



Data-Driven Mechanism Design: Jointly Eliciting Preferences and Information

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We study mechanism design when agents have private preferences and private information about a common payoff-relevant state. We show that standard message-driven mechanisms cannot implement socially efficient allocations when agents have multidimensional types, even under favorable conditions.

To overcome this limitation, we propose data-driven mechanisms that leverage additional post-allocation information, modeled as an estimator of the payoff-relevant state. Our data-driven mechanisms extend the classic Vickrey-Clarke-Groves class. We show that they achieve exact implementation in posterior equilibrium when the state is either fully revealed or the utility is affine in an unbiased estimator. We also show that they achieve approximate implementation with a consistent estimator, converging to exact implementation as the estimator converges, and present bounds on the convergence rate.

We demonstrate applications to digital advertising auctions and large language model (LLM)-based mechanisms, where user engagement naturally reveals relevant information.

A full version of this paper can be found at <https://arxiv.org/abs/2412.16132>.

CCS Concepts: • **Theory of computation** → **Algorithmic mechanism design**.

Additional Key Words and Phrases: Mechanism Design, Data-Driven Mechanism Design, Large Language Models, Click-Through Rate, Posterior Equilibrium

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