Speed Up the Cold-Start Learning in **Two-Sided Bandits with Many Arms**

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Abstract

Multi-armed bandit (MAB) algorithms are efficient approaches to reduce the opportunity cost of online experimentation and are used by companies to find the best product from periodically refreshed product catalogs. However, these algorithms face the so-called cold-start at the onset of the experiment due to a lack of knowledge of customer preferences for new products, requiring an initial data collection phase known as the burn-in period. During this period, MAB algorithms operate like randomized experiments, incurring large burnin costs which scale with the large number of products. We attempt to reduce the burn-in by identifying that many products can be cast into two-sided products, and then naturally model the rewards of the products with a matrix, whose rows and columns represent the two sides respectively. Next, we design two-phase bandit algorithms that first use subsampling and low-rank matrix estimation to obtain a substantially smaller targeted set of products and then apply a UCB procedure on the target products to find the best one. We theoretically show that the proposed algorithms lower costs and expedite the experiment in cases when there is limited experimentation time along with a large product set. Our analysis also reveals three regimes of long, short, and ultra-short horizon experiments, depending on dimensions of the matrix. Empirical evidence from both synthetic data and a real-world dataset on music streaming services validates this superior performance.

Bio

Wanning Chen is an assistant professor in the Information Systems group at Foster School of Business. She completed her Ph.D. in business from Stanford University in 2022. Her research focuses on developing statistical methodology for datadriven decision making. In particular, She designs novel machine learning algorithms for problems where the underlying data has a natural matrix structure.

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