

Player ID: \_\_\_\_\_

Player Type: \_\_\_\_\_

Computer #: \_\_\_\_\_

## Instruction

You are about to participate in an economics experiment in which you will earn money based on the decisions you and others make. All earnings you make in the experiment are yours to keep. Please do not talk to each other during the experiment. If you have a question, please raise your hand and the experimenter will come and help you.

## Overview

- All values and prices will be stated in francs. Each franc you earn can be converted into US currency at the rate specified by the experimenter. The exchange rate is **12 francs (₣) per dollar (\$)**.
- In this experiment, you will participate in a series of auctions that allocates time use of a major piece of scientific equipment. The computer will be the auctioneer and you will compete against 8 other people in the room.
- If you win a time slot at the end of an auction, your profit will be the difference between your value of that time slot and the price you pay for it. If you do not win any time slot, your profit will be zero. Therefore, for you:

$$\text{Profit} = \text{value} - \text{final price}.$$

Please note that your profit, which will be used to determine a portion of your payment for the experiment, depends on the **difference** between your value and the final price, **not** your value alone.

- At the end of each auction, you will fill out your Auction Worksheet and a monitor will verify your earnings.

## Background

You are one of nine scientists who are bidding for access time to a piece of major scientific equipment. Three researchers are conducting big projects, which require at least 3 months of equipment time to complete, while six researchers are conducting smaller experiments that require at least 2 months to complete. The time slots (also called packages) on which you will be bidding are composed of consecutive months within a 24-month timeframe. You only have one experiment that you want to run. No matter how many packages you bid on, you will never be allocated more than one package.

## Value Determination

You will have a unique value for each time slot (package) depending on when you are able to start using the equipment as well as the length of time for which you can use your equipment.

The values of the various time slots to different researchers depend on several factors.

- 1). *Value for each minimum package for a small researcher* (2 months) is randomly drawn from the set of integers between 20 and 100, inclusive, where each integer is equally likely to be drawn. A package of fewer than 2 months is worth zero to a small researcher.
- 2). *Value for each minimum package for a big researcher* (3 months) is randomly drawn from the set of integers between 20 and 150, inclusive, where each integer is equally likely to be drawn. A package of fewer than 3 months is worth zero to a big researcher.
- 3). *Value for each additional month* is randomly drawn from the interval between 10 and 20, inclusive. Both sets of researchers get added value from using the equipment for more time than the absolute minimum. Small researchers derive more value from using the equipment for 3 months instead of 2, and the most value from using the equipment for 4 months. Using the equipment for five or more months, however, gives them no more value than just using it for four months. Similarly, large researchers get more value from 4 months of use of the equipment as opposed to 3, and they get the most value from using the equipment for 5 months. More than 5 months of time, however, does not give them any additional value.
- 4). *Starting month*: If your player ID starts with the digit 3, 7, 8, or 9, you prefer to use the equipment earlier rather than later. If your player ID starts with the digit 2, 5, or 6, you are indifferent between starting earlier and later. Finally, if your player id starts with the digit 1 or 4, you prefer to start later rather than earlier.

For each participant, the various components of his or her value will be randomly drawn in each auction. Whether you are a big or small researcher, and whether you prefer to start earlier or later will already be taken into account in the values for packages that you see on your screen.

## Auction Process

The experiment may have several auctions. For each auction, you may bid on packages. At the end of each auction, you will see if the bids that you submitted were winning or losing.

## Months and Packages

In the experiment, you can only bid on packages, but packages are constructed from individual months. In this case, there are 24 different months. The packages are all the possible ways in which the months can be put together in consecutive order with lengths of 2, 3, 4 for a small researcher and lengths 3, 4, 5 for a big researcher.

The starting month and the length of the package uniquely identify a package. For example, if a package starts on month 1 and lasts for three months, it consists of month 1, month 2, and month 3.

## Submitting an Order

The packages will be presented to you in a table format. The different rows will represent different starting months, and the different columns will represent different durations. For example, to find a package that starts on the 4th month, and lasts for 3 months, you will first look for the row that is labeled 4, and find the column that is labeled 3.

In each cell, you will see the value of that package to you. If you wish to bid on that package, you can submit a price in the textbox and then click on the submit button. Note that you will need to click the submit button for each time that you submit a bid. Refer to Figure 1 below to see how your screen will look during the submission process.

You are allowed to submit a price for a package that is higher than your value for that package, but if you end up winning the package, you may make a negative profit. **If you earn a negative profit for an auction, that amount will be deducted from your experiment pay. If your cumulative earning becomes negative, that is, if the sum of your show up fee, quiz score, and profit from participating in the experiment is negative, you will be asked to leave the experiment.**

Figure 1: Submission Sample

Bid submitted.

### Vickrey Experiment

Player: 3 (big)

All Done

	Total number of months		
	3	4	5
starting month 1	value: F63.0 bid: 1.0 Cancel	value: F81.0 bid: <input type="text"/> Submit	value: F99.0 bid: 5.0 Cancel
starting month 2	value: F56.7 bid: <input type="text"/> Submit	value: F72.9 bid: <input type="text"/> Submit	value: F89.1 bid: <input type="text"/> Submit
starting month 3	value: F51.03 bid: <input type="text"/> Submit	value: F65.61 bid: <input type="text"/> Submit	value: F80.19 bid: <input type="text"/> Submit
starting month 4	value: F45.93 bid: <input type="text"/> Submit	value: F59.05 bid: <input type="text"/> Submit	value: F72.17 bid: <input type="text"/> Submit
starting month 5	value: F41.33 bid: <input type="text"/> Submit	value: F53.14 bid: <input type="text"/> Submit	value: F64.95 bid: <input type="text"/> Submit

Done

## Canceling an Order

You can always cancel a bid before you click on the “All Done” button. You can do this by clicking on the “Cancel” button for the bid that you want to cancel.

## All Done Button

Once you have submitted all the bids for a round, please click on the “All Done” button. You do not have to wait until time runs out before pressing the button. You will be instructed to wait until all the other players have clicked on the “All Done” button.

## The Solver

At the end of each auction the solver will determine which bids are the winning bids. The solver selects the combination of bids that maximizes the revenue to be received. For simplicity, in all subsequent examples, we assume that there are only three months, and the minimum package is one month.

Example: At the end of an auction, the following bids have been submitted:

Bidder 1: {month 1, month 2, month 3} = 200

Bidder 2: {month 1} = 100

Bidder 3: {month 2, month 3} = 75

The solver can choose to allocate the months in two different ways.

- 1). Give month 1, month 2, and month 3 to Bidder 1. The total revenue is 200.
- 2). Give month 1 to Bidder 2 and month 2 and month 3 to Bidder 3. The total revenue is 175.

Since the first allocation gives a higher total revenue, the solver will make Bidder 1 the winning bidder of month 1, month 2, and month 3.

## The Rebate

The amount that the winning bidders are required to pay at the end of the auction depends on the additional revenue that each bidder generated, which is calculated by comparing the revenue obtained by the auctioneer, versus the revenue obtained by the auctioneer when the given bidder was ignored.

Example: At the end of an auction, the following bids have been submitted:

Bidder 1: {month 1, month 2, month 3} = 200, {month 1} = 80

Bidder 2: **{month 1} = 100**, {month 1, month 2}=120

Bidder 3: **{month 2, month 3} = 150**, {month 3} = 80

The winning bids are Bidder 2's bid and Bidder 3's bid, because they generate the highest revenue  $100 + 150 = 250$ .

However, the auctioneer does not ask Bidder 2 to pay 100. Suppose that Bidder 2 were ignored. The winning bids then become Bidder 1's bid on (month 1) and Bidder 3's bid on (month 2, month 3).

Bidder 1: {month 1, month 2, month 3} = 200, **{month 1} = 80**

~~Bidder 2: {month 1} = 100, {month 1, month 2}=120~~

Bidder 3: **{month 2, month 3} = 150**, {month 3} = 80

Then the auctioneer calculates the revenue that those winning bids would generate, which is  $80 + 150 = 230$ . Thus, the additional revenue that Bidder 2 makes is 20, since  $250 - 230 = 20$ . This 20 is the rebate for Bidder 2. Therefore, Bidder 2 pays 100 and receives 20 back. His final price is 80.

Similarly, Bidder 3 might not have to pay 150. When Bidder 3 is ignored, the winning bid is Bidder 1's bid on (month 1, month 2, month 3).

Bidder 1: **{month 1, month 2, month 3} = 200**, {month 1} = 80

Bidder 2: {month 1} = 100, {month 1, month 2}=120

~~Bidder 3: {month 2, month 3} = 150, {month 3} = 80~~

The revenue to the auctioneer would be 200. Therefore, the additional revenue that Bidder 3 generates is 50, since  $250 - 200 = 50$ . The rebate for Bidder 3 is 50. Bidder 3 pays 150 and receives the rebate of 50. Thus, Bidder 3's final price is 100.

Notice that your final price depends on other bidders' bids, which you cannot observe during the auction.

## Timing

For each auction, you will be given up to 7 minutes to submit your bids. An experimenter will alert you when your time for each auction is up and will ask you to click the "All Done" button if you have not already.

## **Auction Results**

At the end of each auction, please record your winning package, if any, the value you have for that package, and your profit.

## **Special Notes**

We do not offer any guarantees that the software will not crash. When the computer crashes there may be some excitement, but there is no need to panic.

## **Worksheet**

Please fill out the worksheet completely as instructed. Your values are private information. Please do not reveal them to anyone.

At the end of the auction the owner of each package will receive his or her profit. Again, this is calculated in the following way:

$$\mathbf{Profit = value - final price.}$$

There will be a total of 8 auctions. Your total profit will be the sum of profit in each of the 8 auctions.

Player ID: \_\_\_\_\_  
 Player Type: Big or Small (circle one)  
 Computer #: \_\_\_\_\_

## Review Questions:

(You will be **paid** the specified amount for each correct answer.)

### Q.1 Number of winning bids. (\$0.50)

- (\$0.25) What is the minimum number of **winning bids** you may have at the **end** of the auction?
- (\$0.25) What is the maximum number of **winning bids** you may have at the **end** of the auction?

### Q.2 Winning Bids (\$1)

Suppose the bids submitted by four bidders are as listed in the table below. Which set of bids will be the winning bids?

	Package	Bid
Bidder 1	1–2	£30
Bidder 2	1–2	£20
Bidder 3	1–4	£60
Bidder 4	3–5	£40

### Q.3 Rebate (\$1)

Suppose the bids submitted by four bidders are as listed in the table below.

	Months	Bid
Bidder 1	1–3	£30
Bidder 2	1–3	£50
Bidder 3	2–5	£70
Bidder 4	4–5	£50

The winning bids are Bidder 2's bid and Bidder 4's bid, because they generate the highest revenue  $50 + 50 = 100$ . To compute the rebate for Bidder 2, let us ignore Bidder 2's bid.

- (\$0.25) Which set of bids will be the winning bids if Bidder 2's bid was ignored?
- (\$0.25) How much is the revenue that those winning bid(s) would generate?
- (\$0.25) How much is the additional revenue that Bidder 2 generates?  
(Hint: The highest revenue is 100 when Bidder 2's bid is not ignored.)
- (\$0.25) How much is the final price for Bidder 2?  
(Hint: The final price = Bid – Rebate)

## Review Questions:

(You will be **paid** the specified amount for each correct answer.)

### Answer Keys:

#### Q.1 Number of winning bids. (\$0.50)

- a) (\$0.25) What is the minimum number of **winning bids** you may have at the **end** of the auction? **Answer: 0**
- b) (\$0.25) What is the maximum number of **winning bids** you may have at the **end** of the auction? **Answer: 1**

#### Q.2 Winning Bids (\$1)

Suppose the bids submitted by four bidders are as listed in the table below. Which set of bids will be the winning bids?

	Months	Bid
Bidder 1	1–2	₱30
Bidder 2	1–2	₱20
Bidder 3	1–4	₱60
Bidder 4	3–5	₱40

**Answer: Bidder 1 and Bidder 4's bids (adds up to ₱70).**

#### Q.3 Rebate (\$1)

Suppose the bids submitted by four bidders are as listed in the table below.

	Months	Bid
Bidder 1	1–3	₱30
Bidder 2	1–3	₱50
Bidder 3	2–5	₱70
Bidder 4	4–5	₱50

The winning bids are Bidder 2's bid and Bidder 4's bid, because they generate the highest revenue  $50 + 50 = 100$ . To compute the rebate for Bidder 2, let us ignore Bidder 2's bid.

- a) (\$0.25) Which set of bids will be the winning bids if Bidder 2's bid was ignored?  
**Answer: Bidder 1 and Bidder 4's bids (adds up to ₱80).**
- b) (\$0.25) How much is the revenue that those winning bid(s) would generate?  
**Answer:  $30 + 50 = 80$ .**
- c) (\$0.25) How much is the additional revenue that Bidder 2 generates?  
(Hint: The highest revenue is 100 when Bidder 2's bid is not ignored.)  
**Answer:  $100 - 80 = 20$ .**
- d) (\$0.25) How much is the final price for Bidder 2?  
(Hint: The final price = Bid - Rebate)  
**Answer:  $50 - 20 = 30$ .**



Player ID: \_\_\_\_\_  
 Player Type: Big or Small (circle one)  
 Computer #: \_\_\_\_\_

### Earning Work Sheet:

Auction #	Winning Package (starting month, package length)	Value	Profit
Example	(2,3)	100	20
Auction 1			
Auction 2			
Auction 3			
Auction 4			
Auction 5			
Auction 6			
Auction 7			
Auction 8			
Total		Auction Profit=	

$$\left( \frac{\text{Auction Profit}}{\text{Exchange Rate}} \right) + \text{Quiz Score} + \text{Show Up Fee} = \text{Total Earning}$$

Player ID: \_\_\_\_\_  
Player Type: Big or Small (circle one)  
Computer #: \_\_\_\_\_

## Demographics Information

Age: \_\_\_\_\_  
Gender: \_\_\_\_\_  
Major: \_\_\_\_\_

### **Undergrad:**

**First Year, Second Year, Third Year, Fourth Year, Fifth Year, Six or more**  
Or

### **Grad:**

**First Year, Second Year, Third Year, Fourth Year, Fifth Year, Six or more**

**Number of Game Theory Classes Taken:** \_\_\_\_\_

**Have you discussed auction strategy in any of your courses? Yes or No.**  
**If so, which courses?**

**Strategy (record the strategy you used here and on the back):**

1. How did you decide which packages to bid on?

2. How did you decide what price you were willing to pay for each package?

3. Did you consider the valuation of others in determining your bids?

4. Did you consider your type (big or small) and whether you preferred early or late months in determining your bids?

5. Additional Comments