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

Robust Dynamic Pricing with Two Substitutable Products

by

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The Hong Kong Polytechnic University

(Conducted in English)

Abstract:

We consider a dynamic pricing problem with two substitutable products involving a number of business rules commonly seen in practice. Demand substitution exists between the two products in each period (called inter-product substitution), and may also exist across different time periods (called intertemporal substitution). However, there is limited demand information such that the underlying probability distributions of the demand cannot be characterized precisely. We use an interval to represent, respectively, the demand of each individual product in each period, the aggregate demand of the two products in each period, and the total aggregate demand of the two products across multiple time periods. We propose a robust optimization model for this problem to maximize the worst-case total revenue. For the problem with inter-product demand substitution only, we develop a dynamic programming algorithm which can generate optimal solutions in a reasonable amount of time. For the problem with both inter-product and intertemporal demand substitutions, we develop a more complex dynamic programming algorithm and design a fully polynomial-time approximation scheme which guarantees a proven near optimal solution in a manageable computational time for practically sized problems. For a special case of this problem where one product always has a higher demand uncertainty than the other product, we show that the search spaces in the DP can be reduced greatly. Our computational results show that compared to a risk neutral approach, our robust optimization approach can decrease the variance of the revenue at a small expense of the average revenue. We also generate a number of managerial insights: (i) None of the key structural properties commonly studied in the pricing literature hold for our problem, (ii) The revenue impact of under/over-estimating the lower and upper bounds of the demand intervals is generally insignificant, and (iii) The revenue impact of ignoring intertemporal demand substitution when such substitution exists can be quite significant.

Bio:

Prof. Zhi-Long Chen is Orkand Corporation Professor of Management Science in Robert H. Smith School of Business, University of Maryland. His research interests include supply chain scheduling, production and capacity planning, transportation and logistics operations, and dynamic pricing.

Prof. Chen has received a number of research grants from the National Science Foundation of the US for his research in these areas. He has also collaborated with a number of companies over the years on practice based research projects. A project completed by him and his collaborators for Baosteel won the INFORMS Franz Edelman Finalist Award in 2013. Prof. Chen has published more than 50 articles in a number of premier journals, including INFORMS Journal on Computing, Manufacturing & Service Operations Management, Operations Research, and Productions and Operations Management. He is currently serving on editorial boards of several journals including IIE Transactions, Naval Research Logistics, Operations Research, and Productions and Operations Management.

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All are welcome!