Algorithmic Information Disclosure in Optimal Auctions*

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Classical auction theory typically focuses on models with exogenous signal structures, where all auction participants privately know their item valuations. However, practical scenarios often find buyers initially uninformed about their item values due to the lack of data on item quality or suitability. Instead, buyers rely on seller advertisements to learn their values. For instance, streaming services offer free trials to influence consumer perceptions before subscriptions, while real estate agencies provide property inspections for better buyer estimations.

In these cases, sellers can jointly design their advertising strategies and auction mechanisms. This paper focus on a model by Bergemann and Pesendorfer [2007] for this joint design problem. Here, a seller with one item faces n heterogeneous buyers whose values are drawn from a commonly known product distribution. Initially, neither party knows exact buyer values. Sellers employ Blackwell experiments to help buyers privately and independently learn their values. Despite sellers designing these experiments, resulting signals are only privately observed by buyers, which aligns with advertising and private inspection applications.

We show that in contrast to Myerson [1981] where the optimal auction with exogenous signals can be computed in polynomial time, the optimal joint design problem becomes *NP-hard* when the seller also has the ability to design the signal structures. Our main result is a *polynomial-time approximation scheme (PTAS) for computing the optimal joint design* with at most an ϵ multiplicative loss in expected revenue. Moreover, we show that in our joint design problem, the seller can significantly reduce the information rent of the agents by providing partial information, which ensures a revenue that is at least $1 - 1/e$ of the optimal welfare for all valuation distributions.

A full version of this paper can be found at https://arxiv.org/abs/2403.08145.

CCS Concepts: • **Theory of computation → Theory and algorithms for application domains**; **Algorithmic game theory and mechanism design**;

Additional Key Words and Phrases: information design, auctions, revenue maximization

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