

Internet Economics and Financial Technology

Computer Science COMSM0019

Lectures 5 & 6: Economics of the Internet III & IV

- Part II: Applications

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- Part II – Auctions in Practice

- Collusion and entry attractiveness
- eBay, Google, the financial markets

Using and Abusing Auction Theory

“Economic theory is often abused in practical policy-making.

“There is frequently excessive focus on sophisticated theory at the expense of elementary theory;

“too much economic knowledge can sometimes be a dangerous thing.”

Using and Abusing Auction Theory



The Handbook of Market Design

Nir Vulkan, Alvin E. Roth, and Zvika Neeman

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Using and Abusing Auction Theory

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Abstract and Keywords

Economic theory is often abused in practical policy-making. There is frequently excessive focus on sophisticated theory at the expense of elementary theory; too much economic knowledge can sometimes be a dangerous thing. Too little attention is paid to the wider economic context, and to the dangers posed by

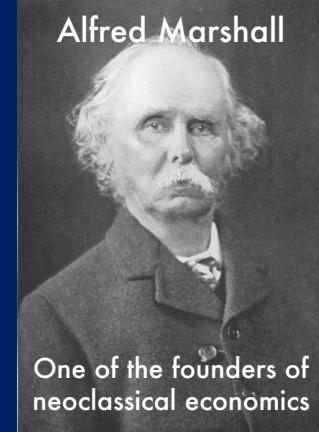
Klemperer (2013), *Using and Abusing Auction Theory*. Chap. 4 of *The Handbook of Market Design*, Vulkan et al (Eds.), 36 pages.

Recommended reading

Don't rely on mathematics...

- Marshall (1906) famously stated that “*a good mathematical theorem dealing with economic hypotheses [is] very unlikely to be good economics,*” and continued by asserting a series of rules:

- (1) translate [*mathematics*] into English;
- (2) then illustrate by examples that are important in real life;
- (3) burn the mathematics;
- (4) if you can't succeed in (2), burn (1)!



Alfred Marshall

One of the founders of
neoclassical economics

- Klemperer (2013) “*good mathematics need not necessarily be good economics*”. To slightly update Marshall's rules, “if we can't
 - (1) offer credible intuition and
 - (2) supply empirical (or perhaps case-study or experimental) evidence, we should
 - (4) be cautious about applying the theory in practice.“

Attractiveness and Collusion

- The RET assumes all auctions are equally attractive, and no collusion
- But in practical auction design **attractiveness to entry** and **robustness against collusion** need to be considered
- Profitability depends on number of bidders who participate
 - Participating can be costly, so bidder will only enter if they feel they can win
 - In ascending auctions, strong bidder can always top a weak bidder, so weak bidders may not enter
 - In first-price sealed-bid, weaker bidder may win at a price the stronger bidder could have beaten, but didn't because they chose to shade
- Collusion:
 - Open auctions help facilitate collusion through bids
 - Sealed-bid auctions are more robust – can't observe other's bids, or punish defection during an auction

Example: Collusion via bid signalling

- Germany, 1999:
 - 10 blocks of spectrum (cellular frequencies) sold by simultaneous ascending auctions.
 - Only two major bidders: T-Mobil and Mannesman (Germany's largest mobile phone companies)
 - Auction rule: any new bid on a block had to exceed the previous high bid by at least 10%.
- What happened?

Round one opens

A: T-Mobil

B : Mannesman

- Auctions open.
- No bids yet.
- A enters bids...

Blocks 1-5

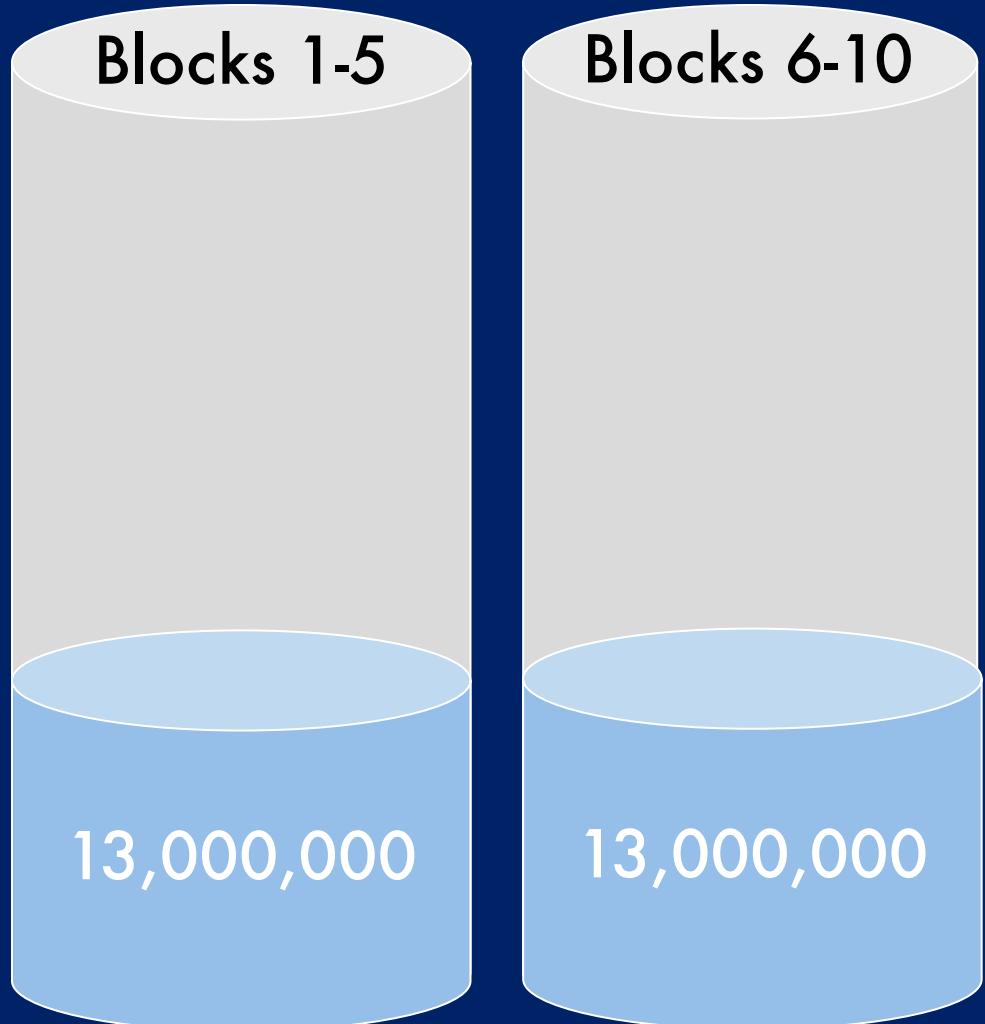
Blocks 6-10

Round one

A: T-Mobil

B : Mannesman

- A's bids showing
- B's turn to enter
(minimum increase 10%)

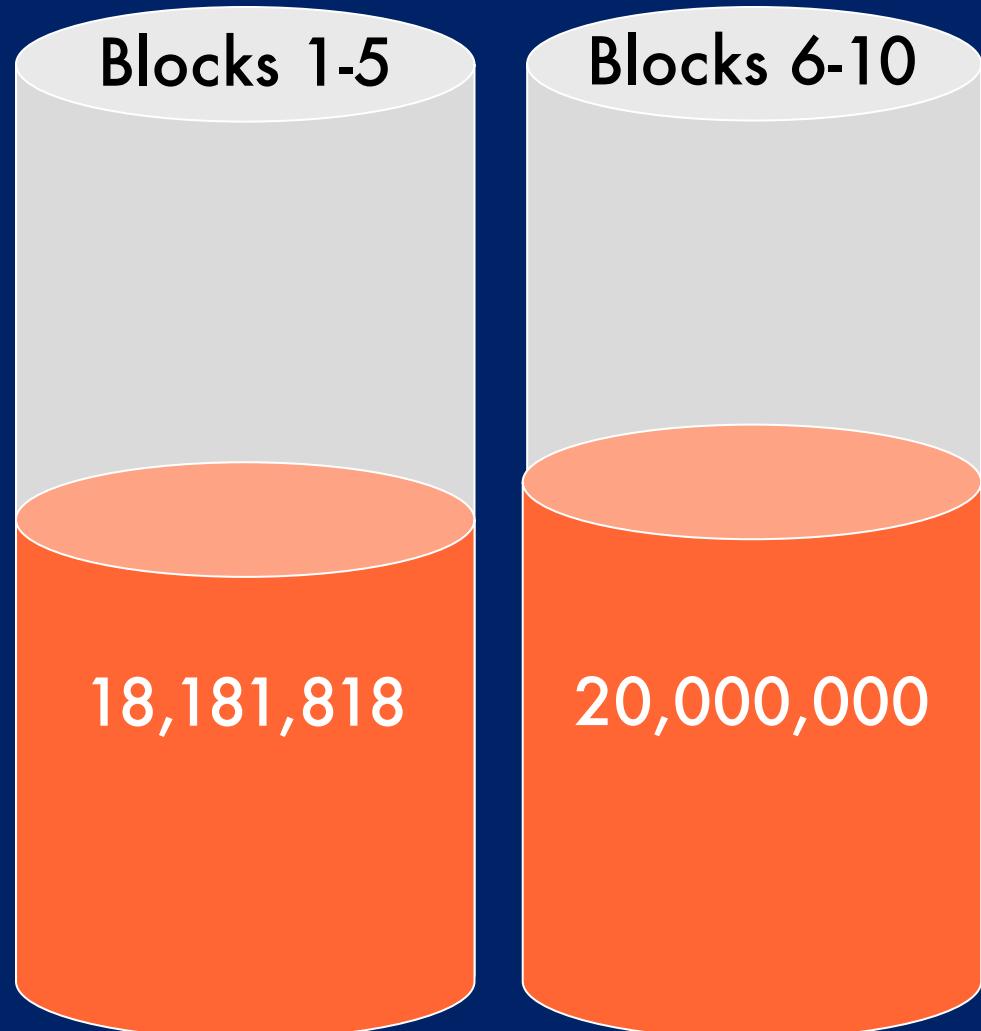


Round One - Closes

A: T-Mobil

B : Mannesman

- B enters bids.
- B bids higher in both auctions
- Round closes

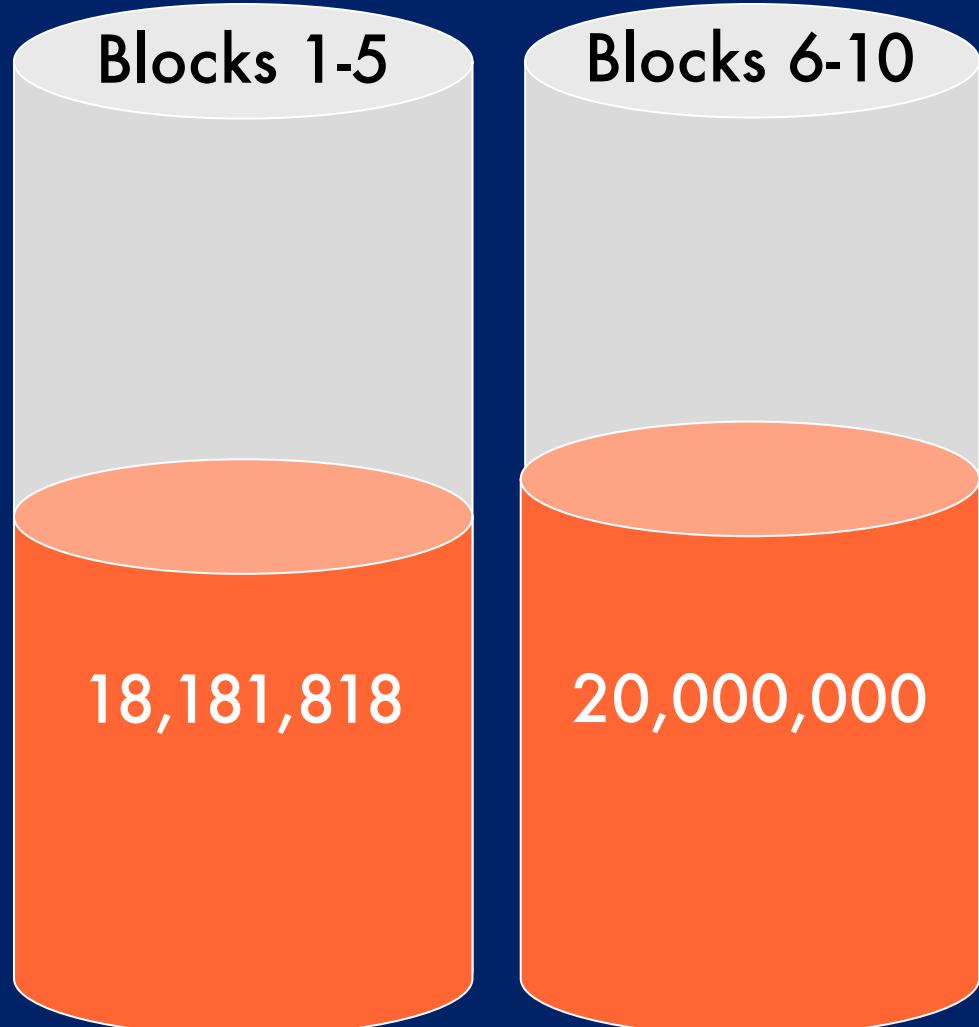


Round Two - opens

A: T-Mobil

B : Mannesman

- A's turn to bid
- B holds highest bid in both auctions
- **QUESTION:** What should A do next, and why?



Round Two - opens

A: T-Mobil

B : Mannesman

- A's turn to bid
- B holds highest bid in both auctions
- **QUESTION:** What should A do next, and why?
- Notice - B's bid for blocks 1-5 is exactly 10% lower than bid for blocks 6-10.

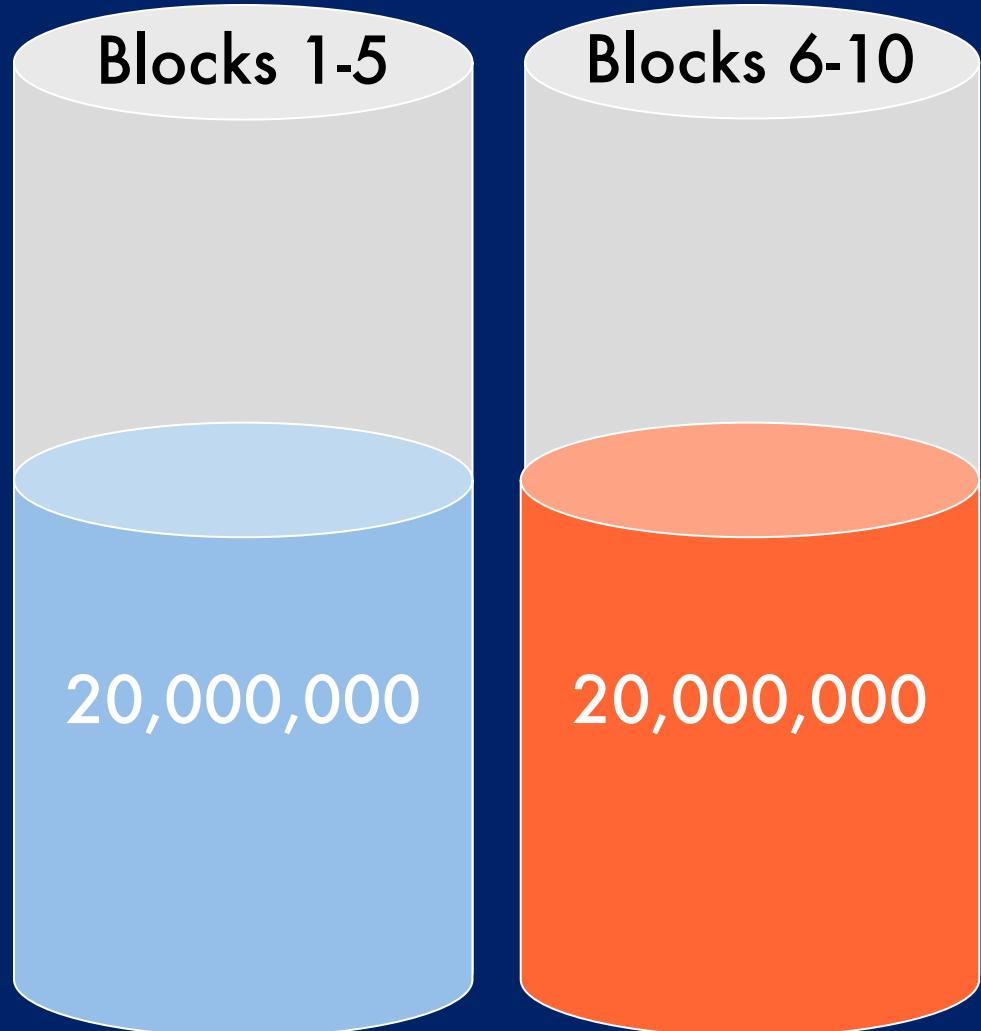


Round Two

A: T-Mobil

B : Mannesman

- A enters one bid of 20 million for blocks 1-5.
- No bid is entered for blocks 6-10.

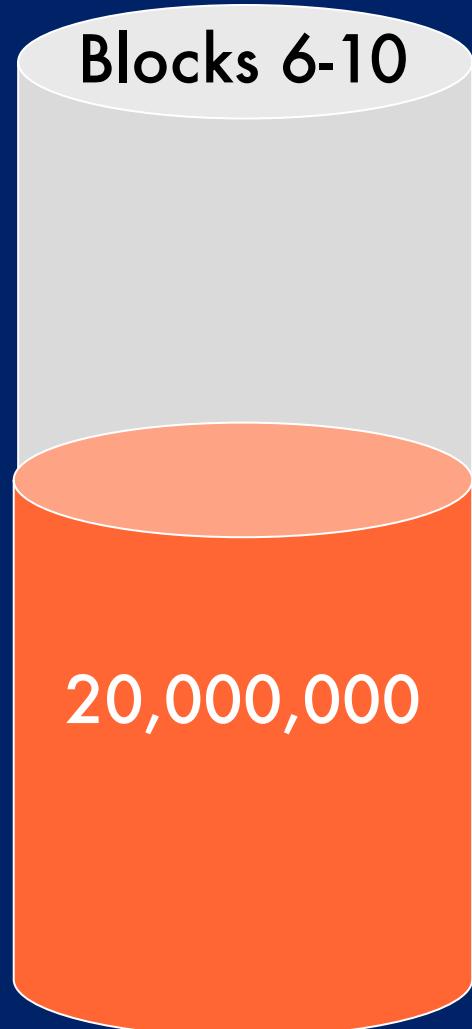


Round Two.

A: T-Mobil

B : Mannesman

- B's turn...
- B enters no bids.
- Round two closes.
- Auction ends.
- A & B share all blocks for crazily low price!
- B signaled to A to share the blocks via the bidding process



Practical concerns of running an auction

Take home message:

- Auction theory helps us understand auction rules and the likely effect these will have on auction outcomes and bidder behaviours
- However, it is naïve to strictly follow auction theory and assume outcomes will be the same in the real world
 - Theory includes lots of simplifications and assumptions that must be considered
- In particular, to ensure your auction works well:
 - You want to avoid collusion (game playing) between bidders
 - And you want your auction to attract lots of bidders

Online auctions

- The Internet enables auctions to be easily run online:
 - Auction rules are algorithmic, so no need for a physical auctioneer
 - Open auctions become easier and cheaper – no need to get everybody in a room, bidders can participate remotely online
 - Sealed auctions also quicker – no physical letter writing, just send electronic message
 - Bidding can be automated, using an algorithm to bid on your behalf
 - Because of all of the above, auctions can be very quick to run
- Auction rules can be easily adapted and do not have to follow the four common auction types exactly
- Auctions can be easily scaled, running many simultaneously, and/or repeatedly one after another
- The Internet has produced a golden age for auctions...

Auctions Online



- Question: name an online auction venue...
 - Probably the most famous auction site is eBay (est. 1995)
 - By 2001, the dominant platform for consumer auctions and third-ranked website by time spent by consumers
 - Mainly C2C and B2C, but also some B2B
 - Near-monopoly as an auction provider: Amazon tried to break in and failed. Remember that because of the network effect and lock-in, auction provision is a market that tends towards monopoly...

eBay auctions

- ‘English’ auctions with a difference...
- Use a **time limit**, rather than ‘going, going, gone....’
- Question: What effect does this have on bidder strategies?
- It can lead to a rush of last minute (or last second) bidding, with people attempting to ‘snipe’ the deal, hoping to:
 - (i) not give away information about their value
 - (ii) get a cheaper price as there is no time for others to out-bid before auction close



- This is not optimal

Qu: Can you think of two possible solutions?

(I) Get everyone to use a sniper...

- eBay introduced “proxy” bidding functionality
- Enter your maximum value and the proxy will bid on your behalf up to that value
- If everyone uses automated proxy bidding, and enters their true maximum bid, then it becomes a Vickrey auction.
- In many ways, a Vickrey auction is a better model for online auctions (as it does not require monitoring), except that it assumes people know in advance what they are willing to pay.

(II) Extend the deadline whenever a bid is placed...

- This turns it into a ‘proper’ English auction.
- Amazon auctions used this approach. Let’s see the result...

Effects of ending rules: bids in the last hour

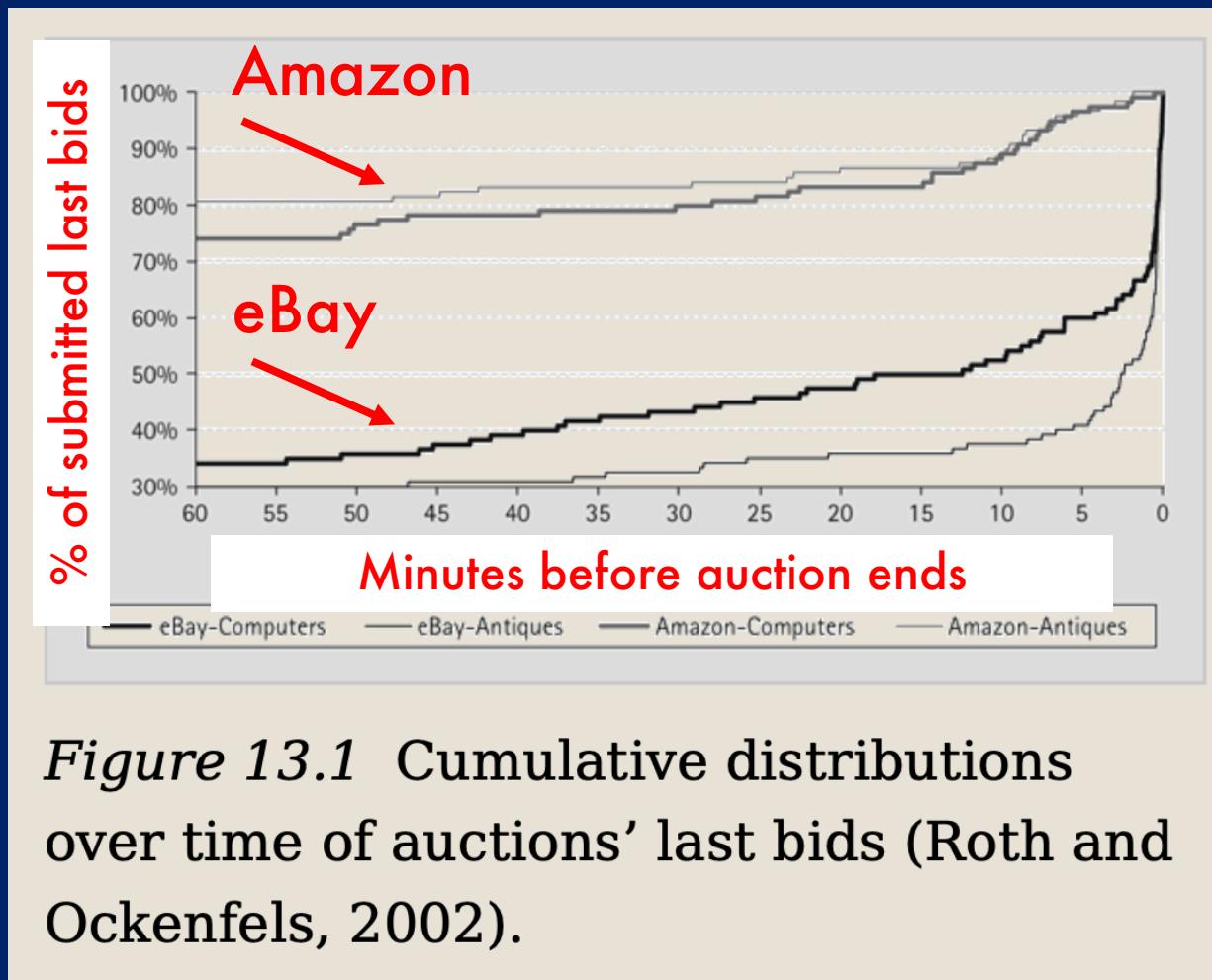


Figure 13.1 Cumulative distributions over time of auctions' last bids (Roth and Ockenfels, 2002).

Ockenfels & Roth (2013), Ending Rules in Internet Auctions, Chapter 14 of The Handbook of Market Design (Vilkman, Roth, Neeman, Eds)

Auctions vs. Posted Prices

- the choice between auctions and posted prices is a trade-off between **competitive price discovery** and **convenience**.
- eBay fits the theory: auctions are favoured by less experienced sellers and for idiosyncratic products, and auction listings sell at a discount but with higher probability relative to comparable posted price listings.

L. Einav, C. Farronato, J. Levin, N. Sundaresan (2018), Auctions versus Posted Prices in Online Markets , Journal of Political Economy, vol. 126, no. 1.

- **Price discovery:**
 - auctions are most useful when sellers are unsure how bidders value an item
- **Differential pricing:**
 - Used in combination, auctions and posted prices enable differential pricing
- eBay holds more than a million auctions per year, but this is not the most held by one company... Qu: Can you guess which company?

The Google Ad Auction

- The largest number of auctions in the world by far (followed by Facebook)
 - an auction per search + per display ad page...
 - Estimated more than two trillion each year! (that's 63,000 / second)
 - Adverts are idiosyncratic, so lend themselves well to auctions
- 11 advert 'slots' are auctioned, with up to 3 premium slots above the search.
- Google assigns them based on:
 - Bid Price * 'Quality'
 - where Quality is dependent on three factors:
 - Historic click through rate for the ad
 - Relevancy (Keyword and Ad Text)
 - Landing page quality and load speed

Quality

The quality score aims to do two things:

- Estimate likely probability of click-through for this display
 - Historic click-through rate and relevance
 - Maximising short-term revenue: (price * probability of clicking)
- Ensure that people who do click through are not disappointed, thus reducing their chance of clicking through on completely different searches in the future.
 - Landing page quality
 - Protecting ‘longer term’ revenue

Google Ad Auction: Second-price sealed-bid

- Originally, Google considered a first-price auction where you pay what you bid.
- Question: what do you think happened?
 - Google noticed that bidders would load the servers by constantly monitoring the system to work out if they could reduce their bid
 - So, they went for a second-price approach instead
 - They want the auction to be incentive compatible to reduce monitoring overheads.
 - Not: here, algorithmic motivations resulted in them ‘rediscovering’ an economic result from auction theory – i.e., Vickrey auction

“Introduction to the Google Ad Auction”

- Video available on YouTube, published by GoogleBusiness
- Presented by Hal Varian
- 9 minutes long – Recommended viewing for this unit
- <http://www.youtube.com/watch?v=a8qQXLby4PY>

What's going on with 'Quality'?

- To a first order approximation, **quality q** is an estimate of '**probability of being clicked**'.
- When a bidder bids a price, **p** , Google is not interested in this. It considers the bid to be **(p^*q)** and uses this to determine the outcome of the auction.
- But the bidder doesn't pay this.
 - The bid below them was **(p'^*q')** say. This is the 'second price' in the auction.
 - **If the winning bidder is clicked, they pay $(p^*q')/q$.**
 - This is the price the bidder below bid, times the ratio of probabilities of being clicked.

Estimating ‘probability of being clicked’

- The probability of being clicked is dependent on two things: **ad quality**, and also **ad placement** on the page.
- Google needs a model for the latter which is independent of ad quality.
- It has done this by randomly allocating adverts to different positions to estimate the position-specific effect.
- They also offer a similar random-placement service to advertisers to allow them to experiment with different adverts and see which is most effective.
- Experiments are far faster and cheaper online. One of the roles of algorithms is ‘**economic experimentation**’ rather than relying on expert forecasting.

The effect of competition

- As the price set depends on the bids of those under you, competition is important for Google.
- An oversold auction makes significantly more than an undersold one
 - You want the auction to attract bidders
- To stimulate competition, Google would prefer advertisers to use ‘partial match’ rather than ‘exact match’ for keywords.

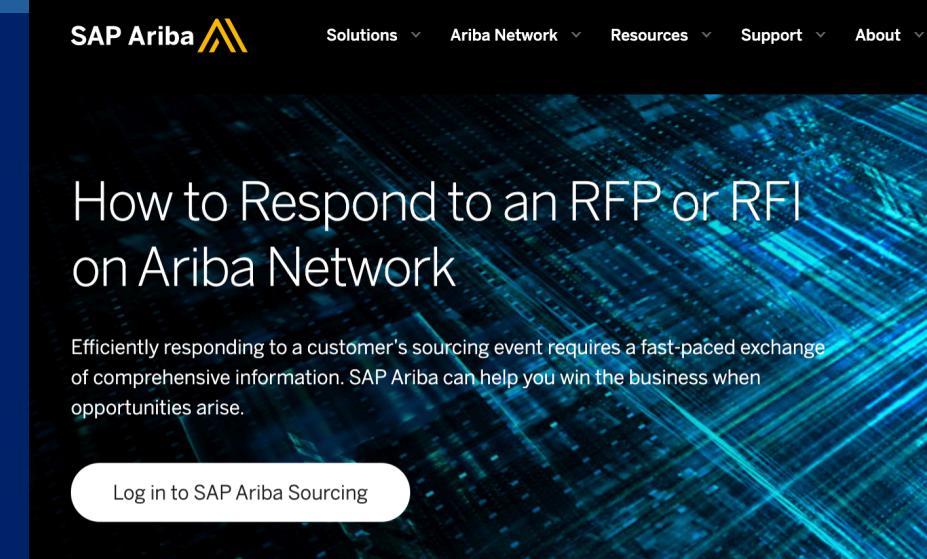
Farewell ‘Pure’ Exact Match, AdWords Will Soon Require All Campaigns To Use Close Variants

Greg Finn on August 14, 2014 at 7:00 pm



Reverse Auction

- A **reverse auction** has suppliers bidding to meet a contract.
- Suppliers bid lower and lower – the lowest bid wins the contract to supply (i.e., sell)
- Often suppliers must be ‘qualified’ before being allowed to participate. Hence less open than eBay.
- Used by many companies, and also the US government.



The screenshot shows the SAP Ariba homepage with a dark blue header featuring the SAP Ariba logo and navigation links for Solutions, Ariba Network, Resources, Support, and About. Below the header is a large, blurred background image of a circuit board. Overlaid on the image is the title "How to Respond to an RFP or RFI on Ariba Network". A subtitle below it reads: "Efficiently responding to a customer's sourcing event requires a fast-paced exchange of comprehensive information. SAP Ariba can help you win the business when opportunities arise." At the bottom of this section is a white button with the text "Log in to SAP Ariba Sourcing".

And a little about auctions

In SAP Ariba Sourcing, an auction is known as a reverse auction. It's an online event in which suppliers respond to RFIs and RFPs in real time with bids to provide specific goods or services. When you participate in a reverse auction, sourcing professionals evaluate your bidding documents and provide feedback on how your bid compares with other participants'. Depending on how the event is configured, that feedback can take the shape of comparisons with the lead bid, overall bid ranking, and bid-comparison graphs.

Reverse Auction

- Sellers of a service offer lower and lower prices
- Winner is the lowest offer

Offers to sell

£108

£106

£104

Reverse Auction

Double Auction

- What happens if we put an open ascending auction and a reverse auction together?
- We call this a **double auction**

Offers to sell

£108
£106
£104

Open-ascending

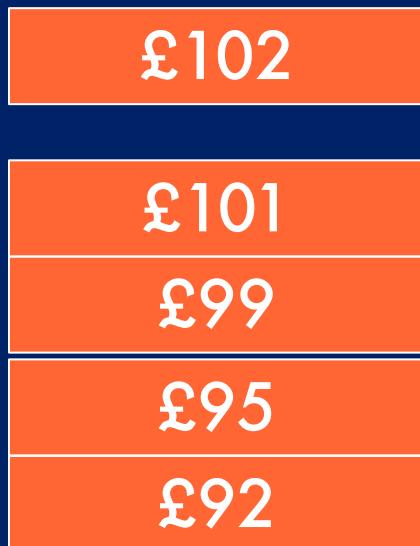
£99
£95
£92

Bids to buy

Reverse Auction

Double Auction

- When the prices cross, we get a match



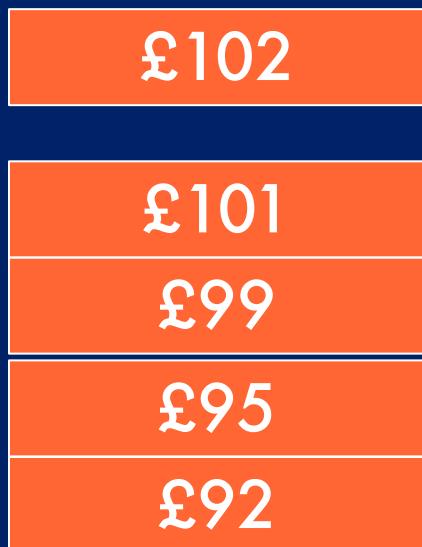
Trade at £102

Offers to sell

£108
£106
£104
£102

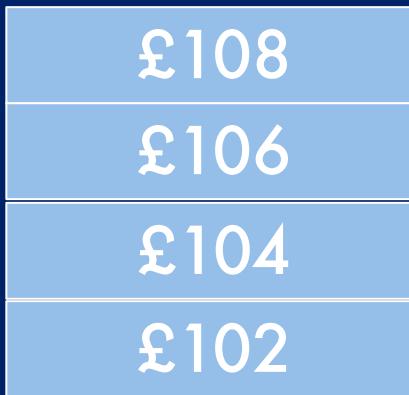
The Continuous Double Auction

- The continuous double auction (CDA) allows buyers and sellers to post bids and offers at any time



Trade at £102

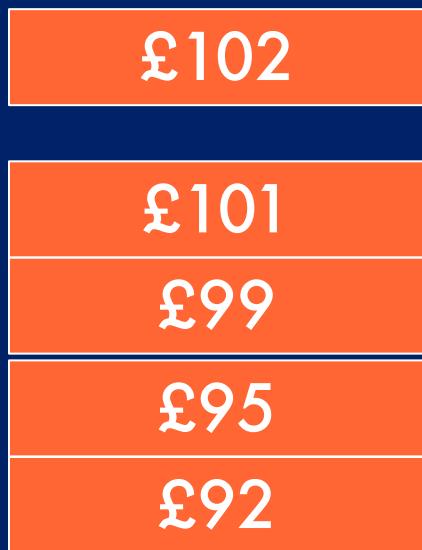
Offers to sell



Bids to buy

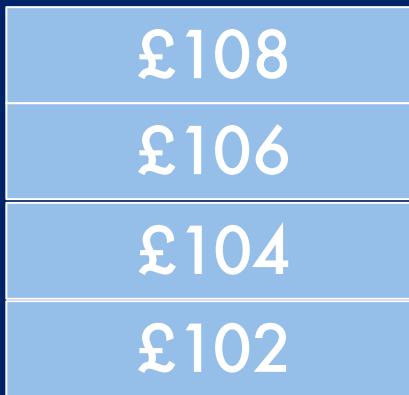
The Continuous Double Auction

- The **continuous double auction** (CDA) allows buyers and sellers to post bids and offers at any time



Trade at £102

Offers to sell



- This kind of auction underpins the **financial markets**
- It is how shares, commodities, etc., are bought and sold

Financial Markets

- Major financial exchanges, e.g., London Stock Exchange, trade using a CDA.
- Bids to buy and offers to sell are visible in a **Public Order Book**
- Right now:
 - You can buy the stock for £102, or put a lower bid in, e.g., £100 and wait
 - You can sell the stock for £101, or put a higher offer in, e.g., £102 and wait
- This open and continuous trading enables efficient price discovery – prices can change extremely quickly based on new events such as news

Bids to buy

£101
£99
£95
£92

Offers to sell

£102
£104
£106
£108

Trading in the dark

- But sometimes when you are trading you do not want to give away your private information...
- If you want to sell a large amount of stock (e.g., 1 million shares of Apple), then if you tell everybody by posting to the public order book it is likely to move the price against you
 - Share price will fall as you have dramatically increased supply (a supply shock)
- So, there are some financial exchanges that allow you to trade in secret. These are called dark pools.
- Orders in a dark pool cannot be seen by others, so you are not revealing any information when you send your bid or offer
 - A public order book is equivalent to an open auction,
 - A dark pool is similar to a sealed auction

Warning: trust nobody when money is involved!

- Dark pools are designed to keep your trading intentions secret so that there is no price impact to your bid/offer
- But what happens if the owner of the dark pool is using your information against you? This happens (a lot!)
- Recent research: ways to fully encrypt dark pools using Multi-Party Encryption, so that the owners cannot look at (and abuse) the information inside
- Compulsory reading: Sections I - 2.3 [first four pages]
 - J. Cartlidge, N. P. Smart, and Y. Talibi Alaoui (2019), “**MPC Joins the Dark Side**”, in Proceedings 14th ACM Asia Conference on Computer and Communications Security (AsiaCCS '19): Auckland, New Zealand, 9-12 Jul. 2019, pp. 148–159.
 - <https://eprint.iacr.org/2018/1045>

Summary

- Auction theory lets us understand behaviours and expected outcomes in common auction mechanisms
 - But mathematics can only take us so far
 - Auctions in the real world need to be designed to stop collusion and other game-playing strategies
 - Experimentation is a better method to understand behaviours/dynamics
- The internet has enabled auctions to flourish
 - Ease of access
 - Algorithmic bidding/trading
- Auctions particularly useful for price discovery:
 - When it's hard to know how much bidders are willing to pay
 - To enable prices to change quickly in response to demand and supply (e.g., the financial markets)

Example Questions

A.12 Describe an English auction. Describe a Vickrey auction. Explain why (assuming goods have private value) these are (almost) equivalent in terms of revenue.

[4 marks]

B.1(c): What is a Dutch auction mechanism? Explain why a monopoly provider may not want to use a Dutch auction to sell their product or service.

[6 marks]

Next Week

- **Flipped session:**
 - Dave: In-class financial market experiment and the CDA
- **Before next weeks session, things to watch/read:**
 - Video lecture will be made available on Blackboard
- I'll see you in two weeks time

[END]