INDIAN STATISTICAL INSTITUTE

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Theoretical Statistics and Mathematics Unit

Monday Colloquium

Date: December 19, 2022 Time: 04:15 P.M.

Venue: L-infinity, Stat-Math Unit (5th Floor, A.N. Kolmogorov Bhavan)

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TITLE:

DYNAMIC PRICING UNDER SHAPE CONSTRAINTS

ABSTRACT:

The increasing prevalence of online marketplaces has generated recent interest in the problem of dynamic pricing in both statistics and optimization literatures. The generic problem is that of a firm (or firms) selling a large number of different products to customers that arrive over time. The firm/s) need/s to determine and adjust the selling prices of products over time based on statistical learning and policy optimization, in order to maximize its/their revenue.

In this paper, we study the contextual dynamic pricing problem where the market value of a product is linear in its observed features plus some market noise. Products are sold one at a time, and only a binary response indicating the success or failure of a sale is observed. Our model setting is similar to earlier work by Javanmard and Nazerzadeh (arXiv preprint arXiv:1609.07574) except that we expand the demand curve to a semi-parametric model and need to learn dynamically both parametric and non-parametric components, as in very recent work by Fan, Guo and Yu (arXiv preprint arXiv:2109.06368). However, unlike Fan et. al., we do not use a kernel based approach, but rather exploit the natural shape constraints in this problem to construct non-parametric estimates (MLE, LS) that avoid bandwidth selection choices. We propose a dynamic statistical learning and decision-making policy that combines semi-parametric estimation from a generalized linear model with an unknown link and online decision-making to minimize regret (maximize revenue). Under mild conditions, we show that for a market noise c.d.f. F with 2-th order derivative, our policy achieves a regret upper bound of e $O(T^{17/25})$, where T is the time horizon, which is faster than the ones obtained in Fan et. al's work , albeit under different but closely related assumptions. More importantly, our method offers natural computational advantages over competing procedures.

This is joint work with Daniel Bracale and Yuekai Sun.

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