

Data Science for Economists

A Quick Primer on Auctions

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1. Auctions

Auctions

Motivation

Auction theory has been one of the successes of economics in the past 30-40 years.

Since auctions are very common in the real world, economists who study empirical auctions have also cropped up to estimate the models the theorists have developed.

While we will not delve too deeply into auctions, I do need to give you just enough information for the problem set.

Auction Models

The way we model auctions is that bidders have some *valuation* v_i that comes from some distribution F_v . The valuation is how much one "values" the object.

The valuations could be iid¹ or iid conditional on observables or have correlated valuations.

Bidders then know the rules of the auction and submit bids. They bid in such a way that maximizes their expected utility:

$$\max_{b_i} v_i \Pr(\text{win with } b_i) - E[p(b_i)|b_i]$$

I am keeping this vague because there are different auction formats and not all require paying the exact bid you submitted e.g. second price auctions.

¹ Independent and identically distributed. This means each valuation is independent of all others and all valuations come from the same distribution.

Auction Models (Cont.)

Once a bidder has her valuation, we think that she forms some optimal bidding strategy $b(v_i)$ that maps her valuation to a bid. We denote the observed bid b_i and we say that $b_i = b(v_i)$ with equilibrium bidding.

In empirical auctions, the goal is to be able to recover v_i or F_v from a bunch of bidding data $(b_i)_{i=1}^N$, information about how the auction was ran, and assumptions about bidding behavior.

As long as $b(v_i)$ is monotonic (higher the valuation, higher the bid), then recovering v_i comes down to inverting $b(v_i)$, or since $b_i = b(v_i)$, then $v_i = b^{-1}(b_i)$.

Some auction formats:

1. First-Price Sealed Bid
2. Second-Price Sealed Bid
3. English (Ascending)
4. Dutch
5. All-Pay

Auction Formats

- First-price Sealed Bid: All bidders submit a secret bid, then highest bidder wins and pays the bid.
- Second-Price Sealed Bid: All bidders submit a secret bid, then highest bidder wins but pays the second highest bid.
- English: Bidding starts at some initial bid and bidders can incrementally increase the bid until only one bidder remains. Sometimes there is a minimum bid increment.
- Dutch: The price starts at a very large value and incrementally decreases until someone declares they are willing to pay that price for the object.
 - "Strategically equivalent" to first-price sealed bid auction.
- All-Pay: Similar to other sealed bid auctions, but everyone pays their bid regardless of winning or losing.
 - Sometimes used to model R&D races/competitions.