

Lecture 2

Strategically Equivalence

There are many different types of auctions. We explain some more common formats and begin our investigations of optimal bidding. Optimal bidding may depend on the auction format, but certainly depends on how correlated signals of valuations are for the auctioned item, not to mention the number of (rival) bidders.

There are different types of auctions

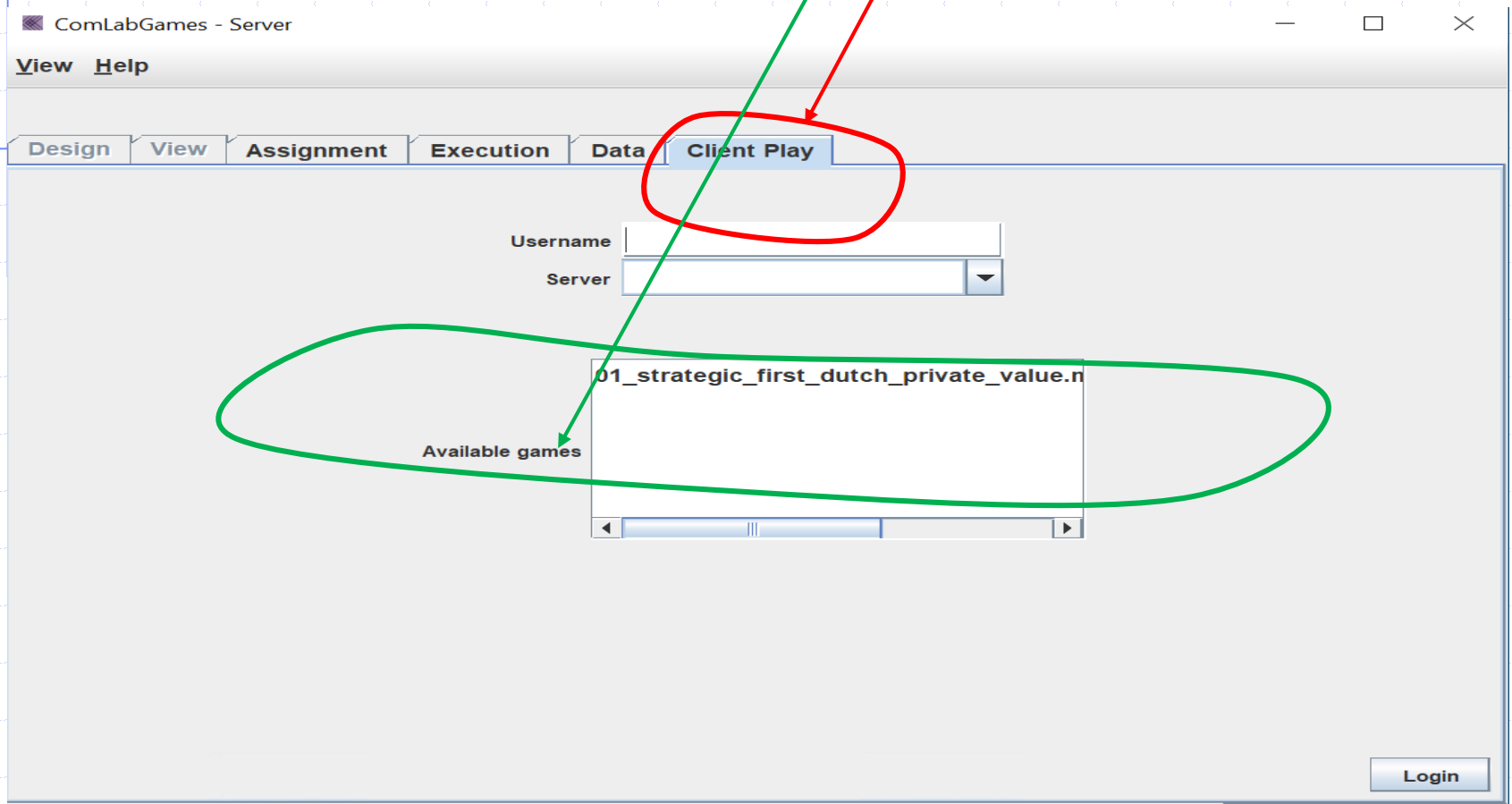
- ◆ In a **first price** sealed bid auction, each bidder submits his/her bid without knowing what the others are bidding, and the auctioneer sells the good to the highest bidder at the price he submitted.
- ◆ In an **English** auction bidders compete against each other by raising the price until everyone but one bidder drops out of the bidding.
- ◆ In a **Dutch** auction, the auctioneer reduces the price until a bidder indicates he/she is willing to take the object.
- ◆ In a **second priced** sealed bid auction, players simultaneously submit their bids, the highest bidder wins the auction, and pays the second highest bid.

Bidding strategies

- ◆ Does it matter what form the auction takes?
- ◆ Returning to basics, from SCM (45-870) a **strategy** is a complete description of instructions to be played throughout the game
- ◆ The **strategic form** of a game is the set of alternative strategies to each player and their corresponding expected payoffs from following them.
- ◆ Two games are **strategically equivalent** if they share the same strategic form.
- ◆ In strategically equivalent auctions, the set of bidding strategies that each potential bidder receives, and the mapping to the bidder's payoffs, are the same.

Login instructions for auction game

1. To play a game, click on "Client Play".
2. Click on Available games: "01_strategic_first_dutch..."



Required steps to login

1. Server address: 172.24.168.226:9876 will appear *automatically* after selecting "01_strategic...". If not type 172.24.168.226 in
2. Write a username.
3. Click on "Login".

The screenshot shows the 'ComLabGames - Server' application window. The 'Client Play' tab is selected. The 'Username' field contains 'Francesca'. The 'Server' dropdown menu is set to '172.24.168.226:9876'. A green oval highlights the 'Server' field, and a green arrow points from the text '172.24.168.226' in the first step of the list to this field. Below the input fields, the 'Available games' list shows '01_strategic_first_dutch_private_value.mgd - 172.24.168.226:9876'. A red oval highlights the 'Login' button in the bottom right corner. The status bar at the bottom shows the file path: 'C:\45-871 Trade and Investment Strategy\45-871 Games\01_auction_formats_games\01_strategic_first_dutch_priva...'.

ComLabGames - Server

View Help

Design View Assignment Execution Data Client Play

Username Francesca

Server 172.24.168.226:9876

01_strategic_first_dutch_private_value.mgd - 172.24.168.226:9876

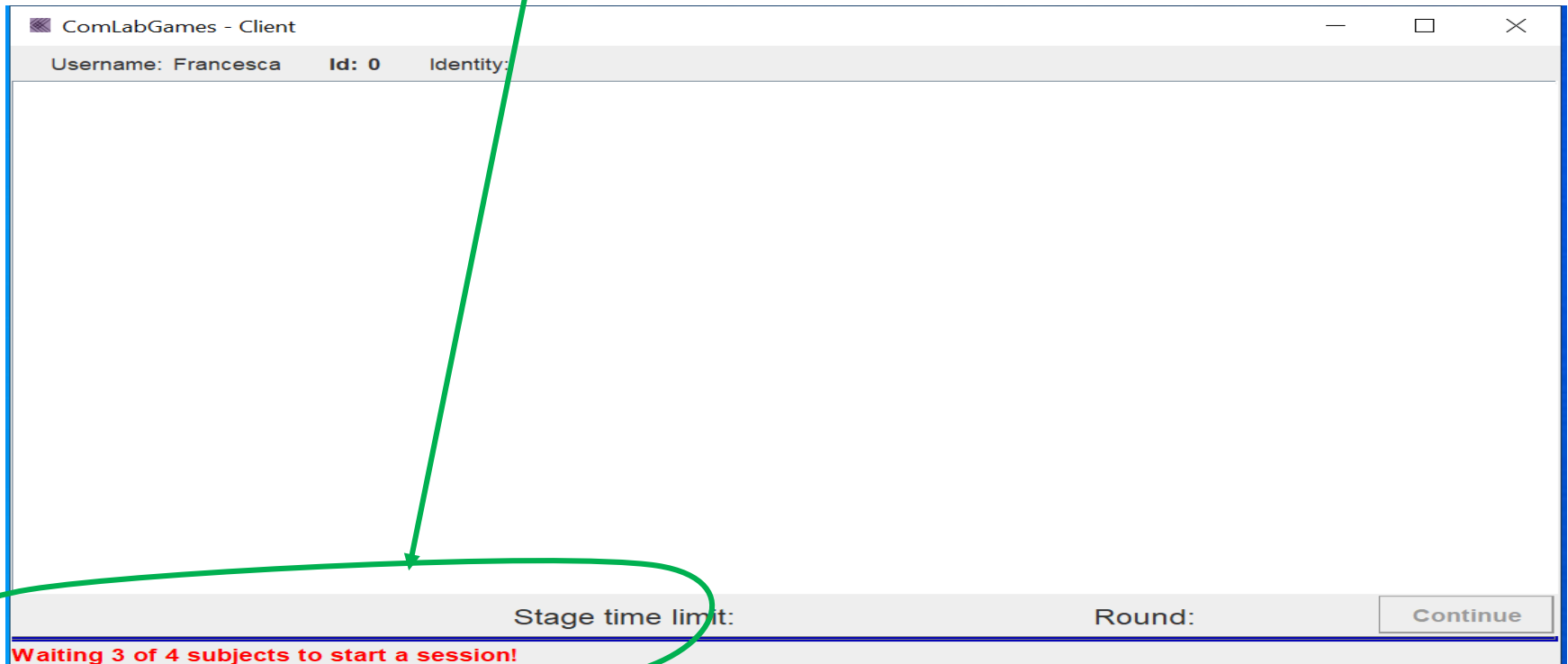
Available games

Login

C:\45-871 Trade and Investment Strategy\45-871 Games\01_auction_formats_games\01_strategic_first_dutch_priva...

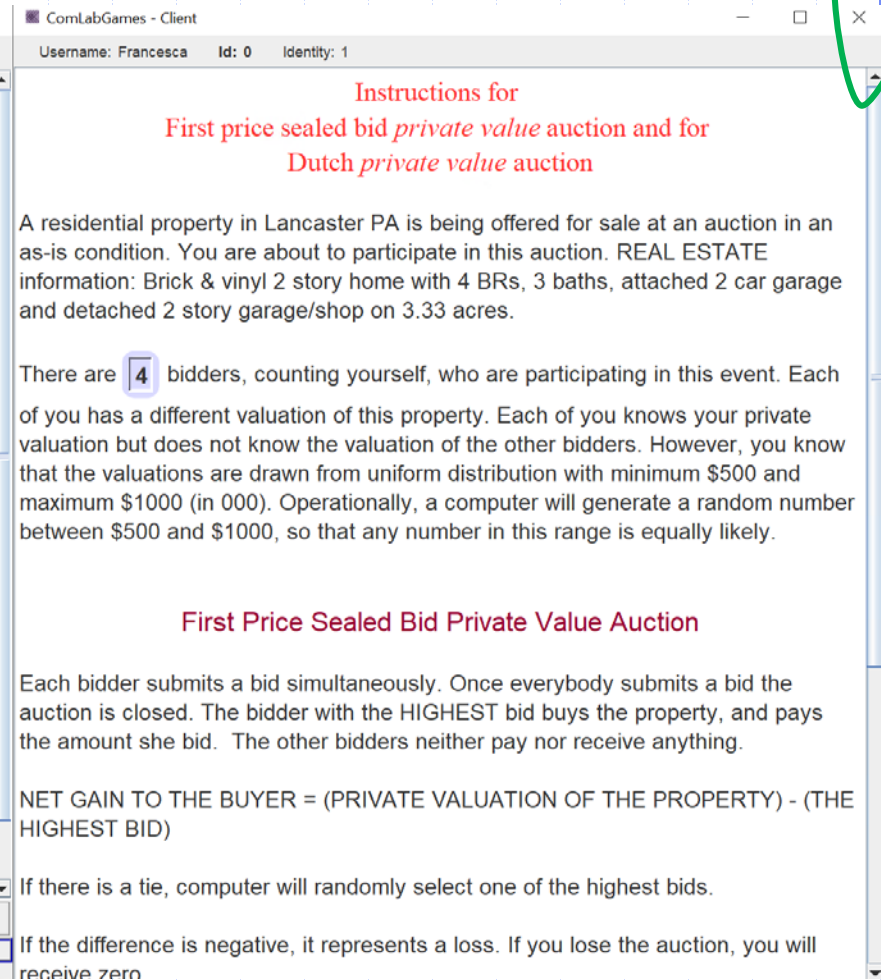
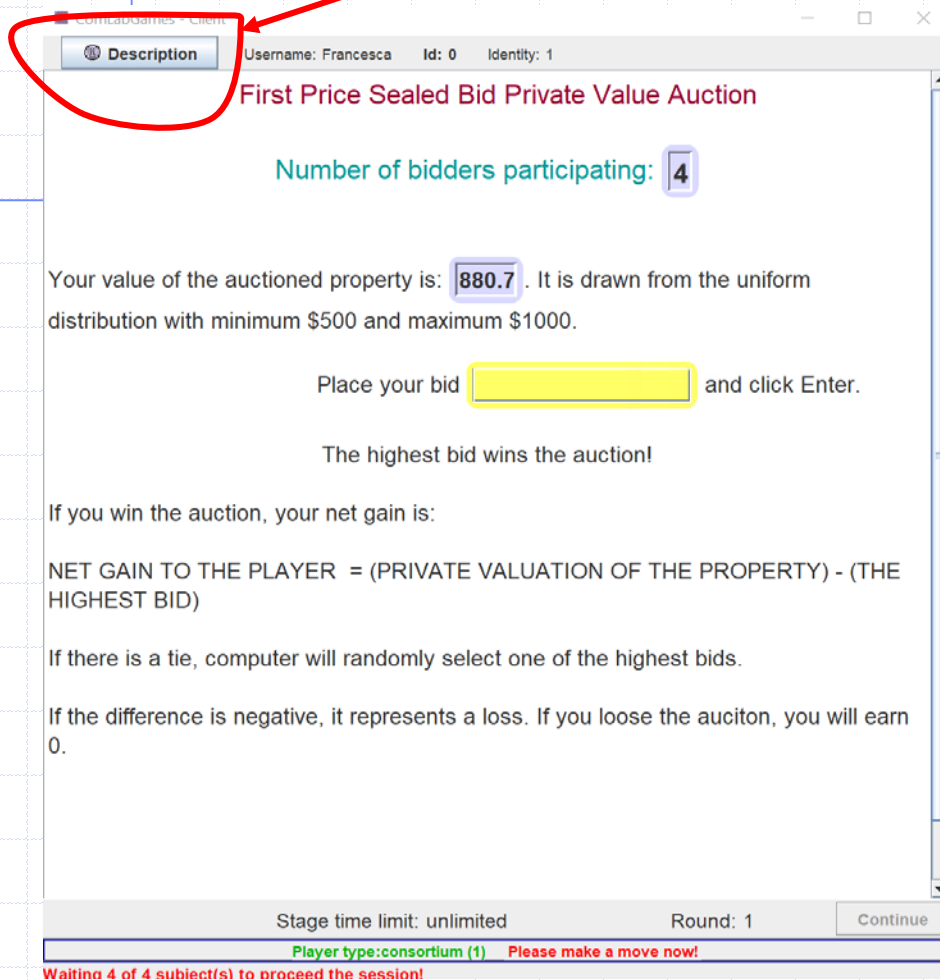
Auction window

1. In this example four subjects need to login to start the auction game. The first three subjects to login will see a blank screen.
2. When a required number of subjects login, the auction window replaces the blank window.



Auction window and instruction window

1. Instruction and auction window appears on your screen.
2. To close the instruction window click on "x". To retrieve it click on "Description".



Write a bid in a first price sealed bid auction

1. Write a number and click Enter (you can enter decimal number).
2. After submitting the bid, your bid should be colored in red.
3. Wait for all players in your session to submit bids.

ComLabGames - Client

Description Username: Francesca Id: 0 Identity:

First Price Sealed Bid Private Value Auction

Number of bidders participating: 4

Your value of the auctioned property is: 880.7. It is drawn from the uniform distribution with minimum \$500 and maximum \$1000.

Place your bid and click Enter.

The highest bid wins the auction!

If you win the auction, your net gain is:

NET GAIN TO THE PLAYER = (PRIVATE VALUATION OF THE PROPERTY) - (THE HIGHEST BID)

If there is a tie, computer will randomly select one of the highest bids.

If the difference is negative, it represents a loss. If you loose the auciton, you will earn 0.

Stage time limit: unlimited Round: 1 Continue

Player type:consortium (1) Please make a move now!

Waiting 4 of 4 subject(s) to proceed the session!

ComLabGames - Client

Description Username: Francesca Id: 0 Identity: 1

First Price Sealed Bid Private Value Auction

Number of bidders participating: 4

Your value of the auctioned property is: 880.7. It is drawn from the uniform distribution with minimum \$500 and maximum \$1000.

Place your bid and click Enter.

The highest bid wins the auction!

If you win the auction, your net gain is:

NET GAIN TO THE PLAYER = (PRIVATE VALUATION OF THE PROPERTY) - (THE HIGHEST BID)

If there is a tie, computer will randomly select one of the highest bids.

If the difference is negative, it represents a loss. If you loose the auciton, you will earn 0.

Stage time limit: unlimited Round: 1 Continue

Player type:consortium (1) Please wait for other players to make their choices!

Waiting 3 of 4 subject(s) to proceed the session!

Summary page for sealed bid auction

1. Click "Continue" to move to Dutch auction.
2. Wait for all players in your session to click "Continue".

ComLabGames - Client

Description Username: Francesca Id: 0 Identity: 1

Brief Summary of the First Price Sealed Bid Private Value Auction

Your private valuation of the property was : **880.7**, and your bid in this auction was **821.46**. Please click "Continue" and proceed to the next auction. Summary results will be given at the end of the experiment.

Stage time limit: unlimited Round: 1 **Continue**

Player type: consortium (1) Please make a move now!

Waiting 4 of 4 subject(s) to proceed the session!

Dutch auction page

1. Every *3 seconds* limit order price is lowered by \$20.
2. The first subject in a session who click on **Buy** ☐ buys the property.

ComLabGames - Client

Description Username: Francesca Id: 0 Identity: 1

Dutch Private Value Auction

Number of bidders participating: **4**

Your own valuation of the property is: **880.7**. This valuations are drawn from uniform distribution with minimum \$500 and maximum \$1000. Operationally, a computer will generate a random number between \$500 and \$1000, so that any number in this range is equally likely. Each of you has a different private valuation of the property.

Current limit order price: **1040**

Select **Buy** ☐ if you want to buy the property.

Each **3** seconds the auctioneer places consecutive limit order order that lowers the price of the auctioned property by **20** dollars until the first bidder clicks on **Buy** ☐ button. At that time the aution concludes. The bidder who submitted a market order to **Buy** ☐ buys the property at the current (most attractive) limit order price. The buyer's net gain is the private valuation of the property minus the current limit order price. The other bidders neither pay nor receive anything.

Stage time limit: **2** Round: 1

Player type: consortium (1) Please make a move now!

Continue

Summary page

ComLabGames - Client

DescriptionUsername: FrancescaId: 0Identity: 1

Summary

For both auctions, your private value of the auctioned property was **880.7**.

Sealed bid private value auction: The winning bid was **960**, your bid was **821.46** and your net gain is **0**.

Dutch private value auction: The current limit order price at which the property was bought was **860**. You clicked on **Buy** ☐ and your net gain is **0**.

Below is the list of all the decisions, valuations, prices, and net gains for your session.

Player's userna...	V(Property)	Bid first price	Winning bid first..	Net gain first pri...	Dutch Buy Sele...	Winning bid Dut...	Net gain Dutch
Francesca	880.7	821.46	960	0	<input type="checkbox"/>	860	0
David	970.58	960	960	10.58	<input type="checkbox"/>	860	0
Ann	995.95	920.78	960	0	<input checked="" type="checkbox"/>	860	135.95
Thomas	974.17	900	960	0	<input type="checkbox"/>	860	0

Stage time limit: unlimitedRound: 1Continue

Player type:consortium (1)

Game is over!

Bidding in a Dutch (descending) auction

- ◆ During the course of a descending auction a bidder receive **no information** about:
 - ☐ his own valuation (if he already knows it).
 - ☐ how competitive the other bidders are.
- ◆ A bidder only learns something about the valuation of his **most aggressive rival**:
 - ☐ after the auction is over.
 - ☐ if the rival wins the auction.
- ◆ Bidders set their own reservation price **before the auction starts**:
 - ☐ to evaluate the merchandise without distractions.
 - ☐ and not be influenced by the **excitement** of the auction format.
 - ☐ submitting **a market order** to buy if and when the limit auctioneer's limit order to sell falls to that point.

Dutch auctions are strategically equivalent to first-price auctions

- ◆ In both Dutch and first price auctions each bidder:
 - ❑ essentially **picks one number**, a price.
 - ❑ has the **same information** when making that choice.
 - ❑ wins the auction if his price is **higher** than all the others.
 - ❑ would **pay the price he picks** if he wins.

- ◆ Therefore the Dutch and first price auctions are strategically equivalent, sharing the same strategic form. (See 45-870.)

Rule 1: Pick the same reservation price in Dutch auction that you would submit in a first price auction.

Private value auctions

- ◆ A bidder has a **private value** for the merchandise if she does not improve her estimate of her valuation from obtaining information for the other bidders have.
- ◆ This could arise because:
 - ❑ the bidder **knows** her own valuation exactly.
 - ❑ the difference between the true value of the merchandise to the bidder and her estimate is **independently distributed** of the information other bidders have.
 - ❑ For example a contractor's workload and schedule might be a little uncertain, affect his willingness to bid aggressively for a new project, but has no bearing on how another contractor values the contract.
- ◆ If every bidder has a private value we say the auction is a **private value auction**.

Increasing the number of bidders in private value auctions

- ◆ In almost all auctions the **highest bidder wins**.
- ◆ Note this is **also true of procurement auctions** where the winning bid typically offers the goods and/or services:
 - for the least cost to the procurement agency
 - that is the highest price . . . when they are all negative.
- ◆ Therefore the winning bid is **greater than the highest losing bid**, which by definition is the maximum of all the other bids.
- ◆ As the **number of bidders increases**, the probability of winning with a given bid declines, affecting the tradeoff between:
 - the **probability of winning**
 - the **net gain** if the bidder wins
- ◆ In a private value auction it is optimal to raise your bid as the number of bidders increases.

Common value auctions

◆ A common value:

- ❑ is unknown to all the bidders before the auction.
- ❑ is revealed to the winner after the auction.
- ❑ affects the usefulness or value of the auctioned item ex post.

◆ For example:

- ❑ plumbing, wiring and foundations are not so visible to buyers but affect the utility of the house and therefore have common value components.
- ❑ panoramic views, access to airports, and modern conveniences are features that help determine home buyers' valuations, but are known before the auction, so are not common values.

◆ Common value auctions are so named because the auctioned items have common values.

Oil field tract

- ◆ Consider a new **oil field tract** that drillers bid for after conducting seismic their individual explorations.
- ◆ The (common) value of the oil field is:
 - the same to each bidder
 - but unknown.
- ◆ The n^{th} bidder receives a signal s_n which is distributed about the **common value** v , where:

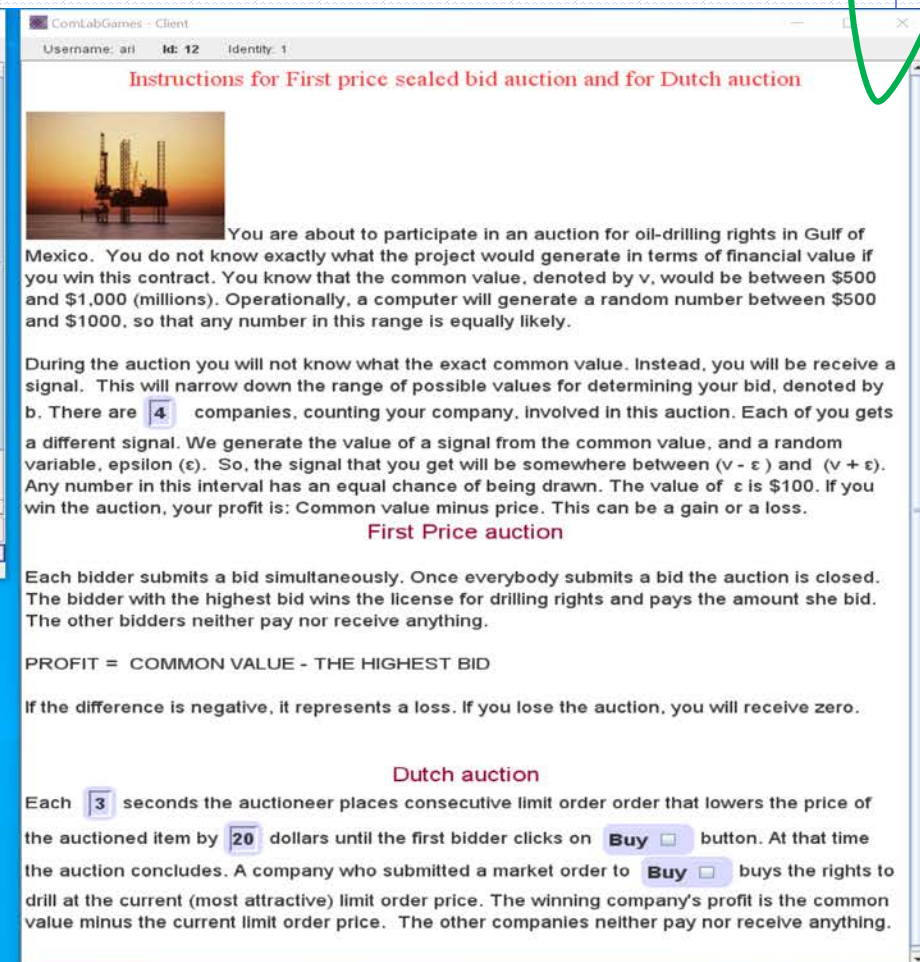
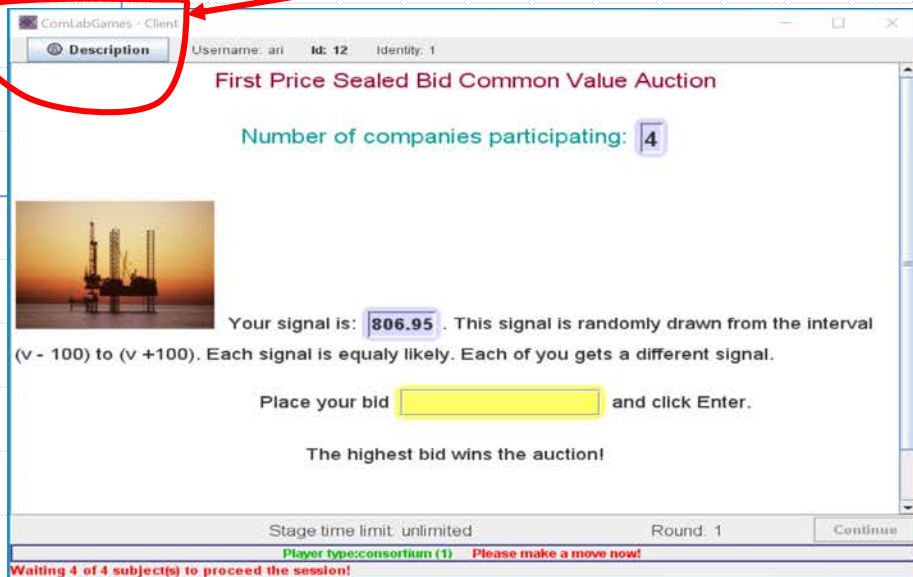
$$S_n = V + \varepsilon_n$$

and $\varepsilon_n \equiv E[v | s_n] - v$ is independently distributed across bidders.

- ◆ Each drilling company would infer more precise estimates of the common valuation by reviewing the geological survey results of their rivals.

Auction window and instruction window

1. Instruction and auction window appears on your screen.
2. To close the instruction window click on "x". To retrieve it click on "Description".



Write a bid in a first price sealed bid auction

1. Write a number and click Enter (you can enter decimal number like 800.25).
2. After submitting the bid, your bid should be colored in red.
3. Wait for all players in your session to submit bids.

The image displays two side-by-side screenshots of the 'ComLabGames - Client' window, illustrating the bidding process in a 'First Price Sealed Bid Common Value Auction'.

Left Screenshot:

- Header: Description, Username: ari, Id: 12, Identity: 1
- Title: First Price Sealed Bid Common Value Auction
- Information: Number of companies participating: 4
- Image: An offshore oil rig at sunset.
- Text: Your signal is: 806.95. This signal is randomly drawn from the interval $(v - 100)$ to $(v + 100)$. Each signal is equally likely. Each of you gets a different signal.
- Action: Place your bid and click Enter. (The input field is highlighted with a green circle and an arrow pointing to it from the first instruction.)
- Rule: The highest bid wins the auction!
- Footer: Stage time limit: unlimited, Round: 1, Continue button.
- Status: Player type: consortium (1) Please make a move now!

Right Screenshot:

- Header: Description, Username: ari, Id: 12, Identity: 1
- Title: First Price Sealed Bid Common Value Auction
- Information: Number of companies participating: 4
- Image: An offshore oil rig at sunset.
- Text: Your signal is: 806.95. This signal is randomly drawn from the interval $(v - 100)$ to $(v + 100)$. Each signal is equally likely. Each of you gets a different signal.
- Action: Place your bid 800 and click Enter. (The bid '800' is highlighted in red, corresponding to the second instruction.)
- Rule: The highest bid wins the auction!
- Footer: Stage time limit: unlimited, Round: 1, Continue button.
- Status: Player type: consortium (1) Please wait for other players to make their choices! Waiting 3 of 4 subject(s) to proceed the session!

Summary page for sealed bid auction

1. Click "Continue" to move to Dutch auction.
2. Wait for all players in your session to click "Continue".

ComLabGames - Client

Description Username: ari Id: 12 Identity: 1

Brief summary of the sealed bid auction

Your signal was: **806.95**, and your bid in this auction was **800**. Please click "Continue" and proceed to the next auction. Summary results will be given at the end of the experiment.

Stage time limit: unlimited Round: 1 **Continue**

Player type: consortium (1) Please make a move now!

Waiting 4 of 4 subject(s) to proceed the session!

Dutch auction page

1. Every *3 seconds* limit order price is lowered by \$20.
2. The first subject in a session who click on **Buy** ☐ buys the drilling rights.

ComLabGames - Client

Description Username: ari Id: 12 Identity: 1

Dutch Auction

Number of companies participating: **4**

Your signal is: **806.95**. This signal is randomly drawn from the interval $(v - 100)$ to $(v + 100)$. Each estimate is equally likely. Each of you gets a different value estimate of a project.

Current limit order price: **940**

Select **Buy** ☐ if you want to buy the drilling rights.

Each **3** seconds the auctioneer places consecutive limit order order that lower the price of the auctioned item by **20** dollars until the first bidder clicks on **Buy** ☐ button. At that time the aution concludes. The bidder who submitted a market order to **Buy** ☐ buys the drilling rights at the current (most attractive) limit order price.

Stage time limit: **1** Round: 1 **Continue**

Player type: consortium (1) Please make a move now!

Summary page

ComLabGames - Client

Description

Username: ari

Id: 12

Identity: 1

Summary

For both auctions, your signal was **806.95**, and common value (v) was **791.33**.

Sealed bid auction: The winning bid was **800**, your bid was **800** and your profit is **0**.

Dutch auction: The current limit order price at which the drilling rights were bought was **740**. You clicked on **Buy** ☒ and your profit is **51.33**. Below is the list of all the decisions, valuations, prices, and profits for all sessions.

Player's us...	s	v	b first price	Winning bi...	Profit first ...	Dutch Buy ...	Winning bi...	Profit Dutch
ari	806.95	791.33	800	800	0	<input checked="" type="checkbox"/>	740	51.33
ari1	704.03	791.33	760	800	0	<input type="checkbox"/>	740	0
ari2	839.16	791.33	800	800	-8.67	<input type="checkbox"/>	740	0
ari3	774.25	791.33	750	800	0	<input type="checkbox"/>	740	0

Stage time limit: unlimited

Round: 1

Continue

Game is over!

Player type: consortium (1)

The expected value of the item upon winning the auction

- ◆ The n^{th} bidder might (perhaps should) reason that if he wins the auction, his signal would be the highest:

$$s_n \equiv \max\{s_1, \dots, s_N\}$$

so he would condition the expected value of the item on this information.

- ◆ His expected value would now be the expected value of v_n conditional upon observing the maximum signal:

$$E[v_n | s_n \equiv \max\{s_1, \dots, s_N\}]$$

- ◆ The bidder should use this value in the auction: he should recognize that unless his signal is the maximum he will (probably) lose the auction and receive zero payoff.

The Winner's Curse

- ◆ Conditional on the signal, but before the bidding starts, the expectation of the common value is:

- ◆ We define the **winner's curse** as:

$$\begin{aligned} E[v|s_n] - E[v|s_n = \max\{s_1, \dots, s_N\}] \\ = s_n - E[v|s_n = \max\{s_1, \dots, s_N\}] > 0 \end{aligned}$$

- ◆ Although bidders should make due allowance for the fact that their valuation will typically overstate the true value of the object if they win the auction, novice bidders typically do not take it into account when placing a bid.

How does the winner's curse vary with the number of bidders?

- ◆ For the most part bidders with higher signals make higher bids.
- ◆ Increasing the number of bidders from N to $N+1$:

$$E[v_n | s_n \equiv \max\{s_1, \dots, s_N, s_{N+1}\}]$$

- ◆ Given s_n , the value of this expression falls as N increases.
- ◆ That is, the expected value, conditional on winning, falls, as the number of bidders increases.
- ◆ Intuitively the signal that n gets becomes more biased, even though its unconditional expectation remains unchanged.
- ◆ *The greater the number of bidders, the more pronounced the winners curse, and hence the lower the optimal bid!*

Comparing optimal bidding in private versus common value auctions

- ◆ We have seen that the Dutch and first price sealed bid auctions are strategically equivalent:
 - So you should bid the same amount in both auction formats regardless of the information structure.
 - The bid is increasing in your private valuation and also in your signal (in common value auctions).
- ◆ As the number of bidders increase:
 - given the same private valuation you should increase your bid (because the intensity of competition increases so the prospect of rent falls).
 - given the same signal, the winner's curse is exacerbated in a common value auction, putting downward pressure on bidding that at least partially offsets increased competitive pressure.