

The 12th POMS-HK Chapter International Conference
Beyond All Limits: The Future of POM Research

8-9 January 2022



Venue: Lingnan University, Tuen Mun, Hong Kong

Conference Program

8 January 2022, Saturday

08:25 – 11:20 **Opening Ceremony**
<https://lingnan.zoom.us/j/93371807704?pwd=L0VzWWx4emxGbGJkbVJRWHp4bTRsdz09>
Zoom Meeting ID: 933 7180 7704 Passcode: 78273654

08:25 – 08:40 **Welcome Remarks**



Prof Max Z J Shen
Vice-President and Pro-Vice-Chancellor (Research)
Chair Professor in Logistics and Supply Chain Management
The University of Hong Kong



Prof Mingming Leng
General Chair, Conference Committee of 2022 POMS-HK Conference
Dean of Faculty of Business and Professor of Computing and Decision Sciences
Lingnan University, Hong Kong

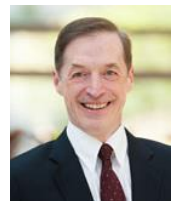
08:40 – 09:40 **Keynote Speech I**



“Analytics for Tackling Covid-19”
Prof Georgia Perakis
Editor-in-Chief, Manufacturing & Service Operations Management
William F. Pounds Professor of Management
Professor, Operations Management and Operations Research and Statistics
MIT Sloan School of Management

09:40 – 10:20 **Break**

10:20 – 11:20 **Keynote Speech II**



“Lessons from the COVID-19 Pandemic for Production and Operations Management”
Professor John Birge
Editor-in-Chief, Operations Research
Hobart W. Williams Distinguished Service Professor of Operations Management
The University of Chicago Booth School of Business

13:00 – 14:30 **Concurrent Session 1 & Career Fair**

Session 1A: Data-driven Operations Management
<https://lingnan.zoom.us/j/6273466341?pwd=eC8vcUwzU2RCUVFuc3BMMTYwaUdsdz09>
Zoom Meeting ID: 627 346 6341 Passcode: 87419712
Session Chair: Zuneera Umair, Hong Kong Shue Yan University

Designing a System for Data-driven Risk Assessment of Solar Projects

Abstract: Solar energy is the fastest growing source of renewable energy worldwide. Solar energy projects have a projected lifetime of over 25 years and while the returns are attractive, investors rarely oversee the risks that impact their Return on Investment (ROI) over the operational term. In the wake of increasingly fiercer competition among PV module manufacturers, quality often takes a backseat. Under-performing solar energy projects are common. In this project, we propose a data analytics solution for de-risking and operations management of utility scale solar energy projects. This system provides project stakeholders insight into risks they are exposed to. The system is calibrated using data gathered by Sinovoltaics Group, a leading solar quality assurance company, with 10+ years of data on solar projects.

Data-driven Inventory Control with Nonperishable Items using Sample Average Approximation
*Yufei Zhao**, Xiangyu Gao

Abstract: We consider the online learning setting of the classic periodic-review inventory system with nonperishable items. The demand is not known *a priori* and need to be learned over time. We study the performance of an online learning algorithm using the sample average approximation (SAA) approach. We prove that the cumulative regret is $O(\log T)$ with the minimal separation assumption and $O(\sqrt{T})$ without the assumption.

Credit Rating Prediction Through Supply Chains: A Machine Learning Approach
*Zhaocheng Zhang**, Jing Wu, Sean Xiang Zhou

Abstract: As supply chain channels physical, financial, and information flows as well as associated risks, a firm's supply chain information should be helpful in understanding and predicting its credit risks. Credit ratings as an approximate but important measure of corporate credit risks have been widely used by investors, creditors, and supply chain partners in their decision-making. This paper studies the role of supply chain information in predicting companies' credit ratings. Using firm-level supplier-customer linkages and corporate credit rating data, we develop a machine learning framework with gradient boosted decision tree to examine whether and what supply chain features can significantly improve the prediction accuracy of credit ratings, and what types of supply chain links have higher information content that positively affects the predictability of the supply chain features. We construct a firm's supply chain variables from its supplier and customer portfolios to be used in the machine learning models. We show that incorporating supply chain features can improve prediction accuracy over the benchmark credit rating model using only the focal firm's features. Moreover, the informativeness of supply chain links in focal credit risk prediction depends on the focal firm's industry sector, the relationship strength of such links, and the switching costs. Finally, we develop a focal credit rating prediction model with a high accuracy level using supply chain factors solely, which can potentially be applied to predict credit risks of small and medium-sized enterprises (SMEs) and private firms with no public financial information, as long as their supply chain information is available.

IoT for Smart Mobility: Hong Kong Perspective
*Chun-Hung Cheng**

Session 1B: Supply Chain Management (I)

<https://lingnan.zoom.us/j/4784011965?pwd=L1dYMVNlb3FsMjZ5MVVpWTl6UkZ1dz09>

Zoom Meeting ID: 478 401 1965 Passcode: 20864862

Session Chair: Tianqi Song, City University of Hong Kong

Managing Panic Buying with Bayesian Persuasion
*Tianqi Song**, Biying Shou, Pengfei Guo

Abstract: Information provision by a retailer to its customers plays a vital role in influencing the market demand. In this paper, we study the structure of the signaling mechanism in the supply chain under supply disruption risk. The better-informed retailer can send persuasive signals to influence the customers' purchase decisions. We first apply the Bayesian persuasion framework in this context and derive the analytical solution by the geometric method. Our results show that the signaling mechanism can alleviate the panic buying in the market and offer more flexibility to the retailers on inventory decisions.

Impact of Disruption on Supply Chain Network: Network Structure and Disruption Location
*Yixin Zhu**, Hongfan Chen, Sean Xiang Zhou

Abstract: Disruption occurs increasingly often to supply chains nowadays. We consider supply chain networks with three tiers, each tier consisting of two firms. Each firm decides its order quantity from the upstream suppliers, and the lowest tier firms sell to the market. One of the firms in the network is susceptible to disruption risk. With both complete or incomplete network, we analyze and compare the impact of disruption to the network and individual firms when the unreliable firm is located in different positions of the network.

Replenishment of Emergency Supplies using Dedicated and Pooled Systems

*Fang Liu**, Linqiu Li, Arvind Sainathan, Fan Wang

Abstract: Governments usually store a certain amount of emergency supplies at local relief suppliers. Motivated by a real life example, we consider a relief supplier who jointly manages emergency supplies along with regular inventory. The government's request may occur only after certain periods from the previous request and it must be fulfilled after a certain lead time. Nonetheless, the regular demand occurs every period and it can be backlogged. The supplier either separately stocks the emergency supplies and regular inventory in different warehouses, i.e., dedicated system (DS), or jointly manages them in one warehouse, i.e., pooled system (PS). We characterize the structure of the optimal policies for managing the emergency supplies and regular inventory under the two systems. Under both DS and PS, the optimal replenishment policy for the emergency supplies is to reserve the least amount of emergency supplies without affecting the fulfillment of the government's request. The optimal production policy under both systems is a produce-up-to policy characterized by a sequence of optimal thresholds.

If the supplier can replenish all the emergency supplies within the lead time, then DS and PS generate the same optimal thresholds and expected cost. Otherwise, PS results in lower optimal thresholds and expected cost than DS. Our results can provide guidance to the supplier on which system to choose.

Resource Allocation in Correlated Competitions

*Jiahao He**, Jiheng Zhang, Rachel Q. Zhang

Abstract: Consider multiple competitors engaging in multiple competitions, each with some attributes and a reward to the winner or winners if there is a tie. Since the competitions may share certain attributes, a costly effort to improve an attribute may have different effects on a competitor's winning chances in multiple competitions, i.e., the competitions may be correlated. Furthermore, such impacts may vary for different competitors due to their abilities in the attributes. We first define the competitor-specific correlation of the competitions and model a competitor's problem as finding a resource allocation to all the attributes that maximizes her expected total reward from all competitions, given other competitors' decisions. We then characterize a symmetric equilibrium decision with two competitions and homogeneous competitors, which can be extended to multiple pair-wise positively or negatively correlated competitions, and asymmetric equilibrium decisions for some special cases with two types of competitors.

Session 1C: Healthcare Operations Management

<https://lingnan.zoom.us/j/3425399745?pwd=YjFNZ1pNT0xiMEJ3UGJpYW5Dek1PZz09>

Zoom Meeting ID: 342 539 9745 Passcode: 05542651

Session Chair: *Shrutivandana Sharma*, Singapore University of Technology and Design

Reducing Non-urgent Visits and Emergency Department Congestion: Perception Improvement and Pricing
*Shrutivandana Sharma**, Ying Xu, Manu Kumar Gupta, Costas Courcoubetis

Abstract: A major reason behind crowding in emergency departments (EDs) is non-urgent patients' visits to ED. In this paper we study how patients' imperfect perception of their urgency and self-interested choice affect non-urgent ED visits and social cost. We then investigate how perception-improvement measures and economic incentives influence patients' choice, social cost, and profit of the healthcare network. We model patients' problem of choosing between an expensive/congested ED and general practitioners (GPs), who refer urgent patients to the ED, as a queueing game. We analytically characterize equilibrium and socially optimum patient flows, and find that improving patients' perceptions may increase non-urgent ED visits and social cost under certain equilibria. We identify sufficient conditions on ED/GP fees, service costs and waiting time externalities under which this happens. We further show that perception-improvement guarantees to reduce the social cost if socially optimum flows are induced at equilibrium. Motivated by a real case, we design a novel differential pricing "GP-r" mechanism (incorporating GP-referral discount) to induce optimum patient flows at equilibrium, and analyze its properties/benefits. We derive all results for general ED waiting times that are increasing and convex in arrival rates, which makes our results applicable to a wide variety of ED queueing systems. Our

results imply that perception-improvement measures, implemented alone, may not always prove beneficial, unless they have high accuracy. This limitation can be overcome by deploying them together with economic incentives that can induce optimum patient flows. In terms of economic incentives, the proposed GP-r mechanism provides a benefit of lowering the ED fee required to induce optimum flows, compared to a traditional pricing mechanism that only raises ED fee. This benefit can be achieved without extra budget investment in the healthcare network, and is most prominent when status quo ED fee is not too large compared to GP fee, but the resources/congestion at ED are much costlier compared to GP.

Real-Time Patient Transfer under Ambulance Offload Delay

*Wenqian Xing**, Cheng Hua

Vaccine Appointment Scheduling: The Second Dose Challenge

*Sarah Yini Gao**, Chaitanya Bandi, Rajeeva Moorthy, Chung-Piaw Teo, Kim-Chuan Toh

Abstract: The COVID-19 vaccination program faces great challenges, especially due to the feature of a two-dose regimen of most COVID-19 vaccines. The need to reserve vaccines for the second-dose appointment may "block" the take-up rate for the first-dose appointment. In this paper, we use the concept of "booking curve" to develop a practical optimization tool that jointly determines the vaccine appointment booking limits, and an invitation schedule. The optimization problems can be efficiently solved by linear and conic programs. A numerical study based on the Singapore vaccination program is presented to demonstrate the novelty and advantage of the framework.

Share or Hide Emergency Department Queue-lengths to Reduce Congestion?

*Shrutivandana Sharma**, Yufeng Zhang, Costas Courcoubetis

Session 1D: Information Design and Incentive Management

<https://lingnan.zoom.us/j/8149429990?pwd=Q2RML2JkaTd5OE16SlgraDF0QnJvdz09>

Zoom Meeting ID: 814 942 9990 Passcode: 33130298

Session Chair: Feng Tian, The University of Hong Kong

Dynamic Moral Hazard with Adverse Selection - A Pontryagin Approach

*Feng Tian**, Feifan Zhang, Peng Sun, Izak Duenyas

Abstract: We study the optimal incentive scheme for a long-term project with both moral hazard and adverse selection. The agent's effort, which increases the arrival rate of a Poisson process, is not observable by the principal. In addition, the agent's effort cost is also the agent's private information. The principal needs to design the optimal menu of contracts, each of which is chosen by the agent with a specific effort cost. We fully characterize the optimal menu in the case of two types of agents and then explore the more general case with continuous types of agents.

Impact of Self-Service Technology in Designing a Service Delivery System

*Jie Wang**, Lijun Ma, Weili Xue, Yong-Hong Kuo

Abstract: Self-service technologies have been widely adopted in those industries involving delivering physical products by services, in which consumers evaluate the product both from the product value and the service value. A typical service delivery system usually involves sales agents or self-service technology, e.g., online service or kiosks, to serve consumers by a co-production process, i.e., both the sales agent (or self-service machine) and the consumers should exert efforts with corresponding service costs. By modeling the co-production output with a Cobb-Douglas (CD) function, we establish a three-sided principle-agent model to study the value of self-service technology in designing a service delivery system when the sales agent's service cost is private information. We first characterize the main tradeoff between the sales agent and the self-service machine when the firm provides only one service. Then, we analyze the value of the self-service machine when the firm can provide both services. Interestingly, we find that the firm may possibly provide both services, i.e., the sales agent and the self-service machine, when the information asymmetry level is high and the self-service machine's service cost is mediate. Moreover, when both services are offered, only the efficient sales agent will be contracted and the inefficient sales agent are screened out of market by the self-service machine, i.e., the self-service machine can help the firm to eliminate the information rent. We also investigate how the firm's service weight in the coproduction process and information asymmetry influence the consumer surplus, the firm's choices, the contract parameters, and the corresponding profits.

Optimal Stockist Selection and Contract Design: Evidence from Supply Chain in Indian
*Yu Long**, Wei Jiang, Jussi Keppo, Omkar Palsule-Desai

Abstract: We derive a unified two-period model, incorporating bandit selection, Bayesian learning, contract theory, and structural estimation, to investigate (i) how does a firm select stockist and design the incentive contract in an optimal way facing asymmetric information and opportunity cost of learning, and (ii) how does a stockist operate optimally facing career concern, competition and switching cost. Using data gathered from India, we are able to calibrate the model and to interpret firm and stockists' features and behavior in emerging market where the level of mistrust is high, learning and contract switching are costly, and competitions is intense.

The Economics of Bestsellers: Consumer Search, Sales Ranking, and Social Learning
*Wentao Lu**, Man Yu

Abstract: Motivated by major e-commerce platforms' diverse practices in bestseller information provision, we examine consumers' learning, searching, and purchasing behavior under uncertainty about products' values. We find that a bestseller list constitutes a noisy signal whose informativeness is determined by the granularity of the bestseller information. Our results suggest that the platform may withhold some information at the cost of consumers.

Session 1E: Best Student Paper Competition (I)

<https://lingnan.zoom.us/j/8165270329?pwd=bzBILytDWjJyOVNjWitxcvtCNWRvUT09>

Zoom Meeting ID: 816 527 0329 Passcode: 66678425

Session Chair: Zhipeng Liang, The Hong Kong University of Science and Technology

Generalized Linear Bandits with Local Differential Privacy
*Zhipeng Liang**, Jiheng Zhang, Yang Wang

Abstract: Contextual bandit algorithms are useful in personalized online decision-making. However, many applications such as personalized medicine and online advertising require the utilization of individual-specific information for effective learning, while user's data should remain private from the server due to privacy concerns. This motivates the introduction of local differential privacy (LDP), a stringent notion in privacy, to contextual bandits. In this paper, we design LDP algorithms for stochastic generalized linear bandits to achieve the same regret bound as in non-privacy settings. Our main idea is to develop a stochastic gradient-based estimator and update mechanism to ensure LDP. We then exploit the flexibility of stochastic gradient descent (SGD), whose theoretical guarantee for bandit problems is rarely explored, in dealing with generalized linear bandits. We also develop an estimator and update mechanism based on Ordinary Least Square (OLS) for linear bandits. Finally, we conduct experiments with both simulation and real-world datasets to demonstrate the consistently superb performance of our algorithms under LDP constraints with reasonably small parameters (ϵ, δ) to ensure strong privacy protection.

Managing Retail Inventory and Pricing in the Presence of Stochastic Purchase Returns
*Alys Jiaxin Liang**, Stefanus Jasin, Joline Uichanco

Abstract: In US alone, returns cost retailers a total of hundreds of billions of dollars each year in the last few years. Also known as the “ticking time bomb” or the “trillion-dollar problem” in the industry, the ever-increasing rates of returns, especially for online sales, have prompted many businesses to take a closer look at how to properly manage their operations in anticipation of purchase returns. The responds vary. While some retailers charge extra delivery costs, others increase their prices to cover the cost of returns, and some even implement “returnless refund” where customers are given full refund but told to keep the item. It is generally accepted in the industry that although some returns can potentially be reduced, others are inevitable and often considered as the necessary cost of doing business. Motivated by the high rates of returns and their likely persistence in the foreseeable future, in this paper, we consider a single warehouse/store joint inventory and pricing problem in the presence of stochastic purchase returns. New orders can be placed periodically and each new order will arrive a few periods later. A purchase made in a period can be returned at a later period for a full refund. Once returned, the product will be inspected to see whether it can be re-stocked for resale. Unsatisfied demand is lost. A key feature of our model is that we allow a general stationary (random) return time distribution. This problem is very challenging to solve optimally since we need to keep track not only the new orders placed in the past and but also potentially the return status of every single purchase. We propose an

easy-to-implement joint inventory and pricing policy and show that it is near optimal in the setting with a large annual market size, which is a practically relevant setting for many product categories.

Emergency Care Access vs. Quality: Uncovering Hidden Consequences of Fast-Track Routing Decisions
*Shuai Hao**, Zhankun Sun, Yuqian Xu

Career Fair

<https://voovmeeting.com/s/kOgHkeJ5gdGV>

VooV Meeting ID: 189-053-384

14:30 – 15:00 **Break**

15:00 – 16:30 Concurrent Session 2 & Career Fair

Session 2A: Empirical Research in Operations Management

<https://lingnan.zoom.us/j/6273466341?pwd=eC8vcUwzU2RCUVFuc3BMMTYwaUdsdz09>

Zoom Meeting ID: 627 346 6341 Passcode: 87419712

Session Chair: Jing Wu & Zi'ang Wang, The Chinese University of Hong Kong

Do Financial Innovations Affect IT Investment?

*Ziyi Wang**, Ruiqi Liu, Jimmy Yong Jin, Xin Xu

Abstract: Using a US market sample, we empirically examine the causal relationship between financial innovation, proxied by Credit Default Swap (CDS), and firm level IT investments. The initiation of CDS trading changes the lender-borrower relationship and further enhances the underlying firms' debt capabilities. In presence of CDS, the lenders have higher risk tolerance level. Consequently, the underlying firms are willing to pursue more in IT investments, which can be risky. The effects are more pronounced in firms that rely more on debt financing and IT under-investment industries. Our findings are robust and have important implications for research and practice.

Local Opioid Abuse and Corporate Innovation

*Chang Shi**, Chong Chen, Tao Yuan

Abstract: This paper examines the impact of the local opioid epidemic on corporate innovation. We find that firms located in a county with a higher death rate caused by opioid overdose are less innovative, measured by their patenting activities. To establish causality, we employ the state implementation of Prescription Drug Monitoring Programs as a quasi-natural experiment and an instrumental variable approach. Further analysis suggests that opioid abuse hurts firm innovation via a labor channel: opioid abuse negatively affects the number of a firm's inventors as well as their productivity.

Labor Coordination and Division: Human Capital Investment in Supply Chains

*Zi'ang Wang**, Ling Cen, Michael Hertzels, Jing Wu

Abstract: We document the coordination of recruiting activity by supply-chain partners consistent with relationship-specific investment in human capital. We find that recruitment by dependent suppliers caters to the needs of their major customers. In addition, using detailed job descriptions and skill requirements, we find that supply chain partners similarly recruit common, labor-intensive, and general skills positions together, while pursuing labor division for positions of specialized, technology-intensive occupations needing specialized skills.

Session 2B: Production and Inventory Management

<https://lingnan.zoom.us/j/4784011965?pwd=L1dYMVNlb3FsMjZ5MVVpWTl6UkZ1dz09>

Zoom Meeting ID: 478 401 1965 Passcode: 20864862

Session Chair: Jin Yao, The University of Hong Kong

How Does Risk Hedging Impact Operations? Insights from a Price-setting Newsvendor Model

*Jin Yao**, Liao Wang, Xiaowei Zhang

Abstract: Financial asset price movement impacts product demand, and thus influences the pricing and production decisions of a firm. We develop and solve a general model that integrates pricing, production, and financial risk hedging decisions for firms of newsvendor type. We find that in general, the presence of hedging

reduces the optimal price; it also reduces the optimal service level when the asset price positively impacts the product demand (“asset price benefits demand”), while it may increase the optimal service level by a small margin when the impact is negative (“asset price hurts demand”). We construct the mean-variance efficient frontier that characterizes the risk-return trade-off and quantify the risk reduction achieved by the hedging decision. Our numerical case study using real data of Ford Motor Company shows that the markdowns in pricing and service levels are small under our model, and the hedging decision can substantially reduce risk without materially decreasing operational profit.

Managing Hybrid Manufacturing/ Remanufacturing Inventory Systems with Random Production Capacities
*Suting Liu**, Xiting Gong

Abstract: In this paper, we study hybrid manufacturing/remanufacturing inventory systems that produce a single product to satisfy random demands over a finite planning horizon. In each period, the firm receives random demand and random product returns. A serviceable product can be manufactured from raw materials or remanufactured from a returned product. Both operations face random capacities modeled as positively dependent random variables. The firm’s objective is to minimize the expected total discounted cost over the planning horizon. We partially characterize the firm’s optimal policy for the general model and completely characterize it for the models with deterministic manufacturing or remanufacturing capacity, by two increasing functions with slopes at most one. For the special case with unlimited manufacturing capacity, we further characterize the optimal policy and obtain additional insights. In particular, we connect this model with an auxiliary dual-sourcing inventory model and show that they have the same optimal policy under certain conditions. Finally, we conduct a numerical study to derive further insights into the effects of random capacities. Among others, we find that ignoring randomness of the manufacturing capacity often incurs significant cost to the firm while the cost of ignoring capacity correlation is negligible.

Sampling-Based Approximation for Series Inventory Systems
*Zhanyue Wang**, Kairen Zhang, Xiangyu Gao, Sean Xiang Zhou

Abstract: We consider inventory management of an infinite-horizon, series system with multiple stages and unknown demand distribution. Each stage orders from its upstream stage and incurs inventory holding cost while the most downstream stage faces random demand and incurs inventory holding and demand backlogging cost. Lead times between stages are constants. The objective is to minimize the expected total discounted cost over the planning horizon. We apply the sample average approximation (SAA) method and study the performance of the resulting solution under the empirical distribution function constructed from a demand sample (of the underlying demand distribution). We derive the sample size bound (i.e., distribution-free bound) required to guarantee the performance of the SAA solution be arbitrarily close (i.e., with arbitrarily small relative error) to the optimal policy, which has full information about the demand distribution. This result is obtained by first deriving a decomposable and tight cost upper bound of the whole system that depends on the (given) echelon base-stock levels and then showing the cost difference between the SAA and optimal solutions can be measured by the distance between empirical and real demand distribution functions. Furthermore, when the one-period demand distribution function is absolutely continuous and has an increasing failure rate (IFR), we derive a tighter sample size bound (i.e., distribution-dependent bound) that guarantees the same performance of the SAA solutions. A special case of this result for the newsvendor problem generalizes the existing result by Levi et al. (2015). In addition, both the distribution-free and the distribution-dependent bounds increase polynomially as the number of stages increases. Finally, our numerical study corroborates the theoretical results.

Primal-dual Algorithm for Online Integrated Production and Transportation Problem in a Make-to-order Environment
*Yuejuan Zhu**, Zhixue Liu, Feng Li

Abstract: In this paper, we study an online make-to-order problem with period-dependent costs. The manufacturer receives orders from customers and is responsible for producing and transporting products. The orders from the customers arrive in an online manner. The manufacturer needs to determine an integrated schedule of production and transportation under the situation where the quantity of future orders, the cost structure of the later periods are not known, such that the total cost of production, inventory, waiting, transportation is minimized. We analyze this problem by utilizing linear programming relaxation and dual theory, and propose a primal-dual algorithm.

Vehicle Rebalancing in the Shared Micromobility System with Crowdsourcing Relocation Riders

*Ding Zou**, Kai Pan, Yulan Wang, Zuo-Jun Max Shen

Abstract: Shared micromobility vehicles (e.g., bikes, e-bikes, e-scooters, and e-mopeds) provide people the eco-friendly form of short-distance travel, help alleviate city congestion, and achieve a more sustainable urban transportation system. Vehicle rebalancing across service regions (i.e., vehicle relocation) is a key operational issue in the shared micromobility vehicle system. In this paper, we consider that a micromobility service provider can crowdsource individual riders to conduct vehicle relocation with reward incentives and outsource relocation to a third-party logistics provider (3PL). The former performs vehicle relocation continuously while the latter runs the relocation periodically on a given schedule. We construct a time-space network with multiple regions and formulate a two-stage stochastic programming model incorporating demand uncertainty. The first stage concerns the upfront vehicle allocation across service regions, while the second stage concerns vehicle operation across the time horizon. We develop an efficient solution algorithm to solve the model with real-world data in large-scale instances. We find that rider crowdsourcing is a more efficient way to mitigate the vehicle supply-demand mismatch than 3PL outsourcing. These two methods implemented together can further reduce the demand loss and hence show a complementary relationship. In this case, 3PL relocates the majority of vehicles due to a lower average cost. When crowdsourcing is adopted (together with 3PL outsourcing), interestingly, as its budget increases, the two relocation means are first complements and then substitutes. We find crowdsourcing can relocate more vehicles when the demand exhibits a unimodal pattern than a bimodal pattern, while the reverse holds for the 3PL outsourcing.

Capacity Sharing for Bicycle-Sharing Firms Under Demand Uncertainty

*Ziliang Jin**, Kai Pan, Zuo-Jun Max Shen, Wenxin Xu

Abstract: The prosperously developing bicycle-sharing industry brings significant operational challenges to both bicycle-sharing firms and regulators. Firms are struggling to survive under high operating expenses and low-profit margins, while regulators are striving to balance situations where there are too many shared bicycles on roads and maintain the benefits of the bicycle-sharing service to citizens. To address those challenges, we propose an innovative capacity-sharing agreement between bicycle-sharing firms, under which a firm can share its spare capacity for a fee with the other firm when they are competing in the same market. We employ stochastic programming models to examine the effectiveness of this sharing scheme. We numerically characterize the firms' strategies in equilibrium, and we show that the scheme could bring about cost reductions to firms and alleviate traffic congestion. Moreover, we find that consumers' preferences towards firms considerably affect firms' decisions on capacity development, daily operations, and profits and further affect the benefits of the capacity-sharing scheme. In particular, when the two firms have similarly sized loyal consumer segments, the benefits of the capacity-sharing scheme fade. Our results provide not only a practical operational plan for bicycle-sharing firms but also suggestions to regulators.

Data-Driven Chance-Constrained Planning for Distributed Energy Generation

*Shiyi Jiang**, Jianqiang Cheng, Boshi Yang, Feng Qiu, Kai Pan

Abstract: With high penetration of distributed generation resources (e.g., renewable generators, dispatchable distributed units, and energy storage), the power grid transitions from a centralized paradigm to a decentralized one, promising low energy losses, reliable power delivery, and high environmental friendliness. To enable the success of such transition, the grid operator is facing significant challenges in properly allocating emerging renewable distributed generation and energy storage units to meet governments' regulations on clean energy while satisfying local demands under uncertainty. This paper proposes a novel data-driven chance-constrained model for optimal allocation planning by considering multiple periods. To support practical use in industry, we propose two sampling techniques to reformulate the proposed chance-constrained model: the standard sample average approximation (SAA) method and a new partial sample average approximation (PSAA) method, both leading to tractable formulations. In the PSAA method, we introduce additional continuous variables to reformulate the model (compared to using binary variables in SAA) and further apply a non-parametric estimation method to approximate the cumulative distribution function of a random variable, leading to an efficient data-driven approach. Finally, we perform extensive numerical experiments to compare the performance of the SAA and PSAA formulations. We observe that the latter outperforms the former in terms

of both solution time and quality. We also conduct experiments to show the significant benefits of energy storage in stabilizing power delivery and reducing operational costs.

A General Matching Function of Ride-sourcing Markets
*Jintao Ke**, Xinwei Li, Hai Yang, Hai Wang

Abstract: This paper presents a general matching function to delineate the on-demand matching process in ride-sourcing markets under different matching mechanisms with different matching time intervals and matching radius. The matching function characterizes a stationary matching equilibrium for the ride-sourcing market in which passengers can be matched in consecutive batches, and drivers are in either an idle, pick-up, or delivery state. The function well approximates the expected driver idle time and the expected passenger matching time and pick-up time under different supply-demand conditions and platform matching strategies. The general function also unifies several prevailing inductive and deductive matching functions developed in the literature and demonstrates their specific application scope.

Session 2D: Analytics and Optimization

<https://lingnan.zoom.us/j/8149429990?pwd=Q2RML2JkaTd5OE16SlgraDF0QnJvdz09>

Zoom Meeting ID: 814 942 9990 Passcode: 33130298

Session Chair: *Yi Xiong, The Chinese University of Hong Kong*

Debiasing Samples from Online Learning Using Bootstrap
*Yi Xiong**, Ningyuan Chen, Xuefeng Gao

Abstract: It has been recently shown in the literature that the sample averages from online learning experiments are biased when used to estimate the mean reward. To correct the bias, off-policy evaluation methods, including importance sampling and doubly robust estimators, typically calculate the conditional propensity score, which is ill-defined for non-randomized policies such as UCB. This paper provides a procedure to debias the samples using bootstrap, which doesn't require the knowledge of the reward distribution and can be applied to any adaptive policies. Numerical experiments demonstrate the effective bias reduction for samples generated by popular multi-armed bandit algorithms such as Explore-Then-Commit (ETC), UCB, Thompson sampling (TS) and Epsilon-greedy (EG). We analyze and provide theoretical justifications for the procedure under the ETC algorithm, including the asymptotic convergence of the bias decay rate in the real and bootstrap worlds.

Consumer Choice Models and Estimation: A Review and Extension
*Mengying Xue**, Qi Feng, J. George Shanthikumar

Abstract: Choice models are widely applied in psychology, economics, transportation, marketing, and operations studies. An operational data analytics (ODA) framework is presented to estimate the general consumer choice model using data. This framework, generalizing the existing estimation methods for specific structural models, strikes a delicate balance between the (likely imprecise) structural knowledge and the data. This is achieved by articulating the domain of validation through extending the structural knowledge and by formulating the data-integration model based on the associated structural properties. We demonstrate the implementation of the ODA framework to identify the appropriate consumer choice models. The ODA estimate outperforms the existing parametric and nonparametric methods, particularly over the choice sets that are not covered in the data.

Screening with Limited Information: The Minimax Theorem and A Geometric Approach
*Ruiqin Wang**, Zhi Chen, Zhenyu Hu

Abstract: A seller seeks a selling mechanism to maximize the worst-case revenue obtained from a buyer whose valuation distribution lies in a certain ambiguity set. For a generic convex ambiguity set, we show via the minimax theorem that strong duality holds between the problem of finding the optimal robust mechanism and a minimax pricing problem where the adversary first chooses a worst-case distribution and then the seller decides the best posted price mechanism. This observation connects prior literature that separately studies the primal (robust mechanism design) and problems related to the dual (e.g., robust pricing, buyer-optimal pricing and personalized pricing). We provide a geometric approach to analytically solving the minimax pricing problem (and the robust pricing problem) for several important ambiguity sets such as the ones with mean and various dispersion measures, and with the Wasserstein metric. The solutions are then used to construct the optimal robust mechanism and to compare with the solutions to the robust pricing problem.

Sublinear Regret for Learning POMDPs
*Yi Xiong**, Xuefeng Gao, Ningyuan Chen, Xiang Zhou

Abstract: We study the model-based undiscounted reinforcement learning for partially observable Markov decision processes (POMDPs). The oracle we consider is the optimal policy of the POMDP with a known environment in terms of the average reward over an infinite horizon. We propose a learning algorithm for this problem, building on spectral method-of-moments estimations for hidden Markov models, the belief error control in POMDPs and upper-confidence-bound methods for online learning. We establish a regret bound of $O(T^{2/3}\sqrt{\log T})$ for the proposed learning algorithm where T is the learning horizon. This is, to the best of our knowledge, the first algorithm achieving sublinear regret with respect to our oracle for learning general POMDPs.

Session 2E: Best Student Paper Competitions (II)

<https://lingnan.zoom.us/j/8165270329?pwd=bzBILytDWjJyQVNjWitxcytCNWRvUT09>

Zoom Meeting ID: 816 527 0329 Passcode: 66678425

Session Chair: Xingyu Fu, The Hong Kong University of Science and Technology

When Should the Regulator Allow/ Prohibit Inter-Temporal Transfer of Emission Permits?

*Xingyu Fu**, Ying-Ju Chen, Guillermo Gallego, Pin Gao, Mengqian Lu

Abstract: Emission permits are widely adopted to combat climate change and regulatory authorities sometimes allow for the inter-temporal banking and borrowing of emission permits so that firms can flexibly respond to market uncertainties. We find that such time flexibility may lead to poor social performance, especially when the production cost fluctuation is sufficiently large. This result is failed to be captured by the classic simplified assumption where firms can not sub-exercise emission permits. Furthermore, we demonstrate that the inter-temporal permits transfer should be prohibited when the market is at the red ocean stage or when the pollutant generates relatively instant damage. Lastly, we analyze some restricted permits transfer policies such as transfer discount and transfer cap, which are shown to dominate both the taxation and the non-transferable permits in terms of social welfare.

Innovative Business Models in Ocean-Bound Plastic Recycling

*Zhuoluo Zhang**, Opher Baron, Gonzalo Romero, Sean Xiang Zhou

Abstract: About 30 million tons of plastic waste, or 10% of the world's annual plastic production, reaches the oceans each year, most from developing coastal countries. We study novel business models that leverage new technologies to address this pressing global problem. Firms aim at profitably recycling plastic to reduce ocean pollution while positively impacting local communities. These firms sell (a) plastic offsets and (b) segregated plastic. We introduce and analyze a supply chain model of a firm adopting (a) or (b) or both. We find that (a) or (b) can generate larger environmental and social impacts and profitability depending on their market sizes. When the firm adopts both, it attains a more significant environmental impact, gives a higher income to the collectors while enjoying a higher profit than under (a) or (b) alone. However, the largest collectors' share of the local supply chain profit is attained by (b) only. Moreover, if the sales volume of segregated plastic is small, the largest social impact may be attained by (a). We use empirical data to calibrate our model, numerically illustrate our main results, and unveil additional insights. We find that if the organization aims at maximizing a combination of its profit and the total recycled plastic volume rather than profit only, it can generate much larger environmental and social impacts with a slight reduction in its profit. Our model and results provide theoretical support and insights into some of the new initiatives for tackling global ocean plastic pollution.

Optimizing Initial Screening for Colorectal Cancer Detection with Adherence Behavior

*Ruijie Zhang**, Yan He, Yini Gao, Zhichao Zheng

Abstract: Two-stage screening programs are widely adopted for early colorectal cancer (CRC) detection. Individuals receiving positive outcomes in the first-stage (initial) test are recommended to undergo a second-stage test (colonoscopy) for further diagnosis. We study the initial test design—i.e., selecting cutoffs to report test outcomes—to balance the trade-off between screening effectiveness (i.e., cancer detection) and efficiency (i.e., colonoscopy costs), considering that not all individuals adhere to the guidelines to follow up with a colonoscopy after receiving positive outcomes. We integrate the Bayesian persuasion framework with information avoidance to model the problem. We show that under certain conditions, using a single cutoff in the initial test is optimal for follow-up maximization, and a continuous test (i.e., showing exact readings of the

biomarker) is optimal for effectiveness maximization. We apply the framework to Singapore's CRC screening design and calibrate the model using various sources of data, including a nationwide survey in Singapore. Our results suggest that compared with the current practice, increasing the cutoff to the level that maximizes expected follow-ups by cancer patients can detect 969 more CRC incidences and prevent 37,820 colonoscopies. The current practice of using lower cutoffs to achieve high sensitivity can backfire and lead to excessive unnecessary colonoscopies and low adherence. Leveraging the interpretable clustering technique, we find that using a lower cutoff for males older than 60 and females older than 70 (high-risk and high-adherence groups) and a higher cutoff for the remaining screening population (low-risk and low-adherence groups) can further improve screening effectiveness and efficiency.

Asymmetric Information of Product Authenticity on C2C E-Commerce Platforms: How Can Inspection Services Help?

*Lingju Li**, Xin Fang, Yunfong Lim

Abstract: Problem definition: We consider a customer-to-customer (C2C) platform that provides an inspection service. Uncertain about his product's authenticity, a seller sells his product through the platform. Before purchasing, a buyer obtains a signal of the product authenticity from the product's price set by the seller. The platform's inspection service can detect a counterfeit with a probability. If the product passes the inspection, the platform sends it to the buyer and charges the seller a commission fee. Otherwise, the platform returns it to the seller and charges the seller a penalty fee.

Methodology/results: We develop a two-stage game-theoretical model. In the first stage, the platform designs a contract specifying the commission and penalty fees. In the second stage, the seller signals his product authenticity by setting a price and the buyer decides whether to purchase it. This results in a contract design problem that governs a signaling game. We find that the effect of inspection is beyond merely detecting counterfeits. The inspection, even an imperfect one, changes the signaling game's structure and incentivizes the seller who likely has an authentic product to sell through the platform. This can only be achieved by carefully choosing the commission and penalty fees. Interestingly, a higher platform's expected profit does not imply a higher price or commission fee in equilibrium. Under some mild conditions, the optimal commission increases but the optimal penalty decreases as the platform's inspection capability improves.

Managerial implications: The inspection service is not widely available among leading C2C platforms as it is considered imperfect and costly. Our study shows that its benefit may be underestimated in practice. Moreover, the inspection can eliminate the seller's information rent and generate more revenue for the platform. This paper provides guidance on how to set commission and penalty fees when the inspection service is provided.

Career Fair

<https://voovmeeting.com/s/kOgHkeJ5gdGV>

VooV Meeting ID: 189-053-384

16:45 – 17:00 Announcement of Best Student Paper Awards

<https://lingnan.zoom.us/j/99006530059?pwd=RGwvSzhCWmswYXhLV05aZnRnWm1sQT09>

Zoom Meeting ID: 990 0653 0059 Passcode: 15663583

9 January 2022, Sunday

09:00 – 10:30 Concurrent Session 3

Session 3A: Revenue Management and Pricing

<https://lingnan.zoom.us/j/6273466341?pwd=eC8vcUwzU2RCUVFuc3BMMTYwaUdsdz09>

Zoom Meeting ID: 627 346 6341 Passcode: 87419712

Session Chair: *Zhuoluo Zhang, The Chinese University of Hong Kong*

Dynamic Pricing under Trade-in Programs

*Zhuoluo Zhang**, Murray Lei, Sean Xiang Zhou

Abstract: We consider a firm who offers trade-in program that collects used products and resells refurbished products to the market. Bargainers sells their used products either for cash or for trade-in for upgrade and new customers purchases refurbished products. We propose near-optimal pricing policy and show the loss is $O(T^{\frac{1}{3}} \log^{\frac{1}{2}} T)$.

Prices vs. Quantities Revisited: Optimal Regulation under Market Uncertainty
*Guokai Li**, Pin Gao, Zizhuo Wang

Abstract: In this paper, we examine the ranking of two mainstream environmental regulations, price instruments and quantity instruments, in the presence of market uncertainty. We find that the expected social welfare of price instruments is comparatively higher only when the pollutant damage coefficient and the market volatility are both high or low. The results contrast with the classical prediction in Weitzman (1974) where the ranking only depends on the damage coefficient, and such difference is because we do not allow negative production but allow sub-exercise of emission cap, both of which are recommended in practice.

Approximation Algorithm for Bundling
*Mina M Irvani**, Guillermo Gallego, Masoud Talebian

Abstract: We propose an approximation algorithm for the bundle pricing problem that can take any feasible solution as a starting point. The algorithm alternates between pricing and bundle selection to reduce the gap with an upper bound. Our algorithm has significantly higher expected profits relative to the best bundle size pricing heuristic. We also consider the Shapley value of the products as a heuristic for component pricing. Based on the Shapley values, our algorithm provides a performance guarantee relative to the clairvoyant firm optimal solution.

Data-driven Robust Dual-Sourcing Inventory Management Under Purchase Price and Demand Uncertainties
*Xing Xiong**, Yanzi Li, Wenguo Yang, Huaxiao Shen

Abstract: We develop an actionable data-driven approach to a periodic-review dual-sourcing inventory management system in the presence of purchase price and demand uncertainties. The two supply sources differ in their lead times and prices due to, e.g., different transportation modes. We adopt robust optimization because the limited historical data is insufficient to construct meaningful distributions to characterize purchase price and demand fluctuations. Specifically, we build a robust rolling-horizon model and, in particular, the uncertainty sets, with data and business insights. Using a four-year data set from a real firm, we show that our approach can yield significant cost savings compared to the other popular methods. Our experiments echo the earlier theoretical finding that a firm may incur a lower total cost under a more volatile purchase price process. However, we find that under data-driven decision making, many counter-intuitive results may arise. For example, first, considering a longer planning horizon may backfire. Second, some feasible region-reducing business constraints such as limited inventory capacity may lead to unintended benefits. Third, dual sourcing may not dominate single sourcing. These findings are largely driven by the sampling error and our practically limited ability, as almost always, to characterize uncertainties. Our research therefore calls for prudence in extending theoretical insights to data-driven decision-making scenarios.

Cyclic Pricing with Waiting Customers and Population Dynamics
*Xiaoxiao Li**, Yimin Yu, Zheyi Li

Abstract: We consider a dynamic pricing problem in the presence of waiting customers and their population dynamics. The seller makes the pricing decision with a menu of prices at each period. Customers purchase if the current price is less than their willing-to-pay. The seller has the option to offer a clearance price to attract all waiting customers to purchase. We build a continuous-time model by exploiting the impulse control. We find that the optimal pricing strategy is a cyclic pricing policy and obtain the closed-form cyclic time with the two-price menu. For a multi-price menu, we show that the optimal policy is a cyclic pricing policy with increasing prices in each cycle.

Session 3B: Smart City Operations (II)

<https://lingnan.zoom.us/j/4784011965?pwd=L1dYMVNlb3FsMjZ5MVVpWTl6UkZ1dz09>

Zoom Meeting ID: 478 401 1965 Passcode: 20864862

Session Chair: Yihang Yang, City University of Hong Kong

Fleet Repositioning for Vehicle Sharing Systems: The Optimality of Balanced Myopic Policy
*Yihang Yang**, Yimin Yu, Qian Wang, Junming Liu

Abstract: We consider the fleet repositioning problem for a free-floating vehicle sharing system. The objective is to decide on the vehicle distribution dynamically in the network in order to maximize the long-run average

social welfare, i.e., to match the vehicle supply and travel demand at the least total cost of repositioning and lost sales. We formulate the problem as a Markov decision process by considering an ex ante vehicle distribution decision in each period. Interestingly, we show that a balanced myopic policy is optimal, i.e., it is optimal to maintain the vehicle distribution which best matches the vehicle supply and trip demand. We also extend our results to systems with seasonal demand. The optimality of the (generalized) balanced myopic policy overcomes the curse of dimensionality. Our results suggest a simple and effective solution procedure for fleet repositioning, and shed light on how to design effective heuristics. We also quantify the operational value of the balanced myopic policy through a case study of a real-world vehicle sharing system.

A Stable Matching Approach for Crowdsourcing Last-mile Delivery

*Nian Zhang**, Zhixue Liu, Feng Li, Zhou Xu

Abstract: This study investigates a crowdsourcing last-mile delivery problem considering orders with different destinations and time windows and crowdsourced drivers with different origins, destinations, and time windows. Each driver has a preference over groups of orders based on his profits and meanwhile each order has a preference over the drivers based on the drivers' arrival times at the distribution center. We propose an integer programming model and develop a greedy algorithm to find stable matchings for small-scale instances. For large-scale instances, we then develop a heuristic algorithm to find feasible assignments of orders to drivers.

Drone-assisted On-time Delivery in Urban Areas

*Wenqian Liu**, Lindong Liu, Xiangtong Qi

Abstract: In this paper, we propose a new operational model for adopting drones in urban logistics, where drones are employed to facilitate the current truck-based on-time delivery. Specifically, trucks are dispatched from a distribution center at a cutoff time, and drones are used later to transport late-ready packages to trucks en route for further delivery. We develop a time-expanded network flow model with side constraints, which is solvable for practical problems, and design a greedy algorithm to solve the problem in real-time. Managerial insights and guidance derived can be implemented in different scenarios, such as overnight shipping and online shopping.

Synchronizing Ramp Operations Vehicles of Airport Baggage Handling Services

*Yong Chen**, Gang Chen

Abstract: Assigning ground vehicles to baggage handling tasks is challenging and needs to consider service performance, resource input, and such synchronous constraints as task and operation. We formulate the problem as a multi-objective optimization model, which minimizes the quantity combination of vehicles while simultaneously meeting the baggage service requirements. Based on the baggage handling process, we design an effective heuristic algorithm. The results show that baggage service time is affected by the type of flight, aircraft body, stand and buffer time. Our experiments also show that the speed and load of electric tractors have a significant impact on flight delays.

Session 3C: Interface Between OM and Marketing/IS

<https://lingnan.zoom.us/j/3425399745?pwd=YjFNZ1pNT0xiMEJ3UGJpYW5Dek1PZz09>

Zoom Meeting ID: 342 539 9745 Passcode: 05542651

Session Chair: Junxue Zhang, The Hong Kong University of Science and Technology

Bundling Ancillary Services: Going Vertical or Horizontal?

*Junxue Zhang**, Chenguang Wu, Ying-Ju Chen

Abstract: Many firms provide ancillary services to support their main service. We study the optimal bundling strategies for a monopolist selling a main service with multiple ancillary services in markets where consumers have heterogeneous valuations for both the main and ancillary services. We study two dimensions of bundling these services, namely, a vertical dimension that bundles the main service with an ancillary service, and a horizontal dimension that bundles multiple ancillary services altogether, and both. We demonstrate how the optimal (un)bundling strategy varies with the market heterogeneity as well as the correlations between customers' valuations for ancillary services.

Simultaneous or Sequential? Retail Strategies of a New Product and an Extended Warranty

*Xiaolin Wang**

Abstract: This paper studies the retail strategies of a firm selling a new product and an extended warranty directly to end consumers. We aim at investigating the impact of consumer choice scenarios on the firm's optimal warranty/pricing decisions and profitability. We find that the firm can benefit from inducing a simultaneous consideration of the product and warranty; compared to its sequential counterpart, the simultaneous consumer choice scenario, at optimality, can attract more consumers to purchase the product-warranty bundle by setting a lower warranty price, and make more profit by charging a higher margin on the product.

Should a Sharing Platform Adopt the Bilateral Review System?

*Xuanqi Chen**, Gang Li, Shengli Li, Quan Zheng

Abstract: The sharing economy and platforms have gained popularity in recent years, raising concerns about demand-side information asymmetry: the cost to serve each buyer is typically unknown to sellers. To mitigate this concern, some platforms like Airbnb adopt the bilateral review system (BRS), where both buyers and sellers can rate each other, different from the traditional unilateral review system (URS). We examine the effect of different review systems on the operation of sharing platforms. We analyze a decentralized platform in which heterogeneous sellers with one-unit capacity set prices simultaneously and then get matched with buyers with different serving costs. We show that with URS, even when perfect seller information is provided, the high-quality sellers can still be driven out of the market, owing to buyer information asymmetry and the “co-production” nature of the serving cost, in contrast to adverse selection in the classic used-car market. Additionally, we identify the critical role of serving cost structure. Although BRS can alleviate the adverse selection problem with a convex cost function and benefits the platform, it is detrimental to the platform with a linear cost function. Interestingly, we find that providing buyer information could help buyers but hurt sellers. Moreover, BRS could lead to a win-win-win outcome for the platform, buyers, and sellers. Our results not only shed light on the review system design but also provide a plausible explanation for the business practice that BRS is widely used by sharing platforms like Airbnb and Fiverr.

Gaining Virtual or Real Value? Exploring the Impact of Virtual Reality Marketing Initiatives on Firm Value

*Yangchun Xiong**, Hugo K.S. Lam, Sahar Karimi

Abstract: Despite the increasing prevalence of VR marketing initiatives in various industries, the understanding of their influence on firm value remains elusive. To address this gap, this research adopts an event study method to quantify the impact of VR marketing initiatives on firm value. We gather a sample of 201 VR marketing initiatives announcements between 2010 and 2019 in the US market. Based on a perspective of technology readiness, we find that VR marketing initiatives have an immediate negative and significant effect on firm value. Moreover, such a negative effect is contingent on technology partnership, firm uncertainty and strategic emphasis.

Session 3D: Responsible Operations Management

<https://lingnan.zoom.us/j/8149429990?pwd=Q2RML2JkaTd5OE16SlgraDF0QnJvdz09>

Zoom Meeting ID: 814 942 9990 Passcode: 33130298

Session Chair: *Jiahui Zhou*, The Chinese University of Hong Kong

Combating Collusion in Responsible Sourcing

*Jiahui Zhou**, Shiqing Yao

Abstract: In this paper, we investigate a supply chain responsibility problem under supplier-auditor collusion risk and discuss various deterrence strategies. In particular, we consider a supply chain in which a buyer sources from a supplier, while an auditor takes the task of auditing the compliance of the supplier. We assume that side contracting is possible such that the auditor and the supplier may engage in a collusion if doing so is mutually profitable. We examine two counter measures to mitigate the collusion risk. One approach is to reaudit the supplier and the other is to adopt dual sourcing. We derive the equilibrium decisions of supply chain members with either approach in place and compare the effectiveness of the two approaches. Our analysis reveals that both approaches are able to deter the collusion and reduce the risk of unsalable products caused by sourcing violation. We also provide the optimal sourcing contract when the buyer faces a more practical but complex situation.

Corporate Social Responsibility in Supply Chain: Green or Greenwashing

*Yilin Shi**

Abstract: Perception regarding a focal firm's corporate social responsibility (CSR) depends not only on itself but also on its known suppliers. This paper provides the first empirical evidence linking CSR and supply chain information disclosure together. Specifically, it uncovers robust evidence that firms greenwash their CSR image via voluntarily disclosing environmentally responsible suppliers while concealing "bad" ones. Exogenous variations in abnormal temperatures around the world drive variations in the selective disclosure of "good" suppliers, supporting a causal interpretation of our finding. Supply chain greenwashing is more prevalent for firms who face higher competition, care more about their brand awareness, and for firms that are more profit-driven and held more by institutional investors. The greenwashing behavior mitigates after implementing mandatory CSR disclosure policies. Finally, firms who greenwash supply chains observe sales increase, but only for the short-term.

Quality Certificate in Responsible Sourcing under Collusion Risk
*Ruoxin Gao**, Shiqing Yao, Ruina Yang

Abstract: Supplier compliance in labor health, working conditions and ethics has become one of the most challenging issues to be solved for companies. Such a problem can be viewed as a process quality problem with respect to production process of products. In lax law enforcement regions, an unethical supplier may collude with an unethical auditor to pass the quality certification with lower production costs. Considering consumer rationality, we develop a game-theoretical model to study the effect of supplier-auditor collusion to a firm's responsible sourcing strategies. Our research provides support for supplier certification practices in responsible sourcing.

Strategic Communications with Socializing Agents under Unknown Public Health Threats
*Ailing Xu**, Qiaochu He, Ying Ju Chen

Abstract: In the context of the COVID-19 pandemic, we develop a cheap-talk framework, where the government makes sequential decisions on information disclosure about the pandemic state and the regulation policy. Moreover, we assume two kinds of agents (i.e., traditional agents and socializing agents) to capture different characteristics of the public due to social and cultural reasons. We find that the effectiveness of the government policy is refrained by the existence of socializing agents. The results provide a natural explanation to the difference in government regulations and the public response to the pandemic among various countries as well as policy insights.

Session 3E: Service Operations Management

<https://lingnan.zoom.us/j/8165270329?pwd=bzBILytDWjJyQVtJWitxcytCNWRvUT09>

Zoom Meeting ID: 816 527 0329 Passcode: 66678425

Session Chair: *Linggang Qi*, City University of Hong Kong

Discrete Choice and Competition in Service Markets with Price- and Delay-Sensitive Customers
*Linggang Qi**, Pang Zhan

Abstract: We consider a service market where capacitated service firms compete on prices and customers are both price- and delay-sensitive. Customers arrive at the market according to a Poisson process and their choices of providers are formulated as a discrete choice model. We first show that in such a system there exists a unique rational expectations equilibrium (REE). We next characterize the structural properties of the REE arrival rate functions and analyze the Nash equilibrium of price competition. We further investigate the explicit price-dependent logit model as an approximate model specification, and compare it to the REE model in a simulation study.

Optimal Routing to Parallel Servers in Heavy Traffic
*Heng-Qing Ye**

Abstract: We study a system with heterogeneous parallel servers, each with an infinite waiting room. Upon arrival, a job is routed to the queue of one of the servers. The objective is to minimize the expected stationary queue length. Under the heavy-traffic condition, we establish the diffusion limit for the round-robin policy (resp. arrival-chasing policy, service-chasing policy), and show that with properly chosen parameters, it achieves the optimal performance asymptotically within the class of admissible policies that require no state information (resp. require arrival history, service history).

Optimizing Queues When Customers Commit the Sunk Cost Fallacy

Abstract: We study a service system in which customers make a join-or-balk decision upon arrival and make a purchase-quantity decision when they are served. Empirical evidence shows that customers in this setting tend to consume more to amortize their sunk waiting costs. We model this sunk cost fallacy and study how it affects a firm's optimal operations strategies. We model the system using an unobservable M/M/1 queue. Customers form references of the waiting times and are influenced when making their purchasing decisions by the resulting reference effect of the average waiting cost per unit purchase. We characterize customers' decisions in equilibrium and analyze how the firm's sales and profit change with the service rate, the waiting environment (captured by the unit-time waiting cost), and the product price. We find that under certain conditions the firm's sales decrease as the service rate increases or as the unit-time waiting cost decreases because of alleviated sunk cost effect and lower per-capita sales. This implies that in the presence of customers' sunk cost fallacy the firm should carefully consider the managerial levers for improving service. Furthermore, we examine how the firm should optimally set prices to complement the sunk cost fallacy. We find that the rate at which the marginal consumption benefit diminishes determines whether a firm should price lower or higher in the presence of customers' sunk cost fallacy. Interestingly, our analysis shows that the sunk-cost effect can reduce deadweight losses caused by a firm's price markup. Social welfare increases with the sunk cost effect if the effect is small but decreases if the effect is large. Specifically, a social planner will refer a mild sunk-cost effect to no such effect, as the former helps to reduce deadweight losses in consumption; in contrast, a social planner will prefer no sunk-cost effect to a severe effect because the latter results in inefficient over-consumption.

10:30 – 11:00 **Break**

11:00 – 12:30 **Concurrent Session 4**

Session 4A: Supply Chain Management (II)

<https://lingnan.zoom.us/j/6273466341?pwd=eC8vcUwzU2RCUVFuc3BMMTYwaUdsdz09>

Zoom Meeting ID: 627 346 6341 **Passcode: 87419712**

Session Chair: Jie Peng, The Chinese University of Hong Kong

Financial Reporting Comparability and Foreign Supply Chain Relations

*Jie Peng**, Jing Wu, Xiangang Xin

Abstract: This study examines the impact of financial reporting comparability on U.S. firms' foreign supply chain relations. We find that U.S. firms have more foreign supply chain relations in one foreign country when their financial reporting is more comparable to the industry peers in that country. Further analysis based on exogenous changes in financial reporting comparability provides consistent evidence. The effect of financial reporting comparability on foreign supply chain relations is more pronounced when the information barrier is higher between U.S. and foreign countries. Lastly, we find that firms with more foreign supply chain relations exhibit lower COGS volatility and sales volatility.

Anticipatory Packing

*Tongwen Wu**, Yanzhi Li

Abstract: With the booming of e-commerce, fulfillment costs for online customer orders has been increasing as e-tail sales grows. Observing the unbalance on order arrivals or operational costs over time, we introduce an anticipatory approach to make prepackages in order to reduce packing cost for online orders and enhance delivery efficiency. Faced with up order uncertainty and the on learning order distribution, we propose a sample-average-approximation (SAA) approach to capture the co-occurrence of products. Next, we provide a comprehensive APX-hardness analysis for this SAA model and give nearly-optimal approximation algorithm. Finally, we demonstrate our superior performance on real-world data.

Drop-shipping Supply Chains with Return Option

*Jingwei Su**

Abstract: We consider drop-shipping supply chain operations under the supplier-retailer-consumer triad relationship structure, and incorporate sales return into drop-shipping research. To our knowledge, we are the first to figure out conditions under which a drop-shipping supply chain would not be formed in the first place. We also describe situations under which supplier does not profit from taking inventory risk in drop-shipping supply chain. There are two key generalizable contribution of this paper. We give academic explanation for high failure rate of drop-shipping supply chain from return option perspective. We also offer operational insight

for suppliers to implement different return policies in accordance with different customer preference and product characteristics.

Behavior-Based Pricing under Social Effect
*Yuanbing Miao**, Guang Xiao, Xiaomeng Guo

Session 4B: Empirical Research in Operations Management (II)

<https://lingnan.zoom.us/j/4784011965?pwd=L1dYMVNLb3FsMjZ5MVVpWTl6UkZ1dz09>

Zoom Meeting ID: 478 401 1965 Passcode: 20864862

Session Chair: Yu Xia, The University of Hong Kong

Vertical Integration and Resource Allocation: An Empirical Study in Chinese Movie Industry

*Yu Xia**, Hailiang Chen

Protagonists in Digital Transformation: The Impact of Chief Digital Officers on Firm Performance

*Minghao Zhu**, Hugo K.S. Lam, Feng Liu, Andy C.L. Yeung, T.C.E. Cheng

Quantifying Disruptive Innovation: From Management to Science

*Jiang Li**, Chunli Wei, Dongbo Shi

Abstract: In management science, disruptive innovation consolidates some components of prior arts while destroying other parts to break from main technological streams. This study attempts to improve the measurement of disruptive innovation in science by considering both destabilization and consolidation. The destabilization (research topic change) of a research article is measured by the "technological change" index proposed by Funk & Owen-Smith (2017) in Management Science. The consolidation of the article is measured by its citations. We creatively combine the two measures to reveal the destabilization and consolidation of prize-winning articles to shed light on the discussion of disruptive innovation in science.

The Bullwhip Effect in the Servitized Manufacturing Firms

*Yimeng Niu**, Jing Wu, Zhibin Jiang

Abstract: This research provides the first empirical evidence disclosing how manufacturers' services influence two within-firm issues related to the bullwhip effect: demand variability and demand distortion. Using difference-in-difference techniques, we find robust evidence that demand variability decreases after manufacturers provide services. By distinguishing between services that complement versus services that replace the purchase of a product, we uncover that demand distortion decreases when providing more substituting services. This suggests a two-step role of manufacturers' services: services first act as demand-smoothing tools for manufacturers, and then distortion-reduction tools. We also identify moderating channels for the demand-smoothing and distortion-reduction effects of manufactures' services.

Session 4C: Supply Chain Management (III)

<https://lingnan.zoom.us/j/3425399745?pwd=YjFNZ1pNT0xiMEJ3UGJpYW5Dek1PZz09>

Zoom Meeting ID: 342 539 9745 Passcode: 05542651

Session Chair: Shuhan Wang, The Hong Kong Polytechnic University

Does Safety Violation Propagate through Supply Chain?

*Shuhan Wang**, Di Fan, Chris K.Y. Lo, Frank Wiengarten

Abstract: Literature has investigated propagation effects among supply chain partners in terms of information flow, financial risk, etc. It is unclear whether socially irresponsible behaviors can propagate. Sampling U.S. listed firms and their tier 1 and 2 suppliers, we developed a dataset of 367,850 triads and conducted a regression analysis with the safety violation data collected from OSHA. Results show that the firm's irresponsible behavior (measured as safety violations and the penalties) positively associates with their suppliers' irresponsible behaviors. This propagation effect is also found from suppliers to the firms. We discussed implications for supply chain management and sustainable operations.

Impacts of Recurrent SDMs on Global Supply Chain Configuration for New Products: A Study on Electric Vehicles during the COVID-19 Pandemic

*Yiji Cai**, Shuyi Wang, George Q. Huang

Abstract: Governments prevent the spread of recurrent COVID-19 by introducing social distancing measures (SDMs). We establish a multi-period supply chain configuration model incorporating changes in production

capacity, market potential, propagation effect of new products, processing time and cost with SDMs' implementation. We find that during new products' life cycle, early SDMs significantly lead to low profits and suppliers switching due to limited capacity and higher processing cost, while late SDMs reduce profits mildly because of unsatisfied demands. Compared with non-cooperation SDMs, international cooperation results in demand fluctuation and higher inventory but the early cooperation could increase profits and production output.

Cross-channel Cooperation of Ecological Chain Products in an Entrepreneurship and Innovation Platform

*Zerong Lyu**, Zhaofu Hong

An Integrated Location-Inventory Model for a Slow-Moving Product with Customer Waiting Time Consideration

*Jie Chu**, Fe Fan, Kai Huang

Abstract: We develop a two-stage stochastic facility location model integrated with inventory and transportation decisions for a large retail chain with slow-moving items. The uncertainty, in terms of customer demands and their waiting time limits, is expressed by a discrete and finite set of scenarios. To solve the proposed two-stage model, we improve the dual heuristic procedure of Louveaux and Peeters (1992) and integrate it with the Sample Average Approximation (SAA) method. The preliminary computational results show that the proposed SAA heuristic can be quite effective and efficient compared with the standard SAA.

Session 4D: Interface Between OM and Finance

<https://lingnan.zoom.us/j/8149429990?pwd=Q2RML2JkaTd5OE16SlgraDF0QnJvdz09>

Zoom Meeting ID: 814 942 9990 Passcode: 33130298

Session Chair: *Zepeng Chen, The Hong Kong Polytechnic University*

Crowdfunding or Bank Financing: Innovation with the Threat of Downstream Imitation and Market Uncertainty
*Zepeng Chen**, Xiaomeng Guo, Guang Xiao, Fasheng Xu

Abstract: This paper studies a firm's optimal funding choice when financing an innovation project with potential downstream imitation and market uncertainty. The firm could run a crowdfunding campaign, but releasing product's information may result in downstream imitation and create competition in retail market. On the other hand, the firm could adopt traditional bank financing strategy, which reduces the risk from imitation but induces additional financing costs due to market uncertainty. Adopting a game theoretical model, we fully derive the firm's optimal funding choices, and characterize how such choices are affected by various factors, including market uncertainty, imitator's efficiency, etc.

The Financial Impact of Manufacturing Repurposing during the COVID-19 Pandemic

*Hugo Lam**

Abstract: Many firms have repurposed their facilities to manufacture personal protective equipment and medical devices during the COVID-19 pandemic, but it is unclear whether firms can benefit from their manufacturing repurposing initiatives financially. Our research addresses this question by employing the event study methodology to quantify the financial impact of manufacturing repurposing. We further analyze how the financial impact of manufacturing repurposing varies across firms with different levels of operational capabilities and slack resources.

Capacity Co-opetition of Make-to-order Firms

*Hua Xiao**, Min Gong, Zhaotong Lian

Session 4E: Online Marketplace & Platform Operations

<https://lingnan.zoom.us/j/8165270329?pwd=bzBILytDWjJyQVNJWitxcytCNWRvUT09>

Zoom Meeting ID: 816 527 0329 Passcode: 66678425

Session Chair: *Venus Hiu Ling Lo, City University of Hong Kong*

Omnichannel Assortment Optimization with Two-Stage Decisions

*Venus Hiu Ling Lo**

Abstract: Suppose an omnichannel retailer operates a physical store and an online store. A customer may visit both stores before completing her purchase. She arrives to the physical store to buy her favourite product, and she purchases it and leaves if it is available. Otherwise, she examines the in-store assortment before proceeding online. Her preferences for the online products depend on the assortment that she examined in-store. Computing

assortments which maximize expected revenue over both stages and channels is NP-hard. I present a fully polynomial-time approximation scheme by introducing a staircase strategy, and discuss insights into assortment structures via numerical experiments.

Competition between Online and Offline Channels with Negative Social Interactions

*Xue Zhao**, Xiaomeng Guo, Guang Xiao

Abstract: We consider price competition between a brick-and-mortar channel and an online channel, with the former suffering from negative social network effect (NSNE). That is, consumers incur a stronger negative utility when the brick-and-mortar store is filled with more shoppers, due to congestion and/or social distancing. We study the impacts of NSNE on two channels' pricing decisions and profit performance. We find that, in a competitive market, NSNE leads to higher prices and benefits both channels, although it directly lowers demand for the brick-and-mortar channel. As NSNE gets stronger, two channels no longer compete, where NSNE would result in different impacts.

Optimal Pricing and Return Policy and the Value of Freight Insurance for a Retailer Facing Heterogeneous Consumers with Uncertain Product Values

*Jiixin Lin**, Juliang Zhang, T.C.E. Cheng

Abstract: We study the optimal pricing and return policy, and the value of freight insurance for a retailer selling a product to heterogeneous consumers with uncertain values of the product. For the case with no return freight cost, we find that the optimal sale price and refund depend on the heterogeneity of consumers and the proportion of high-value consumers. When consumer heterogeneity is relatively high and the proportion of high-value consumers is very high, the retailer should not adopt the return policy; otherwise, the retailer should adopt it. For the case with a positive return freight cost, the retailer has to set a higher refund or a lower price, hurting its profit. When consumer heterogeneity is relatively high and the proportion of high-value consumers is very high, the optimal price is unchanged, but the optimal refund increases. In other situations, the retailer needs to reduce the price or increase the refund to attract consumers. Further considering the case where the retailer provides return freight insurance for the consumers, we find that whether freight insurance benefits the retailer depends on the unit insurance premium and the return freight cost.

To Keep Price Consistency or Not: Multi-Channel Retailing with Consumers' Fairness Concern

*Yumeng Li**, Xiaomeng Guo, Guang Xiao, Wenxin Xu

Abstract: Multi-channel retailing is appealing as it offers an opportunity to reach more consumers, yet retailers need to take caution when determining the selling prices for the same product sold across different channels, especially when the market is filled with some consumers who exhibit inequity aversion and incur disutility if the channel they buy from charges a higher retail price than the other channel. In this paper, we propose a stylized game-theoretic model to investigate a multi-channel retailer's optimal pricing strategy in the presence of consumers' fairness concerns regarding inconsistent prices across channels. We investigate the impact of consumers' fairness concerns on the firm's pricing strategy, profitability, and consumers' surplus. Among other results, we find that the multi-channel retailer should maintain consistent price across both channels only when the fraction of fair-minded consumers is in an intermediate range, and otherwise charging inconsistent channel prices is more profitable. Particularly, as more consumers exhibit fairness concerns, the retailer may even switch from consistent pricing strategy to inconsistent pricing strategy. Moreover, as the fraction of fairness-concerned consumers increases, the retailer may enjoy a higher profit by strategically enlarging the price gap between the two channels to migrate more consumers to shop from the more cost-efficient channel. By contrast, a stronger degree of fairness concern always reduces the retailer's profit. Finally, we investigate the impact of fairness concerns on consumers' total monetary surplus, and find that either enhancing the degree of fairness concerns or expanding consumers' awareness of fairness concerns may not necessarily benefit consumers. Interestingly, we find that both the retailer and the consumers can possibly achieve a win-win outcome as the market fills with more fairness-concerned consumers, but may experience a lose-lose outcome when the existing fairness-concerned consumers have stronger inequity aversion.