The Optimal Auction and Standard Auctions in the Maximum Game
- An Experimental Study

Jinsoo Bae

The Ohio State University

Motivation

- In the Maximum Game where bidders' common value equals the maximum of the signals, theories have shown that a posted price can yield more expected revenue than a standard auction
- A recent study (Bergemann et al.) suggests that the optimal mechanism for the Maximum Game is indeed a posted price under some conditions.
- However, bidders' bidding behavior could be substantially different from the prediction
- Thus, this study experimentally compares revenues between the two mechanism

The Maximum Game

- Bulow and Klemperer (2002) introduced the Maximum Game.
  - There are *n* bidders
  - Each bidder privately observes a signal S_i that is independently and identically distributed from a CDF F(.) on $[\underline{s}, \overline{s}]$
  - Given (s_1, s_2, …, s_n), the common value equals the maximum of the signals. That is, v = max (s_1, s_2, …, s_n)
  - Let $S_{(n,k)}$ denotes the R.V of k-th highest signal among *n* signals.
- The model is applicable to
  - Oil or mineral right auctions (Bulow and Klemperer, 2002)
  - Auctions with intermediaries who will resell the good (Bergemann et al, 2017WP)

Revenues in different mechanisms

- Second price auction
  - Bidding one's own signal is the unique symmetric BNE. $b(s_i)=s_i$ (Campbell and Levin, 2006)
  - Moreover, $b(s_i)=s_i$ is the unique bidding function that remains after two steps of iterated deletion of weakly dominated bid functions
    - Bidding below is (weakly) dominated, then bidding above is.
  - The expected revenue is $E[S_{(n,2)}]$

- (More generally) A standard auction
  - Bidders will behave in the same way as in an independent private value model that has the same distribution. (Bergemann et al.)
  - The expected revenue is the same as the second price auction.

Revenues in different mechanisms

- The optimal posted price
  - A posted price can generates more revenues than standard auctions.
  - In particular, a posted price that a bidder with $\underline{s}$ is willing to accept is the optimal mechanism (All inclusive price)
  - Thus, the optimal posted price is $E[S_{(n-1, 1)}]$, the value of the good conditional on having $\underline{s}$.
  - $E[S_{(n-1, 1)}] > E[S_{(n,2)}]$
  - Note that $E[S_{(n-1, 1)}] = \frac{1}{n} E[S_{(n,2)}] + \frac{n-1}{n} E[S_{(n,1)}]$
  - Posted price earns $\frac{n-1}{n}$ [$E[S_{(n,1)}] - E[S_{(n,2)}]$] more than standard auctions.

Testable prediction of the Maximum Game

- Revenue dominance of posted price over standard auctions ?
- Auctions
  - It is well known that bidders overbid in common-value auctions
    - Revenues could be higher than the prediction
  - Ivanov et al.(2010)'s study used the Maximum Game to study level-k and CE, and the subjects tend to overbid. (Second price auction)
    - But this experiment did not give any feedback to the subjects. With some feedback, subjects may learn to play equilibrium strategy
- Posted price
  - Unlike standard auctions, bidders can (ex-post) lose money in the equilibrium if the realization of highest signal is small.
  - Thus, risk averse bidders may not accept the posted price, and the revenue can be smaller then the prediction

Experimental design

- $\frac{n-1}{n}$ [E[$S_{(n,1)}$] - E[$S_{(n,2)}$]] is the difference in revenue.
  - How to choose parameters (number of bidders, distribution of signal) to maximize (or minimize) this difference.
  - Should I use multiple parameter sets to vary the difference?

- Several modes of the optimal posted-price
  - Ask willingness to accept the posted price, if multiple bidder accepts
    - Randomly choose one bidder and sell the good at the price
    - Divide the good and the price by the number of accepted bidders (divisible good)
  - Ask entry fee equal to posted price divide by n. The good is randomly given to one of bidders who entered. (Lottery)

Experimental design

- What standard auction to use?
  - Second price auction has somewhat stronger theoretical prediction.
  - How about other standard auctions : first-price auctions? all pay auctions?
- Need for eliciting risk aversion or loss aversion?