

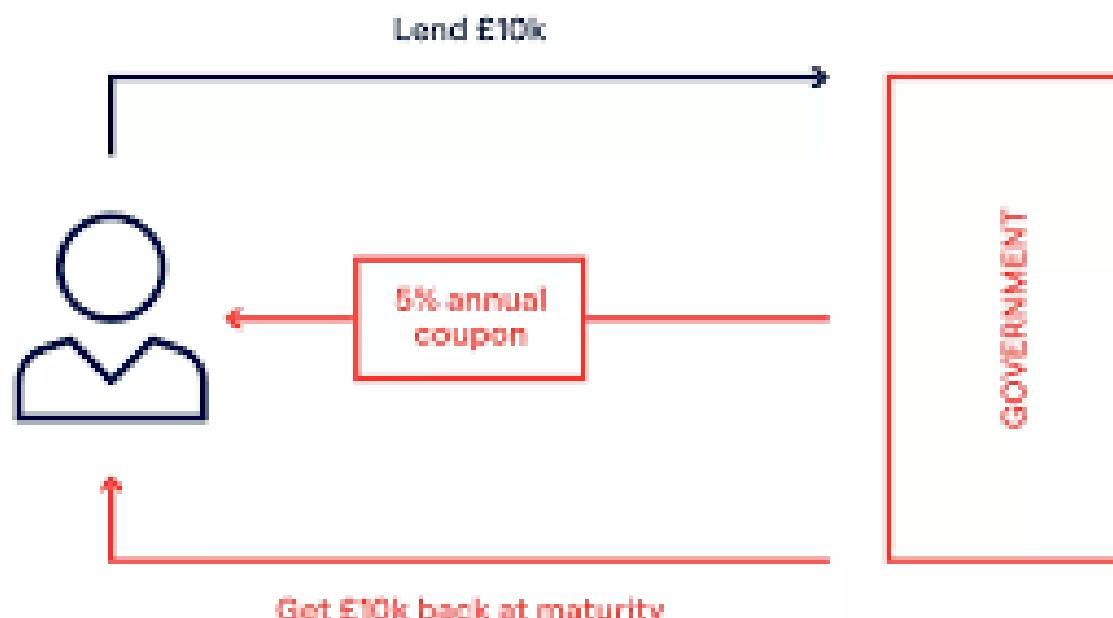
# **UNLOCKING BOND MARKETS, POWER OF AUCTION MECHANISMS IN BOND ISSUANCE**

Week 11 Auctions HASS Microeconomics

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# WHY BONDS MATTER? - I

- Bonds are a **vital** tool for governments and corporations to **raise capital** (e.g., infrastructure, business expansion).
  - Bonds consist of consumers **lending money** to the government for them to raise their capital
- Benefits for investors: **predictable income, lower risk, portfolio diversification.**
  - Especially beneficial as governments, have to promise that they will return the principal and interest amounts on a decided later date.

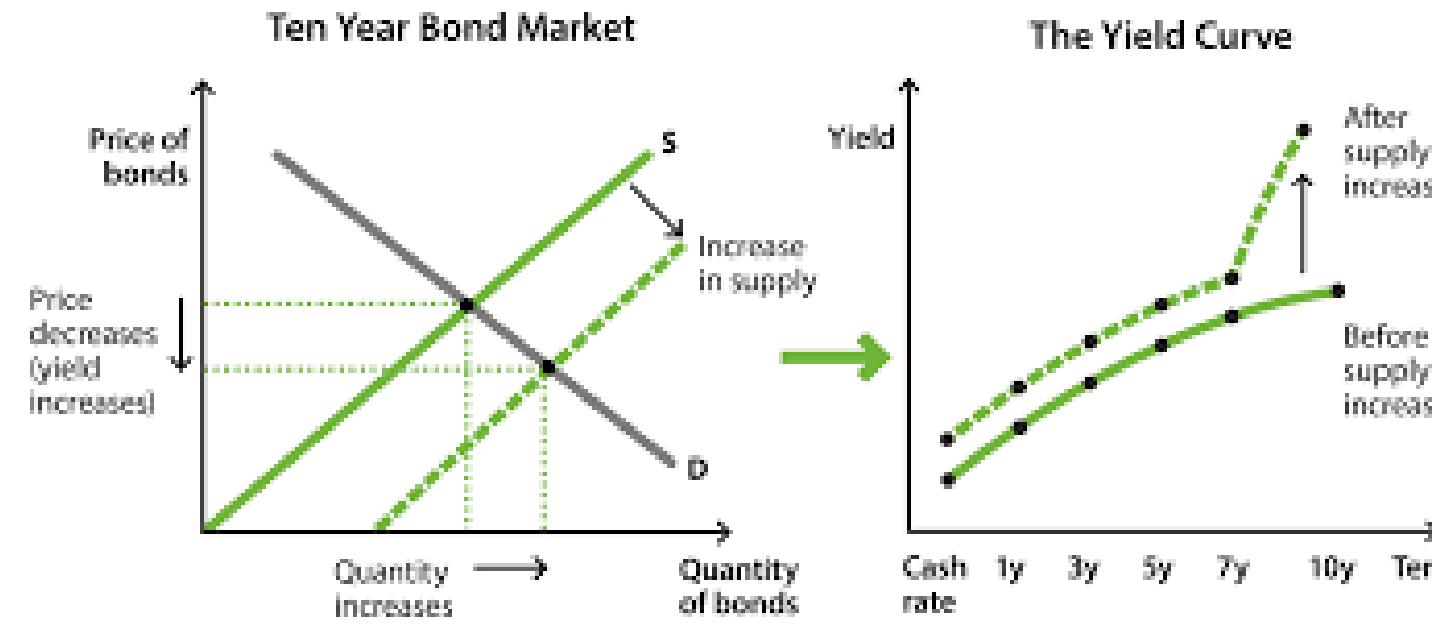


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# WHY BONDS MATTER? - II

- **Economic significance:** links issuers needing funds with investors seeking returns.
- Highly beneficial for **both consumers and the government**
- A perfect **hedge** against **economic slowdown**;
  - **Protect** during inflation or deflation as they are a fixed income structure.
- Role in the financial and economic systems and **indicators**:
  - **Interest Rate determination(Monetary Policy)**
  - **Credit Market**
  - **Yield curve**
  - **Investor Sentiment and Economic Confidence test**



# SLIDE 2: TRADITIONAL BOND SALES VS. AUCTIONS

- **Traditional** method: Bonds are typically sold through **negotiated** sales, where **underwriters** (investment banks) buy the bonds from the issuer and resell them to investors.
  - This process can be **less transparent** and may favour large institutions.
  - Runs the risk of **corruption** or growth in the **informal sector**.



VS



# SLIDE 2: TRADITIONAL BOND SALES VS. AUCTIONS-II

Auction mechanisms:

- Instead of relying on underwriters, issuers **sell bonds directly to investors** through an auction.
- Auctions **increase competition**,
- **Enhance transparency**,
- Thus, can lead to **better and economic pricing**.



# PROJECT FLOW

- Brief overview of what's coming:

→ **History** of auctions



→ Relevant **Economics Concepts**

→ **Mechanics** of auctions

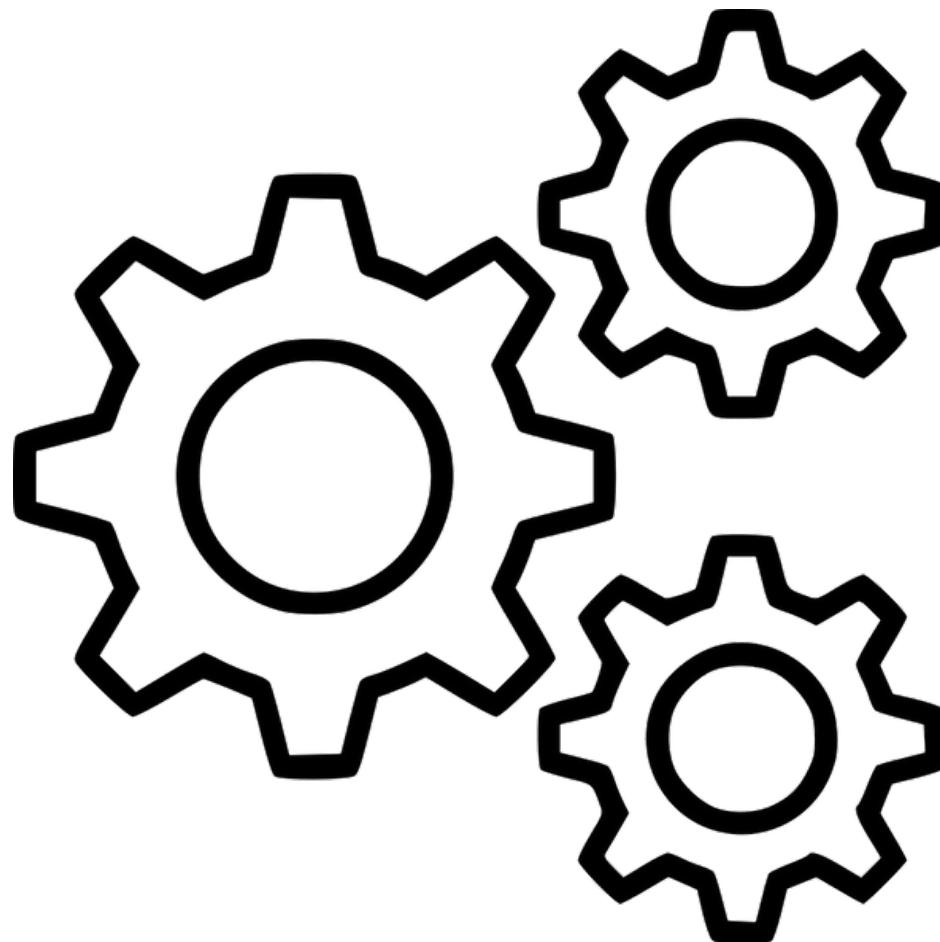
→ **Examples** (Fun Simulation!)

→ **Types** of Auctions



→ **Future** trends of bonds

# MECHANICS OF AUCTIONS

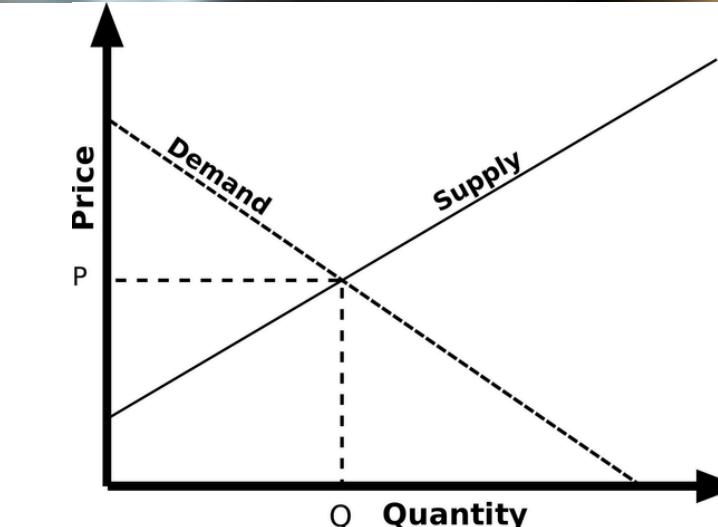


# MICROECONOMICS CONCEPTS OF AUCTIONS

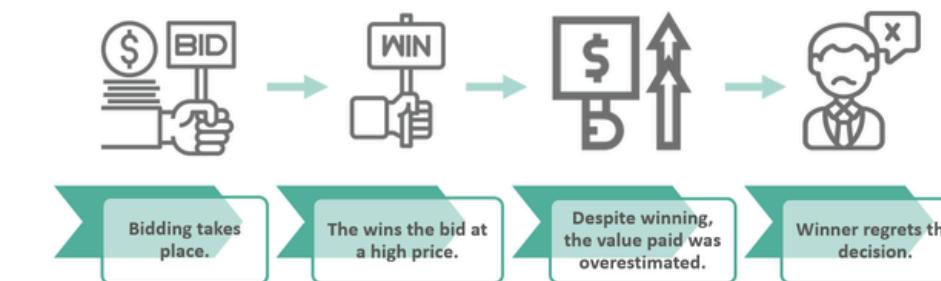
- **Brief recap of Game Theory**
  - A set of tools used by economists and others to analyze strategic decision making



- **Price Discovery**
  - Auctions help discover the 'real' market value of the goods by letting the market (supply/demand) decide its price. More bidders = more accurate pricing



- **Winner's curse**
  - The winner's curse happens when the winner is the one who overestimated the value the most — and overpays

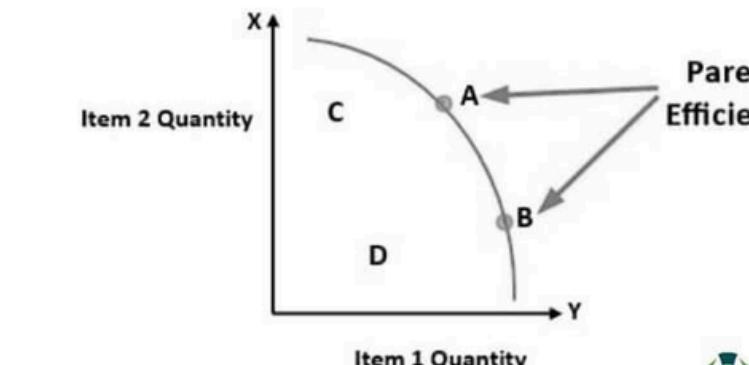


# MICROECONOMICS CONCEPTS OF AUCTIONS

- **Pareto Efficiency**

- Requires that the good be assigned to the person with the highest value.
- Allocates goods so that no one can be made happier without making someone else worse off.

## Pareto Efficiency



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- **Bayesian Nash Equilibrium**

- Bayesian Nash Equilibrium is a strategy profile in which each player's strategy maximizes their expected payoff, given their beliefs (understanding of probability distributions) about other players' types and strategies

	Prisoner B: Cooperate (Silent)	Prisoner B: Defect (Confess)
Prisoner A: Cooperate	A: -1, B: -1	A: -10, B: 0
Prisoner A: Defect	A: 0, B: -10	A: -5, B: -5

- **Nash Equilibrium:** Both defect, because it's the best response to the other's likely move.
- Even though mutual cooperation would be better, **self-interest leads them to defect**.

## Assumptions:

- Risk-neutral bidders
- Independent private values
- Symmetric bidders
- Bidders use Bayesian Nash strategies

- **Revenue Equivalence Theorem**

- Under certain assumptions, all standard auction formats give the same expected revenue to the seller.

# **TYPES OF AUCTIONS - THE NATURE OF GOODS**

1. Private-value Auctions
2. Common-value Auctions



# Private-value Auctions

In private-value auctions, the good has a different true value for everyone.

**Not at risk of Winner's curse**, because each bidder only cares about their own value of the good.

vs

# Common-value Auctions

In common-value auctions, the good has the same true value for everyone, but bidders don't know that value with certainty — they each estimate it.

**At risk of Winner's curse**, when a bidder overestimates the true value of the good.

**Which of these goods will fall in a private-value or common-value auction?**



\*Oil and mineral rights



Monetary Authority  
of Singapore

Regulation Development Monetary Policy Bonds & Bills

[Home](#) / [Bonds & Bills](#) / [T-bills: Information for Individuals](#)

## T-bills: Information for Individuals

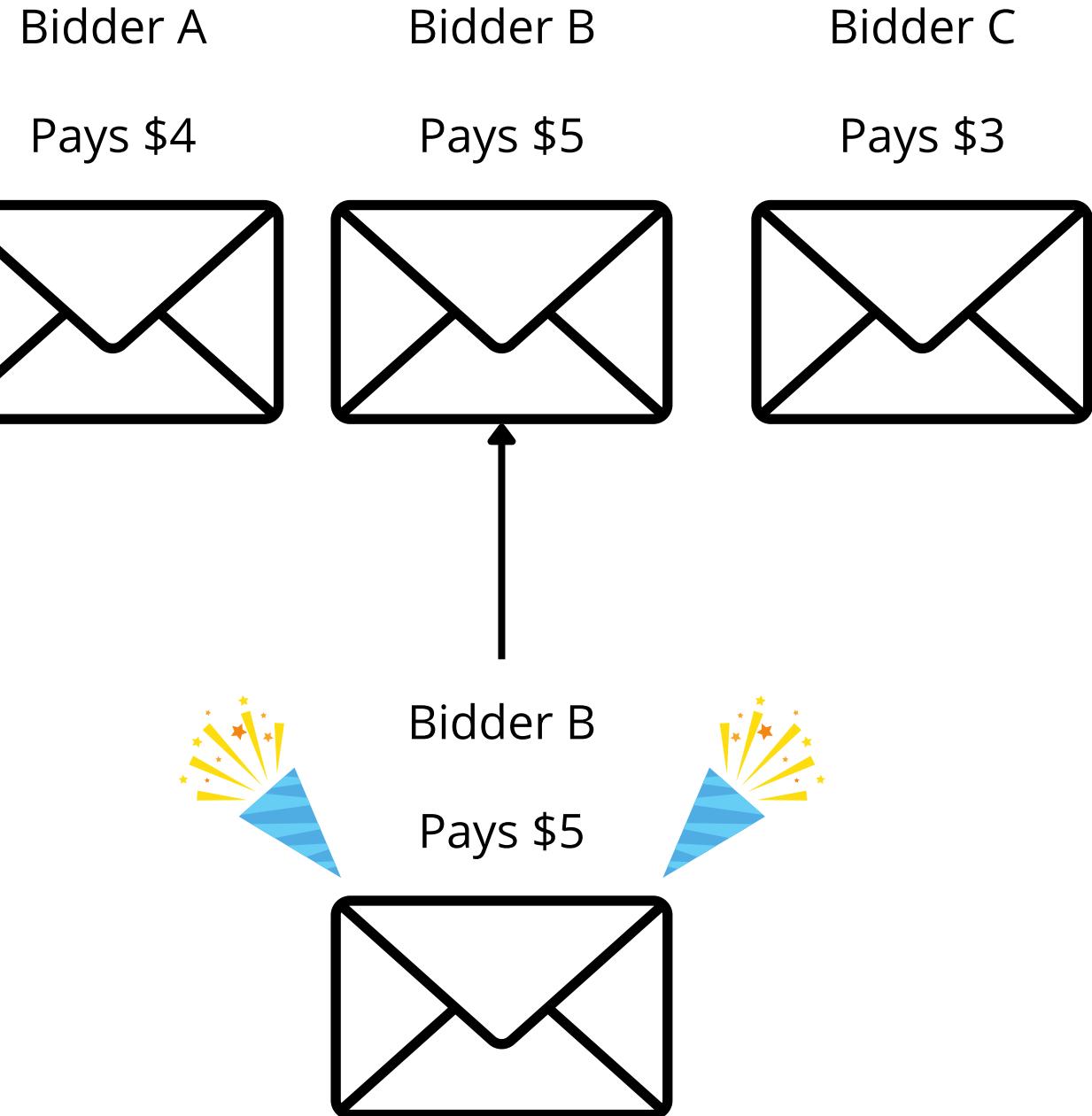
# **TYPES OF AUCTIONS - THE RULES OF BIDDING**

1. First-price Sealed-bid Auctions
2. Second-price Sealed-bid Auctions  
(aka Vickrey Auctions)
3. Dutch Auctions
4. English Auctions



# First-price Sealed-bid Auctions

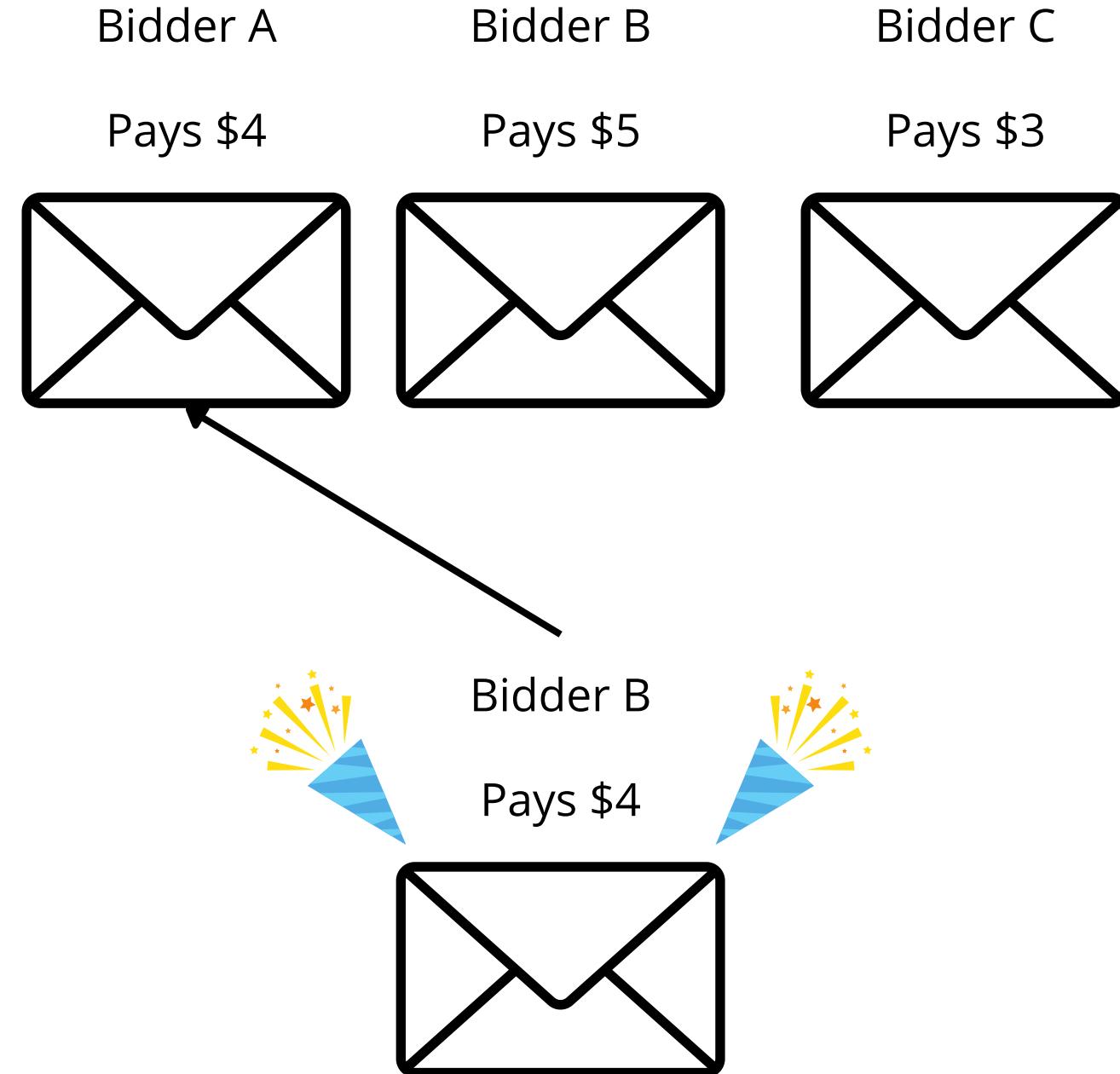
## How it works:



vs

# Second-price Sealed-bid Auctions

## How it works:



# First-price Sealed-bid Auctions

## How do players choose their strategies?

Players bidding their true valuation is a dominated strategy.

### Case 1:

- Alice bids truthfully at \$100, Bob bids \$80
- Alice wins, pays \$100, value is \$100
- Payoff:  $\$100 - \$100 = 0$

### Case 2:

- Alice lies and bids lower at say \$90, Bob still bids \$80
- Alice wins, pays \$90, value is \$100
- Payoff:  $\$100 - \$90 = \$10$

- Shading her bid increases payoff, so bidding truthfully is strictly worse.
- **Truthful bidding is a dominated strategy for first-price sealed-bid auctions.**

# vs

# Second-price Sealed-bid Auctions

## How do players choose their strategies?

Players bidding their true valuation is a weakly dominated strategy.

### Case 1:

- Alice bids truthfully at \$100, Bob bids \$80
- Alice wins, pays \$80, value is \$100
- Payoff:  $\$100 - \$80 = \$20$

### Case 2:

- Alice lies and bids lower at say \$90, Bob still bids \$80
- Alice wins, pays \$80, value is \$100
- Payoff:  $\$100 - \$80 = \$20$  (same)

### Case 3:

- Alice lies and bids lower at say \$70, Bob still bids \$80
- Bob wins
- Payoff: \$0, Alice gets nothing
- Sometimes shading gives same result, sometimes worse.
- Truthful bidding is a weakly dominant strategy — it's never worse, and sometimes strictly better for second-price sealed-bid auctions.**

# First-price Sealed-bid Auctions

vs

# Second-price Sealed-bid Auctions

**How can we derive the Bayesian Nash Equilibrium?**

$$b(v) = 1/2 v$$

(b represents bid, v stands for valuation)

Bayesian Nash equilibrium bidding strategies are both players bid at half of their true values  
(Mathematical/logical proof in the lecture notes)

**Is the Bayesian Nash Equilibrium Pareto efficient?**

Not necessarily. The good might not go to the person who values it most, or the seller might not get the highest efficient revenue. You could reallocate the item or money to make someone better off without hurting anyone.

**How can we derive the Bayesian Nash Equilibrium?**

$$b(v) = v$$

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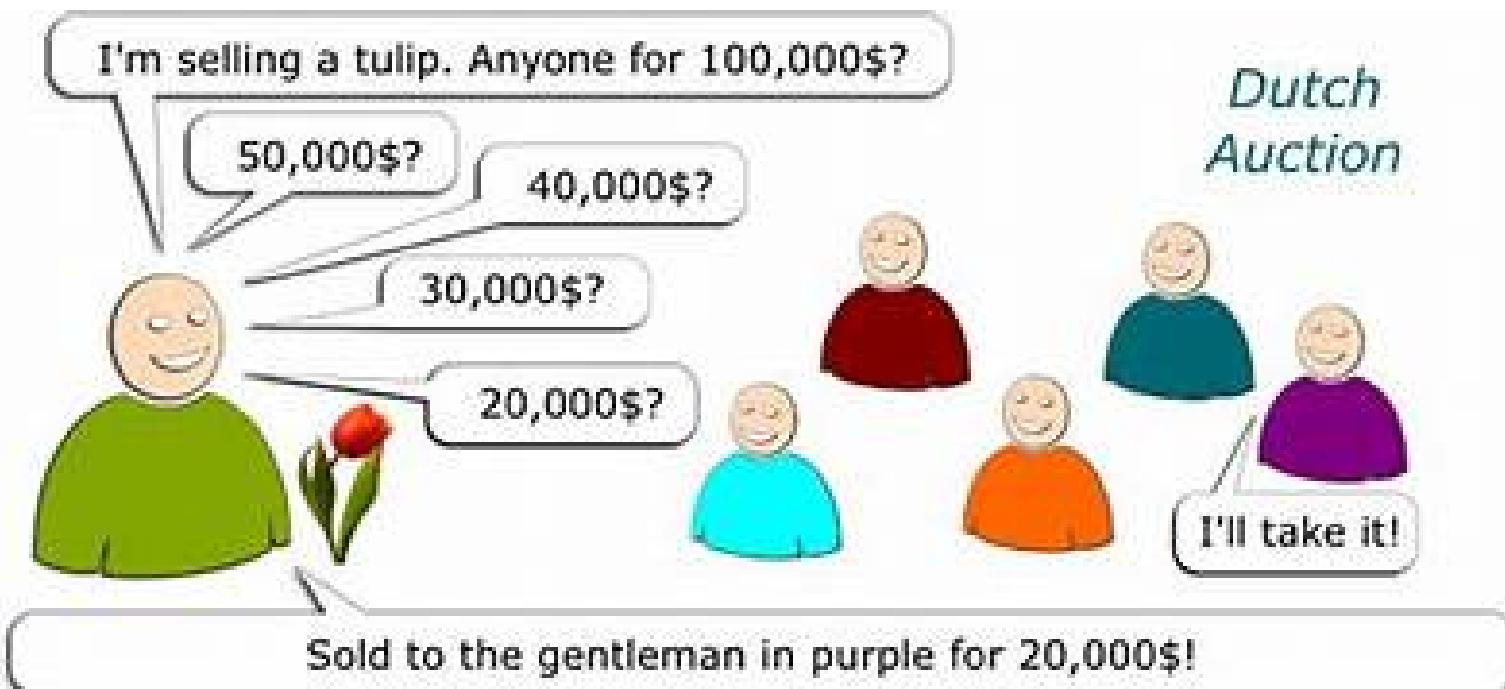
Yes. No reallocation can make someone better off without hurting someone else.

# Dutch Auctions

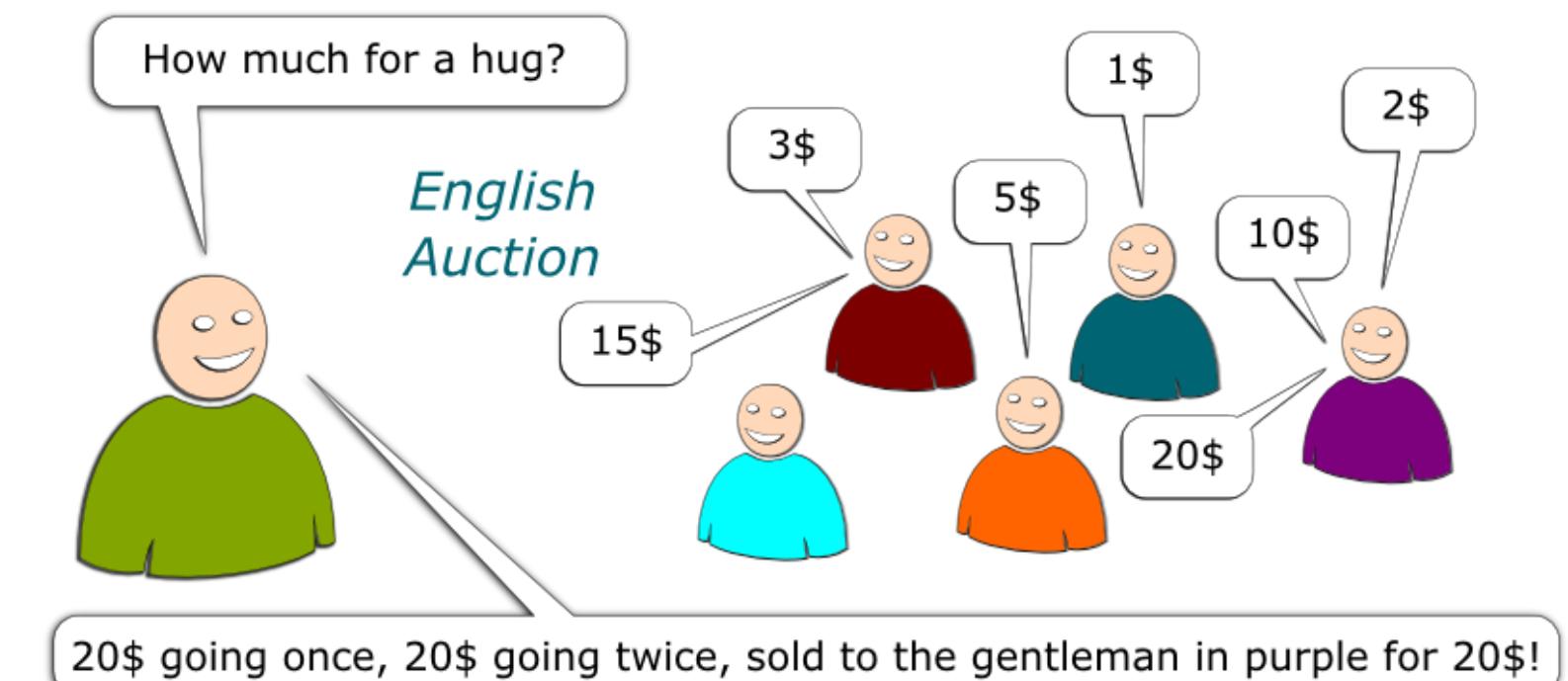
VS

# English Auctions

## How it works:



## How it works:

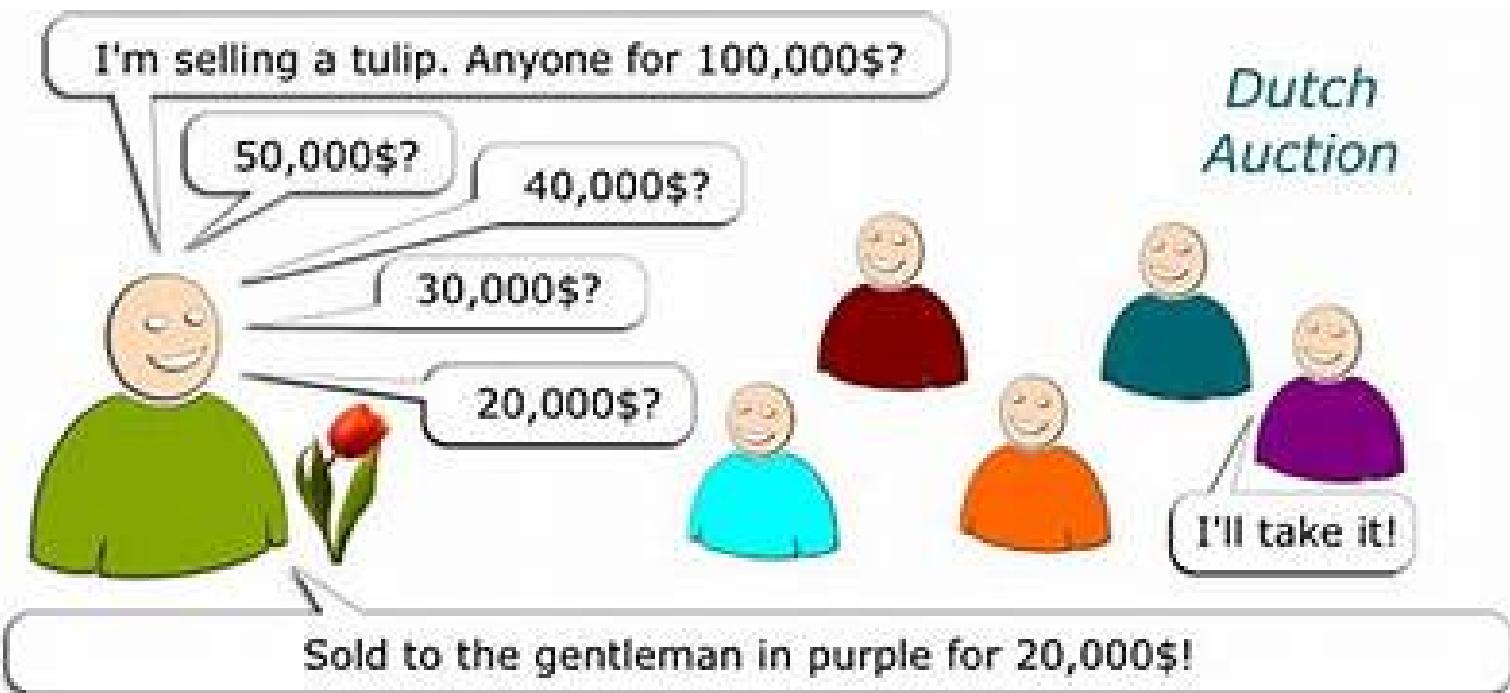


# Dutch Auctions

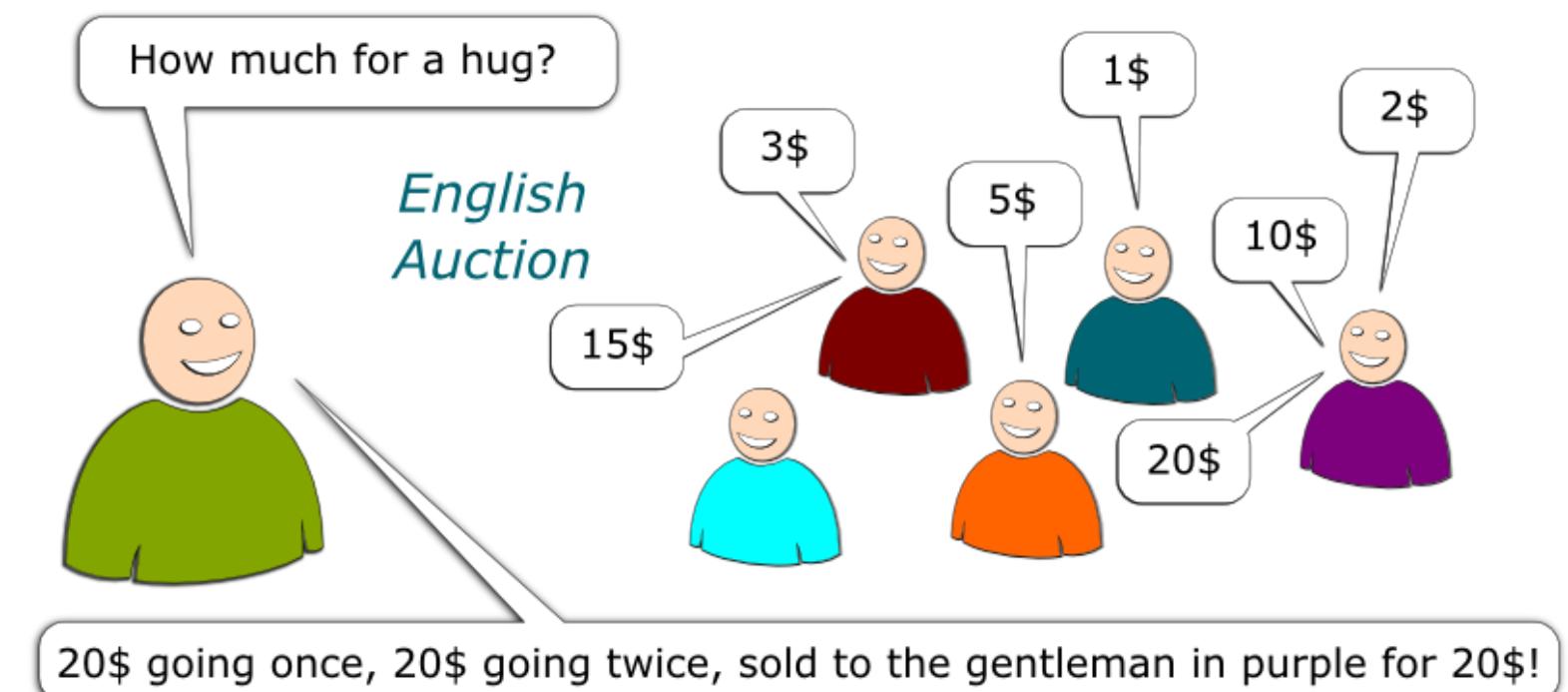
VS

# English Auctions

## How it works:



## How it works:



The auction type you see commonly in movies!!



# Dutch Auctions

## How do players choose their strategies?

Players bidding their true valuation is a dominated strategy.

### Case 1:

Alice waits until \$100 (truthful strategy), Bob waits until price = \$80

→ Alice wins, pays \$100, value is \$100

→ Payoff = \$100 – \$100 = \$0

### Case 2:

Alice accepts early at \$90, Bob still waits until price = \$80

→ Alice wins, payoff = \$10

- Shading her acceptance threshold improves her payoff.

- **Truthful bidding is a dominated strategy for Dutch auctions.**

VS

# English Auctions

## How do players choose their strategies?

Players bidding their true valuation is a weakly dominated strategy.

### Case 1:

- Alice drops out at \$100 (truthful strategy), Bob drops out at \$80

→ Alice wins, pays \$80, value is \$100

→ Payoff: \$100 – \$80 = \$20

### Case 2:

- Alice lies and chooses to drop out early at \$90, Bob still drops out at \$80

→ Alice wins, pays \$80, value is \$100

→ Payoff: \$100 – \$80 = \$20

### Case 3:

- Alice lies and chooses to drop out early at \$70, Bob still bids \$80

→ Bob wins

→ Payoff: \$0, Alice gets nothing

- Sometimes shading gives same result, sometimes worse.

- **Truthful bidding is a weakly dominant strategy — it's never worse, and sometimes strictly better for English auctions.**

# Dutch Auctions

VS

# English Auctions

## How can we derive the Bayesian Nash Equilibrium?

Accept at  $p = 1/2 v$

( $p$  represents price paid,  $v$  stands for valuation)

Bayesian Nash equilibrium bidding strategies are both players willing to accept the price at half of their true values.

## Is the Bayesian Nash Equilibrium Pareto efficient?

Not necessarily. The good might not go to the person who values it most, or the seller might not get the highest efficient revenue. You could reallocate the item or money to make someone better off without hurting anyone.

*(Similar to the First-price Sealed-bid Auctions.)*

## How can we derive the Bayesian Nash Equilibrium?

Stay in until  $p = v$

( $p$  represents price paid,  $v$  stands for valuation)

Bayesian Nash equilibrium bidding strategies are both players stay in the auctions until the price reaches their true values.

## Is the Bayesian Nash Equilibrium Pareto efficient?

Yes. No reallocation can make someone better off without hurting someone else.

*(Similar to the Second-price Sealed-bid Auctions.)*

**LIVE AUCTION!**



# **RULES OF THE LIVE AUCTION GAME**

We will run 2 sets of auctions of 3 rounds each, one set of auctions with Dutch Auction format, another with English Auction format.

We will first split everyone into groups of 5.

## **Rules/Flow of the Live Dutch Auction Game:**

1. The good have a hidden true value (this is common for all as it is a common-value good)
2. The auctioneer will slowly reduce the price from a starting price
3. When you think the value is close to the true value, shout out "I'll take it!"
4. The group that won that round will sit out for the rest of the auction. We will then repeat steps 2 and 3.
5. After 3 rounds, we will calculate the payoff (price they called out - hidden true value) of the group that called out each round. The group with the highest payoff wins the item!

Disclaimer: This live auction game deviates a little from regular auctions due to constraints.

# **RULES OF THE LIVE AUCTION GAME**

Today's item on Dutch Auction:

**Bean Bag!**



# **RULES OF THE LIVE AUCTION GAME**

We will run 2 sets of auctions of 3 rounds each, one set of auctions with Dutch Auction format, another with English Auction format.

We will first split everyone into groups of 5.

## **Rules/Flow of the Live English Auction Game:**

1. The good have a hidden true value (this is common for all as it is a common-value good)
2. The auctioneer will first start the price from a starting price
3. You can choose to raise the price of the item by raising your paddle and suggesting a price.
4. The price will keep increasing until no other groups raises the price.
5. The group that won will sit out for the rest of the auction. We will then repeat steps 2, 3 and 4.
6. After 3 rounds, we will calculate the payoff (price they won at - hidden true value) of the group that called out each round. The group with the highest payoff wins the item!

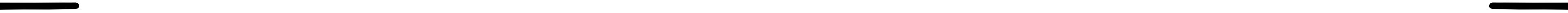
Disclaimer: This live auction game deviates a little from regular auctions due to constraints.

# **RULES OF THE LIVE AUCTION GAME**

Today's item on English Auction:

**Roller Shoes!**





**DUTCH  
&  
ENGLISH AUCTION  
IN FINANCE**

# DUTCH AUCTIONS IN A REAL LIFE APPLICATION IN BOND ISSUANCE

## SETUP

- The U.S. Treasury uses Dutch auctions to issue Treasury securities (bills, notes, and bonds) to finance government operations.
- The Treasury announces the auction, specifying the amount of bonds to be issued and the maturity date.

# DUTCH AUCTIONS IN A REAL LIFE APPLICATION IN BOND ISSUANCE

## BIDDING

- Bidders (such as banks, institutional investors, and individuals) submit bids indicating the quantity of bonds they want and the yield (interest rate) they are willing to accept.
- Bids are ranked from the lowest yield (highest price) to the highest yield (lowest price).

# DUTCH AUCTIONS IN A REAL LIFE APPLICATION IN BOND ISSUANCE

## Ranking and Allocation:

- Bids are ranked from the lowest yield (highest price) to the highest yield (lowest price).
- The Treasury accepts bids starting with the lowest yield until the total amount of securities is allocated.
- The highest accepted yield is called the stop-out yield (e.g., 2.8%).

# DUTCH AUCTIONS IN A REAL LIFE APPLICATION IN BOND ISSUANCE

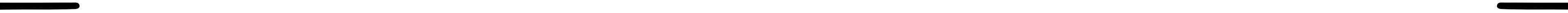
## Pricing:

- All successful bidders—whether competitive or non-competitive—pay the same yield: the stop-out yield (2.8% in the example).
- This uniform pricing ensures fairness, as no bidder pays more than the market-clearing yield.

# DUTCH AUCTIONS IN A REAL LIFE APPLICATION IN BOND ISSUANCE

## Outcome:

- The Treasury issues the securities at the stop-out yield, and all winning bidders receive the same yield, regardless of their initial bid.
- For example, if the stop-out yield is 2.8%, a bidder who bid 2.5% and another who bid 2.7% both pay the price corresponding to 2.8%.



# **ENGLISH AUCTIONS IN A REAL LIFE APPLICATION IN BOND ISSUANCE**

# HOW ENGLISH AUCTION IS USED IN UK GILTS

## What Are UK Gilts?

- Bonds issued by the UK Debt Management Office (DMO).
- Called "Gilts" because early bonds were literally gilded (gold-edged).
- Used to fund the UK government budget.

# DUTCH AUCTIONS IN A REAL LIFE APPLICATION IN BOND ISSUANCE

## Announcement:

- The DMO announces the auction, specifying the amount of gilts to be issued and the maturity date (e.g., £5 billion in 10-year gilts).

# HOW ENGLISH AUCTION IS USED IN UK GILTS

## Bidding:

Investors (mostly institutional, as noted in your excerpt) submit bids with:

- The quantity of gilts they want to buy.
- The yield/price they're willing to pay (lower yield = higher price).

# HOW ENGLISH AUCTION IS USED IN UK GILTS

## Ranking

- Bids are ranked from the highest price (lowest yield) to the lowest price (highest yield).
- The DMO accepts bids starting with the highest price until the total amount of gilts is allocated.

# HOW ENGLISH AUCTION IS USED IN UK GILTS

## Pricing

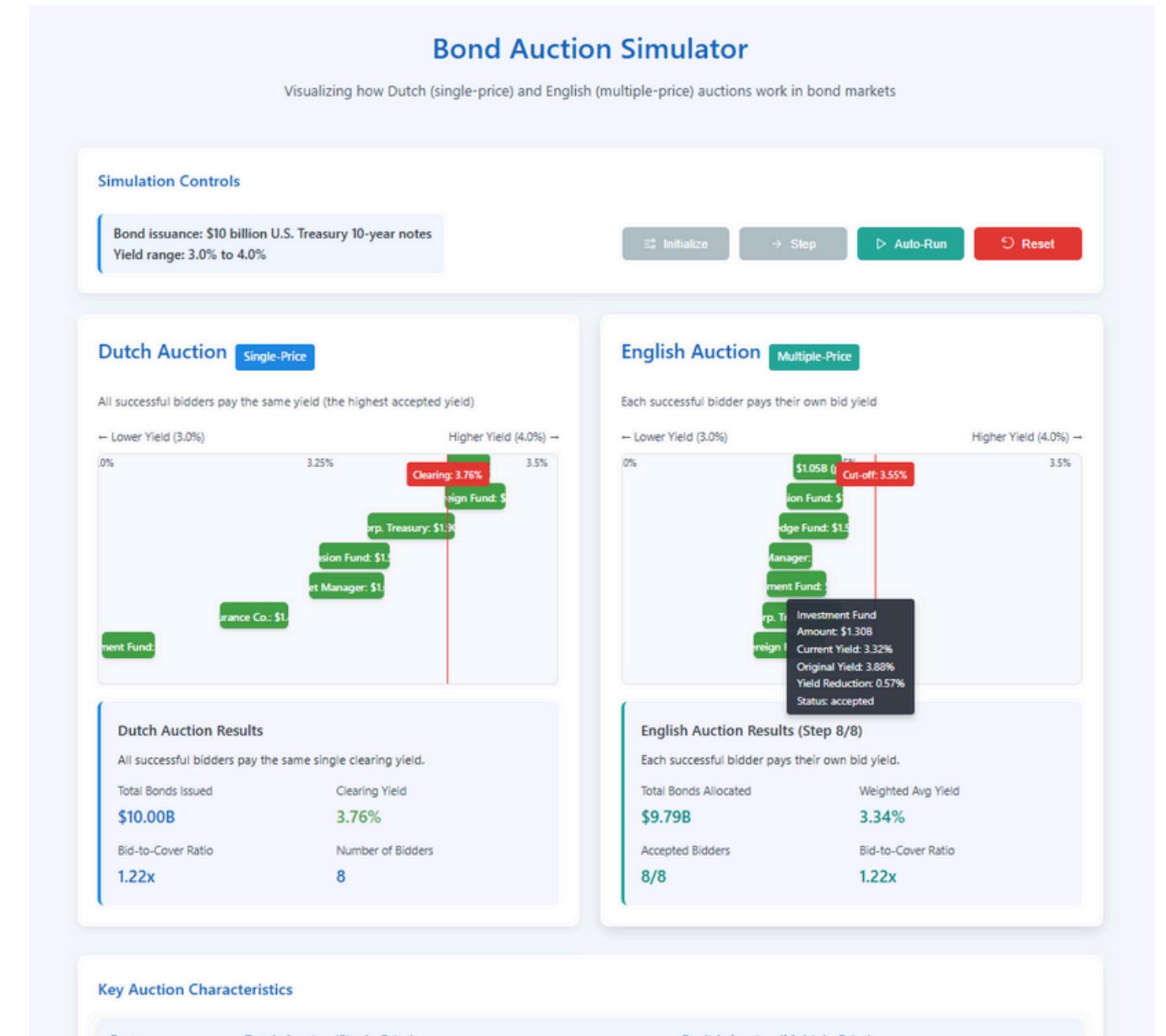
- Unlike a Dutch auction, each winning bidder pays their own bid price—not a single clearing price.
- For example, if Bidder A bids a yield of 2.5% (higher price) and Bidder B bids 2.7% (lower price), and both win, Bidder A pays the price corresponding to 2.5%, while Bidder B pays the price corresponding to 2.7%.

# HOW ENGLISH AUCTION IS USED IN UK GILTS

## Outcome

- The DMO issues the gilts, and each winning bidder receives the gilts at the price they bid.
- This can lead to a "winner's curse," where bidders who win by bidding aggressively (low yields/high prices) may overpay compared to others.

# SIMULATION DEMONSTRATION!



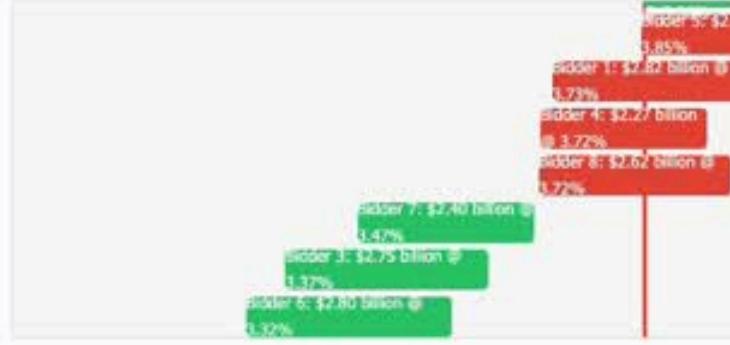
### Simulation Controls

Bond issue: \$10 billion U.S. Treasury 10-year notes

Initialize Auction
Step Forward
Auto-Run
Reset

#### Dutch Auction (Single-Price)

All successful bidders pay the same yield (the highest accepted yield)

Low Yield (3.0%)	High Yield (4.0%)
	

#### English Auction (Multiple-Price)

Each successful bidder pays their own bid yield

Low Yield (3.0%)	High Yield (4.0%)
	

#### Dutch Auction Results

Total bonds issued: \$9.39 billion  
Clearing yield: 3.86%  
All successful bidders pay this single yield.  
Bid-to-cover ratio: 2.08x

#### English Auction Results (Step 1)

Total bonds issued so far: \$9.70 billion  
Weighted average yield: 3.63%  
Each successful bidder pays their own bid yield.

#### Key Auction Information

Feature	Dutch Auction (Single-Price)	English Auction (Multiple-Price)
Price Mechanism	Starts high (yield low), price lowers (yield increases) to clear	Starts low (yield high), price increases (yield decreases) with bids
Pricing	All successful bidders pay the clearing price	Each successful bidder pays their bid (yield)

# IN SUMMARY: ENGLISH AUCTIONS AND THE UK GILTS

The English Auction in UK Gilts is a second price sealed auction. Hence, how accurate does it follow economic theory?

Nature of a second price sealed auction

Applied?

Bayesian Nash Equilibrium of  $b(v) = v$ :  
Bid placed = Valuation

Applied?

Should be Pareto Efficient

Applied?

Winning bidders pay the price of the second highest bidder

In UK Gilts, bidders typically do not bid their true valuation due to 2 key reasons:

- To win at the lowest price possible whilst still securing said asset
- Winner's curse, which spurs them to shade bidding prices to avoid overpaying

Pareto Efficiency requires bidders to bid according to their true valuations, so that the product's true market value is reflected for most efficient allocation.

Since bidders do not bid like that, pareto efficiency is not observed

So,  
how about

And thus...

# SUMMARY: DUTCH AUCTIONS AND THE US TREASURY

The Dutch Auction of US Treasury Bonds is a first price sealed auction. Hence, how accurate does it follow economic theory?

Nature of a first price sealed auction  
Applied? ✓

So,  
how about

Bayesian Nash Equilibrium of  
 $b(v) = 1/2v$ :  
Bid placed =  $1/2$  of valuation

And thus..

Should not be  
Pareto Efficient  
Applied? ✓

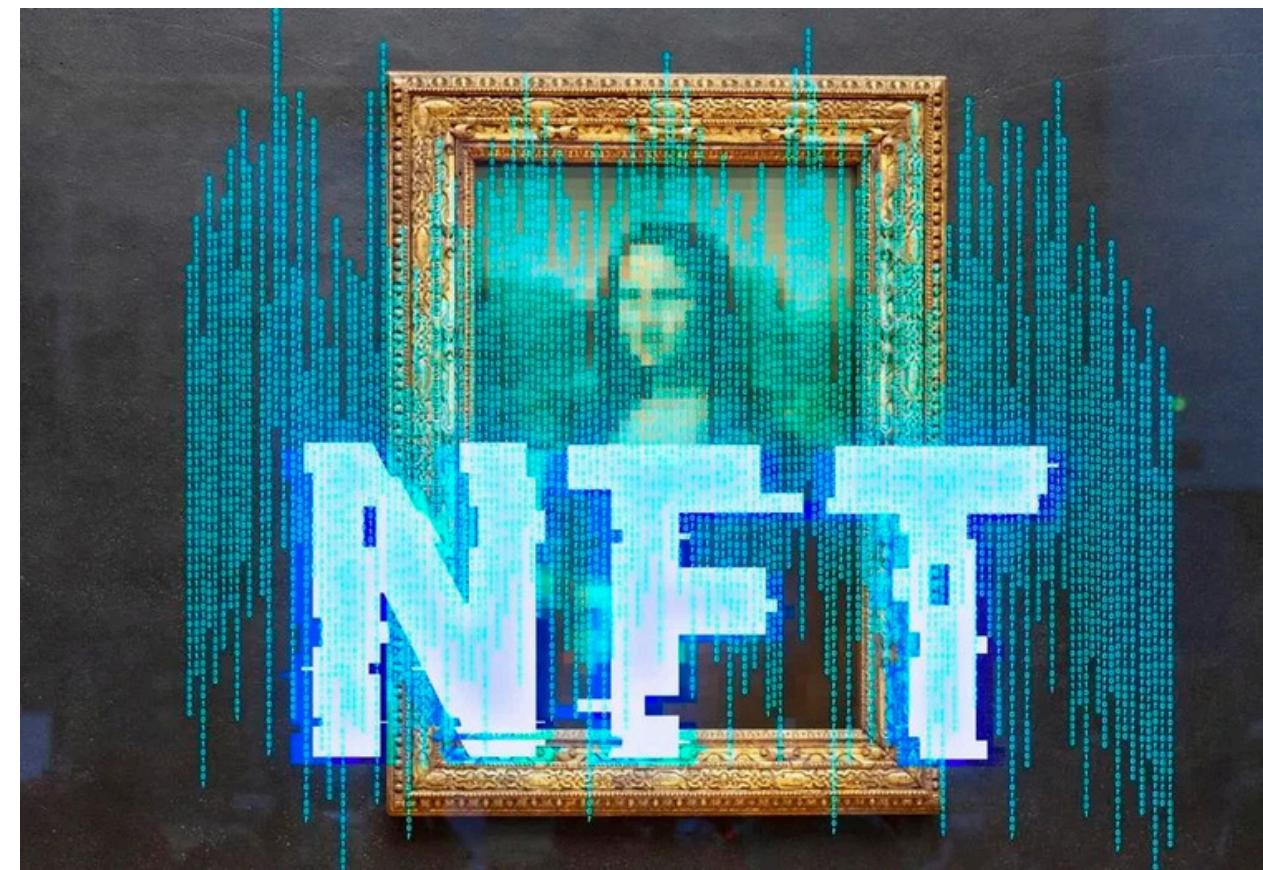
An initial price is announced and slowly decreases, with the first bidder that announces the claim getting the Bond at that price level

In Dutch Auctions of the US Treasury Bonds, Competitive bidders will bid lower than their true valuations in terms of the interest rate of the bond, since the winner is the one who bids the lowest.

Due to bid shading and hence not bidding their true valuation (partly also due to anxiety on losing the bid), the final clearing “price” or interest rate set does not truly reflect the true market valuation of the bond.

Highest bidders also receive the same interest rate as with all other winners, which does not truly reflect their true valuation → suboptimal allocation.

# DUTCH AUCTIONS, FURTHER APPLICATIONS



*NFTs, the new meaning of "Exclusivity"*

- Selling of NFTs revolves around the Dutch Auction process, whereby an initial price is set which slowly decreases.
- Potential Buyers observe the prices, and the first to accept wins the particular NFT.



**THANK YOU!**