Differentially Private Call Auctions and Market Impact
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- Market participants closely guard information about valuations/trades to prevent market impact

- Algorithmitization of market => arms race to preserve/attack privacy; all sorts of algos & extremely complicated market

- Can we use lens of privacy to design simpler market with good properties?

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Technical Ingredients

Call Auction

Joint Differential Privacy

\[
\Pr[\mathcal{M}_i(D) \in S] \leq e^{\epsilon} \Pr[\mathcal{M}_i(D') \in S] + \delta
\]

- D, D’ neighboring databases that differ at single element i
- \( M \) a mechanism that outputs a vector whose dimension is the size of the databases,
Mechanism Overview

Get Valuations

Select Price

Estimate Sellers and Buyers

Select participants

Pr[p] \propto \exp\left(\frac{\epsilon}{2}\text{shares}(p)\right)

\hat{\hat{p}}

\hat{s} = s(\tilde{p}) + \text{Lap}\left(\frac{1}{\epsilon}\right)

\hat{b} = b(\tilde{p}) + \text{Lap}\left(\frac{1}{\epsilon}\right)

Actually have two, with different guarantees, and privately select best one
Results and Guarantees

- Mechanism achieves end-to-end joint differential privacy. WHP, clears close to OPT; little net inventory. Good incentive properties.

- Tradeoff between privacy and performance, but our guarantees are optimal.

- Simulations show even better performance in practical settings.

- Also show theoretical + empirical convergence to OPT when traders are no-regret algos.