MSOM Society Student Paper Competition: Abstracts of 2008 Winners

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The journal is pleased to publish the abstracts of the six finalists of the 2008 Manufacturing and Service Operations Management Society's student paper competition.

The 2008 prize committee was chaired by Zuo-Jun Max Shen (University of California, Berkeley). The other committee members were: Gad Allon, Aydin Alptekinoglu, Yossi Aviv, Achal Bassamboo, Damian Beil, Saif Benjaafar, Fernando Bernstein, Rene Caldentey, Felipe Caro, Ying-Ju Chen, Jiri Chod, Laurens Debo, Nicole DeHoratius, Cheryl Druehl, Don Eisenstein, Vivek Farias, Mark Ferguson, Jan Fransoo, Vishal Gaur, Joseph Geunes, Manu Goyal, Xinxin Hu, Tim Huh, Stylianos Kavadias, Eda Kemahlioglu Ziya, Harish Krishnan, Retsef Levi, Victor Martinez de Albeniz, Rodney Parker, Ali K. Parlakturk, Georgia Perakis, Justin Ren, Guillaume Roels, Paat Rusmevichientong, Amar Sapra, Sergei Savin, Glen Schmidt, Nicola Secomandi, Kevin Shang, Enno Siemsen, Larry Snyder, Greys Sosic, Richard Steinberg, Xuanming Su, Ravi Subramanian, Chung-Piaw Teo, Brian Tomlin, Tunay Tunca, Senthil Veeraraghavan, Owen Wu, Xiaowei Xu, Assaf Zeevi, Fuqiang Zhang, Jiawei Zhang, Yao Zhao, and Shaohui Zheng

The 2008 prize winners are as follows:

First Place
Jagpreet Chhatwal, University of Wisconsin-Madison
"Optimal Breast Biopsy Decision Making Based on Mammographic Features and Demographic Factors"

Second Place
Guoming Lai, Carnegie Mellon University
"Stock Market Pressure on Inventory Investment and Sales Reporting for Publicly Traded Firms"

Finalists
Mustafa Akan, Carnegie Mellon University
"Revenue Management by Sequential Screening"

Diwas KC, Emory University
"An Econometric Analysis of Patient Flows in the Cardiac ICU"

Robert W. Lien, Northwestern University
"Sequential Resource Allocation for Nonprofit Operations"

Zhixi Wan, University of Michigan
"Bargaining Power and Supply Base Diversification"

Optimal Breast Biopsy Decision Making Based on Mammographic Features and Demographic Factors

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Advisor: Oguzhan Alagoz, University of Wisconsin-Madison

Breast cancer is the most common nonskin cancer affecting women in the Unites States. Mammography is the only cost-effective method for early diagnosis of breast cancer, which is generally followed by a biopsy to confirm the suspicious finding as a cancer. Every year, more than 20 million mammograms and 700,000 biopsies are performed in the United States, as many as 55%-85% of these biopsies are found to be benign breast lesions, resulting in unnecessary patient anxiety, treatments, and health care expenditures. This paper addresses the decision problem faced by radiologists: when should a woman be sent for biopsy based on her mammographic features and demographic factors? We formulate the problem as a finite-horizon, discrete-time Markov decision process. We estimate our model's parameters from clinical data and medical literature. We consider patient's perspective to compute optimal policy, which shows that the decision to biopsy should take the patient's age into account; particularly, an older patient's risk threshold for biopsy should be higher than that of a younger patient. When applied to the clinical data, our model outperforms radiologists in the biopsy decision-making problem. This study also derives structural properties of the model, including sufficiency conditions that ensure the existence of a control-limit type policy and nondecreasing control limits with age. Our model supports the idea of personalized care by providing patient-specific policy for breast biopsy in contrast to the current practice of population-based guidelines. Our study can also be used to solve other similar biopsy decision-making problems.

Stock Market Pressure on Inventory Investment and Sales Reporting for Publicly Traded Firms

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Advisor: Laurens Debo, University of Chicago

Operations of publicly traded firms differ from privately owned firms because public firms' managers make decisions based on their own interests. In this paper, we study how stock market pressure may influence a firm's sales and inventory management. Our model is a straightforward extension of a two-period inventory management problem with correlated demand. The manager's compensation is partially based on the firm's stock price, which is influenced by the reported sales revenues. With better information about the "real" demand, the manager may manipulate the stock price by shipping more than the real demand to the downstream customers and claim higher than real sales revenues using a well known form of real earnings management called "channel stuffing." As it does not correspond to real demand, the padded demand will return later to the firm after additional costs are incurred. Hence, channel stuffing destroys the firm's value. Based on a game between the manager and the stock market, we identify two operational factors that influence the manager's incentive to use channel stuffing: the inventory carryover effect and the boundary effect. These two effects arise from the nature of the inventory management problem. When examining the initial inventory decision, we find that, compared to the optimal inventory level of an otherwise identical private firm, the manager who is aware of the costly consequence of padding may under invest inventory to limit the exposure to excess inventory that may stimulate padding, while he may also over invest to limit the incentive to create artificial stockout events. Our theoretical analysis provides insights about how a public firm's inventory decision may be different from a private firm, which is the classical reference framework in operations management.

Revenue Management by Sequential Screening

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Advisor: Baris Ata, Northwestern University

We consider optimal pricing to consumers who are privately informed about both their valuations for the product and when they learn their valuations. Initially, consumers have private information about the distribution of their valuations and when they will learn their valuations, and over time consumers privately learn their valuations. Because of its importance in many revenue management problems, we focus mainly on the case in which consumers with higher expected valuations, e.g., business travelers, learn their true valuations later than consumers with lower expected valuations, e.g., leisure travelers. Using a mechanism design approach, we show that the optimal selling mechanism is a menu of expiring refund contracts. Consumers purchase the good in advance but have the option to return it for a refund immediately after learning their valuations. We identify conditions under which the firm can implement the first-best or complete-information allocation, thereby extracting the entire (expected) consumer surplus. We also characterize the optimal menu of refund contracts when the first best cannot be achieved.

An Econometric Analysis of Patient Flows in the Cardiac ICU

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This paper explores the rationing of bed capacity in a cardiac intensive care unit (ICU). We find that the length of stay for patients admitted to the ICU is influenced by the occupancy level of the ICU. In particular, a patient is likely to be discharged early when the occupancy in the ICU is high. This in turn leads to an increased likelihood of the patient having to be readmitted to the ICU at a later time. Such "bounce-backs" have implications for the overall ICU effective capacity—an early discharge immediately frees up capacity, but at the risk of a (potentially much higher) capacity requirement when the patient needs to be readmitted. We analyze these capacity implications, shedding light on the question if an ICU should apply an aggressive discharge strategy or if it should follow the old quality slogan and "do it right the first time." By comparing the total capacity usage for patients who were discharged early versus those who were not, we show that an aggressive discharge policy frees up capacity in the ICU. However, we also find that an increased number of readmissions occur when the ICU is capacity constrained, thereby effectively reducing peak bed capacity.

Sequential Resource Allocation for Nonprofit Operations

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Advisors: Karen Smilowitz and Seyed Iravani, Northwestern University

The alternate objectives that arise in nonprofit, as opposed to commercial, operations lead to new variations on traditional problems in operations research and inventory management. In this paper, we study a sequential resource-allocation problem motivated by distribution operations of a nonprofit organization. Specifically, we consider the problem of distributing a scarce resource to meet sequentially observed customer demand. In a commercial setting, the amount distributed to each customer is determined to maximize profit. This objective, however, may lead to inequitable distributions among customers. Our work in a nonprofit setting solves the sequential resource allocation problem with an objective function aimed at *equitable* and *sustainable* service. We define service in terms of fill rate (the ratio of the allocated amount to observed demand) and develop an objective function to maximize the expected minimum fill rate among customers. Through a dynamic programming framework, we characterize the structure

of the optimal allocation policy for a given sequence of customers. In addition, we address the problem of customer visitation order by identifying properties to consider in sequencing decisions to optimize the objective. For both inventory-allocation and customer-sequencing decisions, we develop heuristic methods that yield near-optimal solutions.

Bargaining Power and Supply Base Diversification

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We examine a supply base diversification problem faced by a buyer who periodically holds auctions to award short-term supply contracts among a cohort of suppliers (i.e., the supply base). To mitigate significant cost shocks to procurement, the buyer can diversify her supply base by selecting suppliers from different regions. We find that the optimal degree of supply base diversification depends on the buyer's bargaining power, i.e., the buyer's ability to choose the auction mechanism. At one extreme, when the buyer has full bargaining power and thus can dictatorially implement the optimal mechanism, she prefers to fully diversify. At the other extreme, when the buyer uses a reverse English auction with no reserve price due to her lack of bargaining power, she may consider protecting herself against potential price escalation from cost-advantaged suppliers by using a less diversified supply base. We also examine cases where the buyer has intermediate bargaining power and can employ a reserve price and/or a first-price sealed-bid auction, and we find that in general the more bargaining power the buyer has to control price escalation from cost-advantaged suppliers, the more she prefers a diversified supply base.