Guest Lecturer Seminar Series ~ Management Sciences

Inventory Balancing with Online Learning

Xinshang Wang
Alibaba's DAMO Academy

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9:30–11:00 a.m.

S207 Pappajohn Business Building

Abstract

Abstract: (joint work with Wang Chi Cheung, Will Ma and David Simchi-Levi) We study a general problem of allocating limited resources to heterogeneous customers over time, under model uncertainty. Each type of customer can be serviced using different actions, each of which stochastically consumes some combination of resources, and returns different rewards for the resources consumed. We consider a general model framework, where the resource consumption distribution associated with each (customer type, action) combination is not known, but is consistent and can be learned over time. In addition, the sequence of customer types to arrive over time is arbitrary and completely unknown. We achieve near optimality under both model uncertainty and customer heterogeneity by judiciously synergizing two algorithmic frameworks in the literature: inventory balancing, which "reserves" a portion of each resource for high-reward customer types which could later arrive; and online learning, which shows how to "explore" the resource consumption distributions of each customer type under different actions. We define an auxiliary problem, which allows for existing competitive ratio and regret bounds to be seamlessly integrated. Furthermore, we show that the performance guarantee generated by our framework is tight, using the special case of the online bipartite matching problem with unknown match probabilities. Finally, we demonstrate the practicality and efficacy of algorithms generated by our framework using a publicly available hotel data set.

About the speaker: Xinshang Wang is a senior algorithm engineer at Alibaba's DAMO Academy. Before joining Alibaba, Xinshang worked as a postdoctoral associate at MIT's Institute of Data, Systems, and Society. He received his PhD in operations research from Columbia University, and his BS in physics from Peking University. Xinshang's research spans several areas of stochastic and combinatorial optimization for modern service applications, including data-driven optimization under uncertain and dependent demands, and modeling of customer choice behavior for resource allocation problems. Applications of his interest include, but are not limited to, revenue management, healthcare operations and supply-chain management.