

# Algorithmic game theory

Martin Balko

12th lecture

January 4th 2024



# Social surplus maximization

## Social surplus maximization

- So far, we were designing DSIC mechanisms for single-parameter environments that maximize the **social surplus**  $\sum_{i=1}^n v_i x_i(b)$ .

## Social surplus maximization

- So far, we were designing DSIC mechanisms for single-parameter environments that maximize the **social surplus**  $\sum_{i=1}^n v_i x_i(b)$ .
- We did not care about the **revenue**  $\sum_{i=1}^n p_i(b)$ .

## Social surplus maximization

- So far, we were designing DSIC mechanisms for single-parameter environments that maximize the **social surplus**  $\sum_{i=1}^n v_i x_i(b)$ .
- We did not care about the **revenue**  $\sum_{i=1}^n p_i(b)$ .
- This makes sense in some real-world scenarios where revenue is not the first-order objective.

# Social surplus maximization

- So far, we were designing DSIC mechanisms for single-parameter environments that maximize the **social surplus**  $\sum_{i=1}^n v_i x_i(b)$ .
- We did not care about the **revenue**  $\sum_{i=1}^n p_i(b)$ .
- This makes sense in some real-world scenarios where revenue is not the first-order objective. For instance, in government auctions (e.g., to sell wireless spectrum).



Source: youtube.com

# Social surplus maximization

- So far, we were designing DSIC mechanisms for single-parameter environments that maximize the **social surplus**  $\sum_{i=1}^n v_i x_i(b)$ .
- We did not care about the **revenue**  $\sum_{i=1}^n p_i(b)$ .
- This makes sense in some real-world scenarios where revenue is not the first-order objective. For instance, in government auctions (e.g., to sell wireless spectrum).



Source: youtube.com

- In **single-item auctions**, maximizing social surplus is done by **Vickrey's auction**.

# Social surplus maximization

- So far, we were designing DSIC mechanisms for single-parameter environments that maximize the **social surplus**  $\sum_{i=1}^n v_i x_i(b)$ .
- We did not care about the **revenue**  $\sum_{i=1}^n p_i(b)$ .
- This makes sense in some real-world scenarios where revenue is not the first-order objective. For instance, in government auctions (e.g., to sell wireless spectrum).



Source: youtube.com

- In **single-item auctions**, maximizing social surplus is done by **Vickrey's auction**.
- In general single-parameter environments, we use **Myerson's lemma**.



# Revenue maximizing auctions



Source: Reprofoto

# Revenue maximization

# Revenue maximization

- How to maximize the revenue  $\sum_{i=1}^n p_i(b)$ ?



Source: <https://merger.com/recurring-revenue/>

# Revenue maximization

- How to maximize the revenue  $\sum_{i=1}^n p_i(b)$ ?



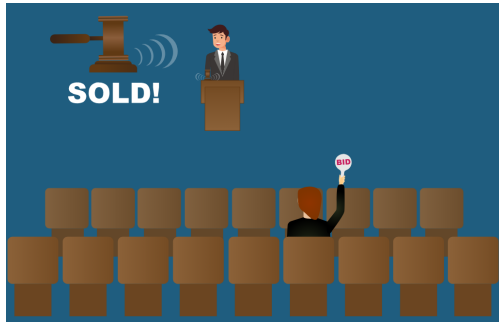
Source: <https://merger.com/recurring-revenue/>

- The situation then becomes more complicated, but we will see some nice results today.

Why is it more complicated?

# Why is it more complicated?

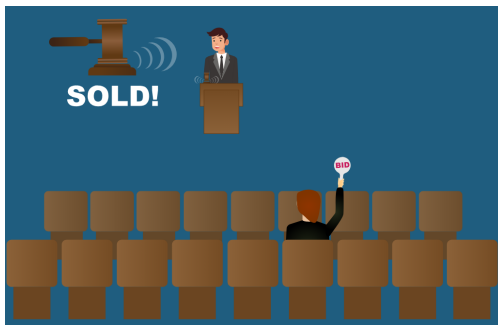
- Consider single-item auction with 1 bidder with valuation  $v$ .



Source: <https://auctions.propertyolvers.co.uk/>

# Why is it more complicated?

- Consider single-item auction with 1 bidder with valuation  $v$ .

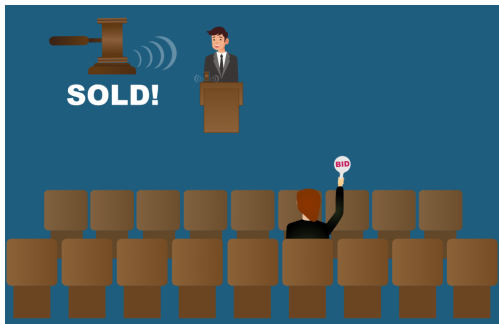


Source: <https://auctions.propertyolvers.co.uk/>

- the **only DSIC auction**: the seller posts a price  $r$ , then his revenue is either  $r$  if  $v \geq r$  and 0 otherwise.

# Why is it more complicated?

- Consider single-item auction with 1 bidder with valuation  $v$ .



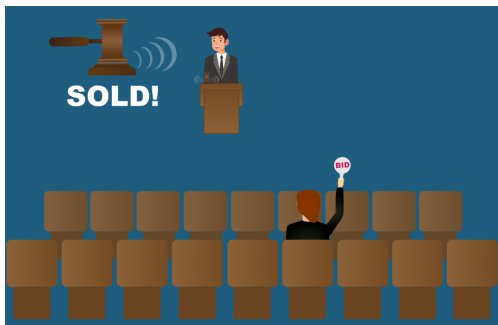
Source: <https://auctions.propertyolvers.co.uk/>

- the **only DSIC auction**: the seller posts a price  $r$ , then his revenue is either  $r$  if  $v \geq r$  and 0 otherwise.
- Maximizing the **social surplus** is trivial by putting  $r = 0$ .



# Why is it more complicated?

- Consider single-item auction with 1 bidder with valuation  $v$ .



Source: <https://auctions.propertyolvers.co.uk/>

- the **only DSIC auction**: the seller posts a price  $r$ , then his revenue is either  $r$  if  $v \geq r$  and 0 otherwise.
- Maximizing the **social surplus** is trivial by putting  $r = 0$ .
- However, when maximizing the **revenue**, it is not clear how we should set  $r$ , since we do not know the valuation  $v$ .



- The Vickrey auction with reserve price is used by eBay.

- The Vickrey auction with reserve price is used by eBay.

Address <http://cgi.ebay.com/ws/eBayISAPI.dll?ViewItem&item=300244682874>


**ebay**® Sign in or register

Categories ▾ Motors Express Stores

[Back to home page](#) Listed in category: [Everything Else](#) > [Weird Stuff](#) > [Totally Bizarre](#)

### A real live ghost! Trapped in a box!

Bidder or seller of this item? [Sign in](#) for your status



**FREE shipping**

Current bid: **US \$38.37**

Your maximum bid: **US \$**  **Place Bid >**

(Enter US \$39.37 or more)

---

End time: **Aug 03 08 20:28:12 PDT (6 days)**

Shipping costs: **Free**  
US Postal Service First Class Mail®  
Service to [United States](#)  
([more services](#))

Ships to: **Worldwide**

Item location: **Marion County, South Carolina, United States**

History: [24 bids](#)

High bidder: [0\\*\\*\\*h](#) (92 ★)

[View larger picture](#)

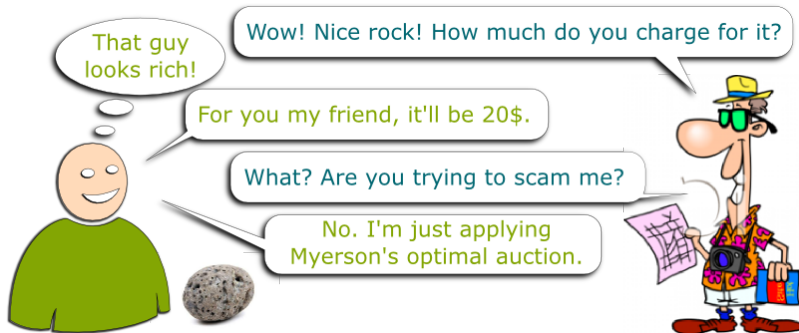
## Reserve price and maximizing revenue

## Reserve price and maximizing revenue

- The theory was developed by [Roger Myerson](#).

# Reserve price and maximizing revenue

- The theory was developed by **Roger Myerson**.
- Very roughly, if the seller believes that bidders have high valuations, he should set a high reserve price accordingly.



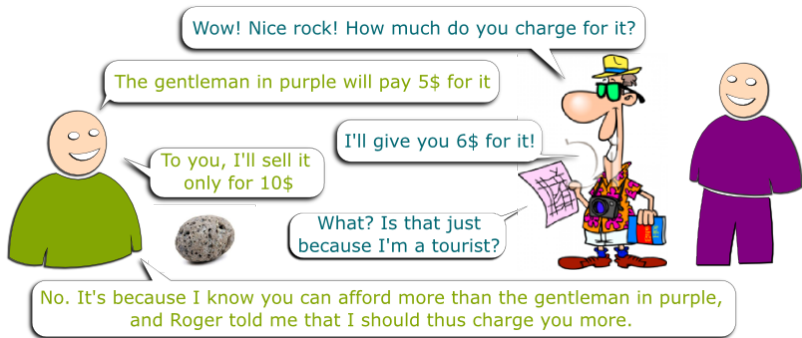
Source: <https://www.science4all.org/article/auction-design/>

## Optimal auctions more generally



## Optimal auctions more generally

- There are also optimal DISC auctions even if we relax the conditions by not insisting on  $F_1, \dots, F_n$  being identical. However, optimal auction can get weird, and it does not generally resemble any auctions used in practice.



Source: <https://www.science4all.org/article/auction-design/>

# Exams

# Exams

- Exam format:
  - Oral exam with preparation, 3 hours max.
  - I will ask about **two topics**, one survey question and one with proofs.

# Exams

- Exam format:
  - Oral exam with preparation, 3 hours max.
  - I will ask about **two topics**, one survey question and one with proofs.
- Dates (so far):
  - **15.1.** – 9:00–19:00, capacity 30
  - **29.1.** – 9:00–19:00, capacity 30
  - **6.2.** – 9:00–19:00, capacity 30
  - **12.2.** – 9:00–19:00, capacity 30

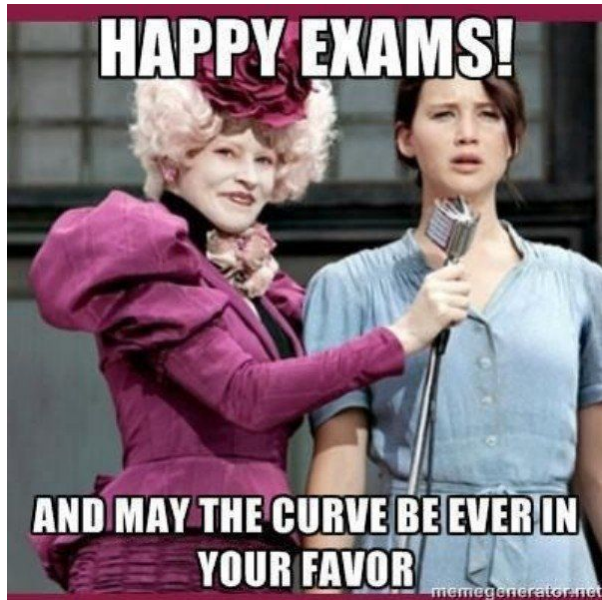
# Exams

- **Exam format:**
  - Oral exam with preparation, 3 hours max.
  - I will ask about **two topics**, one survey question and one with proofs.
- **Dates (so far):**
  - **15.1.** – 9:00–19:00, capacity 30
  - **29.1.** – 9:00–19:00, capacity 30
  - **6.2.** – 9:00–19:00, capacity 30
  - **12.2.** – 9:00–19:00, capacity 30
- **What you should know:** everything that we covered (everything is included in the lecture notes).

**HAPPY EXAMS!**

**AND MAY THE CURVE BE EVER IN  
YOUR FAVOR**

memegenerator.net



Thank you for your attention.