*The Hong Kong Polytechnic University*
*Department of Logistics and Maritime Studies*
*Research Seminar*

# Managing Portfolio of Elective Surgical Procedures: A Multidimensional Inverse Newsvendor Problem

by

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**(joint work with H. Bavafa, C. Leys and L. Ormeci)**

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**The Hong Kong Polytechnic University**

## (Conducted in English)

**Abstract:**

We consider the problem of allocating daily hospital service capacity among several types of elective surgical procedures. Our focus is on the interaction between two major, constraining hospital resources: operating room (OR) and recovery bed capacity. In our model, each type of surgical procedure has an associated revenue, stochastic procedure duration, and stochastic length-of-stay (LOS). We consider arbitrary distributions of procedure and LOS durations and derive a two-moment approximation for the total procedure duration and the daily number of occupied beds for a given portfolio of procedures. For each procedure type, we consider a task of selecting the optimal daily number of elective procedures in the presence of random numbers of urgent procedures described by arbitrary finite-support distributions. We treat the available OR and recovery bed capacity as nominal, allowing them to be exceeded at a cost. The resulting model is a novel, multi-dimensional variant of the inverse newsvendor problem, where multiple demand types compete for multiple types of service capacity.

We characterize the optimal number of elective procedures for single-specialty hospitals. In addition, we derive an optimality bound for a “front-end" capacity management approach that focuses exclusively on OR capacity. For a setting with two dominant procedure types, we provide an analytical characterization of the optimal portfolio composition under a condition where all procedures are elective, and both procedure types have associated revenues proportional to the expected resource use but are asymmetric in terms of the second moments of their resource usage.

For an arbitrary number of procedure types, we use this “elective-only" setting to derive a general analytical description of the optimal portfolio, and easy-to-compute expressions for the optimal portfolio values in the setting where all procedure types have proportional second moments of their resource usage as well as revenues proportional to the expected use of both resources. For the general case of an arbitrary number of procedure types in the presence of urgent procedures, we conduct a numerical study using data we have collected at a medium-size teaching hospital. Our numerical study illustrates the composition of the optimal portfolios of elective procedures in different practical settings and investigates the effectiveness of the “front-end" approach to hospital capacity management.

**Bio:**

Professor Savin’s research expertise is centered on operational aspects of health care delivery, improving patient access to care, and optimal management of diagnostic and treatment capacity. His articles have appeared in Management Science, Operations Research, and Manufacturing and Service Operations Management, among others, and he also actively participates in editorial activities for several premier journals including Management Science, Operations Research, Manufacturing and Service Operations Management, and Production and Operations Management.

Before joining the Wharton School in July 2009, Professor Savin was on the faculty at the Columbia Business School and the London Business School. He received a Ph.D. in Physics from the University of Pennsylvania in 1997 and a Ph.D. in Operations and Information Management from the Wharton School in 2001.

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**All are welcome!**