Manipulative Auction Design

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Overview

- Auction design where bidders get partial feedback about the distribution of bids in earlier auctions
  - Asymmetric bidders (and past bids are disclosed in an anonymous way)
  - Several auction formats are used but not disclosed
- **Analogy-based expectation equilibrium** (Jehiel 2005)
  - Bidders form their beliefs by looking at the history of past bids
- **What is the role of feedback policy as an instrument in mechanism design? Effect on efficiency and revenues.**
  - Strategic use of feedback disclosure in mechanism design
  - Providing coarse feedback in first-price auctions is a possible way to promote competition

Introduction

- Standard approach for game with incomplete information: players know the distribution of types and strategies
- Very demanding! All the information feedback is available and is used to converge to equilibrium.
- Suppose bidders can only look at the bids submitted in earlier similar auctions
- In eBay or treasury auctions, bidders have access only to the aggregate distribution of bids
- ABEE (analogy-based expectation equilibrium): bidder anonymous analogy partition. Players choose a best response to the *conjecture* that the distribution of proposals is the same as the aggregate distribution of proposals they have access to.

Preview of results

- Setting: asymmetric auction, bidders i have different valuation distributions $f_i(v_i)$
- The seller can choose mechanisms and feedback structure
- First-price auction with aggregate feedback induces an efficient outcome and always generates an expected revenue strictly greater than the second-price
- Failure of the revenue equivalence theorem under ABEE: the designer can achieve a better result by changing the auction mechanism

Model (Introduction)

- A single seller repeatedly sells similar objects
- Bidders for each auction are new (or have no memory)
- Designer creates a partition of the bid history that can be coarse across mechanisms or bidder characteristics
- Bid history: long-run assumption
- The bidder cares about efficiency and revenues (part 1) or about revenues only (part 2)

Model (Setup)

- n bidders $i = 1, 2, \ldots, n$
- Only private valuation v_i is known
- Seller valuation v_s
- Distribution of valuations independent across bidders $f_i(v)$
- Bidders are risk neutral and have quasilinear preferences
- The object is auctioned off through possibly different formats M_k with probability λ_k common knowledge
- All bidders are simultaneous, based on b determine the probability of i winning $\varphi_i^k(b)$ (nondecreasing in b_i) and the transfer $\tau_i^k(b)$ (nondecreasing in b_i and b_j)
- Ex post quitting rights: the winner needs to approve the terms of contract

Model (Feedback)

- Bidders initially have no prior about $f_i(v)$
- Feedback about past play is made available by the designer and is used to form expectations
- Strategy: family of bid functions $\beta_i = (\beta_i^k(v_i))_k$, one for each auction format
- Perceived expected utility in M_k

$$u_i^k(v_i, b_i, \tilde{b}_{-i}) = E_{\tilde{b}_{-i}}[\varphi_i^k(b_i, b_{-i}) max(0, v_i - \tau_i^k(b_i, b_{-i}))]$$

- NE: for each k and v_i, play a best response to actual bids distribution

$$\beta_i^k(v_i) \in argmax_{b_i} u_i^k(v_i, b_i; \beta_{-i}^k)$$

Model (ABEE)

- Partial feedback: each bidder i is endowed with a partition P_i of the set $\{(j,k) : j \in I, k \in K\}$: analogy partition of bidder i. An element of P_i is denoted by α_i
- Bidder gets informed only of the empirical distributions where b_j submitted in M_k with $(j,k) \in \alpha_i$ cannot be distinguished
- Feedback about individual bids, not the distribution of bid profiles
- Auction design $A = (M_k, \lambda_k, P_i)$
- An analogy-based expectation equilibrium of A is a strategy profile β such that $\forall k, v_i$

$$\beta_i^k(v_i) \in argmax_{b_i} u_i^k(v_i, b_i; \bar{\beta}_{-i}^k)$$

where $\bar{\beta}_j^k$ is the aggregate distribution of bids in $\alpha(j,k)$

Bundling of bidders or formats

- **Bidder-anonymous analogy partition**. One auction format, feedback is aggregate across all bidders.
- $K = \{1\}$ and $P_i = \{\bigcup_j \{(j, 1)\}\}$
- No feedback about the characteristics of the bidders

- **Format-anonymous analogy partition**. Bidder know the aggregate distribution of bids across auction format but they differentiate the distribution for the various bidders
- $P_i = \{\bigcup_k \{(j, k)\}\}$

Efficiency and revenues

Proposition 1. Consider a two-bidders auction setup with asymmetric distributions $F_i(v)$.
There is a unique analogy-based expectation equilibrium of the first price auction with bidder anonymous analogy partition.

- This ABEE induces an efficient outcome and it generates a strictly higher revenue than the second-price auction

Efficiency and revenues

Proposition 2. Consider an n-bidder setup and assume $\bar{R} \geq R^{SPA}$ [expected revenues from the *fictitious* and real second price auction]. There is a unique ABEE of the first-price auction with bidder anonymous analogy partition. Moreover, this ABEE induces an efficient outcome and it generates a strictly higher revenue than the second price auction.

- $\bar{R} \geq R^{SPA}$ always holds with two bidders, but with more than two the revenue comparison can go either way

Optimal auctions

Proposition 3. The largest expected payoff that the designer can achieve in a manipulative auction design is strictly larger than her expected payoff in Myerson's optimal auction R^M

- Now the designer wants to maximize the expected payoff
- Example: auction design with Myerson design and $\lambda = \epsilon$ FPA

Proposition 4. The best expected payoff that the designer can achieve is strictly smaller than the full information expected payoff $R^F = E(max_i(v_i, v_s))$

Discussion

- **Novelty: feedback partitions are viewed as a choice made by the designer**
- In Jehiel (2005) and Jehiel and Koessler (2008) it was exogenous
- Relation with self-confirming equilibrium literature (best respond to a *conjecture* of bids an mechanism probabilities): ABEE is a slection of SCE
- Esponda (2008): FPA with the same bidders taking part in a sequence of auctions and receive limited feedback
- Optimal auction design literature
- Learning in MD and equilibrium selection
- Further restriction on the set of mechanisms
- Shill bidding can lead to a revenue close to R^F
- Cheating on feedback, other forms of feedback,...