Experimental Procedures

This Appendix contains additional information about the experimental procedures, including instructions, comprehension quiz, and subjects pool.

Eleven auction laboratory experiments were conducted between May 26th and June 5th 2009 in the Computer Laboratory of the Main Library at Northwestern University using the z-Tree experimental software. A total of 66 subjects, recruited by email and via campus posters among Northwestern University undergraduate students, participated. Each session lasted for approximately one hour, including the time for reviewing the instructions, and was identically administered by me personally. First, a welcoming speech was given, describing the structure and timing of the experiment. Then, a four-page copy of the instructions was distributed to all of the participants, who then had 10 minutes to read the instructions and ask questions. Students who wished to ask questions would raise their hand and I would answer their questions privately. Students were allowed to keep a copy of the instructions during the entire session.

After reading the instructions, the subjects completed a comprehension quiz[1], which helped them better understand the rules of the game and test their comprehension. Being the quiz a self-test tool, all subject, irrespective of their performance on the quiz, were allowed to proceed in the experiment. Section E.2 includes descriptive results about the subjects' performance on the quiz, providing evidence that most of the participants understood well the rules of the game. Once the experiment was over, subjects filled in a questionnaire, consisting of questions about gender, age, major, year of graduation, familiarity with the game, and number of classes taken in several fields.[2] Subjects were paid individually in a sealed envelope.

1. Instructions (Market with 8 players)

Welcome! This is an experiment in decision-making. Please follow these instructions carefully. In this experiment we are going to simulate a market of a commodity in which some of you will be buyers and some of you will be sellers. You will use the computer to buy or sell. To ensure the best results for yourself, do not talk with other people in the room, and do not discuss your information with others at any point during the experiment.

A market consists of 8 participants, including you. Of the 8 participants, 4 are buyers and 4 are sellers.

You will play the game for 15 rounds. The participants in the market are randomly matched at the beginning of the experiment and don't change across rounds.

At the end of the session, the computer will randomly select one of the rounds, and you will be paid according to your performance in that round only.

In the first round the computer will randomly select your role as either a buyer or a seller. If the computer selects the role of buyer for you, then you will be a buyer in rounds 1 to 5, a seller in rounds 6 to 10, and a buyer again in rounds 11 to 15. Similarly, if the computer selects the role of seller for you, then you will be a seller in rounds 1 to 5, a buyer

[1] The comprehension quiz was referred to as a 'guided example'.

[2] The participants were also given the option to leave specific comments about the way they played the game and/or general comments about the experiment.

in rounds 6 to 10, and a seller again in rounds 11 to 15. You will see the information on the screen.

If you are a buyer, you will have $10, and if you are a seller, you will have 1 unit of the commodity.

There are two ways to earn profits: trading, and forecasting.

HOW TO TRADE

Each buyer can purchase a single unit of the commodity from any seller, and each seller can sell a single unit of the commodity to any buyer.

How buyers and sellers submit their choices

Each buyer will see on the screen his or her **personal value V** of the unit, and each seller will see his or her **personal cost C**. You will not know the personal values and costs of other buyers and sellers.

Each buyer's personal value and seller's personal cost are assigned randomly: the computer determines them by a random draw of the 1000 numbers (to the nearest penny) between $0.00 and $9.99. Each number is equally likely. Each draw is independent from any other draw: the value for each buyer and the cost for each seller do not depend on the numbers drawn for other buyers or other sellers.

If you are a **buyer**, after being informed about your personal value, you'll be asked to **submit your bid B**. Your bid is the highest price, which you are willing to pay to purchase the commodity.

If you are a **seller**, after being informed about your personal cost, you'll be asked to **submit your offer O**. Your offer is the lowest price, which you are willing to accept to sell the commodity.

Type in the your choice and click on the OK button to submit it. Once you have clicked on OK you can't change your choice.

How the market price is determined

All trades in the market occur at a unique price: the market price P. What the market price turns out to be depends on the specific bids and offers submitted by you and by the other three participants in the market.

The computer gathers the submitted bids and offers, and it computes the market price in such a way that the numbers of units sold and purchased is the same, i.e., to equalize demand and supply. Later, we explain, using an example, how the bids and offers jointly determine the market price.

Who trades at the market price

If you are a **buyer**, whether you buy or not depends on the relation between your bid and the market price.

***IF* your bid $\geq$ market price $\rightarrow$ *THEN* you buy and pay the market price**

Otherwise, you will not buy.

If you are a **seller**, whether you sell or not depends on the relation between your offer and the market price.

***IF* your offer $\leq$ market price $\rightarrow$ *THEN* you sell and receive the market price**

Otherwise, you will not sell.

How trading profits are computed

Trading profits can be either positive, negative, or zero. For a buyer or a seller who does not trade, trading profits are zero. For a buyer or a seller who trades, trading profits depend on the market price P and on the personal value (if a buyer) or the personal cost (if a seller).

A **buyer** with a personal value V who buys a unit at market price P will earn:

buyer's profit = personal value - market price = V - P.

For example, a buyer with a personal value of \$3.08 who buys at market price \$2.58 earns a profit of \$3.08 - \$2.58= \$0.50. A buyer will earn a negative profit (lose money) if she buys at a market price above her personal value. For example, a buyer with a personal value of \$3.08 who buys at market price \$3.20 earns a negative profit of \$3.08 - \$3.20= -\$0.12, i.e., loses \$0.12.

A **seller** with a personal cost C who sells a unit at market price P will earn:

seller's profit = market price - personal cost = P - C.

For example, a seller with a personal cost of \$0.63 who sells at market price \$2.70 earns a profit of \$2.70 - \$0.63= \$2.07. A seller will earn a negative profit (lose money) if she sells at a market price below her personal cost. For example, a seller with a personal cost of \$0.63 who sells at market price \$0.60 earns a negative profit of \$0.60 - \$0.63= -\$0.03, i.e., loses \$0.03.

Whatever profit you make by trading is yours to keep. However, a buyer's initial cash and a seller's unsold unit do not count towards profits. If you earn a negative profit, such amount will be deducted from your show-up fee.

HOW TO FORECAST

Besides having the opportunity to trade, you will also be given the opportunity to make predictions. The questions will appear on your screen automatically.

You will be asked to forecast what the percent chance is that other participants in the market will make particular choices. Specifically, you will **assign a percent chance to each possible outcome**. A percent chance is a number between 0 and 100 percent, where 100 percent chance assigned to an outcome means that you are certain that such outcome is going to be the correct one, and 0 percent chance means that you are certain that such outcome is *not* going to be the correct one.

You will be paid based on the accuracy of your forecasts. Specifically, we will give you \$2 from which we will subtract an amount which depends on how inaccurate your prediction was.

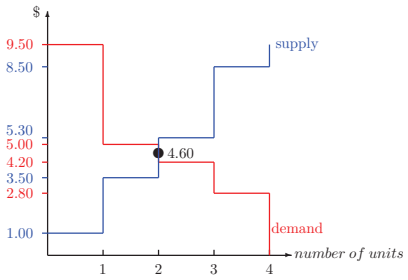
Suppose that you are a seller and that you have to forecast the percent chance that any of the 4 other buyers in the market will choose one of two possible alternatives X and Y. Suppose that your forecasts are p_X and p_Y respectively.

For every other buyer who chooses X, the amount $\frac{1}{4}\{(\frac{p_X}{100}-1)^2+(\frac{p_Y}{100})^2]$ is subtracted from the initial \$2. For every other buyer who chooses Y, the amount $\frac{1}{4}\{(\frac{p_X}{100})^2+(\frac{p_Y}{100}-1)^2]$ is subtracted from the initial \$2.

The worst you can do is to assign a 100 percent chance to X when all 4 buyers choose Y instead. In this case your payoff is $\$2-\frac{1}{4}\{0+4[(1)^2+(0-1)^2]\}=\$0$.

The best you can do is instead to assign a 100 percent chance to X when in fact all 4 buyers choose X. In this case your payoff is $\$2-\frac{1}{4}\{4[(1-1)^2+(0)^2]+0)\}=\$2$.

Since your predictions are made when you don't know what other participants have chosen, **the best thing you can do to maximize the expected size of your payoff is to simply state what you think.**



Example Suppose that a market consists of 8 participants. Of the 8 participants, 4 are buyers and 4 are sellers. Suppose that the 4 buyers submitted bids of \$2.80, \$4.20, \$5.00, \$9.50, and the 4 sellers submitted offers of \$1.00, \$3.50, \$5.30, \$8.50. The bids and offers are represented in this figure.

The red line is the demand curve. The steps of the curve represent the bids submitted by the buyers: one buyer is willing to pay at most \$9.50, another buyer at most \$5.00, another buyer at most \$4.20, and another buyer at most \$2.80.

The blue line is the supply curve. The steps of the curve represent the offers submitted by the sellers: one seller is willing to accept no less than \$1.00, another seller no less than \$3.50, another seller no less than \$5.30, and another seller no less than \$8.50.

The two curves intersect within the range of prices between \$4.20 and \$5.00. The market price is set at the midpoint of this range, at $\frac{\$4.20+\$5.00}{2} = \$4.60$.

Who will trade at the market price? Those buyers willing to pay a price higher than or equal to \$4.60, and those sellers willing to accept a price lower than or equal to \$4.60. Therefore, the buyers who submitted bids of \$5.00 and \$9.50, and the sellers who submitted offers of \$1.00 and \$3.50 will trade. On the other hand, the buyers who submitted bids of \$2.80 and \$4.20 will not buy (for them the market price is too high!) and the sellers who submitted offers of \$5.30 and \$8.50 will not sell (for them the market price is too low!). Demand equals supply at the market price: two buyers buy and two sellers sell, i.e., two units are bought and two units are sold.

What are the profits? The buyers and the sellers who don't trade earn zero profit. The buyers who trade earn a profit equal to the difference between their value and the market price. For example, if the buyer with bid of \$5.00 had a value of \$5.64, then he or she would earn \$5.64 - \$4.60 = \$1.04. The sellers who trade earn a profit equal to the difference between the market price and their cost. For example, if the seller with offer of \$3.50 had a cost of \$2.98, then he or she would earn \$4.60 - \$2.98 = \$1.62.

The market price can also be quickly determined in the following way. Let's sort all 8 bids and offers in increasing order, irrespective of whether it's a bid or an offer. We have: \$1.00, \$2.80, \$3.50, \$4.20, \$5.00, \$5.30, \$8.50, and \$9.50. The middle two (i.e. the 4th and 5th highest numbers) are \$4.20 and \$5.00. *The market price is set at the midpoint between the middle two bids and offers*, i.e. $\frac{\$4.20+\$5.00}{2} = \$4.60$.

Priority for trading is always given to sellers whose offers are smallest and to buyers whose bids are largest. If this criterion does not make demand and supply equal, then a coin toss determines who trades among the remaining participants.

2. Performance in the Comprehension Quiz

After reading the instructions, subjects had 10 minutes to complete a comprehension quiz, which consisted of an example of an auction followed by four questions. Each question allowed for two attempts. After an answer was submitted, the computer announced whether the answer was correct. If incorrect, a short explanation and a hint appeared on the screen, and the subject was invited to answer the question again. After the second attempt, the computer announced once again whether the answer was correct. If incorrect, a longer explanation appeared on the screen. Subjects received $5 if they answered correctly all four questions, regardless of whether the answers were correct the first or second time around.

I introduced the comprehension quiz and rewarded correct answers in order to provide the subjects with a stronger incentive to concentrate on reading and understanding the rules of the game. For the same reason, each question allowed for two attempts and correct answers were remunerated whether they were correct the first or second time around. Additionally, the subjects were allowed to consult the printed instructions while answering the questions. The data collected from the comprehension quiz provide evidence that most of the participants understood the rules of the game.

Table 1 shows details about the participants' performance in the comprehension quiz. The first question required sorting in increasing order the bids and offers in the auction example. The second question required determining the market price. The third question required determining whether each trader in the example would trade or not at the market price. A subject's answer was correct if she correctly stated whether each trader would trade or not. The fourth question required determining the profit of a selection of traders in the market. For each trader three alternatives were shown and only one of them was correct. A subject's answer was correct if she correctly stated the profit of each trader.

Table 1: Performance in the comprehension quiz.

topic		1st attempt		2nd attempt*	
		No.	%	No.	%
ordering	*correct*	66	100		
price	*correct*	57	86	8	89
	incorrect	9	14	1	11
trades	*correct*	56	85	7	70
	incorrect	10	15	3	30
profits	*correct*	16	24	20	42
	incorrect	48	73	25	52
	no answer	2	3	3	6

* if 1st attempt is incorrect

3. Subject Pool

The sample contains similar proportions of freshmen, sophomore, junior and senior students. Among participants, 9, 18, 49, and 24% have a major in the Humanities, the Sciences, the Social Sciences (excluding Economics), and Economics, respectively. According to the most recent available statistics provided by the Office of the Registrar, in the 2007 graduating class the proportions were 18, 25, 47 and 10%, respectively. If the 2007 graduating class is considered as the population of Northwestern undergraduates, the following differences between the sample and the population stand out: (1) students with a major in the Social Sciences are over-represented, (2) students with a major in the Humanities are under-represented, (3) the over-representation of students with a major in the Social Sciences coincides with an over-representation of students with a major in Economics. Finally, female students are over-represented in the sample compared to the population (71 versus 53%).

4. Belief elicitation

Belief elicitation employed the following wording.

> *Think about the other buyers and sellers in the market. Their personal values and costs, as your own value*[3]*, are also determined by the computer as a random draw of the numbers between 0.00 and 9.99. What do you think they will choose? Please answer the following questions.*
>
> *What do you think the percent chance is that another*[4] *BUYER in the market will choose a bid in each of the following intervals? Assign a percent chance to each interval. Remember: a percent chance is a number between 0 and 100. Also, percent chances should add up to 100.*

between $0 and $2	between $2.01 and $4	between $4.01 and $6	between $6.01 and $8	between $8.01 and $10	larger than $10

> *What do you think the percent chance is that a*[5] *SELLER in the market will choose an offer in each of the following intervals? Assign a percent chance to each interval. Remember: a percent chance is a number between 0 and 100. Also, percent chances should add up to 100.*

between $0 and $2	between $2.01 and $4	between $4.01 and $6	between $6.01 and $8	between $8.01 and $10	larger than $10

[3] 'Value' is displayed if the player is a buyer,'cost' is displayed if the player is a seller.
[4] 'Another' is displayed if the player is a buyer, 'a' is displayed if the player is a seller.
[5] 'A' is displayed if the player is a buyer, 'another' is displayed if the player is a seller.