A Nonparametric Approach to Multiproduct Pricing

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Developed by General Motors (GM), the Auto Choice Advisor website (http://www.autochoiceadvisor.com) recommends vehicles to consumers based on their requirements and budget constraints. Through the website, GM has access to large quantities of data that reflect consumer preferences. Motivated by the availability of such data, we formulate a nonparametric approach to multiproduct pricing.

We consider a class of models of consumer purchasing behavior, each of which relates observed data on a consumer's requirements and budget constraint to subsequent purchasing tendencies. To price products, we aim at optimizing prices with respect to a sample of consumer data. We offer a bound on the sample size required for the resulting prices to be near-optimal with respect to the true distribution of consumers. The bound exhibits a dependence of O(n logn) on the number n of products being priced, showing that—in terms of sample complexity—the approach is scalable to large numbers of products.

With regards to computational complexity, we establish that computing optimal prices with respect to a sample of consumer data is NP-complete in the strong sense. However, when prices are constrained by a price ladder—an ordering of prices defined prior to price determination—the problem becomes one of maximizing a supermodular function with real-valued variables. It is not yet known whether this problem is NP-hard. We provide a heuristic for our price-ladderconstrained problem, together with encouraging computational results.

Finally, we apply our approach to a data set from the Auto Choice Advisor website. Our analysis provides insights into the current pricing policy at GM and suggests enhancements that may lead to a more effective pricing strategy.