

Game Theory

Auction design 2: eBay

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- Proxy bidding
- Updating rules

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Auctions on internet

How to run an auction on the Internet?

- Most important questions:
 - What **price** the highest bidder pays?
 - What **information** is posted about the current bidding?
- Tend to emulate **English outcry auction**.

Issues: First-price auction

- Most obvious choice is a **first-price** auction (in the form of an English outcry auction).
 - Pay your bid if you win (easy to explain).
 - Post highest bid so far.
- Such an auction makes sense only if bidders are logged on at the **same time** and follow the auction in real time:
 - In practice, people are not watching 24/7 the auction.
 - Need to **make auction “safe”** for buyers that they do not need to be constantly following the auction they are participating in.
- A first-price auction **may not be interesting for buyers**.
 - Bidding one's valuation is not interesting ($\text{surplus} = 0$).
 - Makes the game more complicate: how much underbid?
 - Buyers not enticed to come back if surplus is too small.
- Running a first-price internet auction over an extended period of time is not a good way to emulate the English outcry auction.

Issues: Second-price auction

- So let's do a 2nd price auction.
- What price should we **display**?
 - Suppose we display the highest bid.
 - There are 2 bids so far: \$1 and \$100.
 - My value is \$50: I don't want to bid (I know I lose).
 - Bidder with \$100 wins, pays only \$1: a **disaster for the seller**.
- Solution adopted by eBay:

display (something close) the **2nd highest bid**.

- We have the **California auction**:
 - 2nd price auction: displayed price based on 2nd highest bid.
 - dynamic auction: the auction takes time, you can revise your bid.

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Proxy bidding

When a bidder is placing a bid,

- eBay asks him the **maximum bid**,
- and eBay will **bid on the bidder's behalf**, using increments that work like ticking prices.

Current price	Bid increment
\$0.01 – \$0.99	\$0.05
\$1.00 – \$4.99	\$0.25
\$5.00 – \$24.99	\$0.50
\$25.00 – \$99.99	\$1.00
\$100.00 – \$249.99	\$2.50
...	...
\$50,000.00 and up	\$100.00

Example

- The current price on display is \$10.
- I bid \$30.
- The price on display goes to \$10.50.

eBay works like a 2nd price auction:

- eBay bids (on my behalf) “just above” the highest price: the lowest bid I need to win.
- The previous highest price (\$10) is now the 2nd highest bid.
- The new price on display (\$10.50) is then the 2nd highest bid (+ the \$0.50 increment).

Example (Cont.)

- What if there is another bidder comes later and bids \$40?
- eBay will automatically compute the **outcome of the “bidding war”** between me and the other bidder.
 - Up to \$30 I continue to bid. At that price I stop (better said: eBay stops bidding on my behalf)
 - The last price is \$31 = my final bid of \$30 + the increment of \$1.
- Since everybody uses the proxy bidding, the auction is solved **“immediately”**: as soon as I bid \$30, the price jumps to \$31.
\$31 = the lowest bid that the new bidder (with the \$40 bid) needs to win.

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What eBay displays

- Usual information:
 - Time left before the end of the auction,
 - shipping information,
 - description of the item, etc.
- **Current bid 当前出价:**
the price the winner will pay (if there are no further bids).
- * If no bid made yet then eBay shows the **starting bid** (= minimal price set by seller).
- A frame where the bidder can place a bid, saying
“Enter \$X or more”
X is the **minimal bid (你想获胜的) 最低出价**.

$$\text{Minimal bid} = \begin{cases} \text{starting bid,} & \text{if first bid,} \\ \text{current bid} + \text{increment,} & \text{if not first bid.} \end{cases}$$

Formulae

What about the current bid? See what happens if a bid is made.

$$\text{New current bid} = \begin{cases} \text{starting bid} & \text{if first bid} \\ b_2 + \text{incr.} & \text{if } b_2 + \text{incr.} \leq \text{bid} \\ \text{bid} & \text{if } b_2 + \text{incr.} > \text{bid} \end{cases}$$

where $b_2 = 2\text{nd highest bid}$.

Current bid

- General rule:

Current bid = (in general) second highest bid + increment.

- If

(second highest bid + increment) > highest bid,

then eBay does **not** follow the general rule, but instead sets

Current bid = highest bid.

- Winner pays the current bid.

What is the 2nd highest bid?

eBay ranks bids first by **amount** (highest to lowest), then by **date** (earliest to latest)

Example

Bidder	Bid	Date
Alice	\$50	10:00am
Bob	\$40	10:10am
Chris	\$50	10:20am

Rank of bids:

Date	Highest bid (bidder)	2nd highest bid (bidder)
10:00am	\$50 (Alice)	—
10:11am	\$50 (Alice)	\$40 (Bob)
10:21am	\$50 (Alice)	\$50 (Chris)

Case 1: no bid made yet

Starting bid	Minimal bid
\$10	\$10

Alice makes a first bid, of \$20.

Current bid	Minimal bid
\$10	$\$10 + \$0.50 = \$10.50$

Note: Whether Alice bids \$20, \$1,000 or \$10, the table would be the same.

Case 2.1: some bids already made - new bid not highest

Current bid	Minimal bid	Highest bid (Bob)
\$20	$\$20 + \$0.50 = \$20.50$	\$30
		(Not observed by other bidders!)

Chris posts a bid of \$21. She becomes 2nd highest bidder.

Current bid	Minimal bid
$\$21 + \$0.50 = \$21.50$ (Bob)	$\$21.50 + \$0.50 = \$22$
↑	
Lowest bid Bob needs to win	

Case 2.2: some bids already made - new bid is highest

Current bid	Minimal bid	Highest bid (Bob)
\$20	$\$20 + \$0.50 = \$20.50$	\$30
		(Not observed by other bidders!)

Carol posts a bid of \$35. She becomes highest bidder, Bob becomes the 2nd highest bidder.

Current bid	Minimal bid
$\$30 + \$1 = \$31$ (Carol)	$\$31 + \$1 = \$32$
↑	
Lowest bid Carol needs to win	

Case 3.1: some bids already made - new bid not highest

Current bid	Minimal bid	Highest bid (John)
\$40	$\$40 + \$1 = \$41$	\$50
		(Not observed by other bidders!)

Erin posts a bid of \$49.87. She becomes 2nd highest bidder.

Current bid	Minimal bid
\$50 (John)	$\$50 + \$1 = \$51$
↑	
2nd highest bid + incr.	
$= \$50.87 > \text{bid}_{\text{John}}$	

Case 3.2: some bids already made - new bid is highest

Current bid	Minimal bid	Highest bid (John)
\$40	$\$40 + \$1 = \$41$	\$50
		(Not observed by other bidders!)

Erika posts a bid of \$50.03. She becomes highest bidder, John becomes the 2nd highest bidder.

Current bid	Minimal bid
\$50.03 (Erika)	$\$50.03 + \$1 = \$51.03$
↑	
2nd highest bid + incr.	
$= \$51 > \text{bid}_{\text{Erika}}$	

Case 4: a new bid = highest bid

Current bid	Minimal bid	Highest bid (Frank)
\$110	$\$110 + \$2.50 = \$112.50$	\$150
		(Not observed by other bidders!)

Gina posts a bid of \$150, **after Frank**. She becomes 2nd highest bidder.

Current bid	Minimal bid
\$150 (Frank)	$\$150 + \$2.50 = \$152.50$
↑	
2nd highest bid by Gina	
but $\text{bid}_{\text{Gina}} + \text{incr.} > \text{bid}_{\text{Frank}}$	
$\Rightarrow \text{current bid} = \text{bid}_{\text{Frank}}$	

Bidding several times?

- 2nd-price auction: dominant strategy to bid one's valuation.
- But with eBay bidders can change their bids and they indeed do so:
 - They don't understand the bidding proxy system: they don't bid their valuation.
 - They change their estimates of their valuations: common if interdependent valuations (see section about sniping)

Example

Bidder 1	Bidder 2	Displayed price	comment
		\$1.00	Starting price
\$20.00		\$1.25	Bidder 1 wins
	\$40.00	\$20.50	Bidder 2 wins
\$21.00		\$21.50	Bidder 2 wins
\$22.00		\$22.50	Bidder 2 wins
\$23.00		\$23.50	Bidder 2 wins
\$31.00		\$32.00	Bidder 2 wins
\$35.00		\$36.00	Bidder 2 wins

Bidder 1 may believe someone is having a bidding war with her.

- So bidders can quickly end up thinking eBay is just an auction room like Sotheby's, i.e., forgetting about the proxy bidding.
- If auction deadline is close, bidders can engage in a pursuit by bidding only small increments, and get more frantic as the deadline approaches.

eBay as an English outcry (first-price) auction?

Many people believe that eBay is akin to a first-price auction: I pay my bid (if I win).

It comes from bidders' behavior: bidders bid the minimal amount.

- Item for sale, current highest bid = \$10.
- eBay displays:
 - Current bid: \$10.
 - Minimal bid: \$10.50.
- Janis bids \$10.50 (what most people do).
- Suppose she wins (with that bid). So she pays \$10.50.
⇒ She believes she pays her bid.
- Actually, she paid second highest bid + increment.
- * Had she bid \$500, she would still pay \$10.50.

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Bid sniping (last minute bidding)

- From Roth and Ockenfels (Amer. Econ. Review, 2002)
- From 1999 to 2006, Amazon had an auction Website (like eBay).
- Auctions on Amazon worked very much like eBay:
 - English ascending auction,
 - Proxy bidding,
 - Theoretically it's a 2nd price auction.
- However,
 - on eBay: The auction has a **hard deadline**;
 - on Amazon: If there's a bid in the last 10 minutes, the deadline is **extended for an additional 10 minutes**.

Late bidding is bad

Main issue with late bidding is that the bid may not be successfully transmitted.

- Buyers complain that their bid was not processed.
- Lower revenue for sellers.

Proxy bidding aimed at protecting bidders against late bidders:
Submitting one's true valuation is an insurance against snipers.

Late bidding is good

- May face inexperienced bidders who bid by small increments:
 - If I bid early the “incremental bidder” (inexperienced) will overbid, we may end up with a high price.
 - If I bid late, the bid war doesn’t last long,
⇒ lower final price.
 - Last minute bidding: The incremental bidder doesn’t have time to respond.
⇒ Can win the auction at the incremental bidder’s low initial bid.
- A seller may also use **shill bidders** to bid against (real) bidders.
Bidding late is a way to protect from such (dishonest) behavior.

Should observe more late bidding on eBay than on Amazon.

Additional explanations for late bidding

- With interdependent/common values late bidding has a double rationale:
 - More time to **gather information** from the other bids.
 - **Avoid giving information** to the other bidders.
Particularly relevant for bidders who are identified as “experts.”
- Ability to bid without providing information to the other bidders (or information that can be used) is lower on Amazon.
⇒ Should observe more late bidding on eBay than on Amazon.
- But if bidding late a **not a strategic** choice, we should not observe any difference between eBay and Amazon.

Hypothesis about late bidding (summary)

Hypothesis	Predicted observation
Strategic hypothesis <ul style="list-style-type: none"> – Avoid war against incremental bidders – Protecting one's information 	More late bidding on eBay than Amazon
Non-strategic hypothesis <ul style="list-style-type: none"> – Procrastination – Search engines first present soon-to-expire auctions – Bidders unaware of proxy bidding – Valuation increases (endowment effect) – Bidders don't like bids hanging 	No difference between Amazon & eBay

Data analysis

Roth and Ockenfels used data from eBay and Amazon in “Computers” and “Antiques” categories.

- Computers: private values.
 - retail prices are easily available.
 - bidder's valuations are unobserved.
Bids convey little information.
- Antiques: interdependent values.
 - retail prices more difficult to obtain.
 - Valuations are noisy.
expert's opinion is sometimes required.
Bids are likely to convey information.

Data analysis (Cont.)

- Auctions between Oct. 1999 and Jan. 2000
 - Computers: selected monitors and laptops.
 - Antiques: no selection.
- Auction data only included if
 - at least two bidders;
 - reserve price met whenever there was a hidden price.

For each combination Computers/Antiques & Amazon/eBay 120 auctions:

	Computers	Antiques
Amazon	595 bidders	340 bidders
eBay	740 bidders	604 bidders

Data analysis (Cont.)

- Bidders' ratings also collected.
- Ratings differ between Amazon (1–5 star) and eBay (± 1), but can serve as approximate measure of experience.

For each bid, number of seconds before the end of the auction:

- For eBay unambiguous.
- For Amazon: number of seconds before **hypothetical** deadline.

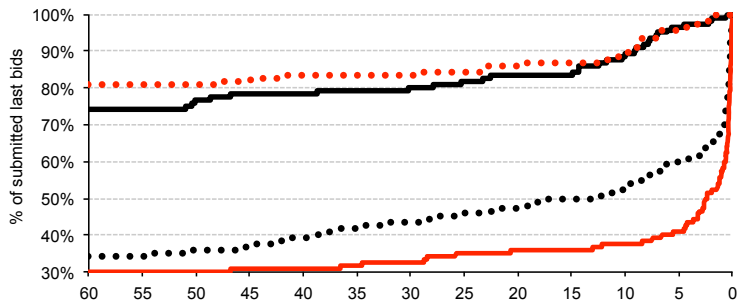
Example: Auction set to end at 11:00am.

- Bidder *A* bids at 10:55am. So new deadline at 11:10am.
- Bidder *B* bids at 11:09am. So new deadline at 11:20am.
- No further bid.

For data analysis:

- Bidder *A*'s bid: 5 minutes before the end.
- Bidder *B*'s bid: 1 minute before the end.

Cumulative distribution of auctions' last bids



... eBay-Computers — eBay-Antiques
 — Amazon-Computers ... Amazon-Antiques

Data

- Percentage of auctions with bid in last 5 minutes:

	Computers	Antiques
Amazon	3%	3%
eBay	40%	59%

(similar pattern when looking at last minute and last 10 seconds).

- on eBay bidders bid later in Antiques than in Computers.
- Significant differences for:
 - more late bidding in eBay than Amazon for Computers;
 - more late bidding in eBay than Amazon for Antiques;
 - more late bidding in eBay-Antiques than eBay-Computers.

(Amazon-Antique \approx Amazon-Computer).

- Experienced bidders bid significantly later on eBay.

Conclusion

- For eBay: late bidding significantly more pronounced for antiques (where expertise matters).
- In a survey, bidders explicitly say that late bidding is
 - to avoid bidding wars (and keep the price down);
 - to avoid sharing information with other bidders.
- Conclusion: Auction design influences behavior.
- Hard deadline gives incentive to bid late.
- Stronger effect with:
 - experienced bidders;
 - interdependent values (bids are informative).

Reserve price

The seller can put a **reserve price**, which is the minimal price for which the good can be sold.

- Reserve price \neq start price.
 - low start price to encourage bidding
- The reserve price can be public.
 - Signal to bidders that the item is valuable
- Secret reserve price.
 - Becomes equivalent to a “shill bid.” Whenever someone bids below, it is outbid.
 - Can trigger a bidding war with the bidders.

eBay: what's next?

- First item sold on eBay:
Sept. 1995, a broken laser pointer, sold for \$14.83.
- By 2002 eBay has hosted for \$15 billion of transactions.
- More registered users than the UK population.
- Today: only 20% of sales involve auctions.
- 2000: eBay introduces “hybrid auctions”:
 - Regular auction.
 - Auction can be circumvented by clicking on “Buy it Now”.
 - Study shows that high “Buy it Now” price boosts the final auction price (bidders think the object is valuable).
- Professional sellers set minimal bid to the “Buy it Now” price, making the auction irrelevant.

eBay: what's next? (Cont.)

- 2002: eBay allows sellers to post objects at fixed prices, without auction.
- Analysis by Einav, Farronato, Levin and Sundaresan (2017):
Between 2005 and 2009, share of auctions dropped by 33%:
 - 2.5% greater presence of mass-produced goods
 - 2.8% presence of professional sellers.
 - 27.7% = ?

Findings

- Few bidders use the “proxy bidding”.
- Most buyers adjust their bids from time to time (30% of bidders submit more than one bid).
- Open the way for snipping, but make auctions a hassle.
- Makes the auction “labor intensive” shopping method, it needs attention. Users prefer “fast methods”.
- Objects sold through an auction get a discount of about 8%: the “cost” of shopping, searching.

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eBay auctions: conclusion

- eBay implements a Vickrey auction using proxy bidding in a dynamic setting:
 - The auction lasts several days/weeks;
 - Bidders can revise their bids.
- Since the price I pay (if I win) depends on the 2nd highest bid, I have incentives to try to “influence” the value of that 2nd highest bid.
 - Feasible when opponents do not fully understand the system (and use small incremental bids).
 - We have (partially) common values: my bid can signal how much the item is worth.
 - Hard deadlines for the auction allow for sniping behavior.
- Bidding one's value is not a dominant strategy anymore.

Take-away

- The eBay auction is, at its core, a **second-price** auction.
- Bidding is made via a **proxy**: eBay bids on behalf of the voters.
- Unlike the Vickrey auction, the eBay auction is also **dynamic**: bidders can update their bids.
- Truthful bidding is not a dominant strategy on eBay.

Take-away (Cont.)

- Sniping (late minute bidding) is an important part of eBay's auction.
- Sniping essentially occurs because of **hard deadlines**.
- Sniping less likely to occur when valuations are private (as opposed to interdependent or common values).
- Use of auctions on eBay is declining, the use of posted price (buy it now!) increases.