second, a BXGO program can create a win-win for the seller and consumers. Third, if consumers derive transaction utility for the rewarded product, a BXGO program can be viable even when reward points never expire.

Keywords: redemption threshold, finite expiration term, forward-looking consumer, dynamic programming

Voice commerce could be the next frontier of e-commerce? Focusing on purchase behavior

Li Wang, SungMin BAE
Hanbat National University

Recently, voice commerce is one of the fastest growing segments in retail, but consumers are still purchase in point-and-click method. This paper aims to understand user acceptance of voice search for products. By integrating task-technology fit (TTF) theory and technology acceptance model (TAM), we proposed a framework that task technology fit, perceived ease of use (PEOU), and perceived usefulness (PU) jointly determine individual's intention to use. Analyzing data collected from 263 respondents, the results reveal that task-technology fit and PU positively influence intention to use; technology convenience, personal innovativeness, and social influence give positive effects on task-technology fit, PEOU, and PU, while perceived risk and personal shyness exert negative effects.

Keywords: Voice search, purchase behavior, task-technology fit, technology acceptance model, individual characteristics

Estimation of dual market diffusion models: Divide and Conquer Approach

Taegu Kim
Hanbat National University
Jungsik Hong

Seoul National University of Technology

In spite of its usefulness in describing the dynamics of heterogeneous consumer population, dual market models have not been applied widely. It is mainly because their complexity lead to unstable estimates. We suggest a two stage approach to tackle this problem with divide and conquer algorithm. First, a postulated segment as main market is estimated with BMIC and linearized formulae of Bass and Logistic. Then results are utilized to second stage estimation. We demonstrate the inherent limitation of dual market models and compare the estimation results with proposed approach in terms of reproducibility and fitness.

Keywords: Innovation diffusion, Dual market, Bass, Logistic, BMIC

Power of Dynamic Pricing in Revenue Management with Strategic (Forward-looking) Customers

Yiwei Chen
University of Cincinnati
Stefanus Jasin
University of Michigan

We study a canonical revenue management problem wherein a monopolist seller seeks to maximize revenue from selling a fixed inventory of a product to customers who arrive over time. We assume that customers are forward-looking and rationally strategize the timing of their purchases. Chen et al. (2018) show that the so-called fixed price policy is asymptotically optimal in the high-volume regime where both the seller's initial inventory and the length of the selling horizon are proportionally scaled. Specifically, the revenue loss of the fixed price policy is $O(k^{1/2})$, where k is the system's scaling parameter.

Keywords: revenue management, dynamic pricing, strategic customers, re-optimization, asymptotic

Herding Out the Crowd

Jussi Keppo
National University of Singapore
Ville Satopaa
INSEAD

This article analyzes multiple experts who forecast an underlying dynamic state based on a stream of public and private signals. Each expert forecaster minimizes a convex combination of her forecasting error and deviation from the other experts' forecasts. As a result, the experts exhibit herding behavior — a bias that has been well-recognized in the economics and psychology literature. Our first contribution derives and analyzes the experts' optimal forecast

under different levels of herding. This extends the Kalman filter and smoothing to applications where the underlying dynamics can be non-linear and herding is an important part of the process. Our second contribution is a welfare analysis where we show that, on average, the precision of public information affects welfare more than the level of herding among the experts. However, on average, the level of herding decreases the heterogeneity in the experts' forecasts more than the precision of public information. Our third contribution is an estimation scheme for our model and a resulting simple compensation scheme that minimizes the herding effect.

Session 2C: Healthcare Operations Management II

Sat 14:40 – 16:10

Chair: Shan Wang (Shanghai Jiao Tong University)

Room 5-206

Managing Quality of Care for Healthcare Services: The Role of Information, Competition and Incentives

Linggang Qi
City University of Hong Kong
Zhan Pang
Purdue University
Sergei Savin
University of Pennsylvania

Patients always prefer hospitals with high-quality services, but such hospitals are crowded, which will make some patients give up choosing them. In this paper, we will use a mixed multinomial logit (MMNL) model to capture the choice behavior of patients who are sensitive to service quality and waiting time. Facing such patients, hospitals maximize their revenues by altering their service quality. We will study how hospitals decide their service quality in competitive markets with different reimbursement contracts. Also, we will investigate how the accuracy of quality information that patients can get influence hospitals' quality decisions.

Keywords: healthcare competition; patient choice; incentives; information transparency

Continuity of Care versus a Second Opinion: Evidence from the Opioid Crisis

Michael Freeman
INSEAD
Lawrence Huan, Stefan Scholtes
University of Cambridge

In the US, mortality from the opioid crisis is quickly eclipsing the AIDS epidemic, taking an estimated 49,000 lives in 2017 alone. Despite risk warnings, opioids continue to be frequently used in general practice. We investigate the impact of continuity of care versus a second opinion for patients with a first opioid prescription. Continuity of care is generally commended as a

single doctor has full oversight into the patient's treatment plan. However, in the context of opioids, it may be difficult for a doctor who prescribed the first opioid to transition the patient to a different treatment. Using a nationwide dataset, we find that the second opinion may be a critical tool in curbing opioid dependence.

Keywords: healthcare; opioids; empirical methods; primary care

Managing Telemedicine Platforms with Independent Physicians

Xianyi Wang, Xiaofang Wang, Rongyi Huang
Renmin University of China

In the telemedicine platform, the quality of service derived by a patient depends on the service rate. Thus, in addition to the quality and speed trade-off, the manager needs to decide the wage paid to physicians who make individual decisions whether or not to join the platform with the help of mobile Internet. In a strategic queueing framework, we study how a telemedicine platform make the optimal service fee, wage and service rate decisions. We show several insights with respect to social welfare and the effects of regulation policies.

Keywords: telemedicine platform; queueing games; discretionary services

Payment Mechanisms Incentives for Improving Prevention and Treatment in Chronic Diseases

Shifu Pan, Haiyan Wang
Southeast University

The aim of this study was to reducing the morbidity of chronic diseases, the funder through regulates the financial risks associated with patient morbidity of chronic diseases many payment mechanisms such as fee-for-service, pay-for performance, and bundled payment. To illustrate different payment mechanisms how to incentive the hospital and cost sharing how to incentive the patient coproduced in reducing morbidity of chronic diseases, The impacts of the obtained results are provide some policy guidelines to the funder.

Keywords: Fee-for-service, Pay-for-performance, Bundled payment, morbidity of chronic diseases

Session 2D: OM-Marketing Interface II
Chair: Weifen Zhuang (Xiamen University)

Sat 14:40 – 16:10
Room 5-207

Local-Content and Pricing Decisions of a Multinational Firm in a Duopoly Market

Liping Liang, Mingming Leng
Lingnan University
Nanqin Liu
Xiamen University

The internationalization of production requires each multinational firm to determine a local content rate for its product made and sold in a foreign country. We investigate the local content rate and pricing decisions for a multinational firm who competes with a local firm in a market without and with a local content requirement (LCR). We derive conditions under which the multinational firm meets the LCR. We also investigate the impact of the LCR on the two firms and how the impact is affected by the technology level in the host country compared to that in the multinational firm's parent country.

Keywords: Game theory; local content rate; local content requirement; duopoly market.

Wardrobing: Is It Really All That Bad?

Ahmed Timoumi,
Indian School of Business
Anne T. Coughlan
Northwestern University

An item is said to have been “wardrobed” when it is bought by a consumer; used for a short time; and then returned to the store as if it were unused, for a full or partial refund. This paper considers the benefits and costs of wardrobing. We show that wardrobing is in fact not entirely bad because it offers the retailer the ability to practice price discrimination among consumers who vary in their product usage valuations. It also serves as a commitment mechanism for a monopolist retailer allowing him to increase his profit.

Keywords: game theory; product returns; durable goods.

Why stakeholders prefer performance-based contracting?

Yamini S
Indian Institute of Management

For any firm to sustain in the market in long run, quality is an important metric. Information asymmetry may exist between the transacting parties, since the quality can be evaluated only after purchase, resulting in the risk of moral hazard. To mitigate this effect, a mechanism is

designed using game theoretic framework to motivate the agent to reveal the truthful information. The principal can also employ an external agent to monitor the agent, nonetheless the downsides of it and the value of information are illustrated by comparing the mechanisms developed for an external agent and the agent itself.

Keywords: Quality Management; Mechanism design; Information asymmetry

Impacts of Distributional Social Comparison Behavior on Corporate Social Responsibility: Power of the Small

Xin Fang
Singapore Management University
Zhizhuo Wang
Dalian University of Technology
Mingzheeng Wang
Zhejiang University

Motivated by the emergence of various corporate social responsibility (CSR) rankings and awards, we study the impacts of distributional social comparison behavior of firms on CSR in a supply chain. We find that if a retailer is a large enterprise who has strong negotiation power in the supply chain, his ahead-seeking behavior cannot motivate an uptier manufacturer to increase CSR investment. In contrast, if the retailer is small, his ahead-seeking behavior can lead to significant increase in the manufacturer's CSR investment.

Keywords: Corporate Social Responsibility; Social Comparison Behavior; Small and Medium-size Enterprise (SME).

Dynamic Channel Control and Pricing of a Single Perishable Product on Multiple Distribution Channels

Weifen Zhuang
Xiamen University
Boqian Song, Michael Z.F. Li
Nanyang Technological University

This paper studies dynamic channel control and pricing of a single perishable product distributed through multiple channels with the objective of maximizing the total expected profit over a finite horizon. Two types of contracts, namely, proportional and fixed commission contracts, are examined under dependent and independent channels. Utilizing the stylized linear function to characterize dependent demand flows from different channels, we derive the optimal pricing and channel control policy, based on which the optimal prices offered on open channels can be directly associated with the opportunity cost of capacity in closed forms. This significantly

reduces the computational complexity of the stochastic dynamic program, especially when the number of channels is high. When channels are independent, we provide a necessary and sufficient condition for the optimality of a nested channel control policy by commission rates, which is also sufficient for the optimality of the nested channel control policy in a distribution system with two dependent channels. Then we characterize structural properties of optimal policies. Finally, we illustrate analytical results and explore the impact of the channel substitution effect on channel control through numerical studies.

Keywords: Revenue Management, Dynamic Pricing, Multiple Distribution Channels, Channel Control Policy

Session 2E: Interface of Operations and Finance II
Chair: Harry Fok (Lingnan University)

Sat 14:40 – 16:10
Room 6-207

Supporting a Capital-constrained Supplier with Cash in Advance and Purchase Order Financing

Andy Wu, Hsiu-Yuan Tsao
National Chung Hsing University

We consider a supply chain including a credit-worthy buyer and a capital-constrained supplier. The supplier uses Cash in Advance (CIA) and Purchase Order Financing (POF) to fund his operation. The supplier's action on production input and loan amount are affected by the advance amount, purchase price, and order size specified by the buyer. Our analysis shows (1) the buyer prefers a pure CIA scheme if her budget is large. POF will be used only if the buyer's capital is also limited. (2) If order separation is permitted, taking CIA as the major facility and POF as the backup is optimal.

Keywords: Purchasing; Production Control; Cash in Advance; Purchase Order Financing

Supplier-Stackelberg Newsvendor Game with Trade Credit

Vandana Rai
Indian Institute of Technology Madras

In this article, we investigate the two-echelon newsvendor problem under the trade credit policy. Moreover, supplier-Stackelberg under two price competitive retailers are considered under the non-cooperative game theory. The problem stated as single supplier supplies the single item and offer credit period to the retailers, moreover the retailers are facing random demand from the customers based on the competitive price. The goal of this article is to obtain the optimal values of the decision variables of the retailer's as order quantity and selling prices and optimal interest rate for the supplier.

Keywords: Trade-credit; newsvendor problem; Bertrand competition; default risk

Global Supply Chains and Cross-Border Financing

Jie Peng, Jing Wu
City University of Hong Kong

Financial globalization is still far from complete four decades after the end of the Bretton Woods System largely due to transaction costs and informational frictions. In this study, we ask if global supply-chain relationships help firms access cross-border financing in the international capital markets. Comparing two firms that are otherwise similar, we observe the firm that has formed global supply-chain relationships to have more cross-border financing after the supply chain formation. This result is supported empirically by all major financing vehicles, including stock cross-listing, bond issuance, bank loans, and M&A deals.

Keywords: Global Supply Chains, Cross-Border Financing, Difference-in-Difference method

Credit Risk Propagation Along Supply Chains: Evidence from the CDS Market

Jing Wu
City University of Hong Kong
Senay Agca, Volodymyr Babich
George Washington University
John R. Birge
University of Chicago

We find that credit risk propagates through multiple supply chain tiers for both positive and negative credit shocks. Specifically, we show sizeable rating and industry- adjusted CDS spread changes of 44-71 bps at the first tier of supply chains in response to extreme CDS jumps. The reaction to adverse credit shocks persists for 2nd and 3rd tiers, but attenuates for favorable shocks. The effects of credit shocks on supply chain partners disappear when supply chain links are inactive and are magnified with longer- term supply chain relations, trade credit, sales contribution, differentiated products, and customer leverage. Risk propagation is moderated when a customer is investment grade or has more inventory. Furthermore, credit risk propagation is considerably stronger for supply chain partners followed by the same analysts.

Keywords: Supply Chains, CDS Contagion, Multi-Tier Supply Networks, Credit Risk

The Effect of Customers' Abnormal Inventory on Suppliers' Earnings Quality

Harry Fok, Wilson Chan, Liming Liu
Lingnan University

This study examines whether the suppliers selling to customers with abnormal inventory performance behave differently in their financial reporting. In particular, we hypothesize that suppliers with high customer's abnormal inventory growth faces higher uncertainty about future demand and profitability. This kind of suppliers are likely to engage in more earnings management activities to mitigate the risk towards meeting the future earnings targets. We use inventory metrics used in operations management to illustrate that customers with higher abnormal inventory growth (AIG) and abnormal inventory (ABI) are associated with high discretionary accruals, high real manipulation in operating activities and more SEC investigations. The proposed study suggests that poor customer inventory performances are likely to drive managers to produce poor quality financial reports.

Session 2F: Humanitarian and Socially Responsible Operations

Sat 14:40 – 16:10

Chair: Geoffrey A. Chua, Di Yin (Nanyang Technological University)

Room 6-208

Post-Disaster Humanitarian Logistics Planning: A Time-to-Survive Framework

Yini Gao
Singapore Management University
Guodong Lyu
National University of Singapore

Designing and planning humanitarian supply chains for post-disaster response entails great challenges due to disrupted supply chain under uncertain decision environment coupled with great urgency. One of the most critical issues is the delay in the transportation of emergency relief items due to disrupted infrastructure capacity. Moreover, at the early stage after disasters, the transportation conditions are uncertain to decision makers before the actual shipping due to lack of information or other human factors. In this paper, we consider the post-disaster relief resource logistic planning problem in the presence of uncertainty in transportation capacity. We propose to use Time-to-survive (TTS) as a new performance measure for the humanitarian relief effort and adopt a two-stage distributionally robust approach to determine the optimal transportation plan. We show that this two-stage distributionally robust problem is equivalent to a conic problem that can be solved via a positive semi-definite program. We apply this analytical framework to a post-disaster humanitarian logistics planning problem, extracted from a case study on Typhoon Haiyan.

Keywords: humanitarian logistics, time-to-survive, robust optimization

The Online Logistics Distribution Alliance Problem: Cooperative Game and Vehicle Routing

Jiang Hang Chen, Qinghua Zhu
Shanghai Jiao Tong University
Weizhen Rao
Shandong University of Science and Technology

The transportation industry is extremely competitive and fierce competitions have driven freight rates down and thus profit margins of carriers have declined significantly. Horizontal collaborations among carriers are ways to boost carriers' efficiency and mitigate the adverse impacts of competitions. In horizontal collaborations, carriers set up coalitions to perform parts of their logistics operations jointly. We will introduce the concept of online logistics distribution alliance and in order to establish a stable alliance, a cooperative game coupling with vehicle routing problems (multiple depots) need to be solved. Solution algorithms for the problem and numerical experiments will be presented.

Keywords: horizontal collaborations, collaborative vehicle routing problem, online logistics distribution alliance, cooperative games

Socially Optimal Incentive Schedules for Public Health

Sze-chuan Suen
University of Southern California
Diana Maria Negoescu
University of Minnesota
Joel Goh
National University of Singapore, Harvard University

Premature cessation of antibiotic therapy (non-adherence) can severely compromise health outcomes. We design a schedule of incentive payments to induce socially-optimal treatment adherence levels given (a) budget requirements, (b) heterogeneous patient preferences for treatment adherence, which are furthermore (c) unobservable to the social planner. A unique challenge in this problem is that any prior commitment that a patient makes to a given level of treatment adherence typically cannot be enforced and contracted upon. We show that the optimal payment schedule can be constructed through the solution of a single convex optimization problem and provide numerical examples.

Keywords: mechanism design, contract design, infectious disease, public health

Delay Announcement: Managing Non-Cooperative Behavior of Disaster Survivors in Post-Disaster Recovery

Di Yin, Fang Liu, Geoffrey A. Chua
Nanyang Technological University

Disaster survivors are observed to exhibit non-cooperative behavior during post-disaster reconstruction, e.g. spreading rumors or being suspicious of aid workers, because they lack knowledge of the reconstruction completion time. How can a public agency motivate survivors to avoid such behavior through information disclosure? We formulate this as a stopping time problem, characterize the optimal announced delay and the optimal time to release the information, and discuss the trade-off between a short and a long delay.

Keywords: disaster management, post-disaster recovery, information disclosure, stopping time

Session 2G: Logistics I

Sat 14:40 – 16:10

Chair: M. S. Gajanand (Indian Institute of Management)

Room 6-209

Stock market reaction to green logistics initiatives: evidence from China

Jinan Shao, Yongyi Shou
Zhejiang University

Although several studies have investigated the relationship between environmental management and firm performance, scant research attention has been paid to the Chinese logistics industry. We examine the performance value of green logistics initiatives (GLIs) made by logistics service providers (LSPs) in China by analyzing the stock market reaction to their announcements of GLIs with the event study approach. We observe that the stock market reacts positively to LSPs' announcements of GLIs. We find further that the market reaction is more positive for LSPs with a lower level of operational slack. However, financial slack does not significantly affect the market reaction.

Keywords: Green logistics initiatives; Stock market reaction; Operational slack; Financial slack; China

Travel time analysis in the Autonomous vehicle storage and retrieval system

Jingjing Yang, Xiaolong Guo, Yugang YU
University of Science and Technology of China

The autonomous vehicle storage and retrieval systems (AVS/RSs) are becoming increasingly popular among e-commerce companies. The vehicle which takes care of storing or retrieving the unit load can get to any tier through the lift in the system. In this paper, we formulate the

continuous travel time model for dual-command mode in an AVS/RS in which the number of vehicles is less than the number of tiers. We derive closed-form formulas for the expected travel time and validate the results by simulation. The result shows the travel time decreases with the increasing number of vehicles.

Keywords: Logistics, AVS/RS, dual-command mode.

Impact of hard and soft time window restrictions on fuel consumption

M.S. Gajanand
Indian Institute of Management

Routing of vehicles to minimize the fuel consumption has become important due to the increasing fuel prices and the perceived environmental and social benefits. The load carried, distance travelled and the speed significantly affect the fuel consumed by a vehicle, apart from other vehicle-specific parameters. Time window, in the context of vehicle-routing, refers to the interval of time during which the customer wants the goods to be delivered. This study explores the economic, environmental and operational impact of hard and soft time window restrictions. The study presents key insights for making business and policy decisions related to time windows.

Keywords: Time-windows; Green logistics; Vehicle-Routing; Fuel consumption

Joint ship-pack size and unpacking location optimization in a retail supply chain with product returns

TAN Ke-wei, ZHAO Quan-wu
Chongqing University

Ship-pack size, unpacking location and product returns are deterministic cost drivers in the retail supply chain. But existing literatures have not investigated them simultaneously. We present a joint ship-pack size and unpacking location Optimization model under product returns to find the optimal trade-off among the related costs. The new model delivers an optimizing operational solution at Stock-Keeping Unit (SKU) level which minimizes total supply chain cost under the constraints of sorting and picking capacity in DCs. To solve the model, we put forward two propositions and an efficient hybrid algorithm. Our methodology is illustrated with a retail supply chain from a leading Chinese retailer (Yonghui) in Chongqing. Numerical analysis suggests that optimal solutions can reduce the total supply chain cost significantly by comparison with the current solution. This paper also studies the effects of the various parameters to the retail supply chain and point out some management implications.

Keywords: Ship-pack size; unpacking location; product returns; Modern retail operations

Session 2H: Supply Chain Management III

Sat 14:40 – 16:10

Chair: Sameer Hasija (INSEAD)

Room 6-211

Optimal Pricing for Selling to a Static MultiPeriod Newsvendor

Xiao Alison Chen
University of New Hampshire
Zizhuo Wang
University of Minnesota
Hongsong Yuan
Shanghai University of Finance and Economics

This paper considers a multi-period supply chain model in which a supplier sells to a multi-period newsvendor. Such a problem is relevant in industries with long production lead times. We study the optimal pricing problem for the supplier. We derive procedures for solving the optimal prices and show that the optimal pricing sequence is decreasing in time. We also show that the optimal prices are increasing in the backorder cost when the cumulative demand functions have increasing generalized failure rates.

Keywords: Newsvendor; pricing; supply chain management.

Competitive product service mode induced by the manufacture in OEM supply chain

Liping Liu, Lindu Zhao
Southeast University

Manufacturing servitisation provides an effective path to alleviate the fierce competition for the manufacturing industry. This study considers a new service mode that product services will be provided by the upstream module supplier who is rich in the ability of product service when the products are sold. We constructed a Stackelberg game model and found that different market types will have an impact on product pricing, product service quality and profit. When the wholesales are exogenous variables there exists a unique optimal pair of commission fees to make the OEM obtain the maximal profit.

Keywords: Servitization; Modularization; Module service; OEM supply chain

The Contract Manufacturer Encroachment with Loyal Consumers

Jing Hou, Houcai Shen
Nanjing University

Considering a fraction of customers are loyal consumers who only consider buying products from original equipment manufacturer (OEM), we study whether a contract manufacturer (CM) would encroach on the end-market with self-branded products and determine its quality level for the best profit in such case. The impact of contract manufacturer encroachment (CME) on sales strategies and profits of OEM are also studied. The results show OEM's target market may change from the whole market to loyal consumers due to CME and the optimal CM product quality depends on the proportion of loyal consumers and the bargaining power of CM.

Keywords: Encroachment; Contract Manufacturer; Original Equipment Manufacturer; Loyal Consumers

Optimal Profit Allocation and Leadership Assignment of Collaborative R&D in Supply Chain Networks

Changfeng Wang, Yishang Yin
Shandong Jiaotong University

The highly distributed and frequently changing of resources, and the rising costs and uncertainties of developing and launching new products require firms to collaborate in the development of new products with other firms in supply chain networks. In this paper, we investigate the optimal profit allocation and leadership assignment of collaborative R&D in supply chain networks. We make a distinction between cooperative R&D effort and leadership effort. When it is costly to sign contracts on R&D efforts under complete information, it may be optimal to let one firm have the full leadership to lead and direct the project, and claim full residual profit. These rights are limited residual rights of control over R&D actions. In the benchmark case of incomplete information, we have also explored how the optimal assignment of leadership distribution in cooperative R&D and partnership depends on the interaction between each member's importance in cooperative R&D, the effectiveness of leadership and the degree of R&D teamwork. Numerical examples are used to verify the justifiability of the models.

Keywords: Collaborative R&D; Supply Chain Networks; Optimal Profit Allocation; Optimal Leadership Assignment; Principal-Agent Model

Supply Chain and Antitrust Governance: Can Contractual Agreements Reinforce the “Illinois Brick”

Sameer Hasija
INSEAD
Nitish Jain
London Business School
Serquei Netessine
University of Pennsylvania

In a landmark case, *Illinois Brick Co. v. Illinois* (431 U.S. 720, 1977), the U.S. Supreme Court barred an indirect purchaser to sue for antitrust damages based on “pass-on” claim of supracompetitive prices by upstream firms. Although this ruling supports reduction of legal costs, it increases costs of regulatory oversight to curb cartel formation. We identify supply chain characteristics, in particular contractual relationships between buyers and sellers, that facilitate formation of upstream cartels under this ruling. Our results provide regulators a framework to improve case selection, thereby allowing attenuation of regulatory costs while maintaining lower legal costs under this ruling.

Keywords: supply chain contracts, cartels, antitrust regulation

Session 2I: Operations Management and Innovation

Sat 14:40 – 16:10

Chair: Guo Li (Beijing Institute of Technology), Xu Guan (Wuhan University) Room 6-212

Service Order Allocation under Demand Uncertainty: Risk, Competition and Relationship

Weihua Liu, Di Wang
Tianjin University

This paper builds a model of service order allocation under uncertain demand. Three factors including the risk of service integrator, the competition of service provider and the relationship between integrator and provider are considered in the framework of order allocation. The influences of these factors on order allocation and the relationship between them are studied. It is found that the "offsetting effect" between risk aversion behavior and relationship strength, the "amplification effect" between peer competition and relationship strength, and the "dependency effect" when all three factors exist. Finally, the conditions that three factors need to meet when the service integrator's utility is improved are proposed.

Keywords: Order allocation; Risk aversion behavior; Competition behavior; Relationship intensity;

Transparency of Demand Information Acquisition in a Dual-Channel Supply Chain

Song Huang, Shuting Chen
South China Agricultural University

This paper studies a manufacturer's contract provision for a retailer's demand information acquisition in a dual-channel setting. Due to complexity and uncertainty, the outcome of acquisition makes the retailer either become informed or remain uninformed of her demand type. We explicitly consider two formats of acquisition: transparent acquisition and non-transparent acquisition, depending on whether the outcome of acquisition is observable to the manufacturer. We show that the manufacturer is consistently better off with transparent acquisition. However, the retailer may prefer transparent acquisition, which happens only when her acquisition capability is low and the market dispersion is in the intermediate range.

Keywords: supply chain management; information acquisition; dual-channel; transparency

Roles of A Preselling Strategy under Asymmetric Cost Information

Zelong Yi
Shenzhen University
Xi Wang
Shanghai Lixin University of Accounting and Finance
Xu Guan
Wuhan University

In many markets, one firm may provide customers an option to buy ahead of time. In this circumstance, customers inevitably need to make purchase decisions under uncertainty on the future price as well as valuations of the product, which critically rely on the marginal cost. The marginal cost is usually private information of the firm in reality. We employ the framework of dynamic games to examine impacts of cost information asymmetry and the corresponding signaling effect in influencing the firm's preselling strategy and profitability. There is a common understanding that the firm would profit a lot from the preselling owing to private information on the marginal cost. However, this paper finds that the role of preselling under asymmetric information is disputable. The firm has less incentive to presell with information asymmetry, and the information superiority may not benefit the firm. Likewise, the disadvantage of information may not hurt the customers due to their rational expectation of cost.

Disappointment Aversion, Quality Disclosure and Market Competition

Xu Guan
Wuhan University
Yulan (Amanda) Wang

The Hong Kong Polytechnic University
Ying-Ju Chen
Hong Kong University of Science and Technology

When the quality of the firm's product is unobservable, consumers may generate some psychological feelings of elation or disappointment when the perceived product quality exceeds or falls short of their initial expectations. This paper considers that consumers are disappointment averse and investigates firms' corresponding optimal information disclosure strategies when launching new products. To examine how consumers' psychological feelings impact firms' equilibrium disclosure strategies and profitability, we consider the following three market situations: a monopoly setting, a duopoly setting where firms do not share their quality information with each other, and a duopoly setting where firms share their quality information with each other. We show that both psychological disappointment and elation can induce the firm(s) to disclose more quality information than that when the consumer is fully rational. In a monopoly setting, the increase of the magnitude of disappointment always undermines the firm's profit while the increase of the magnitude of elation may hurt the firm's profitability. In contrast, in a duopoly setting, the increase of the magnitude of disappointment and/or elation always improves the firm's profitability. Moreover, such improvement can be further enhanced when the competing firms share their quality information upfront before making their disclosure decisions.

Retailer Information Sharing and Supplier Channel Selection in New E-commerce

Guo Li, Hong Zheng
Beijing Institute of Technology
Suresh P. Sethi
The University of Texas at Dallas
Xu Guan
Wuhan University

In new E-commerce, suppliers usually sell their products through both the traditional reselling and agency selling channels. Under such a circumstance, we investigate an online retailer's incentive for sharing her private demand information with a supplier, who has already sold his products via the online retailer through the reselling channel, now wants to establish the agency selling channel to directly sell his products to the market. We show that, the online retailer may prefer to voluntarily share her private information to strategically induce the supplier to establish the agency channel when the entry cost is moderate. Further, we extend to consider the scenario (AR) that the supplier acts as a market entrant, and simultaneously decides whether to establish the both channels. We find that online retailer still has the incentive to share her private demand information to manipulate the supplier's channel establishment decision under scenario AR.

Session 2J: Empirical Operations Management II
Chair: Haoran Zhu (University of Hong Kong)

Sat 14:40 – 16:10
Room 6-213

Exploring endogeneity issues in survey research: Exploring the effect of supplier's relational flexibility on its resilience

Anto J. Vergheze
University of Wisconsin-Whitewater

In this study, we explore the effect of supplier's relational flexibility on its resilience using survey data from 207 supplier firms. Doing so, we validate the need to take potential endogeneity issues arising from the use of a common method, omitted variables, and simultaneity into consideration. Subsequently, we present remedial strategies to test our hypotheses.

Keywords: relational flexibility; supplier resilience; endogeneity; survey research.

Labor Market Demand and Firm Performance

Linbin Luo, Jing Wu
City University of Hong Kong

Firms search suitable employees by publish information about their vacancies. We employ a unique dataset that collects online recruitment information which contains the text descriptions of the position requirement to study the impact of labor demand on firm's future development. We explore the relationship between labor market and the firm's performance. And We also explore the heterogeneity brought by different skill requirement to the firm.

Keywords: Job posting; labor demand; asset pricing; big data

The impact of sharing economy practices on sustainability performance in the construction sector

Ying Li
Shandong University

The sharing economy is gradually reshaping the construction industry. This study identified the use of digital platform, internal sharing practices with stakeholders, and external sharing practices with strangers as three critical elements of sharing economy practices from social-technical perspective. And then, the impact of these three elements of on sustainability performance including economic performance, stakeholder satisfaction, and environmental performance was discussed. Based on the survey in Chinese construction industry, this study used structural equation modelling method to test the proposed hypotheses. The findings will enhance the understanding on sharing economy practices in the construction sector.

Keywords: sharing economy, sustainability performance, construction sector, structural equation modelling

Internal Governance and Workplace Safety

Haoran Zhu
University of Hong Kong
Zhifeng Yang
Stony Brook University
Rengong (Alex) Zhang
City University of Hong Kong

We examine whether firm internal governance with respect to headquarter plant monitoring affects workplace safety. We use travel time reductions due to new airline routes as exogenous shocks to the cost of monitoring, and find that workplace safety improves afterwards. The results are more pronounced for smaller and rural plants, firms with less financial constraint, and smaller plants of larger firms. Further analyses reveal that greater proximity reduces the workload of previous overloaded plants. The results are consistent with headquarter improving monitoring and setting more realistic expectations of plants. Our results have managerial implications on plant location choices.

Keywords: Internal Governance; Workplace Safety; Sustainable Operations

Session 2K: Student Paper Competition Finalists I

Sat 14:40 – 16:10

Chair: Zhankun Sun, Yimin Yu (City University of Hong Kong)

Room 6-214

Learning Customer Preferences from Personalized Assortments

Yifan Feng, Rene Caldentey, Christopher Thomas Ryan
University of Chicago

A company wishes to identify the most popular version of a product from a menu of alternative options. Unaware of customers' true preferences, the company relies on a feedback system that allows potential buyers to provide feedback on their preferred versions. Under a general ranking-based choice model framework, we study how to dynamically individualize the set of versions shown to each customer for them to provide feedback on. This allows the company to identify the top-ranked version with a fixed probabilistic confidence level using a minimal amount of feedback. We prove an instance-specific lower bound on the sample complexity and propose a sampling policy (Myopic Tracking Policy), which is both asymptotically optimal and intuitive to implement. Our methodology draws on previous work in the sequential design of experiments and best arm identification. We illustrate our methodology using a special class of choice models based on Luce's (1959) attraction model and provide a simple closed-form solution that reveals a number of key properties of our proposed Myopic Tracking policy.

Managing Appointment-based Services in the Presence of Walk-in Customers

Shan Wang, Guohua Wan
Shanghai Jiao Tong University
Nan Liu
Boston College

Despite the prevalence and significance of walk-ins in healthcare, we know relatively little about how to plan and manage the daily operations a healthcare facility that accepts both scheduled and walk-in patients. In this paper, we take a data analytics approach and develop the first optimization model to determine the optimal appointment schedule in the presence of potential walk-ins. Our model is the first known approach that can jointly handle general walk-in processes and heterogeneous, time-dependent no-show behaviors. We demonstrate that, with walk-ins, the optimal schedules are fundamentally different from those without. Our numerical study reveals that walk-ins introduce a new source of uncertainties to the system and cannot be viewed as a simple solution to compensate for patients no-shows. Scheduling, however, is an effective way to counteract the negative impact from uncertain patient behaviors. Using data from practice, we predict a significant cost reduction (42%-73% on average) to our proposed schedules. Though our work is motivated by healthcare, our models and insights can also be applied to general appointment-based services with walk-ins.

The Upside and Downside of Pay Transparency with Over and Under-confident Agents

Xiaoshuai Fan, Ying-Ju Chen
Hong Kong University of Science and Technology
Christopher S. Tang
University of California, Los Angeles

Pay transparency is the last taboo in business. Enterprises are still far away from reaching an agreement on carrying out the transparent payment. Academic/Practical Relevance: To provide guidelines for practice, we theoretically study the upside and downside of pay transparency policy when agents are over- or under-confident in their working capabilities. The key distinction induced by publicizing salaries is social comparison behaviors, i.e., agents may experience a disutility (utility) from a relatively low(high) wage. The former is described as behind-averse behavior and the latter is defined as a head-seeking behavior. Methodology: In this paper, we explore a one-principal-two-agent model to derive agent's optimal effort decision and principal's optimal payment schemes under the secret or transparent payment policies. Furthermore, we consider three modes of social preference, i.e., behind-averse model, full social preference model and type dependent social preference model.

Results: We find that relative to the secret payment policy, (i) pay transparency will motivate different groups of agents under different social preference models, but in general, pay transparency will improve agent's performance; (ii) the job satisfaction will decrease when both agents are overconfident, irrespective of the social preference model, and (iii) high job satisfaction as well as high performance could be achieved simultaneously within a proper combination of agents. Extending to a multiple-agent case under the full social preference model, we observe that the under-confident agent will exert less effort as the number of agents increases. Managerial implications: Our analysis reveals the relationship between the transparency of a payment policy and the performance as well as the job satisfaction, which provides guidelines for principals to implement the transparent payment policy properly. Also, we elaborate on the design of the payment scheme to maximize the principal's profits in the presence of social comparison behavior and over- and under-confident biases.

On the Benefits of Reserve Pooling over the Warranty Life Cycle

Xiaolin Wang, Lishuai Li
City University of Hong Kong
Wei Xie, Yuanguang Zhong
South China University of Technology

In this paper, we investigate the warranty reserve planning and pooling problems faced by manufacturers selling new products. For manufacturers who manage warranties for multiple products, it is better for them to dynamically maintain a combined reserve fund to enhance the liquidity and reduce the financial risk. Our objective is to evaluate the benefits of risk pooling for warranty reserve management during the entire warranty life cycle. To this end, we first propose a model coupling the product sales and failure processes to forecast the aggregate warranty cost (AWC), which allows the manufacturers to plan their warranty reserves periodically. The forecasting method can be used to explain the general trend of empirical warranty claim data. On this basis, the benefits of reserve pooling are analytically investigated based on a distributionally robust method, because the exact distribution of AWC is generally unknown. When more than one product is considered, we prove that the relative benefit of warranty reserve pooling decreases as the range of standard deviations increases. In addition, we find that the pooling benefits change over different stages of the warranty life cycle.

Session 2L: Inventory Management

Sat 14:40 – 16:10

Chair: Xiting Gong (The Chinese University of Hong Kong)

Room 7-207

Mean-Variance Hedging for Production Planning with Multiple Products

Liao Wang

The University of Hong Kong
David Yao
Columbia University

We study production planning in a multi-product setting, in which demand for each product depends on multiple financial assets. In addition to the production quantity decision at the beginning of the planning horizon, there is also a real-time hedging decision throughout the horizon. We optimize both decisions jointly. With a mean-variance problem formulation, we first derive the optimal hedging strategy, given the production quantities. This leads to an explicit objective function by which the production quantities can be optimized. Then, we give a complete characterization of the mean-variance efficient frontier, and quantify the variance reduction achieved by the hedging strategy.

Keywords: Production risk management, mean-variance optimization, hedging strategy

Dynamic Inventory Management with Inventory-based Financing

Ke Fu
Sun Yat-sen University
Vernon N. Hsu
The Chinese University of Hong Kong
Jive Xue
China Financial Futures Exchange

We consider a multi-period stochastic inventory management problem where a cash-constrained firm can obtain additional working capital through an inventory-based financing facility by pledging its inventory to obtain loans from a lender. We show that it is optimal to deploy a state-dependent base stock policy. We find that when the firm anticipates a shortage of capital with which to meet high demands in a future period, it may strategically over-stock its inventory in earlier periods to secure the necessary capital.

Keywords: Inventory-based financing, dynamic inventory control, Markovian decision

Asymptotic Optimality and Heuristics of Base-stock Policies for Perishable Inventory Systems

Jinzhi Bu, Xiting Gong
The Chinese University of Hong Kong
Xiuli Chao
University of Michigan, Ann Arbor

In this paper, we study the asymptotic properties of the base-stock policies for a classical perishable inventory system with fixed lifetime. We prove that the best base-stock policy is asymptotically optimal with large product lifetime, large demand size, and large unit penalty cost. Moreover, the optimality gap of the best base-stock policy decays exponentially fast to zero in the lifetime and demand size. We also construct a class of simple heuristic base-stock policies with the same asymptotic properties as the best base-stock policy. Finally, we conduct a numerical study to show the effectiveness of the best and heuristic base-stock policies.

Keywords: asymptotic analysis, perishable inventory, base-stock policy, exponential decay

Stochastic Optimization with Decisions Truncated by Dependent Random Variables

Xiangyu Gao

The Chinese University of Hong Kong

Xin Chen

The University of Illinois at Urbana Champaign

Inventory management problems with random supply capacities become a pressing issue. The analysis of these problems encounters significant technical difficulties. In practice, the random supply capacities may be dependent, which makes the analysis even more difficult. We propose a framework to study a class of stochastic optimization problems with decisions truncated by dependent random variables, which provides a technique for studying inventory management problems with random supply capacities.

Keywords: stochastic optimization, inventory management, supply capacity uncertainty

Session 3A: Emerging Operations Management in China

Sat 16:35 – 18:05

Chair: Lijun Ma (Shenzhen University)

Room 5-203

Competition in Transportation: Traffic Information Provision and Impacts of Network Effects

Zelong Yi

Shenzhen University

Ki Ling Cheung, Ying-Ju Chen

The Hong Kong University of Science and Technology

We consider a private business platform (e.g., Uber) providing a personalized transportation service based on APP-enabled smartphones in this project. Three most leading factors in this business model including information, competition and network effects will be involved. We intend to study the platform's best information management strategy with competition from the public transportation (e.g., MTR) or other forms of private transportation service (e.g., taxi), as

well as the impacts of information release on traffic congestion. We preliminarily find that information release may or may not improve the platform's profitability. Concerning the network effects, it may not be able to mitigate the congestion issue by providing traffic information to public. We have also examined the head-to-head competition between the private business platform and other forms of private transportation service such as taxi.

Information Provision for Reward-based Crowdfunding under Competition

Feiyang Shen, Weili Xue
Southeast University
Xiaoqiang Cai
Chinese University of Hong Kong (Shenzhen)
Xiaolin Xu
Nanjing University

This paper investigates the information provision strategy for an entrepreneur who designs a reward-based crowdfunding campaign for an innovation product facing the potential risk being plagiarized. Specifically, we develop and analyze a game theoretic model based on a duopoly market with an innovator, who initially shares his business campaign but can strategically release information about its product in the crowdfunding site, and an imitator, who begins developing a competing product as soon as it become aware of the innovator's product. We find that, the innovator firm should strategically preannounce its product by both ensuring the success in the crowdfunding stage and considering the competition intensity in the duopoly stage. Our analysis has important policy implications from the managerial insight.

Pricing competition for ocean container transportation with heterogeneous carriers and empty container repositioning

Mingzhu Yu, Jiayin Qva, Zelong Yi
Shenzhen University

Abstract is absent.

A Multi-Objective Scheduling and Routing Problem in Home Health Care Structure

Meiyan Lin, Lijun Ma
Shenzhen University
K.S. Chin

City University of Hong Kong

Home health care (HHC) structures are inclined to optimize their activities in order to meet the demand with multiple, often conflicting performance indicators, such as minimum operational cost, maximum service satisfaction of customers, and balance workload among care workers. This paper addresses a real-life multi-objective routing and scheduling problem, satisfying various requirements such as nurse's skills, preferences, continuity of care, and workload balance. We propose a multi-objective algorithm, aiming to compute a set of Pareto-optimal alternatives with different trade-offs for the managers to choose from, and compare them to evolutionary multi-objective algorithms from the literature. Experiments based on the real case demonstrate the effectiveness of the proposed algorithms.

Session 3B: Behavioral Operations Management III

Sat 16:35 – 18:05

Chair: Yongjai Kim (Hankuk University of Foreign Studies)

Room 5-205

Behavioral aspects of inventory decision-making

Yamini S

Indian Institute of Management

The traditional newsvendor model has focused on deriving the optimal order quantity that minimises the trade-off between over-stocking and under-stocking. In the early 2000s, behavioral operations researchers have taken roots to analyse the behavioral dynamics influencing the inventory decisions in newsvendor settings. This research has then progressed in the direction of understanding the learning dimensions, information acquisition, multiple subject pool, individual heterogeneity, and also the cognitive heuristics impelling the biased decision-making. A review on the advancement of research associated to the newsvendor biases is drafted by constructing a framework to appreciate the behavioral aspects of the minds underlying this process

Keywords: Behavioural Operations Management; Newsvendor problem; Inventory decision-making

Construal Level Theory in OM Decision-Making

Sam Kirshner, Brent B. Moritz

UNSW Business School

Construal Level Theory posits that psychological distance impacts the way in which people process information. Environmental factors priming a high (low) construal level mindset induce people to mentally represent unrelated tasks as psychologically distant (close). Experimental evidence shows that environmental and mindset primes for high or low construal levels impact decision making. We explore the impact of construal level on system neglect, and operational decisions related to forecasting and inventory management.

The influence of process management activities on diverse types of innovations: An analytical model

Yongjae Kim
Hankuk University of Foreign Studies

This work investigates the trade-off between firm's efficiency and creativity during the development of a new product. Although this trade-off has long been discussed in terms of practical application, little analytical research has been performed to enhance theoretical understanding. We present an extreme value model that accounts for diverse innovation type, and offer a set of theoretical insights to demonstrate that the influence of process management depends on the nature of the innovation employed. Our results show that the inverse relationship between efficiency and creativity is more pronounced if R&D projects represent radical innovations rather than incremental innovations.

Keywords: Extreme value model, process management, innovation, analytical model

Session 3C: Healthcare Operations Management III
Chair: Yu-Hung Chen (National Taiwan University)

Sat 16:35 – 18:05
Room 5-206

Data-driven Outpatient Appointment Scheduling with Patient Choice Using Integrating Optimal Simulation Budget Allocation and Genetic Algorithm

Xuanzhu Fan, Jiafu Tang, Chongjun Yan
Dongbei University of Finance and Economics

The imbalanced patient choice between general outpatient service and expert outpatient service in healthcare institutions has become a major problem faced by hospital administrators, which leads to low utilization of general doctors while lots of patients unable to receive treatment within an effective time. In this research, we develop a simulation optimization framework which integrates the data-driven discrete-event simulation (DES), the multi-objective optimal computing budget allocation (MOCBA) and the genetic algorithm (GA) together to find the multiple servers' patient approximate Pareto joint capacity planning and appointment scheduling considering the patient choice and patience limits, which can comprehensively improve the overall system performances and be a quantitative decision tool for decision makers.

Keywords: Appointment Scheduling, Simulation Optimization, Data-driven, Patient Choice

Data-driven surgery scheduling: from data analysis to modeling and optimization

Jin Wang, Kwok Leung Tsui
City University of Hong Kong

The uncertainty of surgery duration has been well considered in the existing literature relevant to surgery scheduling. However, with the availability of the detailed data in operation rooms (ORs), more properties of surgery durations can be detected, which is expected to benefit surgery scheduling. In this paper, we first find that the scheduling in ORs influences surgery duration, which denies the basic assumption in literature that surgery duration is independent of scheduling decisions. Hence, with the finding in consideration, we propose a new scheduling model. Simulations are conducted to show the performances and advantages of the new model.

Keywords: Healthcare operations management; data-driven OM; surgery scheduling; surgery duration

A hierarchical framework for forecasting emergency department patient arrivals

Jiaxuan Peng, Bi Fan, Hainan Guo
Shenzhen University

Forecasting patient arrivals help to improve resources allocation in overcrowded emergency department (ED). The accuracy of forecasting model is well concerned. The uncertainty associated with ED patients forecasting is less quantified. Thus we propose a hierarchical framework for accurate prediction and uncertainty qualification of patient arrivals. The basic model (ARIMA) with statistical process control chart monitors trend and uncertainty. The dynamic model kernel extreme learning machine (KELM) leverages internet engine indexes, temperature and holiday, which investigates the dynamic characteristics of regional ED arrivals to obtain accurate result. This hierarchical framework shows good performance and robustness on Hong Kong ED data.

Keywords: Emergency department (ED) arrivals forecasting, hierarchical framework, internet engine index, Kernel extreme learning machine, uncertainty.

Impact of Management Type on the Adoption of Revenue Sharing for Medical Treatments between Equipment Vendors and Hospitals

Yu-Hung Chen, Ling-Chieh Kung, Jiun-Yu Yu

National Taiwan University
Hsin-Jung Tsai
Far Eastern Memorial Hospital
Yu Jen Wang
Fu Jen Catholic University

Many medical treatments rely on medical equipment while the reliability of medical equipment is typically privately observed by the equipment vendor. We study the contracting problem between an equipment vendor and a hospital for medical treatment. The private equipment reliability information possessed by the vendor prevents the hospital from paying a high price for a reliable machine. In this environment, we show that the popular revenue-sharing contract can serve as a signaling device and enhance the system efficiency. Moreover, signaling through revenue sharing is more effective for non-profit hospitals than for for-profit ones.

Keywords: medical management, revenue sharing, signaling, information asymmetry

Session 3D: OM-Marketing Interface III
Chair: Kyunghwa Chung (Cornell University)

Sat 16:35 – 18:05
Room 5-207

The Impact of Corporate Social Responsibilities on Shareholder Wealth in South Korea, 2006-2016

Antonio K.W. Lau
Kyung Hee University
Chris K.Y.Lo
Hong Kong Polytechnic University

This study investigates the relationship between corporate social responsibilities (CSR) events and shareholder value for large family controlled business (Chaebol) in South Korea. Following a short-term event study methodology, we used a 3-day study period for 758 CSR events identified from all KOSPI-listed firms in year 2006 to 2016 and examined firms' cumulative abnormal return in response to the CSR events. First, we find a significant relationship between CSR events and firms' market value. Among six GRI reporting elements, environment and society elements significantly affect the firm value. Second, we find that chaebol has a significant moderating effect on such relationships.

Keywords: Corporate social responsibility, event study, South Korea, family business

An Analysis of Two Donation Schemes when Manufacturer Engages in Social Responsibility

Minghui Xu, Xin Li
Wuhan University

A stylized model is proposed to study the level of investment in corporate social responsibility (CSR) and pricing behavior of a firm who donates to charities. Two types of donations schemes are considered: the fixed amount donation and percentage donation. For each donation scheme, we derive the optimal decisions under profit-maximizing and social-welfare-maximizing objectives, respectively. The results indicate that the optimal degree of donation and selling price are non-monotone with the magnitude of consumer perception. Both the manufacturer and consumers will benefit from CSR. Our findings also provide theoretical support and operational procedures for managers how to integrate donation scheme into its business routines.

Keywords: Corporate social responsibility; Consumers utility; Donation Schemes; Consumer surplus

Omnichannel Retailing and Channel Integration Strategy

Kyunghwa Chung, Rohit Verma
Cornell University

This research investigates multichannel retailer's channel integration strategy. Though the proliferation of multichannel retailing, channel integration is not well facilitated and consumers often experience inconveniences while shopping across multiple channels. We conducted an experimental study and investigated the effect of widely implemented two channel integration strategies, order-fulfillment integration and promotion integration. The results of our study show that cross-channel integration positively influences consumers. Our research has significant implications in the retailing management area both academically and practically.

Simplicity is Beauty: Pricing Coordination in Two-Product Supply Chains with Simplest Contracts under Voluntary Compliance

Tsan-Ming Choi
The Hong Kong Polytechnic University
Bin Shen, Xiaoyan Xu
Donghua University

We explore the pricing coordination challenge in two-product supply chains with the use of simplest contracts. We find that simple contracts such as the three-parameter two-part tariff (3P-TT) contract and the three-parameter revenue sharing (3P-RS) contract, can coordinate the two-product supply chain. We extend the analysis in two cases: (i) the case when the products are substitutable, and (ii) the case when the retailer is risk averse, and show that both the 3P-TT and 3P-RS contracts can coordinate the respective supply chains. We further highlight how the

degrees of product substitution and retailer's risk aversion influence the supply chain performance.

Keywords: Multiple products, supply chain coordination, voluntary compliance

Session 3E: From Data to Decision

Sat 16:35 – 18:05

Chair: Simai He (Shanghai University of Finance and Economics)

Room 6-207

Aggregation Bias in Estimating Price Elasticity

Yaowu Zhang

Shanghai University of Finance and Economics

Because pricing is one central concern of retailers, estimating the price sensitivities is one of the most important issues in marketing. In practice, companies often only have aggregate demand data in a daily granularity, even though they may have changed prices within each day. In order to characterize the relation between the offered price of the firm and the customers demand, a common approach in that case is to take a simple/weighted average of prices and use it as the price for each day (and the total demand as the demand for that day). However, such an approach may result in a bias in price elasticity and demand estimation. In this work, we investigate under what conditions using such aggregate approach will result in an underestimation or an overestimation of price sensitivities. We also examine the practical data from Alibaba to see practical effects of demand estimation using aggregate data.

Data Driven Investigation of Repeat Purchases, Demand Forecasting and Revenue Management

Hongsong Yuan

Shanghai University of Finance and Economics

We use data from Cainiao on the retail business of TMall to consider three interrelated problems: repeat purchases, price- and reference price dependent demand forecasting, and revenue management. Firstly, we use the customer-level data to systematically analyze customers' repeat purchases. Secondly, we study the impact on demand forecasting of factors such as reference prices and word of mouth effect in reference prices. Finally, we use a dynamic programming procedure to solve the revenue management problems when demand depends on reference prices, and develop theories on the structure of the value functions.

Multilocation Newsvendor Problem: Centralization and Inventory Pooling

Chaolin Yang
Shanghai University of Finance and Economics

We study a multilocation newsvendor model with a retailer owning multiple retail stores, each of which is operated by a manager who decides its order quantity for filling random customer demand of a product. The store managers and the retailer are all risk-averse while the managers are more risk-averse than the retailer. We adopt conditional value-at-risk (CVaR) as the performance measure and consider two alternative strategies to improve the performance of the system. First, the retailer centralizes the ordering decisions. Second, the managers still decide the order quantity for their own store whereas their inventories are pooled together. We analyse and compare the optimal order quantities and the resulting CVaR values of the systems and study their comparative statistics. We find that when there is no inventory pooling, each store has a higher inventory level in the centralized system than in the decentralized system. More interestingly, centralization brings positive benefits to the retailer as long as some store manager(s) is strictly more risk-averse than the retailer. When there is inventory pooling, the ordering decisions in a decentralized system depends on the allocation of the residual profit. We study several allocation rules and show that as long as the store managers are sufficiently more risk-averse than the retailer or the demands are very heavy-tailed, inventory pooling brings less benefit than centralization. Our analytical results are illustrated using a data set from an online retailer in China and various comparative statics are further examined via extensive numerical experiments.

When Prospect Theory Preference Meets Mean-Reverting Asset Returns: A Dynamic Asset Allocation Model

Jianjun Gao
Shanghai University of Finance and Economics

We examine how the evidence of mean reversion in stock returns affects dynamic trading behavior for investors with prospect-theory preferences. Under general assumptions for the continuous-time financial market, we develop the semi-analytical portfolio policy by the inverse Fourier transformation. Through the revealed policy, we find that a small degree of mean reversion can be sufficient to reverse the trading direction of an investor with prospect-theory preferences. Introducing mean reversion also diminishes the role of loss aversion in yielding the status quo effect. Further simulation results demonstrate that the combination of prospect theory and mean reversion can generate the disposition effect close to the data at reasonable values of the underlying parameters. The results indicate that it can be seriously misleading if the prospect-theory-based trading analysis ignores time variation in expected returns such as mean reversion.

Session 3F: Sustainability I
Chair: Wang Dong (Guangzhou University)

Sat 16:35 – 18:05
Room 6-208

Does Mandatory Environmental Reporting Affect Firms' Operational Efficiency? Evidence from a Quasi-natural Experiment in the UK

Hugo Lam
University of Liverpool
Andy Yeung
Hong Kong Polytechnic University
Jeff Ng
Chinese University of Hong Kong

While regulators around the world have started to force firms to report environmental performance compulsorily, little is known about the impact of such mandates on firms' operations. Our research tackles this important and timely issue based on a quasi-natural experiment in the UK, in which we utilize propensity score matching and difference-in-differences methodologies to examine whether and how mandatory environmental reporting affects firms' operational efficiency. Our research provides a better understanding of the operational consequences of mandatory environmental reporting and offers some important implications for both practice and research.

Keywords: Mandatory environmental reporting; Operational efficiency; Quasi-natural experiment

Examining Porter Hypothesis on Green Innovation in Chinese Listed Firms

Jing Dai
University of Nottingham Ningbo China
Jingbo Cui
Wuhan University
Xiande Zhao
China Europe International Business School

Using a panel dataset of Chinese listed firms, we investigate whether environmental regulation induces firms to develop green innovation and ultimately achieve competitiveness (i.e. Porter Hypothesis). Using a difference-in-difference (DID) method, our findings suggest that there is a positive regulation effect on green innovation, but this positive regulation effect is only effective on encouraging incremental environmental innovation rather than radical environmental innovation. Moreover, the innovation induced effect mainly occurs in the SOE firms rather than Non-SOE firms. As of the relationship between green innovation and firms' competitiveness, radical environmental innovation is positively associated with firms' values but incremental one is on the contrary.

Keywords: Environmental Regulation, Patent, Green Innovation, Porter Hypothesis, Chinese Listed Firms

Risk mechanism of air pollution and meteorological condition on length of stay for asthma

Zhilin Yong, Li Luo
Business School of Sichuan University

The prevalence of asthma is largely attributed to exposure to air pollution. In this retrospective study, we aimed to explore the temporal pattern of length of stay, and assess the risk mechanism of air pollution and meteorological condition on length of stay for asthma inpatients. In our analysis, the trace of length of stay showed distinguished patterns in different age groups. Besides, length of stay within the same group also presented a bit of difference in different seasons. In our model, three putative mechanisms were investigated in relation to length of stay for asthma inpatient: air pollution, meteorological condition and comorbidity character involved in this hospitalization. The real mechanisms were fitted by Structural Equation Model (SEM), and adjusted by gender. In results, PM10 and temperature played important roles in observed variables. The risk mechanisms of air pollution (0.015; 95%CI: 0.007, 0.023) and meteorological condition (0.146; 95%CI: 0.08, 0.21) on length of stay of asthma inpatients were confirmed. Besides, the effect of number of comorbidities on length of stay was dominant (0.34; 95%CI: 0.29, 0.39). It's obvious to find that the severity of asthma inpatients largely affected the length of stay. More attention should be paid on this kind of inpatient.

Keywords: Structural Equation Model, Length of Stay, Ambient Air Pollution, Meteorological Condition, Risk Mechanism

Impact of e-service quality on purchasing intention of green products in online shopping context

Wasim Ahmad, Qinyu Zhang
University of Birmingham
Mei Cao
University of Wisconsin

This study examined the relationships between e-service quality and green purchase intention mediated by green perceived value, green trust, green satisfaction, and green involvement. A sample of participants was taken through a questionnaire from several regions of China, and the data were analyzed through Smart PLS. Results and managerial implications are discussed in the paper.

Keywords: green products, e-service quality, online shopping

Impact of Customers' Environmental Preferences and Returns on the Decisions of the manufacturers and retailers in New Retailing Sence

Wang Dong, Chen Yujing, Li HongPing
Guangzhou University

The emergence of new retailing has prompted manufacturers to redesign their traditional channel structures. We propose a model to explore the impact of customers' environmental preferences and returns on decisions of the manufacturer and retailer. When customers' environmental preferences are within a certain range, vertical-integrated manufacturer prefers both direct sales and online sales channels and enjoys the highest profit. When there is a Steinberg game between the manufacturer and retailer, manufacturer chooses both direct and online sales channels regardless of customers' environmental preferences. Low environmental preferences create more value for the manufacturer. This is still true when there are multiple retailers.

Keywords: New retailing; Environmental preferences; Returns; Sales channels; Decision analysis

Session 3G: Logistics II

Sat 16:35 – 18:05

Chair: Chu-xuan Huai (Shandong University of Finance and Economics)

Room 6-209

Two-Stage pricing mechanism improves logistics service flexibility

Yu Zhang, Nan Liu
Zhejiang University

Logistics flexibility is the ability of the logistics system to respond to external changes. Currently, leading logistics services providers (such as UPS) are seeking ways to enhance flexibility. They found that clients' requirements for delivery time might be dynamically changing, so they provide "redirect" services that allow clients to adjust the services level of in-transit cargos. The sustainability of this flexible service is inextricably linked to an effective pricing mechanism. This paper proposes feasible pricing mechanisms of "redirect", discusses the first- and second-best pricing results and the effectiveness of the different pricing strategies in different scenarios.

Keywords: Logistics flexibility, "Redirect" services, In-transit cargos, Pricing mechanisms

Efficiency of Sparse Sets of Routes in the Periodic Inventory Routing Problem

Geoffrey A. Chua
Nanyang Technological University
Luca Bertazzi
University of Brescia
Demetrio Lagana, Rosario Paradiso
University of Calabria

We formulate the Periodic Inventory Routing Problem as a mixed-integer linear program using route variables. In particular, a product has to be shipped from a supplier to a set of customers over an infinite time horizon. Given the plan periodicity, the problem is to determine a periodic shipping policy that minimizes the sum of transportation and inventory costs at the supplier and at the customers. To address the complexity of a formulation with all feasible routes, we show how to choose sparse yet efficient sets of routes, achieving good performance guarantees in short computational time.

Keywords: logistics, routing, inventory management

Real-Time Location-Positioning Technologies for Managing Cart Operations at Distribution Facilities

Yong-Hong Kuo
The University of Hong Kong
Chun Hung Cheng
Logistics and Supply Chain MultiTech R&D Centre Limited
Matthew Petering
University of Wisconsin

Our work was motivated by a real-world problem in a large air mail centre. We have developed an RFID-based location-positioning platform for the application. The RFID tag attachments to carts and reader mounts at the top of the building allow the facility operators to locate target carts quickly. We have also conducted an initial analysis of data collected using this technological infrastructure to understand issues on cart movements and operational efficiency.

Keywords: Air mail centre, distribution centres, RFID, tracking technologies, analytics

Scheduling Vehicles in Autonomous Vehicle Storage and Retrieval Systems

Ran Chen, Hu Yu, Yugang Yu, Xiaolong Guo
University of Science and Technology of China

In this paper, we study how to schedule autonomous vehicle to carry out a set of storage and retrieval requests in the autonomous vehicle storage and retrieval systems (AVS/RSs), considering the constraints of the vehicle interference including the cross-aisle and within-aisle interference. We formulate the mathematical model, prove the computational complexity, and provide an efficient solution method. Furthermore, we compare the performance of different number of vehicles to provide decision support for practitioners.

Keywords: scheduling, warehousing, storage and retrieval requests, AVS/RS

Research on multi-type vehicle routing optimization of cold chain logistics distribution considering transportation effectiveness

Chu-xuan Huai, Guo-Hua Sun
Shandong University of Finance and Economics

In this study, the multi-type vehicle routing problem with cargo damage in cold chain logistics distribution system is considered. The effectiveness of transportation is considered to ensure customer demands are fully satisfied. A mathematical model with the aim to find an optimal strategy minimizing the total travel cost is established. Then a genetic algorithm is designed to solve the problem, since it's impossible to get the optimal solutions in a limited time. The effectiveness of the designed algorithm is proved by simulation. Finally, the algorithm is applied to G company engaged in the distribution of vegetable and fruits and an improved distribution strategy is obtained.

Keywords: cold chain logistics distribution; vehicle routing optimization; transportation effective factor; genetic algorithm; multi-type vehicle

Session 3H: Supply Chain Management IV
Chair: Golnar Behzadi (University of Auckland)

Sat 16:35 – 18:05
Room 6-211

Market development and revenue sharing contract design for mobile game supply chain

Benyong Hu, Chao Meng
University of Electronic Science and Technology of China
Valdosta State University

This paper investigates the coordination and revenue sharing contract design problem in a mobile game supply chain. First, we identify the unique features in the mobile game supply chain in terms of demand pattern and decision variables. Second, we develop optimization models for both centralized and decentralized supply chains and derive the optimal marketing investment, time-to-market, and parameters of revenue sharing contracts. Third, we derive the coordination

condition for the decentralized supply chain. We also demonstrate the profit allocation for the coordinated supply chain under various revenue sharing contract parameters, and show that there exists a Pareto revenue sharing contract.

Keywords: Supply chain management; market development; mobile game; revenue sharing contracts

The Bullwhip Effect in Supply Networks

Jing Wu
City University of Hong Kong
Nikolay Osadchiy,
Emory University
William Schmidt
Cornell University

In this paper, we offer a new network perspective on one of the central topics in Operations Management - demand variability and the bullwhip effect (BWE). The topic has both practical and scholarly implications. We start with a puzzling observation: while the traditional intra-firm measure of the BWE increases at upstream layers of the network, the demand variability experienced by upstream firms actually decreases. To reconcile these two facts, we hypothesize that firms manage their customer base to smooth out the aggregate demand. We test the hypothesis with a novel data set that tracks the evolution of supply relationships over time. By examining customer acquisition, drop, and swap decisions made by suppliers, we provide evidence that buyer-supplier relationship formation or dissolution is associated with smoothing of the aggregate demand experienced by suppliers. This provides a fresh insight into how firms may leverage their buyer- supplier relationships to mitigate the impact of the BWE.

Keywords: Supply Networks, Bullwhip Effect, Demand Variability, Empirical Study

Reliable Flexibility Design of Supply Chains via Extended Probabilistic Expanders

Hao Shen, Yong Liang
Tsinghua University
Zuo-Jun Max Shen
University of California
Chung-Piaw Teo
National University of Singapore

Adding a little flexibility properly is effective in improving operations facing demand uncertainties and ensuring high capacity utilization. However, the legacy flexibility designs may perform poorly under supply disruptions. In this paper, we focus on the design of reliable and

sparse flexibility structures to meet a reasonable performance criterion under both supply and demand disruptions. We propose the concept of extended probabilistic expander, and prove that it guarantees good flexibility performance. We present a randomized algorithm to construct reliable flexibility structures with the least number of edges asymptotically. Numerical results demonstrate that our design outperforms a variety of known structures.

Keywords: flexibility design, supply chain disruptions, extended probabilistic expanders, unbalanced supply chains

Resilience Metrics in Supply Chain Models

Golnar Behzadi, Michael O'Sullivan, Tava Olsen
University of Auckland

The Increasing supply chain resilience improves the supply chain's ability to return to normal, or to an even more desirable situation, quickly and efficiently after disruption. This is especially critical in supply chains with perishable products. In this study, we propose a variety of resilience metrics to capture the recovery process in a supply chain with short life-cycle products following a transportation disruption. The resilience measures include 1) time to recovery, 2) the recovery level, 3) the loss of profit during the recovery time window, and 4) the net present value of the loss of profit over all time-periods.

Managing Disruption Risk in Multi-tier Supply Chains with Competition

Yi Li, Biying Shou,
City University of Hong Kong
Ju'e Guo
Xi'an Jiaotong University

We consider two multi-tier supply chains in the presence of disruption risk and chain-to-chain competition. Each chain consists of one manufacturer in competition, one supplier in Tier-1, and two suppliers prone to disruption in Tier-2. The manufacturer can influence the sourcing decisions of Tier-1 supplier through wholesale prices, which may lead to a significant overlap in Tier-2. We focus on two representative types of supply chain configuration: The V-shaped configuration has no overlap in Tier-2 while the U-shaped configuration has. First of all, we study the benchmark case without competition. We show that the manufacturer can use a low-price strategy (or high-price strategy) to induce its Tier-1 supplier for sole sourcing (or dual sourcing). Second, we study the chain-to-chain competition and derive the strategy equilibrium for manufacturers under each supply chain configuration. An interesting finding is that when the cost difference between low-price and high-price strategies is medium, the equilibrium is not unique and essentially different between V-shaped and U-shaped configurations. Finally, by comparing these two configurations, we show that the manufacturers have some strategy

preferences; and that the overlapped structure in Tier-2 may be either beneficial or detrimental to both manufacturers.

Keywords: disruption risk, dual sourcing, multi-tier supply chain

Session 3I: E-commerce/Online Retailing I
Chair: Zhenyuan Liu (Xiamen University)

Sat 16:35 – 18:05
Room 6-212

Reselling or Agency selling: Strategic Analysis of an E-Commerce Model with Network Externality

Mingdan Zhu, Houcai Shen
Nanjing University

With the development of the e-commerce, more online retailers emerge. But in the past, they still keep the way of reselling products. Nowadays, a new form gradually appears like JD.com and Suning.com – acting as a marketplace for suppliers. Besides of the channel structure, we study the network externality on the e-commerce model. In this paper, we will figure out the choice of the intermediary and suppliers under the effect of the network externality, based on the research that have been done by another paper published.

Keywords: e-commerce, network externality, reselling, agency selling

The impact of product returns on price, delivery time and disposition decisions in online retailing

Sisi Zhao, Feng Wu
Xi'an Jiaotong University

In the context of e-commerce, product returns represent a significant cost to the manufactures since they are typically returned to the manufactures for full credit. Motivated by the observation that an increasing number of e-tailers start to handle the returns directly in the secondhand market, this paper develops a manufacturer-Stackelberg game and investigates the conditions under which the disposition decision made by the manufacture is to accept or reject the product returns, as well as the equilibrium price and promised delivery lead time decisions made by the e-tailer. Our results indicate that the e-tailer will always return back to the manufacture rather than salvaging in the secondhand market if the manufacture accepts the returns.

Keywords: product returns; disposition decision; pricing; promised delivery lead time; ecommerce

Online Demand Fulfillment under Limited Flexibility

Hailun Zhang, Jiheng Zhang, Rachel Zhang
Hong Kong University of Science and Technology

We study online demand fulfillment in sparse networks with arbitrary numbers of resources and request types, and positive Generalized Chaining Gaps (GCG) introduced by Shi et al. (2018). We show that such a sparse network with limited flexibility is both necessary and sufficient to achieve bounded performance gap compared with networks with full flexibility, extending the work by Asadpour et al. (2016) from the long chains to more general sparse networks. We develop simple inventory allocation rules and guidelines for designing sparse network structures with positive GCGs such as generalized long chains. Numerical experiments and a real case study are conducted to confirm our findings as well as some of the flexibility principles conjectured in the literature.

Keywords: process flexibility, online retailing, dynamic resource allocation

Synthesized Model for Light Luxury Products Online Demand Forecasting

Zhenyuan Liu, Shuihua Han, Sirui Liu, Xinyu Han
Xiamen University

Considering the characteristics of a new E-commerce product category named light luxury products and its marketing strategies mainly through social media, this study integrates evaluated marketing effect of WeChat subscription with previous demand forecasting research models, so as to improve the accuracy of online sales forecasting. First, from an innovative perspective of text analytic methods, we propose a DEA-based model to define and evaluate social media marketing effect like WeChat subscription. Further, an ARDL-based demand forecasting model, which involves time series and multi-regression methods accounting for exogenous variables, was constructed. Then, some real data of a female light luxury health products sales in 70 weeks, marketed mainly through Wechat subscription tweets, are used to test the validation of the models above. The empirical study results show an outperformance of synthesized forecasting model regarding online demand forecasting accuracy.

Keywords: Demand forecasting; Social media marketing; Marketing effect evaluation; Time series analysis

Session 3J: Service Operations II
Chair: Qian Qu (Singapore University of Social Sciences)

Sat 16:35 – 18:05
Room 6-213

Service Pricing when Customers Collude

Allen Wu
Hong Kong University of Science and Technology

Chen Jin
National University of Singapore
Senthil Veeraraghavan
University of Pennsylvania

We model the presence of collusion and cooperation in service queues. Typically, individual customers seek to maximize their own payoff ignoring the externalities of their decisions to others. In contrast, in many instances, some collusive customers may join in as one entity to receive better priority or pricing to maximize their aggregate payoff. Using a queuing framework, we explicitly characterize a service provider's optimal pricing and priority decisions facing the interaction between the two types. We show that it is optimal to prioritize collusive customers and charge them with a higher price than individual customers.

Keywords: service operation; queuing game; collusion; pricing; priority

Making customer feedback actionable for societal benefit – A service operations management model

Simon Charles Williams, Nicky Shaw, David Allen
University of Leeds

The English social housing sector provides a rich area for academic study due to the opportunity for real life impact: housing at its most basic level is an essential requirement for human existence, and quality of service within social housing can directly impact quality of life for individuals and benefit society. This research presents case study findings exploring the practices, actions and processes associated with how customer satisfaction feedback from tenants influences service performance improvement in higher and lower performing housing associations. Using this, a new theoretical model for making customer feedback actionable and maximizing service performance improvement is presented.

Keywords: Customer feedback, customer satisfaction, service performance improvement, social housing

Dynamic Routing in a Many-Server Service System with Costly Information

Zhiheng Zhong, Junfei Huang
CUHK School of Business
Ping Cao
University of Science and Technology of China

We consider a service system with multiple stations, serving a single class of arriving customers. Upon each arrival, the system manager must decide to which station the customer is routed, given the routing choice is limited. We propose an MED-FSF(ξ) policy, under which a random number (ξ) is generated at arrival epoch, representing ξ stations are chosen with real-time information examined. The arrival is then routed to one of the selected stations, either with minimum expected delay if all the candidate stations are occupied, or to the station with the fastest available server. We prove the proposed policy can asymptotically minimize the long-run average waiting cost under the Halfin-Whitt regime.

Keywords: dynamic routing; diffusion limit; Halfin-Whitt regime; parallel service system

Managing Service Operations with Quality-Conscious Consumers

Qian Qu, Xuchuan Yuan
Singapore University of Social Sciences
H. Brian Hwang
NUS Business School

We investigate the optimal quality strategy and the service fee and capacity decisions when a firm faces quality-conscious consumers. Offering a high quality service by charging a higher price with a feasibly larger capacity is more profitable when informed consumers become more quality-conscious. In a market with both informed and uninformed consumers, by using a threshold-based quality perception strategy, we find that either the high or low quality strategy may be adopted by the firm. The findings advance our understanding of the commonly observed queuing phenomenon in service industries.

Keywords: Quality Strategy; Service Design; Pricing; Capacity; M/M/1 Queue.

Mathematical model for assigning elective courses to limited time slots

M.S. Gajanand
Indian Institute of Management

A major challenge faced by several educational institutions is the scheduling of elective courses, keeping in mind the requirements of the institution and that of the student. This process varies, depending on the nature of the degree program offered, and may become more complex in some cases. This study presents a Binary Integer Linear Programming (BILP) model for grouping and assigning elective courses by considering student preferences, classroom availability and limited number of time slots. Sensitivity analysis on key model parameters revealed interesting results, which will be useful for educators and academic institutions to make policy decisions.

Keywords: Binary Integer Linear Programming; Elective assignment; Timetabling

Session 3K: Student Paper Competition Finalists II

Sat 16:35 – 18:05

Chair: Zhankun Sun, Yimin Yu (City University of Hong Kong)

Room 6-214

Distribution-free Inventory Risk Pooling in a Multi-location Newsvendor

Aravind Govindarajan, Joline Uichanco
University of Michigan
Amitabh Sinha
Amazon

With rapidly increasing e-commerce sales, firms are leveraging the virtual pooling of online demands across customer locations in deciding the amount of inventory to be placed in each node in a fulfillment network. Such solutions require knowledge of the joint distribution of demands; however, in reality, only partial information about the joint distribution may be reliably estimated. We propose a distributionally robust multi-location newsvendor model for network inventory optimization where the worst-case expected cost is minimized over the set of demand distributions satisfying the known mean and covariance information. For the special case of two homogeneous customer locations with correlated demands, we show that a six-point distribution achieves the worst-case expected cost, and derive a closed-form expression for the optimal inventory decision. The general multi-location problem can be shown to be NP-hard. We develop a computationally tractable upper bound through the solution of a semidefinite program (SDP), which also yields heuristic inventory levels, for a special class of fulfillment cost structures, namely nested fulfillment structures. We also develop an algorithm to convert any general distance-based fulfillment cost structure into a nested fulfillment structure which tightly approximates the expected total fulfillment cost.

Flexible Labor Supply Behavior on Ride-Sharing Platforms

Hao Sun
Tsinghua University
Hai Wang
Singapore Management University
Zhixi Wan
Didi Chuxing

Drivers working as freelancers on ride-sharing platforms can flexibly design their schedules on participation and hours worked. Academic/practical relevance: Understanding flexible labor supply behavior is critical for the platform to manage service capacity. It also helps to evaluate effects of platform incentives on service capacity and driver welfare. Methodology: We propose a labor supply model to describe how freelance drivers rationally optimize their labor supply

decisions on the platform. Specifically, in the presence of drivers' heterogeneity, we model drivers' participation decision at the extensive margin and hours worked decision at the intensive margin, with an objective to maximize their utility from consumption and leisure. Results: The analytical results show that drivers participate in work if the wage rate is above a threshold. Participating drivers spend all of their idle time working only if the wage rate is in an intermediate range, and spend part of their idle time working if the wage rate is lower or higher than the range. A lower other income and higher participation cost would make them to increase their hours worked. More interestingly, participating drivers' working-hour elasticity is negative when the wage rate is very high. With estimated parameters using real data, we find a large proportion of drivers in our dataset have positive working-hour elasticity, and a smaller but non-negligible proportion of drivers have negative working-hour elasticity. Managerial implications: A higher wage rate improves the platform's service capacity along the extensive margin, but it may increase or decrease the capacity through participating drivers' working hours.

Joint Pricing and Production: A Fusion of Machine Learning and Robust Optimization

Qinshen Tang, Melvyn Sim, Peng Xiong
National University of Singapore
Georgia Perakis
Massachusetts Institute of Technology

We integrate machine learning with distributionally robust optimization to address a two-period problem for the joint pricing and production of multiple items. First, we generalize the additive demand model to capture both cross-product and cross-period effects as well as the demand dependence across periods. Next we apply K-means clustering to the demand residual mapping based on historical data and then construct a K-means ambiguity set on that residual while specifying only the mean, the support, and the mean absolute deviation. Finally, we investigate the joint pricing and production problem by proposing a K-means adaptive markdown policy and an affine recourse approximation; the latter allows us to reformulate the problem as an approximate but more tractable mixed-integer linear programming problem. Both the case study and our simulation demonstrate that, with only a few clusters, the K-means adaptive markdown policy and ambiguity set can increase expected profits by more than 1%—as compared with the empirical model—when applied to most out-of-sample tests.

Do Flexibility and Chaining Really Help? An Empirical Analysis of Automotive Plant Networks

Vivek Choudhary, Sameer Hasija
INSEAD
Serguei Netessine
The Wharton School

We study production networks of automotive assembly plants to shed new light on the impact of flexibility on plant productivity. We observe that the contemporary manufacturing networks of automotive assembly plants of three US companies (Chrysler, Ford and General Motors) have become less flexible over the years despite the reported benefits of flexibility. To understand this phenomenon, we utilize flexibility indices that have been developed in the modelling literature to measure flexibility but have never been tested in an empirical setting. We identify shortcomings in existing indices and we propose new indices to measure network flexibility. Using our proposed indices, we find that both extremes of flexibility (too much or too little) affect productivity negatively. Therefore, intermediate levels of flexibility are optimal because they balance the trade-off between better matching of supply and demand with excessive downtime due to model changeovers(changing production from one model to another), which were not accounted for in the modelling literature. Using plant-level production schedules, we find that productivity losses due to changeovers have a significant negative effect on manufacturing productivity, often making celebrated “chaining” approaches to network configuration uneconomical. Counterintuitively, firms can often benefit by reducing flexibility levels, depending on the current level of flexibility in the manufacturing network. Our estimates indicate that a firm with a highly flexible production network can gain up to 8.8% in productivity by rearranging its network. This can result in an average saving of 460,000 labor-hours in a plant with an average production of 200,000 vehicles per year. Using simulation, we show that well-established long chain configurations cease to perform better than sparser configurations when changeover losses are accounted for, indicating that firms can be better off by adopting a sparser structure than chaining to improve productivity.

A General Dual Sourcing Inventory Model: Trading off Lead Time and Cost Differences

Zhe Liu, Awi Federgruen, Lijian Lu
Columbia University

Problem definition: We study a finite horizon, single product, periodic review inventory system with two supply sources and salvage options. A challenging trade-off exists between the two sources because the expedited supplier has a shorter lead time but charges a higher per-unit price. A further complication is the salvage option that allows for bilateral inventory adjustments. All inventory adjustments involve a fixed cost component in addition to variable costs or revenues and may be subject to capacity limits. **Academic/practical relevance:** These strategic dilemmas arise whenever a company decides on off-shoring versus on-shoring, or a hybrid approach which utilizes both suppliers simultaneously. **Methodology:** We analyze our model with dynamic programming and Markov Decision Process techniques. **Results:** We show that an optimal policy first determines the size of an order with the expedited supplier, or the size of any salvage quantity, based, exclusively, on the regular full inventory position. Thereafter, any order with the regular supplier is determined as a function of the adjusted inventory position. Moreover, the dependence of the optimal order sizes and/or salvage quantity, on the period’s starting inventory position follows a relatively simple structure. The above results apply to the special case where

the lead times of the two suppliers differ by a single period. However, our structural results suggest effective heuristics for general lead time combinations. Managerial implications: We evaluate our heuristics in a comprehensive numerical study. We focus on how various model primitives impact on the benefits of dual sourcing. For example, we show that the cost savings due to dual sourcing may be as large as 30%. For a given price differential, the benefits of dual sourcing grow as the lead time difference increases.

Session 4A: Smart City Operations

Sun 10:30 – 12:00

Chair: Long He (National University of Singapore)

Room 5-203

Last Mile Innovation: The Case of the Federated Locker System

Guodong Lyu, Chung-Piaw Teo
National University of Singapore

Under the smart nation initiative, the Singapore government has recently proposed the concept of “Federated Locker System” (FLS) for parcel delivery, to improve the efficiency of last mile operations. We develop a robust framework to address the delivery volume endogeneity issues encountered in the locker network design problem. Using real data provided by the government agency and industry players, we show that with a well-chosen FLS, the volume of parcels delivered into CBD can be reduced by 2%. This will in turn contribute to a sustainable city logistics ecosystem.

Robust Vehicle Allocation with Uncertain Covariates

Zhaowei Hao, Zhenyu Hu, Long He, Jun Jiang
National University of Singapore

Motivated by a leading taxi operator in Singapore, in this paper, we address the idle vehicle redistribution problem to improve vehicle utilization and demand fulfillment. Using multivariate regression tree (MRT), we first construct scenarios of demand distribution with covariate information, e.g., weather. Furthermore, we employ a scenario-wise distributionally robust (SDR) optimization framework to integrate the demand profiles learned from MRT. We show that the SDR optimization model can be exactly and efficiently solved as a second-order cone program, using the linear decision rule technique. In our numerical experiments with both simulation and real data from our partner taxi operator, the proposed SDR solution significantly outperforms the benchmarks such as the traditional distributionally robust optimization and the sample average approximation solutions.

Strategic Switchers, the Unique Feature of Carpooling

Sarah Yini Gao, Rowan Wang
Singapore Management University
Saif Benjaafar
University of Minnesota

In this paper, we analyze the dynamics of carpooling systems such as BlaBlaCar and DiDi Hitch. One unique feature of these carpooling systems is the existence of a pool of users who can be both drivers (supply side) and riders (demand side) when they have a trip need. We call these users the strategic switchers. Depending on the possibility and time to be matched as well as the fare and wage, the strategic switchers make the decision on whether to take a ride or to drive and offer a seat. Using equilibrium analysis, we capture the system dynamics of such carpooling systems. We show the benefits of having such strategic switchers.

Fulfillment by Amazon versus Fulfillment by Seller: A Risk-Adjusted Uplift Model

Libo Sun, Yugang Yu
University of Science and Technology of China
Guodong Lyu, Chung Piaw Teo
National University of Singapore

With dual-channel choices, E-retailers fulfill their demands by either the inventory stored in third-party distribution centers, or by in-house inventory. In this paper, using data from a wedding gown E-retailer in China, we analyze the differences between two fulfillment choices - Fulfillment by Amazon (FBA) and Fulfillment by Seller (FBS). We propose a Risk-Adjusted Uplift Model to address this problem, and develop an explicit decision model to help E-retailers to choose the fulfillment channel. Synthetic experiments and real application demonstrate that our model performs extremely well in this problem, outperforming five popular machine learning algorithms including XGBoost and Random Forest.

Session 4B: Simulation I: Stochastic Optimization and Its Applications

Sun 10:30 – 12:00

Chair: Zhaolin Hu (Tongji University)

Room 5-205

A stochastic programming model for the airline crew pairing problem with stochastic block time

Lei Zhou, Fan Xiao, Zhe Liang
Tongji University

Airline crew pairing problem is one of the important airline scheduling problems, because the crew cost is the second largest operational cost behind fuel cost. In many Chinese airlines, the crew pairing cost is mainly decided by the maximum of two values, scheduled block time

and real block time of flights. When airline sets the block time of flights shorter, the scheduled crew cost is less. However, the result crew schedule may suffer from longer operational delays, and in some situations backup crews have to replace the regular crews whose flying time is longer than regulation. On the other hand, when airline sets the block time of flights longer, the crew pairing cost might increase considerably. We propose a stochastic programming model to solve the crew pairing problem with stochastic block time. Our computational results show substantial savings can be achieved by the proposed model.

Gaussian Mixture Model-based Random Search for Continuous Optimization via Simulation

Wenjie Sun, Zhaolin Hu
Tongji University
L. Jeff Hong
Fudan University

This paper studies integrated random search algorithms for continuous optimization via-simulation (COvS) problems. We first tailor the Gaussian process-based search (GPS) algorithm to handle COvS problems. We then analyze the potential sampling issue of the GPS algorithm and propose to construct a desirable Gaussian mixture model (GMM) which is amenable for efficient sampling and at the same time also maintains the desirable property of exploitation and exploration trade-off. Then, we propose a Gaussian mixture model-based random search (GMRS) algorithm. We build global convergence of both the tailored GPS algorithm and the GMRS algorithm for COvS problems. Finally, we carry out some numerical studies to illustrate the performance of the GMRS algorithm.

Safe Approximations of Chance Constrained Programs via Change of Measure

Zhaolin Hu, Xiaoyi Ma
Tongji University

Chance constrained programs (CCP) are important models in stochastic optimization. However, the models are often difficult to solve. In this paper, we propose a change-of-measure approach to construct some approximations of the chance constraint. We show that the approximations are safe approximations, and in some cases, the approximation problem is more tractable to solve than the original problem. Our approach provides a new idea of balancing the conservativeness and the tractability of the CCPs.

Optimizing Colorectal Cancer Screening Policies Using A Combination of Fecal Immunochemical Test and Colonoscopy

Jing Li Mabel C. Chou
Jiangnan University
Zhichao Zheng
Singapore Management University
Ming Dong
National University of Singapore

Over the years, various countries have adopted a combination of fecal immunochemical test (FIT) and colonoscopy as the preferred protocol for colorectal cancer (CRC) screening and surveillance. Current guidelines recommend two consecutive FITs annually after age 50 and immediate colonoscopy if there is at least one positive outcome from the two FITs regardless of other factors or screening history. The guidelines have not been followed closely in practice, however, and patient compliance with this recommendation is very low. Furthermore, it is unclear from literature about the values of having the FIT as a pre- screening method before colonoscopy, and there is still related debate going on in practice. We propose a finite-horizon, partially observable Markov decision process (POMDP) model to optimize the CRC screening policy that combines FIT and colonoscopy. Our model incorporates information from prior screening history and individual risk factors, including age, body condition, lifestyle, etc. Compared to the screening protocol that uses colonoscopy alone, we demonstrate that when FIT sensitivity is not too low, adding annual FITs can help identify CRC in a timely manner and increase expected total quality-adjusted life years (TQALYs), while at the same time significantly reduce the number of colonoscopies required. Compared to the current guidelines, the proposed screening protocol increases expected TQALYs, and reduces lifetime risk of developing CRC when the disutility of colonoscopy is not too high.

Optimal Stopping for Medical Treatment with Forecast Information

Guang Cheng, Jingui Xie
University of Science and Technology of China
Zhichao Zheng
Singapore Management University

Healthcare related costs have dramatically increased in recent years. This leads to a stream of studies aiming at providing support for medical decisions to improve the efficiency of healthcare service delivery. Meanwhile, the development of machine learning techniques enables accurate

forecast of patient condition in the future. How to efficiently utilize the forecast information in a multi-stage medical decision-making environment, however, remains understudied. In this paper, we develop a discrete time, finite horizon Markov decision process model incorporating forecast information to support medical treatment continuation decisions. We extend our analysis to the situations with forecast errors. We characterize the structure of the optimal policies under different settings and show that knowing forecast information can lead to significantly different policies. We further calibrate and test our model and policies for the extubation problem in the intensive care unit (ICU). Using a patient-level dataset of more than 2,800 cases, we compare the performance of different extubation policies and demonstrate that incorporating forecast information can significantly decrease extubation failure rate, and ICU length of stay, especially for a certain subgroup of patients.

Priority Scheduling of Jobs with Hidden Types

Zhankun Sun
City University of Hong Kong
Nilay Tanik Argon, Serhan Ziya
University of North Carolina at Chapel Hill

Motivated by task prioritization in healthcare and emergency response, we study a stochastic scheduling problem where the decision maker can test a job and reveal its type before serving it. Testing provides useful information but also delays the provision of service. Therefore, it is unclear if and when testing should be performed. Using a Markov decision process formulation, we identify the structure of the optimal policy. We find conditions when it is sufficient to use simple static policies and when dynamic testing is most beneficial. We also find that it is possible to devise near-optimal heuristic policy through numerical experiments.

Allocation of Intensive Care Unit Beds with Patient Readmissions

Huiyin Ouyang
University of Hong Kong

This work aims to use mathematical modeling and analysis to develop insights into and policies for making priority decisions in Intensive Care Units (ICUs) with patient readmissions. We assume patients' health conditions may change over time, and patients who are early discharged from ICU due to capacity constraint might get readmitted to ICU when beds become available later. We propose a stylized mathematical model in which patients' health conditions change over time according to a Markov chain. The ICU has limited bed availability and therefore when a patient arrives to a full ICU, a decision needs to be made as to whether the patient should be admitted to the ICU and if so which patient in the ICU should be early discharged to the general ward. Patients waiting in the general ward could get readmitted to ICU when a bed becomes available, in which case a decision needs to be made as to which patient should be readmitted.

We formulate this decision problem as a Markov decision process and provide some analysis of the structure of the optimal policy.

Session 4D: OM-Marketing Interface IV
Chair: Qi Chen (Donghua University)

Sun 10:30 – 12:00
Room 5-207

Optimal timing for manufacturer's wholesale and direct price-setting in dual-channel supply chains under demand uncertainty

Kenji Matsui
Kobe University

This paper investigates the problem of when a manufacturer managing a dual channel supply chain should set its direct and wholesale prices under demand uncertainty. We first derive the benchmark result that when both manufacturer and retailer forecast demand precisely, the manufacturer should set its direct price not after but either before or when choosing its wholesale price. Second, we show that when the manufacturer and retailer cannot forecast demand precisely, the manufacturer should set its direct price only after the retailer has set its retail price, if the retailer's demand forecast accuracy is high and the manufacturer's is low.

Keywords: Supply chain management; Dual-channel supply chain; Game theory

Robust Salesforce Contracts with Inventory Considerations

Xiangyin Kong, Yimin Yu
City University of Hong Kong
Gengzhong Feng
Xi'an Jiaotong University

We consider the salesforce compensation with limited inventory and model uncertainty where the demand is censored by the lost sales and its distribution is uncertain. The firm jointly decides the compensation plan and inventory levels by the worst-case criterion subject to the robust incentive compatibility and limited liability condition. We show that a quota-based linear contract with commission rates decreasing in inventory is optimal; and that under the optimal robust contract, the firm tends to understock with a multiplicative demand, contrary to the stock-more effect in the literature, while it can either overstock or understock with a general linear demand.

Keywords: salesforce compensation, robust contract, demand censoring, OM/Marketing interface

Decentralized or Centralized Merger under Quality and Price Competition

Yunjuan Kuang, Xiaomeng Guo, Chi To Ng
The Hong Kong Polytechnic University

Many firms adopt mergers and acquisitions (M&A) as an important strategy in competitive business environment. In this paper, we derive a game theoretical model where firms compete in price and quality, taking account of cost synergies from merger. We focus on examining whether and when a merged firm should make centralized or decentralized quality and price decisions under competition. We also study the effects of merger on firms' optimal decisions, profits, and consumers' surplus.

Keywords: horizontal merger, price competition, quality competition, decentralization

Optimal inventory and pricing decision of fashion apparel retailers considering experience service investment and promotional efforts

Qi Chen, Qi Xu, Wenjie Wang
Donghua University

In this paper, considering the impact of fashion degree of apparels on pricing and replenishment policy, we investigate the determinants of a fashion retailer's dynamic pricing and fixed price policy, and optimal replenishment period throughout a fashion product's selling season. We first develop a demand function that considers the important characteristics of fashion of a apparel and consumer reservation price. Next, we construct a fashion degree function that is used to describe fashion clothing's vary character with time. Then, we imply Pontryagin's maximum principle and sequential hierarchical approach to discuss and simulate two alternative optimal pricing and replenishment strategies under fashion degree to investigate the effect of those strategies on the demand and retailer's profits. Our results show that the fashion apparel retailers can benefit from the implementation of dynamic pricing strategies as opposed to fixed-price strategies. Moreover, since the reservation price of consumers is related to the fashion degree, the optimal dynamic pricing is always less than the reservation price. In addition, there exist three optimal dynamic pricing paths according to the different the fashion attenuation coefficient and ordering period. Our paper provides a timely optimal decision and can help fashion retailer to improve inventory and profits.

Keywords: fashion degrees; reservation price; dynamic pricing; solved hierarchically; optimal control method

Session 4E: Data-driven Optimization I
Chair: Xinming Chen (Xiamen University)

Sun 10:30 – 12:00
Room 6-207

Thompson Sampling for Cascading Bandits

Wang Chi Cheung
Institute of High Performance Computing
Vincent Y. F. Tan, Zixin Zhong
National University of Singapore

Motivated by applications in online recommender systems, we consider the cascading bandit model, where a recommender presents lists of items to customers who arrive sequentially. The recommender aims to maximize the attractiveness of the listed items, notwithstanding his uncertainty about the customers' preferences on the items, as well as the partial feedback from the customers. We design a Thompson sampling algorithm, and derive a bound on the algorithm's regret. This is the first non-trivial regret bound of a Thompson sampling algorithm for a stochastic combinatorial bandit problem with partial feedback. Details of the work can be found at arxiv:1810.01187.

Keywords: E-operations, Service operations management and innovation, Online learning, Multi-armed bandits, Thompson sampling

An Optimal Algorithm for Thresholding Bandit Problem Based on Large Deviation Theory

Manjing Zhang, Guangwu Liu
City University of Hong Kong

In this paper we study a multi-armed thresholding bandit problem (TBP), aiming to identify the arms whose expected return are larger than a threshold value. We propose a parameter-free policy for TBP problem based on large deviation theory. We show that the policy is optimal in an asymptotic sense when the budget is large enough. Numerical experiments suggest that the proposed policy may outperform existing algorithms significantly.

Keywords: thresholding bandit problem, large deviation theory.

Improve Multicriteria Location-Selection for Chain Restaurants Based on Machine Learning

Xinming Chen, Shuihua Han, Zhenyuan Liu, Cheng Lei
Xiamen University

This article attempts to translate the factors that influence the location decision into the sales contribution they will make. Traditional wisdom relies on historical data, but with standby sites

not opening yet, there is no such information for us. Therefore, for chain restaurants, we combine Grey Comprehensive Evaluation Method and Kernel Regression to comprehensively abstract and analyze influencing factors of restaurants sales by using the data of other operating branches. Finally, adopting this method, we assist a world-renowned fast food company to evaluate the location selecting process. Without grasping historical data accurately, this article can provide a systematic restaurant location selection solution.

Keywords: Business analytics and data-driven OM; Chain restaurants; Location selection; Kernel Regression; Grey Comprehensive Evaluation Method

Session 4F: Sustainability II

Sun 10:30 – 12:00

Chair: Na Luo (The University of Auckland)

Room 6-208

The Impact of Buyers Network on Supplier's Environmental Compliance

Yi Zhou

Monash University

Kevin Linderman

University of Minnesota

Andy Yeung, Chris Lo

Hong Kong Polytechnic University

This study investigates environmental compliance of all Chinese listed manufacturing firms and tries to understand how their buyers' willingness and ability affect the likelihood of the supplier's noncompliance from network perspective. Instead of traditional measurement of willingness and ability, we measure the buyer-supplier network characters in terms of corruption index in buyer's location, sales volumes from manufacturers to buyers, and language/geographic/culture distance between the buyers and supplier.

Keywords: Supply chain network, Environmental compliance, Network theory, buyer supplier relationship.

Managing Used Products: Who Should Refurbish?

Narendra Singh, Ahmed Timoumi

Indian School of Business

We examine whether a manufacturer should refurbish used products himself or allow his retailer to refurbish them. We show that, under certain conditions, the manufacturer, despite foregoing profits and facing competition from refurbished products, is better off with letting the retailer refurbish used products than with refurbishing them himself. Our analysis reveals a novel strategic effect of the link between the new products and the refurbishing capacity when the retailer refurbishes used products. Under strategic effect, the manufacturer's gain in profit more

than offsets the loss from allowing the retailer to refurbish used products and compete with the manufacturer.

Keywords: Closed-Loop Supply Chain; Refurbishing; Used Products

Site Selection Research of Low Carbon Distribution Centers under the “New Retail”

Yong Wang, Pei-lin Zhang,
Wuhan University of Technology
Xiaofen Zhou
Wuhan Technology and Business University
Cornel Mihai Nicolescu
KTH Royal Institute of Technology

The "Internet +" era, the new retail model will lead the future of business trends. Combining with the characteristics of the development of the new retail industry, from the perspective of carbon emissions, we will focus on the analysis of carbon emission costs and the impact of adding businesses to enterprises, governments or the society. According to the scholar's decision on the location of distribution center, it mainly involves the construction cost of distribution center and the increase of carbon emission cost model for comparative analysis. By comparing the total cost of social, commercial and government, and provide a basis for positioning decisions.

Keywords: New retail, low-carbon, distribution center location

Value of Traceability in Supply Chains

Jingchen Liu,
Peking University
Yao Cui
Cornell University
Ming Hu
University of Toronto

Recent development in the Blockchain technology has enabled end-to-end traceability of supply chains. When product failure occurs, such traceability information can be used to identify the suppliers at fault. This could revolutionize supply chain operations for industries where traceability is difficult to achieve under traditional technologies (e.g., agri-food, pharmaceutical). In this paper, we study how the supply chain traceability enabled by new technologies such as Blockchain can affect suppliers' quality decisions and supply chain contracts. To gain insights into the value of traceability under different supply chain structures, we consider two types of supply chains: 1) parallel supply chains, where all suppliers belong to the same tier of the supply chain and the buyer procures the same material from each supplier, and 2) serial supply chains,

where each supplier belongs to a different tier of the supply chain and manages a particular stage of the production process. We find that in a parallel supply chain, the key value of tracing the suppliers is that it guarantees cash flow feasibility for the buyer when he offers first-best quality contracts to the suppliers, hence improving the implementability of first-best quality contracts in practice. On the other hand, in a serial supply chain, the key value of tracing the production process is that it provides a fairer and more sustainable way for the suppliers to share the risk that arises from the uncertainty in quality outcomes.

Food loss and waste reduction: Literature Review and Research Directions

Na Luo, Tava Olsen
The University of Auckland

Food loss and waste (FLW) reduction is a challenging problem both for enterprises and the government, and has become a high-profile issue in policy debates. We review 76 papers from 49 operation management and general management journals over the period 1994-2018. Meanwhile, as the topic of FLW reduction is an interdisciplinary subject, we also have brief summary for pertinent OM papers in the “Waste Management”, “The journal of Cleaner Production”, “Food Control”, and “Food policy” journals. By discussing the limitations of present researches, we identify some research gaps, and point toward a research direction agenda in the OM field

Keywords: Literature review, Food loss and waste, OM methods

Session 4G: Logistics III
Chair: Yang Liu (Shandong University)

Sun 10:30 – 12:00
Room 6-209

The Optimization and Numerical Experiments of Storage Relocation in An Automated Storage and Retrieval System

Kaiyi Luo, Gang Chen, Haolin Feng
Sun Yat-sen University
Yanli Tang
Hong Kong Polytechnic University

In this paper, we formulate storage relocation optimization as an integer program model with the objective of minimizing crane travel time. The model newly formulates relocation decisions (i.e., storage location assignments of pallet loads that change during the retrieval handling process). We then propose a heuristic algorithm with embedded relocation policies and numerically evaluate their performance in various situations. The analysis shows that random relocation is generally not better than no relocation. Closest-open relocation is effective across different rack

shapes, crane velocity configurations and retrieval characteristics. Furthermore, we derive class-based relocation policies and incorporate SKU turnover dynamics.

Keywords: Logistics; warehousing; automated storage and retrieval systems; retrieval efficiency; storage relocation

Regulating the Hazardous Material Transportation: A Dual Toll Approach

Ginger Y. Ke
Memorial University of Newfoundland
Huiwen Zhang, James H. Bookbinder
University of Waterloo

A dual-toll setting policy is proposed to mitigate the risk caused by the hazardous material (hazmat) transportation in a road network. We use a bilevel programming formulation, where the upper and lower levels respectively reflect the decisions for the regulators and travelers. More specifically, both the total risk (the perspective of regional government) and the equitable distribution of risk (the local government's viewpoint) are addressed. For hazmat carriers and non-hazmat travelers, the total transportation cost, including the toll cost, is minimized. Each type of traveller thus makes routing decisions under the toll policy by arranging its corresponding transportation flows.

Keywords: Transportation of hazardous materials; Bi-level programming model; Risk equity; Traffic congestion; Dual toll

Emergency Evacuation Problem for a Multi-source and Multi-destination Transportation Network

Yang Liu, Jianghua Zhang
Shandong University
Yingxue Zhao
University of International Business and Economics
Tianhu Deng
Tsinghua University

Disasters such as earthquake or tsunami can easily take the lives of thousands of people and millions worth of property in a fleeting moment. A successful emergency evacuation plan is critical in response to disasters. In this paper, we seek to investigate the multi-source, multi-destination evacuation problem. First, we construct a mixed integer linear programming model. Second, based on K shortest paths and User Equilibrium, we propose a novel algorithm (hereafter KPUE), whose complexity is polynomial in the numbers of nodes and evacuees.

Finally, we demonstrate the effectiveness of Algorithm KPUE by a real evacuation network in Shanghai, China. The numerical examples show that the average computation time of the proposed algorithm is 95% less than that of IBM ILOG CPLEX solver and the optimality gap is no more than 5%.

Keywords: Emergency evacuation; disasters and accidents; user equilibrium; shortest path

Session 4H: Supply Chain Management V

Sun 10:30 – 12:00

Chair: Jing Xia (Nanjing University)

Room 6-211

Mean-Variance Theory for Risk Analysis in Global Supply Chains with Air Logistics

Tsan-Ming Choi, Xin Wen, Xuting Sun, Sai-Ho Chung
The Hong Kong Polytechnic University

In this paper, we discuss how the mean-variance (MV) theory can be applied to explore operations management problems in global supply chains associated with air logistics. To be specific, we examine the related literature from four areas, namely air logistics operations, demand management, supply management, and supply-demand coordination. We then highlight some important areas in which the MV theory can be applied for future research. This paper provides useful information to both the practitioners and academics on how the MV theory can be applied to conduct risk analysis for operations with air logistics.

Keywords: Mean-variance analysis, air logistics, global supply chain management

Structure and merge in supply chain network with deterministic demands

Yi Feng, Xu Chen, Benyong Hu, Wenqiang Dai
University of Electronic Science and Technology of China

The structure of the supply chain network and company merge significantly affect supply chain performance. In this paper, we first examine a two-tier supply chain and found the effect of the company number in different tier on the profit of the tiers and the supply chain. Some business insights can be derived from the theoretical analysis. Furthermore, we analyze the effect of vertical and horizontal merge on supply chain performance, and found the post-merge cost structure dominates the choice of vertical or horizontal merge. We further state that the model can be easily extended to the more than two-tier case.

Keywords: Supply chain structure, Supply chain network, Vertical merge, Horizontal merge.

Collaborative Innovation in the Supply Chain: Leadership Structure and Value Creation

Xiaoyan Xu, Bin Shen
Donghua University
Hau-Ling Chan
Hong Kong Polytechnic University

We consider a B2B trading system in which the supplier and buyer co-develop a product X which includes several innovative elements. The supplier is responsible for process innovation and the buyer is responsible for product innovation. We study innovation leadership structure and consider the supplier-lead-innovation (SL) and buyer-lead innovation (BL) games. We further explore the optimal value creation of BL and the optimal value creation of joint pricing and innovation in a supply chain.

Keywords: collaborative innovation, supply chain innovation, B2B, supply chain.

Supplier Encroachment and Process Investment with Spillovers

Jing Xia, Houcai Shen
Nanjing University

Conventional wisdom shows that a retailer becomes worse off when its supplier encroaches on the retail market and competes with it. In this paper, we reveal that supplier encroachment is not always detrimental to an incumbent retailer. We do so through considering supplier encroachment under the case with process investment spillovers. Moreover, the robustness of the main findings is examined under scenarios such as price competition, multiple retailers, and asymmetric sales efficiency.

Session 4I: E-commerce/Online Retailing II

Sun 10:30 – 12:00

Chair: Riki Revianto Putera (National Cheng Kung University)

Room 6-212

The new role of B2B platform: Pricing Games of Platform-based Bargaining on Logistics Service

Xiaohan Ding, Nan Liu
Zhejiang University

This paper explores a new role of B2B platform as a third party coordinator in logistics operations for online transaction. We propose different analytical models to study the impact of platform's involvement on other players (i.e., the users, 3PLs) and social welfare under three

circumstances. The impacts of some key factors (i.e., the users' number and commission schemes) on resulting price, quantity and platform's profit are analyzed. Some useful managerial insights are further provided based on numerical analyses.

Keywords: B2B platform, platform-based bargaining, pricing game

Decision making approaches for online auction with a buyout option

Yonggang Li, Xiangpei Hu
Dalian University of Technology

We consider an online auction with permanent buyout option and propose a new model based on focus points to illustrate the decision making procedure of the seller and bidders. Different people are described by different types of focus points. Under each type of focus points, we obtain the optimal strategy of the bidders during an online auction with buyout price, we state the necessity of providing buyout option and suggest the buyout price for the seller to increase revenues. It is a new method for solving online auction problem which fits the decision procedure of human being intuitively.

Keywords: Online auction; focus points; buyout price

New style launching and e-channel strategies for a fashion product manufacturer

Rizki Revianto Putera
National Cheng Kung University

We study a fashion product manufacturer's style launching and e-channel strategies in a supply chain setting in which the manufacturer sells products through the retailer's physical store and an e-channel, which could be owned by the manufacturer or the retailer. We analyze the manufacturer's and the retailer's decisions by adopting a two-period pricing model under different combinations of the manufacturer's style launching and e-channel strategies. We then explore the conditions under which certain style launching and e-channel strategies benefit the manufacturer most, and derive managerial insights from numerical analysis.

Keywords: dual channel, e-channel option, new style launching, service operations management and innovation, two-period model

Session 4J: Service Operations III
Chair: Yifan He (Xiamen University)

Sun 10:30 – 12:00
Room 6-213

Optimizing Service Process Based on Quality Function Deployment

Zhenyu Liu, Jianjing Sun
Xiamen University

Based on the quality function deployment (QFD), a metric consisting of costs, time, reliability, Usability, and empathy is designed for optimizing service process. A model for optimizing service process is built under constrains of the resource and time invested by the service provider. The service provider is able to use the model to optimize the service process for maximizing the customer satisfaction and the performance of service process.

Keywords: service process; customer satisfaction; optimization

Bundle Pricing of Congested Services

Allen Wu
Hong Kong University of Science and Technology
Luyi Yang
Johns Hopkins University

Bundle pricing is commonly adopted by service firms managing multiple congestion prone service facilities. Under bundle pricing, the firm charges a single price for all services as a whole. This scheme is in contrast to a la carte pricing, under which the firm sets a separate price for each service. The existing theory generally sees bundle pricing as more lucrative. However, in service systems that involve congestion-driven delay, we show that the prescriptive guidelines from the existing theory can be reversed. Specifically, bundling fails to make more revenue than a la carte pricing when the congestion effect is significant.

Keywords: service operation; queuing; bundling; strategic behavior

Hotel Online Booking Cancellation Contract Design

Yifan He, Yongquan Lan
Xiamen University

We learn the hotel's pricing strategies together with two types of booking cancellation policies, deadline cancellation and guarantee fee cancellation while considering consumers' behaviors on their willingness to pay, arriving probabilities as well as their cancellation probabilities. Results indicate that these two cancellation policies equally influence the profit of the hotel when cancelled rooms cannot be resold. However, when taking the salvage value of the cancelled

rooms into consideration, the optimal cancellation policy depends on the average length of consumers' stay. An empirical study is given to support our theoretical predictions.

Keywords: Online Booking Contracts; Pricing Strategy; Cancellation

Session 4K: Analytics and Operations of Online Retailing

Sun 10:30 – 12:00

Chair: Qiyuan Deng, Yun Fong Lim (Singapore Management University)

Room 6-214

Omni-channel Retailing with Consumer Reviews

Qiyuan Deng, Xin Fang, Yun Fong Lim
Singapore Management University

We study a retailer's strategy in providing product information through its offline and online channels. The two channels are operated either separately (dual-channel system) or collectively (omni-channel system). Product information includes descriptions from the retailer and reviews from consumers. Without consumer reviews, the omni-channel system leads to a higher profit than the dual-channel system if the information limitation in the offline channel is large and consumers' valuation of the product is small. However, with consumer reviews, even if the information limitation in the offline channel is small, the omni-channel system can still lead to a higher profit.

Big Data Analytics for Fashion Retailer: Demand Prediction and Assortment Optimization

Jiandong Zhou, Biying Shou, Qingpeng Zhang
City University of Hong Kong

We present our work with an online fashion retailer offering one of the world's largest flash-sales platform for designer apparel and accessories. We study how a retailer can use the wealth of both internal platform data and external online data to formulate fashion demand and optimize operations management decisions. A main challenge is to predict demand and make procurement decisions for brand-new products. We perform machine learning-enabled data analytics on both internal customer-purchase data and external social-media-behavioral data to predict future demand of new products. We reveal the on-time predictive power of considering external behavioral data for efficient operations management.

Managing Bucket Brigades on Discrete Stations with Stochastic Work Times

Peng Wang, Yun Fong Lim
Singapore Management University

We study a J-station, 2-worker bucket brigade assembly line with stochastic work times. We derive the system's average throughput. If the work speeds depend only on the workers, we observe behaviors similar to that of the deterministic model. If the work speeds depend on the workers and the stations, we optimize a system consisting of a generalist and a specialist and uncover two factors determining the throughput. If the work speeds depend on the workers, the stations, and the jobs, the generalist and specialist may switch their roles as they learn. Furthermore, the throughput may drop as the workers learn.

Integrating Pre-planned Replenishment-allocation with Real-time Fulfillment for Online Retailing Using Robust Optimization

Yun Fong Lim, Song Jiu, Marcus Ang
Singapore Management University

An important characteristic that differentiates online retailers from brick-and-mortar retailers is that the former can choose which fulfillment centers (FCs) to satisfy demand. Although this flexibility improves service levels, it may increase the fulfillment cost and complicates inventory allocation and replenishments to the FCs. This motivates us to integrate the pre-planned replenishment-allocation decisions with the real-time fulfillment decisions such that the retailer's expected total cost is minimized. We develop an approach based on robust optimization to solve the problem. A case study with a major online retailer in Asia suggests that our approach can reduce its current cost by 37%.

Session 5A: Innovation in Operations Management

Sun 13:30-15:00

Chair: Pascale Crama (Singapore Management University)

Room 5-203

Bargaining Power: A Double-Edged Sword

Niyazi Taneri,
National University of Singapore
Arnoud De Meyer
Singapore Management University

License agreements present opportunities for innovators (licensors) and their partners (licensees) to leverage each other's complementary capabilities. It is natural for a firm to use a position of higher relative bargaining power for its potential gain but this can lead to a misalignment of incentives: An innovator with higher relative bargaining power may push for higher deal value but a partner facing higher payments at a continuation decision may prioritize other projects in its portfolio. We investigate how deal value is determined and how deal value - and its underlying drivers - influence downstream terminations.

Moral Hazard Problem and Incentive Contract in Engineering Procurement and Construction Project

Zhenzhen Chen, Wanshan Zhu
Tsinghua University
Pascale Crama
Singapore Management University

In the international Engineering-Procurement-Construction (EPC) power general contracting projects, the End User contracts with the general contractor on the overall quality of the project, while the general contractor subcontracts the project to several sub-contractors. The subcontracting stage may occur moral hazard due to the unobservable efforts of the sub-contractor. We work on the design of the contracts between the general contractor and the sub-contractor from the general contractor's perspective, aiming at motivating the sub-contractor to exert high efforts. As a result, the project can obtain a high overall quality, and the general contractor gains high profit.

Economic and Environmental Implications of Biomass Commercialization in Agricultural Processing

Bin Li, Buket Avci, Onur Boyabatli
Singapore Management University

We consider a processor who procures a commodity input from contract and spot markets to produce and sell a commodity output and biomass in the presence of input and output spot price uncertainties. For the economic implications, we investigate how the spot price uncertainty (input and output price volatility and correlation) and the processor's procurement strategy (access to contract and spot markets) shape the value of commercialization. For the environmental implications, we evaluate the net greenhouse gas emissions and find that biomass commercialization is environmentally friendly, only when the biomass demand is not very high; otherwise it is environmentally unfriendly.

Designing Resource Competitions for Research Projects

Wenqi Lian, Pascale Crama
Singapore Management University

Academic research is funded by governments wishing to promote innovation and economic growth as well as by university administered research funds (UARF) at research universities. Government funding is based on competitive peer reviews of project proposals, whereas UARF funding is more relationship-based. We build a model to explore different design choices of the

seed funding decision by varying the objectives and the funding decision rules of the UARF. Our research points to the importance of an appropriate design of the UARF funding system to increase social returns to government funding of research.

Session 5B: Simulation II

Sun 13:30-15:00

Chair: Yijie Peng (Peking University)

Room 5-205

Ranking and Selection with Discrete Covariates

Jianzhong Du, Siyang Gao
City University of Hong Kong

The ranking and selection (R&S) problem seeks to select the best simulated design from a finite set of alternatives. It is a well-established problem in statistics and simulation, and has wide applications in the management of manufacturing, production and service. In this study, we consider R&S in the presence of covariates (also known as the side information or context in the literature), where the covariates correspond to some input information of the simulation model and influence the performance of each design. This is an emerging problem in personalized decision making and big data, and brings new and challenging research questions compared to the classical R&S. In this research, we assume that the covariate space has a finite number of outcomes. To assess the quality of our selection, we first propose three measures and show that they have the same convergence rate. Next, we derive the selection rule that maximizes this rate. Last, we develop a new selection procedure for implementation, and show that this procedure recovers the optimal convergence rate. Numerical experiments demonstrate the superior performance of our proposed method.

Keywords: simulation optimization, ranking and selection, simulation budget allocation, covariates

Efficient Sampling for Selecting Important Nodes in Random Network

Haidong Li, Xiaoyun Xu, Yijie Peng
Peking University
Chun-Hung Chen
George Mason University

We consider the problem of selecting important nodes in a random network, where the nodes are linked with each other randomly with certain transition probabilities. The node importance is ranked by the stationary probabilities of the corresponding nodes in a Markov chain, e.g., in Google's PageRank. In the random network, the transition probabilities are unknown but can be estimated by sampling. Under a Bayesian learning framework, we apply the first-order Taylor expansion and normal approximation to provide a computationally efficient posterior approximation of the stationary probabilities. In order to maximize the probability of correct

selection, we propose a dynamic sampling scheme which uses not only posterior means and variances of certain interaction parameters between different nodes, but also the sensitivities of the stationary probabilities with respect to each transition probability. Numerical experiment results demonstrate the superiority of the proposed sampling procedure.

Keywords: simulation, Bayesian learning, dynamic sampling, ranking and selection

Estimating Risk Contributions via Monte Carlo: A Direct Smoothed Perturbation Analysis Approach

Guangwu Liu
City University of Hong Kong
Zhijian He
South China University of Technology

In this paper we develop a generic and efficient Monte Carlo simulation method to tackle the problem of estimating risk contributions of credit portfolios. Our simple ratio estimators are asymptotically unbiased and are applicable in various popular credit risk models in practice and in the literature. Furthermore, the general methodology, called as direct smoothed perturbation analysis (DSPA), could also be applied to classical sensitivity estimation problems where our estimators are exactly unbiased. In such cases, it can liberate the Lipschitz continuity requirement for conventional infinitesimal perturbation analysis methods on the payoff functions. An exhaustive set of numerical examples show the advantage of our method.

Estimating Sensitivity of Distortion Risk Measure

Yijie Peng
Peking University
Michael Fu
University of Maryland
Peter Glynn
Stanford University
Jian-Qiang Hu
Fudan University

Distortion risk measure, as an alternative to expected utility, has been widely used in behavioral economics and risk management. We propose a new sensitivity estimator for the distortion risk measure, which can handle discontinuous sample paths and distortion functions, and prove asymptotic properties including strong consistency and a central limit theorem

Keywords: simulation, sensitivity analysis, distortion risk measure, asymptotic analysis

Near Optimal Policies for Dynamic Assortment Planning under MNL

Xi Chen

New York University

Yining Wang

Carnegie Mellon University

Yuan Zhou

Indiana University-Bloomington

In this talk, we consider the dynamic assortment selection problem under an uncapacitated multinomial-logit (MNL) model. Since all the utility parameters of customers are unknown, the seller needs to simultaneously learn customers' choice behavior and make dynamic decisions on assortments based on the current knowledge. By carefully analyzing a revenue potential function, we proposed an efficient trisection algorithm that achieves an item-independent regret bound of $O(\sqrt{T \log T})$, which matches information theoretical lower bounds up to iterated logarithmic terms. We also provide experimental results to demonstrate the effectiveness of the proposed method.

Dynamic pricing with sales- and inventory-dependent demand

Mengzhenyu Zhang, Hyun-soo Ahn, Christopher Thomas Ryan, Joline Uichanco
University of Michigan

With growing access to information (through social media, review aggregation websites, and e-tailing webpages), customers are more and more aware of the history of past sales and the amount of available inventory when making their purchasing decisions. We study a joint pricing and initial inventory problem where the demand distribution can be dynamically affected by sales and/or inventory. We propose a policy based on solving the deterministic counterpart which replaces the demand process with its expectation (called certainty equivalent). We provide a unified framework through which we derive a good theoretical performance guarantee for the certainty equivalent. Using these tools, we also analytically demonstrate the benefits of dynamic versus static pricing and characterize when it is optimal to underserve the market by restricting total supply.

The Blessing of Bounded Rationality in Distribution Channels

Lei Zhuang, Tony Haitao Cui, Yusong Wang
University of Minnesota

The extensive adoption of cost plus pricing by retailers in distribution channels is a puzzling phenomenon, considering that retailers can improve their profits by best-responding to wholesale prices announced by their suppliers/manufacturers. In the paper, we incorporate bounded rationality into a model of dyadic channel and show that the lack of best response from cost-plus pricing due to firms' bounded rationality can actually be a blessing for both manufacturer and the channel. More interestingly, we found that under certain conditions all channel members, including the retailer himself, can benefit from his cost plus pricing practice. The result is robust when both the manufacturer and retailer are boundedly rational and when either firm is the Stackelberg leader in the channel. Thus, bounded rationality by firms provides a natural mechanism for the retailer to commit to cost-plus pricing decisions that benefit firms and the channel.

Data Driven Revenue Management in Practice

Simai He
Shanghai University of Finance and Economics

Nowadays many companies have accumulated huge data in sales, logistics, user characteristics, and etc. Particularly, E-retailers usually own a system which track complete data of users' behavior in their websites/apps. In this talk we discuss a few interesting pricing and inventory management cases observed in retailing industry. Especially we will exhibit the power of robust optimization in handling some challenging real situations where data are missing or the quality is low for various reasons.

Session 5D: OM-Marketing Interface V

Sun 13:30-15:00

Chair: Huajiang Luo (Hong Kong University of Science and Technology)

Room 5-207

Technology Choice and Pricing in a Duopoly with Heterogeneous Customers

Harry Groenevelt, Jagan Jacob
University of Rochester

We consider two manufacturers introducing new versions of their respective products. Customers are differentiated by brand preference, price sensitivity, technology affinity and by whether they return a previous generation product. We show that when customers are homogeneous in utilities, an equilibrium in prices and technology choice exists, and study the discount firms offer for returns. When customers are heterogeneous, we derive bounds on technology choice and price and numerically investigate different scenarios involving brand,

technology and price preferences, and find an equilibrium does not always exist and iterated best responses can exhibit interesting cycles, even with only two customer segments.

Keywords: technology management, trade-in rebates, next generation products, price competition.

Advertising and Pricing a New Green Product in Presence of a Non-Green Product Substitute: Simultaneous or Sequential Pricing

Shenyan Liu, Bin Shen
Donghua University
Ting Zhang
Shanghai university
Tsan-Ming Choi
Hong Kong Polytechnic University

In the market, both green and non-green products co-exist. We explore the optimal pricing and green-product-advertising decisions for a green product in presence of a non-green product substitute. We extend the analysis in two possible pricing-decision orders: (i) simultaneous pricing strategy (IP), and (ii) sequential pricing strategies that either green or non-green firm determines its price and then the other makes its decision (GL or NL). We further investigate environmental impacts, consumer surplus and social welfare under these scenarios.

Keywords: green product, product substitution, advertising, pricing, game theory

Integrated Ad Delivery Planning for Targeted Display Advertising

Huaxiao Shen
Sun Yat-sen University
Yanzhi Li, Youhua Chen
City University of Hong Kong

Consider a publisher of online display advertising that sells its ad resources in both an upfront market and a spot market. When planning its ad delivery, the publisher needs to make a trade-off between earning a greater short-term profit from the spot market and improving advertising effectiveness in the upfront market. To address this challenge, we propose an integrated planning model that is robust to the uncertainties associated with the supply of advertising resources. We implement ad serving of our planning model on two real data sets, and we demonstrate how to incorporate realistic constraints such as exclusivity and frequency caps. Our numerical experiments demonstrate that our approach is very effective.

Keywords: display advertising, ad delivery planning, distributionally robust chance constrained optimization, targeted advertising

Sharing Demand Information in Competing Firms

Huajiang LUO
Hong Kong University of Science and Technology
Tian Li
East China University of Science and Technology
Weixin Shang
Lingnan University

We study two competing firms' incentives to share demand information and their production timing strategies. One firm's production time is fixed in her tradition of manufacturing previous product models. The other firm strategically chooses to produce before, simultaneously with, or after the routine firm. The two firms choose whether or not to disclose their private demand information, and then make quantity decisions based on available demand information either concurrently or sequentially. We find that both firms sharing information is the unique equilibrium outcome when the demand uncertainty is low, which is in stark contrast to the extant literature on horizontal information sharing with exogenous production timing.

Keywords: horizontal information sharing, endogenous production timing, first-mover advantage/disadvantage, information leakage

Session 5E: Data-driven Optimization II
Chair: Zhi Chen (Imperial College Business School)

Sun 13:30-15:00
Room 6-207

Target-oriented Robust Location-Transportation Problem

Lianmin Zhang, Houcai Shen, Xin Wang
Nanjing University

To solve the problem of Suning shop, which is a convenience store and also provides home delivery service, a target-oriented multiperiod robust location-transportation problem with uncertain demands has been proposed. The objective is to determine the location of facilities and the quantity of goods so as to maximize the degree of target achievement, which means the managers want to get a highest chance to make the actual fill rate to be closer to the desired fill rate. A tractable conservative approximation of the MRLTP model with both high efficiency of resolution and high quality of solution is also provided.

Keywords: location-transportation problem, distributional robust optimization, fill rate, decision rule, benders decomposition algorithm

Machine-learning detection of food chain vulnerability

Yi-Chun Jai, Pei-Ju Wu, Po-Chu Huang
Feng Chia University

Even when a problem of food safety occurs in one place, it probably disrupts the entire food chain. Nevertheless, few attempts have been made to investigate the risk management of food chain vulnerability based on machine-learning (ML) methods. Accordingly, this study explores safety issues associated with food-chain vulnerability through ML methods based on unstructured data analytics. First, food-chain practices and their characteristics were examined through unstructured text clustering. Then, negative text mining was conducted to identify food-chain vulnerabilities. The ML results of text mining can be used as the basis for a vulnerability detection for food chain risk management.

Robust Distributed Optimization for Supply Chain Management

Zhen Tan
The University of Nottingham Ningbo China

We study a distributed robust optimization model for multi-player supply chain systems with bounded disturbances. Due to the need for robustness, the original control problem is nonconvex with infinitely many constraints. We apply an approximation technique using structured control policy that are easy to implement in practice. When the information sharing among the players satisfies certain condition, this approximation amounts to a finite-dimensional convex problem that can be solved efficiently. Simulations of a system that consists of two retailers and three suppliers shows that the proposed distributed control algorithm can achieve near-optimal solutions under uniformly distributed demand.

Keywords: supply chain management; distributed control; robust optimization

Data-Driven Chance Constrained Programs over Wasserstein Balls

Zhi Chen, Wolfram Wiesemann
Imperial College Business School
Daniel Kuhn
École Polytechnique Fédérale de Lausanne

We provide an exact deterministic reformulation for data-driven chance constrained programs over Wasserstein balls. For individual chance constraints as well as joint chance constraints with right-hand side uncertainty, our reformulation amounts to a mixed-integer conic program. Using a portfolio optimization problem as well as a transportation problem, we present the encouraging in sample and out-of-sample performances of our reformulation in a data-driven setting.

Keywords: Data-driven optimization, ambiguous chance constraint, Wasserstein distance

Session 5F: Mechanism Design for Supply Chain and Allocation Problems

Sun 13:30-15:00

Chair: Geoffrey A. Chua, Gaoji Hu (Nanyang Technological University)

Room 6-208

Dynamic Contract under Quick Response in a Supply Chain

Shilu Tong

The Chinese University of Hong Kong, Shenzhen

Jiahua Zhang

Fudan University

Lian Qi

Rutgers University

We investigate a dynamic contract problem in a supply chain with a manufacturer selling through a retailer over two periods. Before the selling season, neither firm knows the demand information. The manufacturer runs regular production with low production cost but long lead time. In selling season, only the retailer can update the demand information. The manufacturer may further produce and supplement the retailer via quick response, which has a shorter production lead time but higher cost. We analyze three models based on whether the manufacturer adopts quick response or carries inventory.

Incentive Mechanisms for Managing Hidden Rebates and Deceptive Quotes of a Procurement Service Provider

Xiaoshuai Fan, Ying-Ju Chen

Hong Kong University of Science and Technology

Christopher Tang

University of California, Los Angeles

That intermediaries charge their retailers low service fees to be competitive, but collect rebates from some willing manufacturers is pervasive. To reveal unwilling manufacturers' quotes, we explore a deterministic incentive mechanism based on a simple selection rule and a contingent service fee when penalty is unenforceable. We show that this optimal mechanism creates incentive to: (1) deter the intermediary from ignoring the quotes submitted from unwilling manufacturers; (2) reduce the incidence of hidden rebates; and (3) reduce the retailer's

procurement. More importantly, relative to the “lowest quote wins” selection rule, it is Pareto-improving. Furthermore, when penalty is enforceable, a stochastic incentive mechanism is generated.

Mechanism Design with Costly Verification and Limited Punishments

Yunan Li
City University of Hong Kong

A principal allocates an object among several agents, each of whom wants the object and privately knows the value to the principal if he receives it. The object is allocated based on the reports of the agents. The principal can inspect an agent's report at a cost and imposes a limited punishment on the agent who receives the object. An optimal mechanism admits monotonicity in the allocation probability with regards to an agent's value, and takes a two-threshold form, where the values below the lower-threshold and above the upper-threshold are bunched together, respectively.

Optimal Multi-Unit Allocation with Costly Verification

Gaoji Hu, Geoffrey Chua, Fang Liu
Nanyang Technological University

A principal has two homogeneous objects to allocate to two of $I > 2$ agents. Each agent has a strictly positive value for receiving the object. Each agent also has private information which determines the value to the principal of giving the object to him. There are no monetary transfers but the principal can check the value associated with any individual at a cost which may vary across individuals. We characterize the class of optimal Bayesian mechanisms, i.e. mechanisms which maximize the expected value to the principal from his assignment of the goods minus the costs of checking values. We also compare payoffs for the principal under the optimal mechanism and the optimal sequential mechanism.

Session 5G: Airport Operations Management
Chair: Gang Chen (Sun Yat-sen University)

Sun 13:30-15:00
Room 6-209

A Global Aviation Connectivity Index for Tracking and Evaluating Airport Importance

W.H. Wong, K.Y. Cheung
Hang Seng Management College
Anming Zhang

University of British Columbia

The Global Aviation Connectivity Index (GACI) is a comprehensive measure of airport connectivity in the global aviation network. It tracks the progress of over 3000 airports across 5852 cities within 17 geographical regions towards global importance. The GACI leverages a range of network centralities to develop a unique topological metric that can characterize airport connectivity and evaluate the impacts of changing certain airports' connectivity on the rest of the air transport network structure and traffic. The GACI could help airport and airline management, policy makers, and other relevant stakeholders to benchmark the airports' position in the global aviation network.

Scheduling Maintenance Tasks at An Aircraft Maintenance Base

Wen He
Hunan University
Gang Chen, Ke Ma
Sun Yat-sen University

Scheduling maintenance tasks at an aircraft maintenance base is challenging and needs to consider aircraft states (e.g. power off/on, jack off/on), activity precedence relationship, uncertain activity duration, and resource availability. We formulate the problem as a project scheduling optimization model, which minimizes the expected project cycle. The model is NP-hard, and we solve it with a genetic algorithm. The model and the algorithm are applied to a real case. The results are satisfactory, compared with existing scheduling solutions.

Airframe Maintenance Scheduling Optimization in Point-to-Point Flying

Baoyu Lu, Gang Chen, Yingying Han
Sun Yat-sen University

Scheduling airframe maintenance of aircrafts is challenging for airline operators. The maintenance plan must comply with all the mandatory scheduled maintenance requirements and consider airlines' flight plans and regional maintenance capabilities. In this study, we formulate the airframe maintenance scheduling problem in a point-to-point flying network as a mixed integer programming model. We develop an improved enumerative algorithm to solve the model. A real-life case is examined as well.

Optimizing Ground Handling of Baggage Arrival Service at An Airport

Qiaoting Chen, Gang Chen, Jingxuan Wang
Sun Yat-sen University

Airport ramp handling operators must provide baggage arrival service for flights in a timely manner, which transports passengers' checked baggage from landed aircrafts to baggage carousels. The handling process consists of baggage unloading and trolley towing at the ramp area, and baggage infeed and claiming at the reclaim area. We formulate the whole handling process as a mixed integer programming model, while concentrating on optimizing the unloading and towing assignments. An effective heuristic is developed. A real-life case is examined. Managerial issues on airport ground handling assignments are explored as well.

Session 5H: Supply Chain Management VI
Chair: Zhi Chen (Imperial College Business School)

Sun 13:30-15:00
Room 6-211

Managing Shutdown Decisions of Merchant Commodity Plants: A Social Commerce Perspective

Stein-Erik Fleten
Norwegian University of Science and Technology
Alessio Trivella, David Pisinger
Technical University of Denmark
Selvaprabu Nadarajah
University of Illinois at Chicago
Denis Mazieres
University of London

Merchant commodity assets operate in markets with volatile prices and exchange rates. Producers can choose between production, production suspension, and permanent shutdown. However, plant closures adversely affect societal entities beyond the specific plant being shutdown, such as the parent company and the local community. Motivated by an aluminum producer, we formulate a high-dimensional constrained Markov decision process to manage shutdown decisions. Our operating policies show that unaccounted social costs amounting to a few percent of the maximum asset value can justify delaying or avoiding the use of a plant's shutdown option by adapting its operating flexibility in our application.

Keywords: : Stochastic dynamic programming, anticipated regret, machine learning classification, least squares Monte Carlo, reoptimization heuristic

Mismatch risk allocation in a coproduct supply chain

Yangyang Peng, Xiaolin Xu
Nanjing University
Xue Liang
Suzhou University of Science and Technology
Weili Xue
Southeast University

Products such as cattles and pigs can be processed into several types of products (parts) targeting different segments of customers, which belong to the so called coproducts. Mismatch risk is a significant issue in such coproduct supply chains. Under the Stackelberg game setting, we consider a coproduct supply chain consisting of one producer acting as the leader and one retailer being the follower and establish a stylized model to study how the mismatch risk should be allocated. Two supply chain modes are considered, i.e., the P-chain mode under which the producer is responsible for the processing activity and hence holds the mismatch risk, and the R-chain under which the retailer is responsible for the processing activity. We use the unbalanced ratio to reflect the degree of mismatch between supply and demand among different parts of the coproduct and study how the tradeoff between the bargaining power and the mismatch cost, by different mismatch risk allocations, influences the optimal decisions and the performances of the two parties as well as the whole supply chain. Our main findings include: (1) P-chain dominates R-chain from the perspective of the chain performance; and (2) the upstream producer is not always better off in the P-chain under which he bears more mismatch risk. Numerical study shows the robustness of our main results and further studies the effect of demand uncertainty and the processing cost on the performance of P-chain as compared to R-chain.

Keywords: Coproduct, Supply chain design, Mismatch risk management

Environmental Sustainability Trade-offs in the Food Supply Chain

Mahsa Boroushaki, Tava Olsen
University of Auckland

Agriculture production and consumption represent a wide range of worldwide food intake and are responsible for the vast majority of freshwater consumption and greenhouse gas emissions. The literature has identified that global food trade has resulted in long-distance distribution, which contributes to greenhouse gas emissions associated with food supply chain. However, there is relatively little research on a trade-off between the rather low carbon footprint of local production and consumption and any related induced water stress. Meanwhile, these environmental trade-offs in the global food trade can affect companies' competitiveness and coordination schemes; a situation that needs to be carefully assessed.

Keywords: Environmental trade-offs, Food Supply chain, Coordination

The impact of the determination of traceability accuracy on food supply chain sustainability under different dominant modes

Xiongyong Zhou, Zhiduan Xu, Weixia Xue
Xiamen University

Food supply chain traceability is a practice of sustainable operations management, with increasing consumers being willing to pay for traceable products. The current traceability system includes government-led and enterprise-led modes. Considering that the government sets the benchmark traceability accuracy, using dynamic game method, (1) compares the impact of the traceability information sharing degree of core enterprises on supply chain under the centralized and decentralized market structures in different modes and; (2) discusses how the government sets the optimal traceability accuracy standard to get the trade-off between corporate profits and social responsibility, and coordinate supply chain through the profit compensation mechanism.

Keywords: Food supply chain, traceability accuracy, dynamic game, coordination, sustainable operations

Sourcing Innovation: Integrated System or Individual Components?

Zhi Chen, Jurgen Mihm
INSEAD
Jochen Schlapp
Frankfurt School of Finance & Management

Scholars have developed a sound theory of how to design procurement mechanisms for sourcing a simple innovative product. In practice, however, many (if not most) procurement efforts involve complex products consisting of multiple interacting components. Yet theory offers few guidelines regarding the design of procurement efforts for such complex innovations—despite an abundance of pertinent questions. Of these, perhaps the most crucial is whether a firm procuring a complex innovation should purchase (a) an integral product from a single supplier or rather (b) the product's constituent components from (possibly) different suppliers. We use a game-theoretic model to identify the two most critical factors for answering this question: the extent of the required innovation and the size of the supplier base. We also characterize favorable designs of procurement contests that aim to source (respectively) a full product or individual components.

Session 5I: E-commerce/Online Retailing III
Chair: Qiran Wang (South China University of Technology)

Sun 13:30-15:00
Room 6-212

Coordinated scheduling of order picking and sorting-packing processes in online supermarkets

Xiaowei Jiang, Xiangpei Hu, Yuankai Zhang, Lijun Sun
Dalian University of Technology

Order batching is an efficient way for small lot-size orders in online supermarkets. Under the pick-and-sort batch picking strategy, the orders need to be sorted and packaged after picking process. The buffer area between picking process and sorting-packing process is limited. Because of differences between batches, there is backlog or empty phenomenon in the buffer leading to the stagnation of picking process or the idleness of the sorting-packing process. This paper studies this uncoordinated phenomenon to improve the order processing efficiency under limited buffer areas. A control-based order batching and sequencing method is proposed to solve this problem.

Keywords: Order picking; Order sorting-packing; Order batching; Batch sequencing; Limited buffers

Smart Logistics in E-commerce: Impact of Last Mile Consolidation on Pricing

Lan Lu, Chung-Yee Lee
Hong Kong University of Science and Technology
Chung-Piaw Teo
National University of Singapore

This paper investigates the impact on pricing when last mile delivery activities are coordinated by a e-commerce platform. We determine the minimum price needed to sustain the delivery activities of the courier companies, when delivery jobs are coordinated and dispatched by a centralized system like a dominant e-commerce platform player. Distributionally robust optimization and Wasserstein uncertainty set are used to characterize the random demands, and to ensure that the pricing solutions obtained are robust to perturbation in delivery demands. We propose efficient algorithms to solve for the optimal prices and profits of both the platform and the courier companies. Numerical results using real data demonstrate the efficacy of our model and algorithms.

Session 5J: Service Operations IV
Chair: Qiyuan Deng (Singapore Management University)

Sun 13:30-15:00
Room 6-213

Call-Center-Based Scheduling of Sales Field Visits

Yanlu Zhao, Felix Papier
ESSEC Business School

Motivated by the sales-force-operations of a B2B services company in Belgium, we develop a model for scheduling customer appointments for a team of sales agents. The objective is to maximize the number of sales appointments per agent by minimizing the travel and idle times between appointments. We formulate the model as a Markov Decision Process, show the existence of an optimal policy, develop an upper bound, and analytically derive sensitivity properties with regard to several design parameters. We also develop two simple heuristics to solve the complex problem and test them on real data set to derive further managerial insights.

Keywords: Call center operations, Appointment scheduling, Markov Decision Process

Disruption Management in the Airlines Industry: Model and Methods

Deepmala

Indian Institute of Information Technology, Design and Manufacturing Jabalpur

The airline industry is one of the most successful examples of applying operations research methods and tools for the planning and scheduling of resources. Airlines disruption issues arise when an existing flight schedule is disrupted due to some unforeseen events impacting the realized operational performance. Disruption results in a significant increase to airlines operational costs related to crew overtime and additional fuel. In this paper, we propose a mathematical model, where we consider the various classes of aircraft recovery problems which can be formulated as optimization problems. There can be some other goals that will lead to profit such as Operational goals, Marketing goals, Strategic goals. Finally, we indicate the future course of research in this context.

Keywords: Optimization Techniques, Airlines disruption, CPLEX, Mathematical Modelling.

Robust Liner Schedule Design with Service Level Guarantee

Xiaofan Lai, Fan Wang

Sun Yat-sen University

Jun Xia

Shanghai Jiao Tong University

This paper considers a robust schedule design problem in a liner service, which has taken the uncertain port time into account and can ensure a certain level of schedule reliability. Stochastic programming models are formulated and transformed into solvable deterministic models. Extensive experiments have shown the effectiveness and efficiency of the models and methods. The results can be applied to the practice so as to minimize the cost of carriers and also guarantee their service level.

Keywords: Robust schedule design, Service Level, Stochastic Programming

An optimization-based control method for high frequency buses serving curbside bus stop

Bomin Bian
Tianjin University
Michael Pinedo
New York University

A new optimization-based control method is proposed to alleviate the adverse effects of bus bunching. Instead of conventional control methods, we choose to control bus cruising speeds between stops. An optimization-based speed-control model is further proposed. This model allows for control decisions based on the real-time state of the entire bus operation system. Simulation experiments are conducted to examine the model under different scenarios associating with different levels of traffic randomness. Two merits of the speed-control method are unveiled based on the experiment results. The proposed control model is shown to be effective, especially when traffic randomness is high.

Keywords: Bus operation, Optimization-based, Speed- control, Curbside bus stops

Urban Consolidation Center or Peer-to-Peer Platform? The Solution to Urban Last-Mile Delivery

Qiyuan Deng, Xin Fang, Yun Fong Lim
Singapore Management University

The growth of urban population and e-commerce activities increases the demand for urban last-mile delivery, exerting intense pressure on the well-being of cities. To reduce traffic congestion and pollution, an urban consolidation center (UCC) bundles shipments from multiple carriers before delivering them to a city center. Despite the potential benefits, the adoption rate of UCCs in practice is low. In contrast, a notable number of peer-to-peer platforms have been established recently to share delivery capacity among the carriers. We compare the performance of these two business models. We study a game-theoretical model involving a consolidator, who operates a UCC or a capacity sharing platform, and multiple carriers, who choose to use the consolidator's service or to deliver their shipments of random volumes on their own. Our results show that the UCC can be successful if the cost for the carriers to reestablish their logistics capability is low. Otherwise, either the UCC requires significant subsidies or many carriers will not use the UCC's service. In contrast, the platform always earns a profit from a revenue share in each transaction and more efficiently uses the truck capacity, suggesting that the platform may be more effective than the UCC. We compare the consolidator's profit and the carriers' costs in equilibrium under

the two business models. If both the cost for the carriers to reestablish their logistics capability and the impact of long-term performance are high, the consolidator prefers the UCC model. Otherwise, the platform is more profitable for the consolidator. We also find that some carriers prefer the same business model as the consolidator, while the others' preference cannot be aligned with that of the consolidator.

Session 5K: Empirical OM & Logistics
Chair: Philippe Blaettchen (INSEAD)

Sun 13:30-15:00
Room 6-214

Reading between the Stars: Understanding the Effects of Online Customer Reviews on Product Demand

Hallie S. Cho, Sameer Hasija, Manuel E. Sosa
INSEAD

Many studies have examined quantitative customer reviews (i.e., star ratings) and found them to be a reliable source of information that has a positive effect on product demand. Yet the effect of qualitative customer reviews (i.e., text reviews) on demand has been less thoroughly studied, and it is not known whether (or how) the sentiment expressed in text reviews moderates the influence of star ratings on product demand. We are therefore led to examine how the interplay between review sentiment and star ratings affects product demand. Consumer perceptions of product quality—and how they are shared via customer reviews—are of extreme relevance to the firm, but we still do not understand how product demand is affected by the quantitative and qualitative aspects of customer reviews. Our paper seeks to fill this critical gap in the literature by analyzing star ratings, the sentiment of customer reviews, and their interaction. Using 2002–2013 data for the US automobile market, we investigate empirically the impact of star ratings and review sentiment on product demand. Thus we estimate an aggregated multinomial choice model after performing a machine learning–based sentiment analysis on the entire corpus of customer reviews included in our sample. We find that (i) review sentiment and star ratings both have a decreasingly positive effect on product demand and (ii) the effect (on demand) of their interaction suggests that the two components of reviews are complements. Positive sentiments in text reviews compensate for the tendency of consumers to discount extremely high star ratings, and negative sentiments amplify that discounting tendency. The firm should pay greater attention to quantitative and qualitative customer reviews so that it can better understand how consumers perceive the quality of its products or services.

The Role of Feedback in Dynamic Crowdsourcing Contests: A Structural Empirical Analysis

Zhaohui (Zoey) Jiang, Damian R. Beil
University of Michigan
Yan Huang
Carnegie Mellon University

In this paper, we empirically examine the impact of performance feedback on the outcome of crowdsourcing contests. We develop a dynamic structural model to capture the economic processes that drive contest participants' behavior, and estimate the model using a rich data set about real online logo design contests. The model captures key features of the crowdsourcing context, including a large participant pool, entries by new participants throughout the contest, exploitation (revision of previous submissions) and exploration (radically novel submissions) behaviors by contest incumbents, and the participants' strategic choice among these entry, exploration, and exploitation decisions in a dynamic game. Using counter-factual simulations, we compare the outcome of crowdsourcing contests under alternative feedback disclosure policies and award levels. Our simulation results suggest that the full feedback policy (providing feedback throughout the contest) may not be optimal. The late feedback policy (providing feedback only in the second half of the contest) leads to a better overall contest outcome.

Research on multi-type vehicle routing optimization of cold chain logistics distribution considering transportation effectiveness

Chu-xuan Huai, Guo-hua Sun
Shandong University of Finance and Economics

In this study, the multi-type vehicle routing problem with cargo damage in cold chain logistics distribution system is considered. The effectiveness of transportation is considered to ensure customer demands are fully satisfied. A mathematical model with the aim to find an optimal strategy minimizing the total travel cost is established. Then a genetic algorithm is designed to solve the problem, since it's impossible to get the optimal solutions in a limited time. The effectiveness of the designed algorithm is proved by simulation. Finally, the algorithm is applied to G company engaged in the distribution of vegetable and fruits and an improved distribution strategy is obtained.

Keywords: cold chain logistics distribution; vehicle routing optimization; transportation effective factor; genetic algorithm; multi-type vehicle

Sharing of Durable Goods: Business Models for Original Equipment Manufacturers

Philippe Blaettchen, Sameer Hasija
INSEAD
Niyazi Taneri
National University of Singapore

Technological advances enable new business models for original equipment manufacturers (OEMs), replacing or augmenting ownership-based models with access-based consumption. An ever-increasing list of peer-to-peer sharing platforms (e.g., Trringo by Mahindra, Yard Club by Caterpillar, or Coop by Ryder), shows that it is paramount for decision-makers to understand the economic implications of such business models. However, the efficacy of models based on access through sharing or servicization is unclear. As they are still emerging, strong empirical evidence of their performance is lacking, hence motivating the need for analytical insights. This paper focuses on understanding the performance of different emerging business models by considering salient economic and operational factors in the durable goods context. Although business models based on sharing are widely publicized in the media, the optimal model for an OEM will depend on operational factors linked to after-sales services, a point which has been previously overlooked and which deserves closer attention by decision-makers. We show when an OEM prefers setting up a sharing platform for its products, which provides a positive rationale for the emergence of such OEM-owned platforms in practice and provide insights on how OEMs can leverage after-sales services when threatened by a sharing platform established by a third party. Moreover, we show that the optimal business model may lead to cannibalization compared to a traditional model based on ownership. This insight has important implications for organizational structures and incentives.

Session 6A: New Techniques for Vehicle Routing and Packing
Chair: Hu Qin (Huazhong University of Science and Technology)

Sun 15:30-17:00
Room 5-203

A matheuristic approach to the orienteering problem with service time dependent profits

Ning Zhu
Tianjin University

This paper addresses the orienteering problem with service time dependent profits (OPSTP), in which the profit collected at each vertex is characterized by a nonlinear function of service time, and the objective is to maximize the total profits by determining a subset of the vertices to be visited and assigning appropriate service time to each of them within a given time budget. To solve this problem, a mixed integer nonlinear programming model is formulated, and a two-phase matheuristic algorithm is implemented. The numerical results show that our proposed matheuristic algorithm could be quite effective.

Modeling 3D online robotic pallet-packing problem

You Zhou
South China University of Technology

Rapid growth of e-commerce in China creates huge demands for palletization of heterogeneous carton boxes, which is still performed manually in many setups. It becomes the bottleneck as labor cost continue to increase. We propose to employ conveyor belts and robotic arms with

suitable tools to load carton boxes automatically. An effective algorithm is developed to compute loading plans that can be executed by robotics arms. The core component of the algorithm is a novel mathematical model that avoid collision of robotic arm and loaded boxes.

Combining machine learning and column generation techniques to solve the set cover model for a multiple container loading problem

Yutong Ma
South China University of Technology

Many hard combinatorial optimization problems including the Multiple Container Loading Problem (MCLP) can be formulated as a set cover model and solved through column generation (CG) techniques. The effectiveness of CG largely depends on how efficiently the pricing subproblems can be solved. Our strategy: 1. relax the pricing subproblem; 2. train a machine learning model to predict the difference between a relaxation and its true solution; 3. turn a relaxation into a true solution based on prediction. Our strategy can improve the effectiveness of CG for the MCLP by extracting valuable information from the accumulated historical operational data.

Keywords: Multiple container loading cost minimization problem ; Prototype column generation ; Machine Learning ; Integer programming

Optimal Battery-Charging Strategies for Maintaining the Telecommunication Infrastructure Networks

Guangyu Liu
South China University of Technology

In this work, we aim at addressing the problem that the electricity power of base stations of the China Tower Corp Ltd may be cut-off. Thus, we conduct online assignment and routine of maintenance resources to keep the base stations working. The problem can be modeled by a VRP formulation with time windows. The objective is to jointly minimize the number of stations dropped, the dropping time, and the maintenance costs. We propose a variable neighborhood search (VNS) algorithm to solve the problem. A real-world maintenance scenario is presented to illustrate the efficiency and applicability of our maintenance strategy

Keywords: VRP; Time window; Variable neighborhood search algorithm

Strategic Decisions on Establishment of Offshore Warehouses for Manufacturers with E-Commerce Channel

Qiran Wang, Yongzhong Wu, Yongwu Zhou
South China University of Technology

While Chinese manufacturers increasingly use e-commerce platforms to sell products to overseas end customers, expensive air freight is commonly used to meet the short order-to-delivery cycle. Many manufacturers are considering renting or constructing offshore warehouses to reduce logistics costs while ensuring fast delivery. Strategic decisions arise regarding the need, location and capacity of offshore warehouse. With data gathered from consultations, this paper establishes a discrete event simulation model to analyze dynamics of these decisions with key variables, including costs of offshore warehouse, order frequency, and product price. Sensitivity analysis was conducted to explore the change of decisions with varying variables.

Keywords: E-commerce, Offshore warehouse, Discrete event simulation, Order-to-delivery time

Session 6B: Simulation III: Simulation Optimization
Chair: Jun Luo (Shanghai Jiao Tong University)

Sun 15:30-17:00
Room 5-205

Selecting the Best System Using Transient Means with Sequential Sampling Constraints

Hui Xiao
Southwestern University of Finance and Economics,
Loo Hay Lee
National University of Singapore
Douglas Morrice
The University of Texas at Austin
Chun-Hung Chen
George Mason University

This research develops an efficient ranking and selection procedure for selecting the best system based on a transient mean performance measure. The proposed procedure extends the optimal computing budget allocation (OCBA) approach to systems whose mean performances are a function of a certain variable such as location or time. We characterize this as a prediction problem and imbed a regression model into the OCBA procedure. Under the sequential sampling constraints, we determine the optimal simulation budget allocation among all systems concurrently with the optimal simulation run length and optimal number of simulation groups for each system. A heuristic sequential simulation procedure is suggested to implement the budget allocation rule with the objective of maximizing the probability of correct selection with a limited simulation budget. Numerical experiments are conducted to illustrate the applications.

Large-Scale Ranking and Selection

Ying Zhong
City University of Hong Kong
L. Jeff Hong
Fudan University

Ranking and selection (R&S) aims to design statistical procedures that can select the one with the highest mean performance from a group of alternatives. It is a classical problem in the areas of statistics and stochastic simulation. In recent years, more and more researchers are looking at R&S problems with a large number of alternatives (often in the orders of thousands to even millions) and solving them in parallel computing environment. In this talk, we will first talk about how to design efficient fully-sequential procedures in parallel computing environment, and then introduce a completely new idea/procedure that achieves the lower bound of the increasing order of the sample size for R&S problems.

Ship Size Optimization in Maritime Markets with Uncertainty

Hongtao Hu
Shanghai Maritime University

This paper considers the problem of optimizing the ship size of liner shipping between two container terminals. Fluctuations of demand and allowable due times of cargoes lead to challenges in making a robust ship size optimization in a maritime market with uncertainty. In the study, a stochastic dynamic programming method is proposed to calculate the expected total volume of the corresponding containerships within the planning horizon. Using the calculated volumes as input parameters, an integer programming model is then developed to determine the ship size to maximize the profits of the shipping companies. Numerical experiments are performed to validate the effectiveness of the proposed model and the efficiency of the proposed algorithm.

A Fully Sequential Procedure with Adaptive Sampling Rules

Jun Luo, Ruijing Wu
Shanghai Jiao Tong University
Shaoxuan Liu
Ningbo Supply Chain Innovation Institute China

Selecting the best system design from a finite set of alternatives is known as ranking-and-selection (R&S) in the simulation literature. Many procedures, from either frequentist or

Bayesian approaches, has been designed in order to solve R&S problems more effectively or efficiently. Typically, frequentist procedures emphasize more on the effectiveness of a statistical guarantee while Bayesian procedures focus more on the efficiency of using a small number of total samples. In this paper, we aim to take both the effectiveness and efficiency into consideration, from the frequentist point of view. In particular, we design a fully sequential procedure with an adaptive sampling rule, which provide a probabilistic guarantee of correct selection in an asymptotic sense. We demonstrated both the effectiveness and efficiency of our proposed procedure by comparing with KN and OCBA, two classical procedures in frequentist and Bayesian frameworks, through extensive numerical experiments.

Session 6C: OM-Marketing Interface VI

Sun 15:30-17:00

Chair: Ruibing Wang (City University of Hong Kong)

Room 5-206

Cost Information Sharing Under Competition in Remanufacturing

Qiuling Meng, He Huang, Hongyan Xu, Zhou Yu
Chongqing University

This paper studies the competition between an original equipment manufacturer (OEM) and a third-party remanufacturer (TPR) and then investigates incentives of cost information sharing. The remanufactured product quantity is constrained by the new product quantity. We find that the TPR should not always share cost information when the quantity constraint works since cost information sharing can allow the OEM to limit remanufacturing exactly by adjusting the new product quantity and hence hurt the TPR. Further, we examine the impacts of private information on society and environment, and suggest the government to promote information sharing under certain conditions.

Keywords: third-party remanufacturing; competitive strategy; information sharing; government policy; game theory

Competitive Fit-revelation Sampling and Mixed Pricing Strategy

Lingli Wu
Central China Normal University
Shiming Deng
Huazhong University of Science & Technology

Established brands often launch new product lines to meet consumer needs. Though consumers may have built up loyalty to their favorite brands, they are still uncertain whether the newly launched products of the existing brands fit their individual preferences. To alleviate consumers' concern, firms may provide product samples to

help resolve their fit uncertainties. Previous studies have discussed the fit-revelation strategies for experience goods/new products of new brands, yet little is known about how to conduct fit-revelation strategies for newly launched products of established brands in a duopoly market. Also, how would the fit-revelation strategy affect competing firms' mixed pricing strategy. This paper tends to address these questions.

Keywords: Consumer fit uncertainty; Brand loyalty; Fit-revelation strategy; Mixed pricing strategy

The strategic interplay between parallel importation and technology licensing

Hai Li

Zhongnan University of Economics and Law

We develop a game-theoretic model to examine the strategic interplay between parallel importation and technology licensing. By considering the high market is in a monopoly and in a duopoly respectively, we investigate the impact of gray markets on the profits of players and the unit licensing fee. We also analyse the leading manufacturer's licensing decision by considering the presence of gray markets. We find that even though the licensor is always worse off by the emergence of gray markets; the leading manufacturer still has the motivation to license the technology under some conditions. And the profit change of the licensee depends on the trade-off between the demand enhancement effect and licensing fee effect in various cases.

Keywords: gray markets; parallel importation; technology licensing; supply chain management; game theory

Optimal Pricing Strategy and Product Return Policy with Consumer Deliberation

Xiaojuan Puyang, Wei Yu Kevin Chiang

City University of Hong Kong

Consumers often experience valuation uncertainty before purchasing a new product. Allowing consumers to return a misfit product can reduce their consumption risk and thus encourage demand. While a lenient return policy leads to a lower perceived risk for customers, it may make firms worse off if the resulting product return rate is exceedingly high. To decrease the return rate, firms may come up with a pricing strategy which induces some consumers to resolve uncertainty through a costly pre-purchase deliberation. We investigate whether and when it is optimal for a firm to induce deliberation in the presence of a return policy.

Keywords: costly deliberation, product return, pricing

To Preannounce or Not? A Competitive Analysis of New-Generation Product Introduction Strategy

Ruibing Wang, Wei Yu Kevin Chiang
City University of Hong Kong

Preannouncements have been touted as effective means of bringing the awareness of a firm's releasing plan for its new-generation product in high-technology industries. Such an information disclosure, which shifts certain customers' decision from "buy-or-not" to "buy-or-wait," helps to foster the future product adoption through a desirable intra-brand competition. On the other hand, however, preannouncements carry the risk of exposing those waiting customers to potential entrants who are enticed to encroach demand through an unwanted inter-brand competition. We investigate whether and when a firm can benefit from preannouncement under both intra-brand and inter-brand competition.

Session 6D: OM-Marketing Interface VII

Sun 15:30-17:00

Chair: Zhongyuan Hao (Nanjing University of Aeronautics and Astronautics) Room 5-207

On-demand Matching in a Spacial Model with Abandonment

Guangju Wang, Hailun Zhang, Jiheng Zhang
Hong Kong University of Science and Technology

On demand car-hailing platforms, such as Uber and Didi, are changing the way people travel. As an intermediary between passengers and drivers, a platform gathers location information from both sides and makes matching decision accordingly. In general, geographically closer matchings are preferred as they reduce passengers' waiting time and drivers' pickup time. However, the optimization of the matching algorithm is difficult because of its time and spatial dependency. We first propose a spacial model to approximate the pickup distance of a matching based on the number of waiting passengers and idle drivers. In this model, we analyze the queueing dynamics where the platform may control the matching process according to the pickup distance and obtain tractable performance approximations. Based on the approximation, we identify a surprisingly simple optimality condition that is also easy to estimate in a real system, and propose a simple learning rule to help the platform find the optimal decision on pick up distance. We implement our optimal control in a car-hailing system that runs on a hypothetical map. Simulation results suggest that our study has potential practicality.

Pricing and Quality Commitment in Reward-based Crowdfunding

Qian Gao, Xiaolong Guo, Yugang Yu
University of Science and Technology of China

As an innovative way to finance, reward-based crowdfunding helps creators launch different kinds of projects about real products, designs or films. Among these projects, there exists two strategies of product quality disclosure: quality commitment by a detailed introduction about function, design and materials of the product and no quality commitment with a note says “the more money raised, the better quality served”. Through a two-period model, we scrutinize economic performance of the two strategies and the value of quality commitment. Either of the two strategies can be optimal, which is determined by creator’s fixed cost and market characteristics.

Keywords: pricing; quality disclosure; quality commitment; reward-based crowdfunding

All-Or-Nothing or Keep-It-All or Hybrid? For Competitive Crowdfunding Platforms

Lihong Cheng, Xialong Guo, Yugang Yu
University of Science and Technology of China

Motivated by the recent crowdfunding trend, it is interesting to find that the two largest crowdfunding platforms, Kickstarter and Indiegogo, use different funding mechanism. The largest platform, Kickstarter, has always “All-Or-Nothing” (AON). The other platform, Indiegogo, adopts a hybrid mechanism of AON and “Keep-It-All” (KIA). Considering that crowdfunding campaigns are heterogeneous in crowdfunding motivation and inherent enforceability, how competitive crowdfunding platforms choose funding mechanism, AON or KIA or hybrid? This paper develops a game-theoretic model to study the equilibrium of platforms’ crowdfunding mechanism and campaigns’ choices.

Keywords: reward-based crowdfunding; motivation; platform competition; funding mechanism

Direct Selling by Suppliers Improves System-wide Information Flow

Zhongyuan Hao
Nanjing University of Aeronautics and Astronautics
Li Jiang
The Hong Kong Polytechnic University

Consider a bilateral monopoly selling to an uncertain market. The retailer has access to a demand signal. The supplier may add a direct channel for selling to the market. This grants it access to a demand signal. The supplier and retailer can offer payments to acquire signals from each other. We study the effects of direct selling by the supplier on information flow in the system, with profit implications.

Keywords: direct selling; information sharing; signaling; inference

Session 6E: Data-driven Optimization III

Sun 15:30-17:00

Chair: Ruihao Zhu (Massachusetts Institute of Technology)

Room 6-207

A New Approach to Product Assortment Using Marginal Distribution Choice Model

Sun Zeyu, Selin Damla Ahipasaoglu, Bikramjit Das
Singapore University of Technology and Design

Using marginal distribution model to describe customers' choice behavior and newsvendor model to capture retailer's costs, we analyze assortment problems with only static substitutions. We model the problem using a max-max optimization formulation. The outer part of the model is a single-variable optimization problem and the inner part is a knapsack problem, which can be approximated in polynomial time. An algorithm is developed to tackle the problem. Numerical experiments are conducted. Results indicate that our algorithm is much faster than brute force method while possessing a good accuracy and assortment problems with hundreds alternatives can be solved within minutes.

Keywords: product assortment; marginal distribution choice model; newsvendor; static substitution; heuristic

Assortment Optimization under a Single Transition Model

Kameng Nip
Sun Yat-sen University
Zhenbo Wang
Tsinghua University
Zizhuo Wang
Chinese University of Hong Kong

We present a new customer choice model called the single transition choice model. There is a universe of products and customers arrive at each product with a certain probability. If the product is unavailable, then the seller can recommend a subset of available products and the customer will purchase one or choose to leave with certain transition probabilities. We show that the assortment problem under this model is NP-Hard, propose several algorithms for various

cases and a compact MIP formulation that can solve this problem of large size. We also conduct extensive numerical experiments for the model and proposed algorithms.

Keywords: assortment optimization, choice model, mixed integer program, revenue-ordered assortment

Assortment Optimization for an Omnichannel Retailer with Features-based Value Boosts and Discounts

Venus Lo, Huseyin Topaloglu
Cornell University

We consider a retailer who offers assortments in-store and online. Some customers purchase from the in-store assortment. Others test out products that are in-store before purchasing from the online assortment. Products have features, and we describe how features are shared amongst products with a tree. Customers update their preferences for online products based the features that these products share with in-store products. The in-store assortment affects the purchase decision of a customer regardless of which assortment he buys from. The assortment optimization problem is to select an in-store assortment to maximize the retailer's expected revenue. The problem is NP-hard and we present a FPTAS.

Keywords: omnichannel retailing, assortment optimization, features

Thompson Sampling for Online Personalized Assortment Optimization Problems with Multinomial Logit Choice Models

Wang Chi Cheung
Institute of High Performance Computing
David Simchi-Levi
Massachusetts Institute of Technology

Motivated by online retail applications, we study the online personalized assortment optimization problem. A seller conducts sales by offering assortments of products to a stream of arriving customers. The customers' purchase behavior follows their respective personalized Multinomial Logit choice models, which vary according to their individual attributes. The seller aims to maximize his revenue by offering personalized assortments, notwithstanding his uncertainty about the customers' choice models. We propose a Thompson Sampling based policy, which is provably near-optimal even when customers' attributes vary arbitrarily, but not independently and identically distributed. The policy is empirically competent compared to the state-of-the-art.

Keywords: Revenue Management, Assortment Optimization, E-operations, Online Learning, Multi-armed Bandits

Learning to Optimize under Non-Stationarity

Ruihao Zhu
Massachusetts Institute of Technology
David Simchi-Levi
Massachusetts Institute of Technology
Wang Chi Cheung
Institute of High Performance Computing

We introduce algorithms that achieve state-of-the-art dynamic regret bounds for non-stationary linear stochastic bandits setting. It captures natural applications such as advertisements allocation and dynamic pricing in a changing environment. We show how the difficulty posed by the (possibly adversarial) non-stationarity can be overcome by a novel marriage between stochastic and adversarial bandits learning algorithms. Our main contributions are the tuned Sliding Window Upper-Confidence-Bound algorithm with optimal dynamic regret, and the tuning free bandits-over-bandits framework built on top of the Sliding Window Upper-Confidence-Bound algorithm that (surprisingly) matches the optimal dynamic regret when the amount of non-stationarity is moderate to large while attaining best dynamic regret otherwise. We further conduct extensive numerical experiments to show that our proposed algorithms can achieve superior dynamic regret performances.

Session 6F: Modeling and Optimization for Ride-Sharing Services
Chair: Hai Wang (Singapore Management University)

Sun 15:30-17:00
Room 6-208

Tipping Point in Ride-Hailing Service Systems with Sharing Option

Jianfu Wang, Geoffrey Chua, Arvind Sainathan, Akshay Vijayendiran
Nanyang Technological University

This paper examines different car-sharing models offered by ridehailing firms. In the traditional car-hailing model, customers are served individually by taxis or private cars. In the sharing-only model, all customers are willing to share the ride with other customers. In the hybrid model, customers may choose either individual or shared service provided by the same fleet of cars. Customers incur a hassle cost when they share the ride with others. We develop a queueing game-theoretic model to help a monopoly ride-hailing firm (i) determine the arrival rates that create the maximum customer value and (ii) choose admission fees that extract the maximum profits. First, we discover a tipping point in the hybrid model under the optimal customer behavior. When the hassle cost decreases to this point, (i) the optimal customer behavior immediately switches from less than 80% customers using shared service to all using it, (ii) the optimal arrival rate increases dramatically, and (iii) the rate at which a decreasing hassle cost

improves the maximum customer value significantly increases. Second, when the hassle cost is higher than the tipping point, the hybrid model, with homogeneous customers using both individual and shared services, may generate higher customer value than the other two models. This means that the firm can improve customer value by assigning homogeneous customers to differentiated services, which are considered to be beneficial only when customers are heterogeneous in the conventional wisdom. Finally, we propose a profit-maximizing admission fee structure in the hybrid model to maximize the firm's profit, and we demonstrate its effectiveness

Understanding On-Demand Ride Services: Platform Optimization, Network Evaluation, Behavioral Analysis, and Traffic Prediction

Xiqun (Michael) Chen
Zhejiang University

This presentation focuses on the ridesourcing system optimization modeling and behavioral analysis of the shared mobility on demand. The on-demand ride service platform, e.g., Uber, Lyft, DiDi Chuxing, is an emerging technology with the boom of the mobile internet. Ridesourcing or transportation network companies (TNCs) refer to an emerging urban mobility service mode that private car owners drive their own vehicles to provide for-hire rides. The platform serves as a coordinator who matches requesting orders from passengers (demand) and vacant registered cars (supply). There exists an abundance of levers to influence drivers' and passengers' preference and behavior, and thus affect both the demand and supply, to maximize profits of the platform or achieve the maximum social welfare. The following research efforts have been accomplished by or ongoing in the presenter's team: (1) On-demand ride services platform and government regulation policy optimization via coordinating supply and demand; (2) Urban road network-wide performance evaluation by exploring real-world emerging ridesourcing order data extracted from DiDi's platform; (3) Learn on-demand ridesplitting behavior; and (4) Demand/supply/traffic forecasting. Those research initiatives help decision makers better understand the emerging on-demand ride services.

Optimal Pricing and Quality Risk Strategy of Bike-sharing Firm When Facing Delay-sensitive Customers

Yujing Chen, Dong Wang
Guangdong University of Finance

We consider a stylized model in which a monopolistic bike-sharing firm intends to lease to customers with heterogeneous delay-sensitive preferences. In our model, we define quality risk as the possibility of product misfit/defect with the consumers' perception. Bike-sharing firm can reduce the quality risk by raising the quality cost to meet an optimal revenue. Taking social

welfare and environment impact into account, government consider to pay subsidy to improving the quality risk. We find that when the quality cost is relatively low, further increase of subsidy on mitigating the quality risk may not necessarily benefit social welfare and environment impact.

Keywords: Bike-sharing; Delay-sensitive customer; Quality risk; Social welfare; Environment impact

The Logic of Matching in Ride Sharing Markets: Revenues, Service Ratings or Pick-up Times?

Hai Wang
Singapore Management University
Wang Chi Cheung, Guodong Lyu, Chung Piaw Teo
National University of Singapore

We study a class of multi-period multi-objective online optimization problems, where a decision maker takes actions over time in an online fashion without being informed of future scenarios. To balance the trade-offs between different objectives, we develop an efficient online policy to derive the compromise solution, which minimizes the p-distance from the Session Submission for the 10th POMS-HK International Conference 4 SMU Classification: Restricted attained KPIs to the utopia target. Furthermore, we show that the online policy induces a randomized solution to a related class of stochastic single period multi-objective problems. We apply the online policy in ride sharing market settings, and provide an online matching policy that simultaneously incorporates driver service scores, pick-up distances and passenger revenues. Extensive numerical simulations based on real ride sharing records reveal the benefits of the policy: (1) drivers with higher service scores are dispatched with more orders; (2) passengers are more likely to be matched to drivers with higher service scores, and passengers with higher revenues (longer travel distances) are served with higher answer rates; (3) the platform obtains a higher revenue and better long-term brand reputation. Compared to legacy policies currently in use, such as the weighted average policy or the closest distance policy, we observe that all parties in the ridesharing eco-system, from drivers, passengers, to the platform, are better off under our proposed online matching policy.

Session 6G: Revenue Management in Emerging Marketplaces
Chair: Jiannan Ke (Shanghai Jiao Tong University)

Sun 15:30-17:00
Room 6-209

Dynamic Two-Sided Markets: Dealership and Marketplace

Pin Gao, Ningyuan Chen, Guillermo Gallego
Hong Kong University of Science and Technology
Steven Kou
Boston University

We provide dynamic frameworks for two most popular business modes in two-sided markets. 1) In a dealership market, the intermediary sets dynamic bid and ask prices and maintains a proper inventory level. 2) In a marketplace, the platform charges commission fees to facilitate the direct matching of buyers and sellers, without keeping any inventory itself. We explore structural properties of the two business models. Though different, we demonstrate that in a thick market with many sellers and buyers, the two models are equivalent in terms of the optimal revenue and pricing/commission policy.

Keywords: two-sided markets, dynamic pricing, Markov perfect equilibrium

Optimal Forecast Disclosure in Ride-Sharing Platforms

Hao Sun
Tsinghua University
Peng Shi
University of Southern California

Ride-sharing platforms have much access to data to form accurate forecasts about demand. We study how much of this information to disclose to drivers. Using a stylized model, we find that if the objective is to maximize profit, then the platform may want to partially hide the forecast in order to maximize driver participation. Even if the objective is to maximize driver welfare, the platform may still want to hide the forecast. We give examples in which hiding the forecast is simultaneously optimal for both platform profit and driver welfare. However, these incentives for hiding the forecast disappear if the platform can set wages dynamically based on the forecast.

Keywords: forecast disclosure; Bayesian persuasion; ride-sharing platforms; dynamic pricing

On Reformulations of Approximate Linear Programs for Network Revenue Management

Jiannan Ke, Huan Zheng
Shanghai Jiao Tong University
Dan Zhang
University of Colorado

Approximate linear programming is a popular method to approximately solve dynamic programs that suffer from the curse of dimensionality. However, approximate linear programs (ALPs) still pose considerable computational challenge due to the large number of variables or constraints. Recently, Vossen and Zhang (2015) show that several ALPs for the network revenue management problem can be dramatically reduced in size. Their proof relates the ALPs to the Danzig-Wolfe decomposition of appropriate linear programs that are much smaller in size. In this paper, we give an alternative proof based on reformulations of constraints in the ALPs and duality arguments.

Keywords: approximate linear programs, network revenue management, duality

Pricing and Capacity Utilization Strategies: Implications for Manufacturers with Product Sharing

James B.Dai, Yu Nu,
Wuhan University

Recently, emerging sharing modes like Uber of consumer-to-consumer sharing, Mobike of business-to-consumer sharing, have greatly affected traditional manufacturers. In this paper, considering exogenous sharing price and marginal production cost, we examine the pricing and capacity utilization strategies for manufacturers under three sharing modes. We find that the optimal retail price increases in the marginal production cost but decreases in the sharing price, regardless of what the sharing mode is. Furthermore, when the sharing price is low, although both consumer-to-consumer sharing and business-to-consumer sharing will increase the total usage level, only manufacturers with high-cost products prefer to enter sharing market.

Keywords: product sharing, sharing modes, pricing, capacity constraint

Session 6H: Online Marketing Strategy under E-commerce
Chair: Miao Zhaowei, Lan Yongquan (Xiamen University)

Sun 15:30-17:00
Room 6-211

Optimal Online Advertising Portfolio under Cost Constraint

Li Miao, Lan Yongquan
Xiamen University

Today, online advertisement expenditure becomes one of the most important investment of the e-tailer. The portfolio of traffic ads, content ads and/or promotion ads is usually adopted by the e-tailer. We study advertising strategies of a retailer under some cost constraints by comparing the benefits of different advertising portfolios. It turns out that the ads budget determines the number and type of the best ads portfolio, and the optimal advertising strategy can bring the e-tailer greatest benefit.

Keywords: Online Advertising Portfolio, Traffic ads, Content ads, Promotion, Cost Constraint

Conditional Coupon Design in the Online Shopping Carnival: A Perspective of the E-Commerce Platform

Yang Xingyi, Lan Yongquan
Xiamen University

We investigate how the e-platform sets the threshold and the discounted amount of the coupon. We establish a multi-objective function for the platform, including the profit, the sales volume and the externality effects. We learn how the platform will optimally set its coupon threshold and related discounted amount. Our research provides advices on how platform enterprise can set the amount of the coupon in the conditional promotions.

Keywords: Coupon, Online Shopping Carnival, Externality

Seller's Pricing Discrimination Strategies under Adoption of Online Big Data Technology

Wen Pingping, Miao Zhaowei
Xiamen University

With the rapid development of big data technology, a seller is able to identify its targeted customers precisely and fully. Therefore, the seller can take pricing discrimination strategies when facing heterogeneous customers. In this paper, we use a two-stage game model to learn and compare the seller's four types of pricing strategies: uniform pricing, binary differential pricing, individual discrimination pricing and individual discrimination pricing with fairness concerns. Besides, we also investigate consumer surplus and social welfare in these four scenarios.

Keywords: Pricing Discrimination, Bid Data, Heterogeneous Customers, Fairness

Manufacturer's Product Design and Pricing Differentiation Strategies when Selling in Different Channel

Shangguan Lili, Miao Zhaowei
Xiamen University

The differentiation strategy of product design and pricing in different channels has become one of the manufacturer's major concerns today. This paper studies how manufacturer develops effective product design strategies and pricing decisions for its owned dual-channel. We consider four situations of product and pricing differentiation: the same product with the same price, the same product with different prices, different (partially the same) products with the same price and different products with different prices. We solve and compare the above four cases, obtain the optimal strategies under different conditions and finally interpret related managerial insights

Keywords: Product Design, Pricing Differentiation, Channel

Session 6I: Inventory
Chair: Weixin Shang (Lingnan Univeristy)

Sun 15:30-17:00
Room 6-212

Sequential Capacity Allocation under Strategic Ordering

Kun Soo Park
Seoul National University
Bosung Kim
University of British Columbia
Sang Won Kim
Chinese University of Hong Kong
Seyed Iravani
Northwestern University

We consider an allocation of a firm's capacity to its retail branches. Each branch makes ordering decision independently by using private information about the local market condition. We focus on the situation where an allocation to a branch should be made without full information about orders from other branches who order later. To increase the individual profit, each manager of retail branch may inflate its orders. In this situation, we calculate the optimal allocation mechanisms of the firm. We also find that the allocation mechanisms with monetary transfer can achieve the optimal profit of the firm for all possible mechanisms.

Keywords: Sequential Allocation; Allocation Mechanism; Strategic Ordering; Profit Maximization;

Impact of Resource Pooling on Capacity Utilization of the Mechanical Resources in Government Sector

Ajay Kumar Tripathi, Pankaj Shrivastava
A.K.S. University

Government organization of Uttar Pradesh Public Works Department (India) traditionally segregate mechanical resources such as machineries, tools and plants etc. into centralized functional divisions such as Road divisions, Bridge divisions, Building divisions, Maintenance divisions, Mechanical divisions, Electrical and Mechanical divisions, National Highways divisions, P.M.G.S.Y. divisions, World Bank divisions etc. This organizational model is framed based on the fact of specific nature of jobs performed by a division with a view of higher quality of work and efficiency. These mechanical resources are dedicated to the divisions to which they are allocated and perform the jobs related to that division only irrespective of the fact whether the division have scope of work or not. This model is challenged by the fact that higher resource utilization and greater efficiency is achieved when resources are centralized and could perform the jobs related to any division as and when the work is required. This paper examines work load characteristics of divisions to study the favorable conditions for centralization and decentralization of resources from resource utilization point of view.

Keywords: Mechanical resources in government organizations, Resource pooling, Capacity utilization.

Comparative study on the replenishment mode of vending machine in the new retail format

Qingsong Li, Yu Cao, Hanli Hu
Central South University

With the upgrading of consumption and the increase of personalized demand, the new retail format has gradually become the mainstream of Chinese retail industry. In this paper, we explore the vending machine under the new retail format multi-item joint replenishment strategy, considering two replenishment models: replenishment by stock quantity and replenishment by sales amount. The former refers to the replenishment when the vending machine product quantities are under a certain threshold; the latter refers to the replenishment when the product sales amount reaches a certain threshold. And we compare the optimal replenishment time and the optimal replenishment quantities of two different replenishment modes under determined demand and stochastic demand. The research shows that the optimal decision under the two replenishment modes has no significant difference with that under the determined demand. In the case of stochastic demand, when the shortage cost is greater than a critical value, it is better to replenish the goods according to the sales amount. When the shortage cost is small, the choice of replenishment strategy is influenced by the cost of inventory and the type of product. In addition, replenishment quantity threshold and amount threshold are also important factors influencing the optimal decision.

Keywords: new retail; vending machine; stochastic demand; replenishment strategy

Optimal Inventory Control and Design Refresh Selection in Managing Part Obsolescence

Zhenyang Shi
Shanghai Jiao Tong University
Shaoxuan Liu
Ningbo Supply Chain Innovation Institute China

We study the joint part inventory and product design refresh decisions for a manufacturer facing part obsolescence problem. Product design refresh, and inventory control approaches such as last time buy, are studied as two major strategies in obsolescence resolution. We formulate an optimal stopping model with additional decisions to investigate when product redesign should be initiated and how part procurement and inventory should be managed, during product life cycle

after obsolescence. We show the optimality of a threshold policy for redesign choice and well-structured policies including a target interval policy for inventory control.

Keywords: Part obsolescence, Last-time buy, Design refresh, Inventory management, Optimal stopping

Incentive-Driven Bilateral Transshipment in Inventory Competition

Weixin Shang
Lingnan University
Qi Fu
University of Macau

We construct a two-stage game model to examine the transshipment and inventory decisions in overlapping markets with both customer switching and transshipment. We find that there could be no transshipment, partial transshipment, or full transshipment, and obtain the conditions under which a unique equilibrium of order quantities exists. We show that transshipment may intensify or mitigate inventory competition and that there can exist a real incentive for competing firms to transship to others cooperatively. We show the existence of coordinating transshipment prices under which the transshipment and inventory decisions of the competing firms mimic those of the centralized optimal decisions.

Session 6J: Service Operations V

Sun 15:30-17:00

Chair: Xin Zhang (City University of Hong Kong)

Room 6-213

Small Firm R&D Collaboration and Project Success: Disentangling Effects of Research Institution Contributions, Project Domain Diversity, and Formal IP Experience

Mengyang Pan
Southwestern University of Finance and Economics
Aravind Chadrakaran
The Ohio State University

Small firms often rely on research institutions (RIs) for research and development (R&D) efforts. We examine how RI contribution level influences the relationship between domain diversity and project success. We further examine how formal IP experience moderates these relationships. Our analyses suggest formal IP experience has a negative effect for projects with a low RI contribution level. But the effect is insignificant for projects with a high RI contribution level. This key difference offers insights on the opportunistic behavior among small firm scientists depending on the nature of collaboration.

Keywords: Innovation, Small Firms, Collaboration

Profit or Market Thickness? Order Allocation Mechanisms with a Hybrid Workforce

Eryn (Juan) He, Joel Goh
National University of Singapore

This paper considers how the traditional firm-employee business model company collaborates with its subsidiary on-demand platform to meet its stochastic demand, especially when it comes to holidays. The firm determines daily quantities of orders transferred to the platform, which needs to balance a trade-off: in a long-term basis (measured by months), there will be enough active freelancers on the platform to meet the workforce requirement. On the other hand, freelancers' pool size should be regulated to maximize the profit in a short-term basis (measured by hours/days) due to the dynamic wage mechanism of on-demand platform. We use dynamic programming to address this trade-off in finite-horizon case, which is also verified by the data from one pair of Vietnam delivery firm and platform.

Keywords: On-demand platform, innovative business models, dynamic order allocation

The Rhythm of Co-creation in the New Service Development Process

Fengjie Pan
The University of Manchester
Rohit Verma
Cornell University

As the business environment is becoming more competitive, co-creation has been recognized as an effective approach to develop new services or products. Nevertheless, co-creation remains underdeveloped. Therefore, the aim of this paper is to investigate how to co-create and when to co-create with a process perspective by integrating the element of timing in the theory-building process. The research involved multiple case studies methodology, with twenty-five companies from the top 100 creative advertising agencies and forty-five elite interviews conducted. This paper demonstrates that the rhythm of co-creation in the new service development process follows a 'W-shaped' curve pattern.

Keywords: Rhythm, co-creation, W-shaped curve pattern, new service development process

A Mixed Reality Platform for Enhancing Jewellery Businesses

Vincent Cheng, S.H. Choi, H. H. Cheung
The University of Hong Kong

E-commerce and on-line shopping affect the sales of a brick-and-mortar jewellery store. Therefore, this paper proposes a mixed reality (MR) platform to provide interactive services to customers for enhancing their shopping experience and satisfaction. The MR platform has an augmented reality (AR) application developed using an AR development tool, called as Lens Studio, that allows each customer to experience a virtual jewellery try on using either a in-store display panel, or an individual smart phone. This paper would address the application design, architecture, and functions and its implementation issues. In a conclusion, this project may improve retailers' operations and customer loyalty, and hence the profit margin.

Keywords: Mixed Reality, Augmented Reality, Mobile Application, Virtual Try On

Servicizing for the Environment? The Use of Data-centric Service Models

Xin Zhang, Wei Thoo Yue
City University of Hong Kong
Xialong Guo, Yugang Yu
University of Science and Technology of China China

Fueled by new technologies such as the Internet of Things (IoT), big data analytics and cloud computing, the practice of servicization has changed considerably in recent years. Using a two-period game-theoretic model, we scrutinize the economic and environmental performance of two business models: 1) the product model under which products are sold at a fixed price and 2) the servicization model under which consumers are charged a pay-per-use price. Our analysis details the win-win outcome under both product and service models.

Keywords: service improvement capability, environmental impact, network effect

Session 6K: Service Operations VI
Chair: Jianzhong Du (City University of Hong Kong)

Sun 15:30-17:00
Room 6-214

Product Recall Delay & Product Cycle

Wenzheng Mao, Zhanyu Dong, Hsiao-Hui Lee
University of Hong Kong

When a safety defect occurs, manufacturers often use product recalls to mitigate potential consequences. Our empirical observation on large recalls in the automobile industry suggests that the timing of a recall is a key decision, as we find that only recalls made in an early stage of a product cycle significantly influence future product sales. Motivated by this observation, we study the optimal recall timing for a profit-maximizing manufacturer by endogenizing a product's life cycle into our model. Specifically, firms need to make a trade-off between future product sales loss due to a recall and the penalty and costs for a delayed recall. When a product defect is discovered at an early stage of the product cycle, we find that a firm may strategically delay the recall timing to mitigate the negative shock evoked by this recall. However, the delay duration (i.e., the time from when a defect is identified to the recall time) depends on the margin of the product as well as the penalty with respect to recall delays. For a high margin product (with respect to unit recall costs), firms should always delay such recall decisions; however, for a low margin product, such delay decisions are not always optimal. Finally, we use an empirical analysis to confirm the extent to which a properly delayed recall on firm sales is effective. Our findings provide governments and regulation parties with new directions for deploying their investigation efforts to avoid overdue recalls, thereby reducing potential casualties associated with recall delays.

Quality Regulation on Two-Sided Platforms: Exclusion, Subsidy, and First-party Applications

Gaoyan Lyu, Peng Huang, Yi Xu
Peking University

Managing the quality of complementary applications is vital to the success of a two-sided platform. While prior research has focused solely on the policy of exclusion based on a quality threshold, we develop a model in which quality preference is incorporated into the indirect network effect, and compare three quality regulation mechanisms: excluding low quality complementors, providing a fixed amount of subsidy to high quality complementors, and producing high quality, first-party applications by the platform itself. Our analyses reveal that the widely adopted exclusion policy is a special case of quality subsidy policy, and it does not always benefit the platform. In contrast, both quality subsidy and first-party application strategies make the platform owner better off, with greater profits, higher average quality, larger network sizes and higher entry fees levied on both sides of the market. In addition, the tradeoff between quality subsidy and first-party applications strategies depends on the development cost of first-party applications, as well as the fraction of high quality developers. Interestingly, we show that strategies aimed at increasing application variety and those aimed at improving application quality need not be in conflict with one another. We discuss the managerial implications.

Staffing and Work Assignment under Different Information Scenarios in Sharing Economy Platforms

Shengya Hua, Jingchen Liu, Xin Zhai
Peking University

We study the optimal operational decisions of a two-level on-demand platform, which are characterized by the staffing quantities for two types of servers and the assignment policy between them, to minimize the staffing, service failure, and customer waiting costs. We also explore how different levels of information transparency on the complexity of customer requests impact the optimal operational decisions of the platform. Such platforms can often be observed nowadays, particularly in the industries facing the imbalanced allocation of resources due to enormous demand and limited supply, such as medical and manufacturing industries. We construct a stylized model in which the platform is operated as a two-level service system, with each type of servers regarded as an M/M/N queueing system. We derive the optimal operational decisions for the platform under different levels of information transparency. Additionally, we prove the platform's optimal operational decisions are robust by extending our base model to incorporate heterogeneous service rates and endogenize the service quality decision. The information structures we consider in this study are common in different service systems in practice. Our findings provide useful managerial insights for managers in dealing with staffing and workload assignment problems in different industries.

Optimal Design of Waitlist in Public Housing Allocation

Wenwei Wang, Qi Qi, Rachel Q. Zhang
The Hong Kong University of Science and Technology
Changjun Wang
Beijing University of Technology

Waitlist is the most commonly used mechanism for public resource allocation, like public housing and organ transplantation. Motivated by this allocation system, we study the waitlist mechanism with any number of deferral chances. Under a Markov Decision Process model, we investigate the optimal strategy for each agent in the system and characterize the equilibrium state of the system. Then we focus on measuring the performance of the waitlist mechanisms with varying number of deferral chances, concerning four evaluating metrics: idle waiting time, match value, match distribution and social welfare. Some monotonicity properties for these metrics are theoretically proved. We also conduct numerical experiments to investigate how idle waiting time and social welfare are affected by model parameters. Finally, we make a case study on Hong Kong public housing system and find that setting the deferral number to be 5 instead of currently used number 2 can make a significant improvement in performance, meeting the government's targeting idle waiting time and increasing the social welfare by 10%.

Rate-Optimal Ranking and Selection for Personalized Decision Making

Jianzhong Du, Siyang Gao

City University of Hong Kong

The ranking and selection (R&S) problem seeks to efficiently select the best simulated system design among a finite number of alternatives. It is a well-established problem in simulation-based optimization, and has wide applications in the production, service and operation management. In this research, we consider R&S in the presence of context (also known as the covariates, side information or auxiliary information in the literature), where the context corresponds to some input information to the simulation model and can influence the performance of each design. This is a new and emerging problem in personalized decision making. The goal is to determine the best allocation of the simulation budget among various contexts and designs so as to efficiently identify the best design for all the contexts that might possibly appear. We call it contextual ranking and selection (CR&S). We utilize the OCBA approach in the literature of R&S, and solve the problem by developing appropriate objective measures, identifying the rate-optimal selection rule and analyzing the convergence of the selection algorithm. The high efficiency of the proposed algorithm is tested via a number of selection examples. In particular, we apply our algorithm to two real-world service problems (assemble-to-order problem and personalized cancer treatment) and show the superiority of the algorithm in solving these problems and obtaining real-time decisions.

Session 6L: Supply Chain Management II

Sun 15:30-17:00

Chair: Miao Song (Hong Kong Polytechnic University), Yongzhen Li (Jinan University) Room 7-207

Product Bundling in Distribution Channels under Warm-glow Effect

Mingjun Li, Jie Wu, Xiang Ji
University of Science and Technology of China

Non-economic factors should be paid careful attention to when making business decisions. In this paper, we mainly focus on warm-glow effect, which is commonly observed in crowdfunding. We study a manufacturer's optimal decisions on product bundling when the manufacturer sells through either a centralized channel or a decentralized channel. We show that, for a vertically integrated seller, it may have more incentives to use bundling in crowdfunding than in regular selling. This effect can be enlarged by less quality asymmetry. We also show that retailer's crowdfunding for its private-label product plays a critical role in driving the manufacturer's bundling.

Keywords: Warm-glow Effect; Product Bundling; Distribution Channel

Financing the Supplier under Spectral Risk Measure: Buyer Lending vs. Bank Lending

Chaocheng Gu, Yanhai Li, Xuan Jiang
Jinan University

We consider a supply chain where the manufacturer purchases from a capital-constrained supplier and may offer buyer lending. We present a game-theoretical model to capture the interactions between the firms, where the manufacturer is a risk-neutral leader and the supplier is a follower whose risk preference is reflected by a risk spectrum. We show that the manufacturer should charge the supplier an interest rate equal to the risk-free rate. The manufacturer always obtains higher profit in buyer lending than in bank lending. This result preserves in the presence of bankruptcy cost. The effects of the supplier's risk preferences are examined.

Keywords: supply chain management; buyer lending; capital constraint; spectral risk measure; bankruptcy cost

A Branch-and-Price Algorithm for Facility Location with General Facility Cost Functions

Wenjun Ni, Jia Shu, Dachuan Xu, Kaike Zhang
Southeast University
Miao Song
Hong Kong Polytechnic University

Most existing facility location models assume that the facility cost is concave or submodular. Many practical considerations, however, motivate us to study a new location model that considers general nonlinear costs of operating facilities. We first formulate this general model as a set-partitioning model and then propose a branch-and-price approach. Although the corresponding pricing model is NP-hard, we analyze its structural properties and design an algorithm to solve it efficiently. The numerical results obtained from two implementation examples demonstrate the effectiveness of the solution approach, reveal the managerial implications, and validate the importance to study the general framework.

Keywords: Branch-and-Price; Combinatorial Optimization; Facility Location; Integrated Supply Chain

Inventory Hedging against Demand and Production Time Uncertainties

Yongzhen Li
Jinan University
Miao Song
Hong Kong Polytechnic University

This paper considers the production, inventory, and transportation decisions under the restrictions of capacities and production precedence for a multi-item production-distribution network with uncertain demand and production time. We use inventory to hedge against the uncertainties and derive bounds on the hedging inventory through robust optimization approaches, which yield equivalent MILP reformulations and conservative approximations for the robust models. The computational complexity and total unimodularity are analyzed accordingly. Through computational experiments with a real data set, we demonstrate the benefits of our robust approach in addressing demand and production time uncertainties.

Keywords: Integrated production and distribution, Uncertain demand and production time, Robust optimization, Mixed integer linear programming, Total unimodularity