Auctions

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Agenda

• Introduction
• Auctioning a single item
• Basic principles of auction design
• Auctioning many items
• Ascending vs. sealed-bid auctions
Auctions

• What percent of world GNP is traded each year by auction?
• Understanding auctions should help us understand the formation of markets by modeling competition
• Auctions represent an excellent application of game theory, since in an auction the rules of the game are made explicit.

Advantages of Auctions

• Most open and objective assignment method
  – Criteria specified in advance
  – Reason for assignment is publicly observed
• Determine market prices
• Promote efficient allocation and investment
• Assign resource quickly
• Can incorporate public policy goals
Auction Rules Matter

Auction rules will affect:
• Efficiency of assignments
• Revenues
• Other policy objectives, such as promoting new entry and competition

Auctioning a Single Good

Auctions typically take one of four simple forms:

<table>
<thead>
<tr>
<th>Dynamic</th>
<th>Sealed Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>English (↑ price)</td>
<td>2nd Price</td>
</tr>
<tr>
<td>Dutch (↓ price)</td>
<td>= 1st Price</td>
</tr>
</tbody>
</table>
Simple Auctions

- *English*: price increases until only one bidder is left; the remaining bidder gets the good and pays the highest bid.
- *Dutch*: prices decreases until a bidder accepts the price; this bidder gets the good and pays the price at acceptance.
- *Second Price*: each bidder submits a bid in a sealed envelope; the highest bidder gets the good and pays the second highest bid.
- *First Price*: each bidder submits a bid in a sealed envelope; the highest bidder gets the good and pays the amount of his bid.

Auction Exercise

- Bid for a single item
- Your value is the last two digits of your social security number
- Name ______________
- Value ______________
- First price bid ______
- Second price bid ______
Private-Value Auction Outcome

• Value of object = ________
• English auction
  Price = ________
  Profit = ________
• First-price auction    Second-price auction
  Price = ________    Price = ________
  Profit = ________    Profit = ________

Auction Exercise

• Bid for single item
• Common value = $1 per bean
• On slip of paper write:
  – Name
  – Estimate (# of beans × $1)
  – Bid in first-price sealed-bid auction
  – Bid in second-price sealed-bid auction
Common-Value Auction Outcome

• Value of object = ________
• English auction
  Price  = ________
  Profit = ________
• First-price auction               Second-price auction
  Price  = ________
  Profit = ________
               Price  = ________
               Profit = ________

Winner's Curse

I won. Therefore, I overestimated the most. My bid only matters when I win, so I should condition my bid on winning (i.e., that I overestimated the most).

• Winning is bad news about my estimate of value. No one else was willing to bid as much.
Models of Private Information

(1) Independent Private Value:
\[ v_i \sim F_i \text{ independently of } v_j \text{ for } j \neq i. \]

(2) Common Value:
\[ e_i = v + \varepsilon_i, \varepsilon_i \sim F_i \text{ w/ mean 0.} \]

(3) Interdependent Value:
\[ v_i(x,s), \text{ my value depends on private information } x = (x_1,\ldots,x_n) \text{ and state of world } s. \]

Models of Private Information

- Independent private value model: It makes sense if differences in value arise from heterogeneous preferences over the attributes of the item.
- Common Value: It makes sense if the bidders have homogeneous preferences, so they value the item the same ex post, but have different estimates of this true value.
- Affiliated value model: In this model, each bidder has private information that is positively correlated with the bidder's value of the good.
Benchmark Model

Independent Private Values, Symmetric, Risk Neutral Bidders

- buyer values $v_1, \ldots, v_n \sim F$ on $[0, \infty)$
- seller value $v_0$ (common knowledge)
- order statistics $v_{(1)} \geq v_{(2)} \geq \ldots \geq v_{(n)}$.
- Unique equilibrium in dominant strategies:
  - **English**: bid up to your value or until others stop.
  - **2nd Price**: bid your value.
- The bidder with the highest value wins and pays the second highest value.

Benchmark Auction: Revenue Equivalence

- Seller's revenue:
  - $\text{English} = \text{2nd} = \text{1st} = \text{Dutch}$.
- This follows since all four have the same probability of winning,
  \[
  \frac{d\pi}{dv} = \Pr(\text{Win}), \text{ and } \pi(0) = 0,
  \]
  so the bidder gets the same profit in each, and hence so must the seller. [This follows from the analysis of the direct revelation game.]
eBay

- Starting price
- Reserve price
- Ascending proxy auction
- Bid sniping

Google IPO

- Auction many identical items
- Uniform price auction with special features
- Google may set price below clearing price
- Google may expand quantity
- All bids above offer price are rationed
FCC Spectrum Auctions: Simultaneous Ascending Auction

- All assets on the block at the same time
- In each round, can raise bid on any asset
- Auction ends when no new bids on any asset

Ascending vs. Sealed Bid
Why ascending bid?

“Who should get items and at what prices?”

• Price discovery process
  – Open and transparent (legitimate)
  – Reliable market prices (learning)
  – Efficiency
    • Single item: quite general; strategically simple
    • Many items: arbitrage and packaging possible

Why ascending bid?

• Revenue maximization
  – Efficient auctions raise a lot of revenue
    • May be optimal to award to those with highest values
    • Devices to increase revenues often impractical
      – Reserve prices and handicaps
  • Efficiency looks even better in general model
    – Endogenous participation
    – Resale
Revenue maximization

- Reduces winner’s curse
- Others willing to pay nearly as much
- Not raising is a confession of inferiority
  “If its worth $x to them, why isn’t it worth that much to us? Aren’t we a good company?”
- Budget constraints can be relaxed

Why sealed bid?

- Implementation
  - Don’t have to bring parties together
  - Simple
  - Difficult bid evaluation OK
    - Procurement: Quality of job important
Why sealed bid?

• Ex ante asymmetries
  – If know high valuer wins, then no incentive to bid

• Avoid collusion
  – Dynamic process of ascending auction can be used to *identify* and enforce collusive outcome
    • Zero-price equilibria
    • Can be designed to minimize problem
  – Can’t punish deviations in current auction
  – But can punish outside or in another auction
  – Sealed bid not immune from collusion
Simultaneous ascending auction

• Advantages
  – Reduces uncertainty (winner’s curse)
  – Can react to prices in setting bids across items
    • Similar items sell for similar prices
    • Efficient packaging

• Disadvantage
  – May “negotiate” a split of items at low prices
  – But can eliminate undesirable bid signaling

Conclusion

• Ascending bid typically better than sealed bid on both efficiency and revenue grounds

• Concerns
  – May allow bidders to identify and enforce low revenue equilibrium
  – May do worse if weak competition or ex ante asymmetries