Dynamic Capacity Management with Substitution

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Abstract

We examine a multiperiod capacity allocation model with upgrading. There are multiple product types, corresponding to multiple classes of demand, and the firm purchases capacity of each product before the first period. Within each period, after demand arrives, products are allocated to customers. Customers who arrive to find that their product has been depleted can be upgraded by at most one level. We show that the optimal allocation policy is a simple two-step algorithm: first use any available capacity to satisfy same-class demand and then upgrade customers until capacity reaches a protection limit, so that in the second step the higher-level capacity is rationed. We show that these results hold both when all capacity is salvaged at the end of the last demand period as well as when capacity can be replenished (in the latter case, an order-up-to policy is optimal for replenishment). While finding the optimal protection limits is computationally intensive, we describe bounds for the optimal protection limits that take little effort to compute and can be used to effectively solve large problems. Using these heuristics, we examine numerically the relative value of strictly optimal capacity and dynamic rationing, the value of perfect demand information, and the impact of demand and economic parameters on the value of optimal substitution.

Biography

Professor Zhang received his Ph.D. in Operations and Information Management from the Wharton School, University of Pennsylvania in 2004. His main research interests are in supply chain management, which primarily deals with how to match supply with demand. To achieve this goal, a firm needs to carefully manage both sides of the supply chain. The first part of his research focuses on how a firm should contract with upstream suppliers to ensure efficient and responsive supply, i.e., the supply side. The second part of his research is concerned with how to deal with strategic customer behavior that may affect a firm’s operational strategies, i.e., the demand side. The primary methodologies used in his research include stochastic inventory theory, queuing theory, game theory and the theory of incentives. Professor Zhang’s research work has been published in Management Science, Manufacturing & Service Operations Management, and Operations Research.

Currently, Professor Zhang is at the Olin Business School, Washington University in St. Louis. He teaches Operations Management to BSBA students at Olin. Prior to joining Olin, he was at the Merage School of Business, University of California, Irvine, where he taught Management Science and Supply Chain Management courses.

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