

Cost Optimization in Cloud Computing: Capacity Reservation for Intermittent Random Demand Surges

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Abstract

The adoption of cloud computing has been accelerating, while firms are struggling to manage their growing cloud expenditures in the face of intermittent demand surges caused by planned or random events, including marketing campaigns, new product introductions, seasonal holiday shopping, and even pandemics. To deal with such challenges, an enterprise cloud user (the “firm”) can employ reservation contracts to meet the base demand, complemented by supplementary reservation and on-demand contracts to cope with the demand surges. We first analyze a model whereby the surge and inter-surge durations of demands are deterministic, whereas demand magnitude is random, and cancellation of the reservation contracts is allowed. We characterize the optimal capacity management decisions for the firm including the capacity levels and the policy for managing the renewal, cancellation, and expiration of the supplementary contracts. An effective heuristic is employed to a more general model in which the surge and inter-surge durations are random. We also examine a model extension, whereby trades of the short-term reservation contracts are allowed in a secondary marketplace. Our results show that platforms that offer a secondary marketplace are more attractive to firms from a cost standpoint than those that offer cancellation only. However, the latter can achieve parity with the former by offering a lower discounted cost rate for the reservation contracts, thereby bypassing the cost of establishing and administering the secondary marketplace.

Bio

Shi Chen is Marion B. Ingersoll Associate Professor of Operations Management at the Foster School of Business, University of Washington in Seattle. He received the B.E. in industrial engineering and M.S. in management science & engineering from Tsinghua University, and received his Ph.D. in management science & engineering from Stanford University. Dr. Chen’s research interests include supply chain management, inventory management, social responsibility and sustainability of global supply chains, and cloud computing value chains. His publications have appeared in top Operations Management journals, including Operations Research, Management Science, Manufacturing & Service Operations Management, and Production & Operations Management. Dr. Chen is a member of the INFORMS, MSOM, and POM societies and is a senior editor at Production & Operations Management.

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