

Assortment Auctions: A Myersonian Characterization for Markov Chain based Choice Models

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Abstract: In this paper, we introduce the concept of an assortment auction, where a seller is selling substitute products/services with fixed prices (as in assortment optimization), and buyers compete for a limited supply of these products in an auction. Each buyer reports a ranked list of products she is willing to purchase, after which the seller allocates products to buyers using a truthful mechanism, subject to a supply constraint on the total number of products allocated. The seller collects revenues equal to the prices of the products allocated, and would like to design a mechanism to maximize total revenue, when the buyers' lists are drawn independently from known distributions.

When there is one buyer, our mechanism design problem reduces to the assortment optimization problem, which is known to be tractable for lists drawn from a Markov Chain choice model. We extend this result and compute the optimal auction, when there are multiple buyers with heterogeneous Markov chains. Moreover, we show that the optimal auction is structurally "Myersonian", in that each buyer is assigned a virtual valuation based on her report and distribution, after which the mechanism maximizes virtual surplus. Since Markov chains capture the classical notion of a valuation distribution, our optimal assortment auction generalizes the classical Myerson's auction. Finally, we show that without the Markov chain assumption, the optimal assortment auction may be structurally non-Myersonian.

To conclude, we apply our theory in online assortment problems, using the virtual valuations for Markov Chain choice models to derive personalized assortment policies.

Speaker Bio: Will Ma is an Assistant Professor of Decision, Risk, and Operations at the Graduate School of Business at Columbia University. He received his Ph.D. in 2018 from the MIT Operations Research Center, advised by David Simchi-Levi. His research is primarily focused on Revenue Management, building data-driven models to help e-tailers coordinate their product recommendation decisions with their supply chain constraints.

Previously, Will has been a co-founder of Lunarch Studios, the start-up that launched the strategy game Prismata. He is also a former professional poker player, and designed the poker class which is taught yearly at MIT.