Auctions
Types of Auctions I

- **English Auction** (ascending-bid):
  - Initial bid set at seller’s reservation price (reserve price)
  - Bidders bid up, the last bidder gets the good at her bidding price
  - You get information about willingness to pay of others
  - Sometimes time limits
  - eBay Deutschland – Der weltweite Online-Marktplatz
Types of Auctions II

- **Dutch Auction** (descending-bid):
  - Initial price very high
  - Price is lowered at time intervals
  - The first bidder gets the good
  - Used for Dutch flower auctions
Types of Auctions III

- **Sealed-bid auction:**
  - Only one bid per person in a sealed envelope
  - First-price sealed bid auction: highest bidder receives the good at her stated price
  - Reverse sealed-bid auctions used for public procurement (highways, public construction)
Types of Auctions IV

- **Second-price sealed-bid auction:**
  - Vickrey auction
  - The highest bidder receives the good, but she has to pay only the price of the second-highest bidder
Why should you want to use an auction to sell something?

- Rules of the auction can easily be influenced
- Goods in limited quantities (often unique, but not necessarily)
- Way to elicit willingness to pay from consumers
- Online auctions easily done
Baseline model

- **Bidders are symmetric:**
  - Bidders select bid from the same distribution of possible bids
  - But do not necessarily chose the same

- **Bidders are risk-neutral**

- **Bids are based on signals from an independent distribution**
  - Private-value auction: everybody values the good (art) differently: my value does not influence yours
  - Common-value auction: true value unknown, but all bidders would value the good alike (oil field)
    - Each bidder forms expectations about the true value
Bidding situation

- b … bid
- p … price
- \( \text{Pr}_W \) … probability of winning the auction
- \((b-p)\) surplus
- \(\text{Pr}_W (b-p)\) … expected profit of a bid

Revenue equivalence theorem:
- All auctions give the same expected revenue to the seller
Bidding strategies

- Only in English auction bidders learn more about reservation prices of the others

- But dominant strategy:
  - Always bid up to the reservation price (in fact bid one cent above the last bid of the others)
  - Good is sold at reservation price of the second-highest bidder (plus 1c)

- Same prediction in second-price sealed bid auction:
  - Dominant strategy to bid the reservation price
  - Vickrey auction is a truth-telling mechanism:
    - Structure gives an incentive to reveal the true willingness-to-pay.
The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2007

"for having laid the foundations of mechanism design theory"

Leonid Hurwicz
- 1/3 of the prize
- USA
- University of Minnesota
  Minneapolis, MN, USA
- b. 1917
  (in Moscow, Russia)

Eric S. Maskin
- 1/3 of the prize
- USA
- Institute for Advanced Study
  Princeton, NJ, USA
- b. 1950

Roger B. Myerson
- 1/3 of the prize
- USA
- University of Chicago
  Chicago, IL, USA
- b. 1951
Dutch and sealed-bid auction

- Strategically similar
  - No dominant strategy; you have to consider what the others are bidding
  - E.g. Dutch, you should not bid your reservation price, because then no surplus available any more.
  - If distribution of valuations is known, bidders can anticipate bidding.
  - Nash strategy: assume others are behaving rationally; then you should maximize your expected profit
Dutch and sealed-bid auction II

- Nash-strategy:
  - Estimate the reservation price of the second-highest bidder and bid it.
  - How to do it?
  - Number of bidders n is important: the more bidders, the closer you should bid to your own reservation price

- If distribution of bids is uniformly distributed between L (low end) and v (bidders reservation price):
  - \[ B = v - \left(\frac{(v-L)}{n}\right) \]
Strategy for Seller

- Auctions similar to third-degree price discrimination
- Seller should always sell to bidder with highest reservation price
- Auctions are efficient in that sense

Example:
- Four units to sell, MC=0
- Six consumers with WTP (90, 60, 50, 40, 20, 15)
- Seller posts a price of €40
<table>
<thead>
<tr>
<th>Consumers</th>
<th>Reservation price</th>
<th>Win bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$40</td>
<td>$21</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>90</td>
<td>61</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>51</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>41</td>
</tr>
<tr>
<td>Total consumer surplus</td>
<td></td>
<td>66</td>
</tr>
<tr>
<td>Total seller surplus</td>
<td></td>
<td>174</td>
</tr>
<tr>
<td>Total available surplus</td>
<td></td>
<td>240</td>
</tr>
</tbody>
</table>

**Table 16.1 Auction**
<table>
<thead>
<tr>
<th>Consumers</th>
<th>Reservation price</th>
<th>Price paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$40</td>
<td>$40</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>90</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Total consumer surplus</td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Total seller surplus</td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Total available surplus</td>
<td></td>
<td>240</td>
</tr>
</tbody>
</table>

Table 16.2 Posted Price
Use of auctions to gather more information about buyers

- Example: Repurchase Tender Offer (company wants to buy back shares from current shareholders)
- One possibility: fix a price, wait how many shares will come back
- Or: modified Dutch auction: firm announces a price range; shareholders have to provide a supply schedule
- Price is set afterwards
• Company assumes share is worth $20
• Expectations about supply schedule of shareholders under three scenarios
• Profit = (20 - share price) * shares traded

<table>
<thead>
<tr>
<th>Price</th>
<th>Strong</th>
<th>Profit</th>
<th>Medium</th>
<th>Profit</th>
<th>Weak</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$15</td>
<td>400,000</td>
<td>$2,000,000</td>
<td>310,000</td>
<td>$1,550,000</td>
<td>280,000</td>
<td>$1,400,000</td>
</tr>
<tr>
<td>16</td>
<td>415,000</td>
<td>1,660,000</td>
<td>400,000</td>
<td>1,600,000</td>
<td>315,000</td>
<td>1,260,000</td>
</tr>
<tr>
<td>17</td>
<td>600,000</td>
<td>1,800,000</td>
<td>415,000</td>
<td>1,245,000</td>
<td>400,000</td>
<td>1,200,000</td>
</tr>
</tbody>
</table>

Probability of shareholder's willingness to tender

<table>
<thead>
<tr>
<th>Strong</th>
<th>Medium</th>
<th>Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40</td>
<td>0.30</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Table 16.3 Shareholder Supply Schedule
Expected profit if firm does not know supply schedule

- Firm has to set a price:

  - $EV(15) = 2.0 \times 0.4 + 1.55 \times 0.3 + 1.4 \times 0.3 = $1.685$
  - $EV(16) = 1.66 \times 0.4 + 1.6 \times 0.3 + 1.26 \times 0.3 = $1.522$
  - $EV(17) = 1.8 \times 0.4 + 1.245 \times 0.3 + 1.2 \times 0.3 = $1.453$

- $15$ is chosen
Expected profit if auction is chosen

- Price selected only after the auction
- In strong supply case $15 is chosen, in medium $16 and in weak $15
- \( EV(auction) = 2.0*0.4+1.6*0.3+1.4*0.3 = 1.700 \)

- Profit possible, because firm can set a higher price in one of the cases

- How does it work?
  - You need a truth-telling mechanism, so that shareholders reveal the right supply schedule
  - Contract is needed: shareholders cannot sell more share at the specified price (otherwise they would lie)
Priceline: an example for a reverse auction

- [www.priceline.com](http://www.priceline.com)
- Auction for airline seats
- Airline seats are perishable goods, marginal costs are very low, empty seats bring no cash
  - Giving official discounts does not make sense, because price structure would suffer
- Buyers name price they are willing to pay, priceline is auctioning: if an airline is accepting, the sale is done(!)
Priceline.com is a good example of how managers can use sophisticated pricing policies within an auction format. The company was launched in April 1998 after Priceline managers helped develop software for a computer reservation system. The software gave airline managers the ability to make real-time adjustments to prices based on various factors, like unoccupied seats or competitor prices. Each airline sees only its own prices, but managers at Priceline are able to see prices across all member airlines.

Airline seats are perishable goods: Once the plane departs, empty seats are worthless, since they cannot be used again. And the marginal cost of flying a plane with one more passenger is almost zero, so any price is profitable for the airline. As Brian Ek of Priceline.com states, "The airlines fly with up to 700,000 empty seats a day. Naturally they would love to sell those seats if they could without affecting their retail fare structure." Priceline.com developed an auction mechanism to allow airlines to do just that. The company has sold over 5 million airline tickets since 1998.

Priceline.com uses a reverse auction mechanism. In reverse auctions, buyers name the price they are willing to pay for a good or service. The seller then decides whether to accept or reject this price. Priceline's auction operates as follows: A consumer specifies a departure date, the departing and destination airports, the price each is willing to pay for a ticket, and a credit card number. All sales are final. If Priceline finds a ticket at or below that price, the consumer is obligated to purchase it. After receiving a consumer's price, managers at Priceline examine their database to determine if any airline is offering tickets at or below that price. If there are tickets, Priceline buys them. The profit to Priceline is the difference between what the consumer is willing to pay for the ticket and the price Priceline was charged.

Although Priceline claims it has increased the market power of consumers (since they are free to name their own price), many disagree with the claim. Basically, Priceline's reverse auction allows the firm to practice price discrimination. Like airlines, Priceline sells tickets on the same airplane at different prices depending on the price quoted by the consumer. Say I submit a price of $300 for a ticket from New York to Chicago. If my friend submits a price of $250, she would buy an identical product at a cheaper price (assuming airlines were willing to sell tickets for $250). Basically, Priceline's reverse auction gets consumers to name their reservation price, then Priceline charges them this price. So the reverse auction does not guarantee that consumers receive a product at the lowest price, it simply guarantees them the chance to purchase a product at their reservation price.

Priceline's price-discriminating auction also improves on the traditional price discrimination schemes by making discounts less transparent to both consumers and rivals. Airlines need not post any special rates, which reduces the probability that rivals could engage in a disastrous price war. Also, the company is able to practice price discrimination selectively. For example, there is some evidence that Priceline will accept lower prices from first-time customers. When those consumers subsequently bid the same price for the same product, they find their bids are rejected.
Risk aversion

- In second-price auctions risk-aversion does not matter. Why?
- What in a first-price auction or Dutch auction?
  - No dominant strategy
  - Higher bids increase probability of winning
  - If risk-averse bidders want to avoid losing, they will increase their bid
- If bidders can be assumed to be risk-averse, then sellers should chose first-price auctions!!
Expected bid (sale) = reservation price of the second-highest bidder.

More bidders will increase profit for the seller.

Assume reservation price of bidders is uniform between 0 and €100, expected revenue for seller:

\[ B = \frac{(N-1)}{(N+1)} \times \text{(highest reservation price)} \]
Figure 16.2 Expected Revenue versus Number of Bidders
Winner’s curse

- Is it always good to win the auction?
- Be aware in common value auctions!
  - True value of the good not known for sure, but common to all (e.g. oil field)
  - Sealed-bid first price auction:
    - Most optimistic bidder wins
  - Same problem for project procurement (reverse auction)
Figure 16.3 The Winner's Curse

$A = \text{distribution of bids}$

$B = \text{estimates of value}$
Winner’s curse

- Serious problem

- What can you do?
  - The less information you have relative to the others, the lower your bid.
  - The less confident you are, the lower should be the bid.
  - The more bidders, the lower should be the bid.
    - This is just the opposite, the typical „gut feeling“ would tell you!!
Problems in auctions (for sellers)

- Make the auction attractive for bidders:
  - The more bidders you attract, the better
  - Setting a start price too high, can deter bidders from entering

- Collusion of bidders can occur
  - In particular in multi-unit auctions, where several units of a good are sold
  - Collusion is not illegal in auctions in general, but in gov’t procurement reverse auctions

Paul Klemperer

In the Austrian third-generation mobile spectrum sale, for example, six firms competed for twelve identical lots in an ascending auction and not surprisingly seemed to agree to divide the market so each firm won two lots each at not much more than the very low reserve-price. Perhaps six winners was the efficient outcome. But we certainly cannot tell from the behavior in the auction. (It was rumored that the bidding lasted only long enough to create some public perception of genuine competition and reduce the risk of the government changing the rules.)

Firms are also permitted to make explicit statements about auctions that would surely be unacceptable if made about a “normal” economic market. For example, before the Austrian third-generation spectrum auction Telekom Austria, the largest incumbent and presumably the strongest among the six bidders, said it “would be satisfied with just 2 of the 12 blocks of frequency on offer” and “if the [5 other bidders] behaved similarly it should be possible to get the frequencies on sensible terms”, but “it would bid for a 3rd block if one of its rivals did” (Reuters, 31/10/2000)). It seems inconceivable that a dominant firm in a “normal” market would be allowed to make the equivalent offer and threat that it “would be satisfied with a market share of just $\frac{1}{6}$” and “if the other five firms also stick to $\frac{1}{6}$ of the market each, it should be possible to sell at high prices”, but “it would compete aggressively for a larger share, if any of its rivals aimed for more than $\frac{1}{6}$”.9
Books for summer reading: you will enjoy them!