



Optimal Contextual Pricing and Extensions

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Abstract

In the contextual pricing problem a seller repeatedly obtains products described by an adversarially chosen feature vector in $\mathbb{R}^d$ and only observes the purchasing decisions of a buyer with a fixed but unknown linear valuation over the products. The regret measures the difference between the revenue the seller could have obtained knowing the buyer valuation and what can be obtained by the learning algorithm.

We give a poly-time algorithm for contextual pricing with $O(d \log \log T + d \log d)$ regret which matches the $\Omega(d \log \log T)$ lower bound up to the $d \log d$ additive factor. If we replace pricing loss by the symmetric loss, we obtain an algorithm with nearly optimal regret of $O(d \log d)$ matching the $\Omega(d)$ lower bound up to $\log d$. These algorithms are based on a novel technique of bounding the value of the Steiner polynomial of a convex region at various scales. The Steiner polynomial is a degree d polynomial with intrinsic volumes as the coefficients.

We also study a generalized version of contextual search where the hidden linear function over the Euclidean space is replaced by a hidden function $f: \mathcal{X} \rightarrow \mathcal{Y}$ in a certain hypothesis class $\mathcal{H}$. We provide a generic algorithm

with $O(d^2)$ regret where d is the covering dimension of this class. This leads in particular to a $O(s^2)$ regret algorithm for linear contextual search if the linear function is guaranteed to be s -sparse. Finally we also extend our results to the noisy feedback model, where each round our feedback is flipped with a fixed probability $p < 1/2$.

Research

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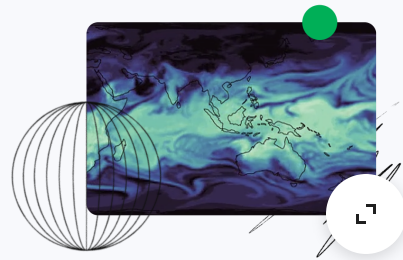
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