EXPERIMENTAL SUPPLEMENT

To "The Efficiency of Negotiations with Uncertainty and Multi-dimensional Deals"

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(for online publication)

This document details the experimental design, provides comprehensive analysis of the key empirical findings, and documents the experimental instructions.

NOTE: The term "period" used in the paper corresponds to the term "bargaining stage" used in this supplement as well as in the instructions that were distributed to experimental participants (which are provided in the Appendix of this supplement). The use of different terms for the same concept is guided by the different audiences for which they are intended.

1. EXPERIMENTAL DESIGN

The goal of the experiments is to gain insight into how subjects negotiate in different settings.

1.1. STRUCTURE

The experiments use two bargaining protocols. The first is an implementation of alternating offers. The second is a free form setup where subjects can engage in text-based chat and, simultaneously, issue offers. Within the alternating offer protocol, we have two treatments (1 good and 4 goods – known surplus), while the free form bargaining has four treatments (1 good, 4goods – known surplus, 4 goods – coin toss, and 4 goods – spin the wheel). Treatment assignment is at the session level and, in each treatment, all rules are common knowledge.

Each treatment requires an even number of participants who experience 10 rounds of bargaining in pairs. We denote the first four rounds "practice" and the last six rounds "real". Earnings are based on an *ex post* random selection of a real round. Each round, participants are assigned the role of either buyer or seller. During the practice rounds, participants experience both roles. Once the practice rounds are completed, participants are assigned the role of either buyer or seller and remain in that role throughout the real rounds. At the beginning of each round sellers and buyers are anonymously and randomly paired (random stranger). Upon role assignment, sellers and buyers are privately informed of their cost(s) and value(s), respectively. Cost(s) and value(s) are equiprobable across rounds and participants.

For each pair, each bargaining round is composed of up to 8 stages of bargaining. A financial discounting penalty is applied based on the number of stages required to reach agreement: 0% in the first stage, increasing arithmetically by 10% every stage until 70% in stage 8. If a pair of traders

fails to reach agreement within 8 stages, bargaining is suspended and traders earn zero profit for that round.

In what follows, financial rewards are expressed in Australian dollars. In the 1-good treatments, seller costs are drawn from {$0, $160} and buyer values from {$40, $200} with equal probability. Hence, three out of the four possible combinations of cost and value imply a strictly positive surplus, whereas one combination implies a strictly negative surplus. The expected surplus of a pair of traders is $70.

In the 4-good treatments with known surplus, the cost and value pairs are {($0, $10), ($0, $50), ($40, $10), ($40, $50)} in every round, but the assignment of each of these combinations on each of the four goods is randomized. Consequently, by way of an example, a seller with a cost of $0 for the first good does not know whether the buyer's value for that good is $10 or $50. In two of the four 4-good treatments (4-good alternating, and 4-good free-form basic), total surplus per round is fixed at $70, equal to the expected surplus in the 1-good treatments.

In one of the remaining 4-good treatments (4-good free-form coin toss), each of the four goods is drawn i.i.d. from the four possibilities, meaning that the expected surplus is equal to $70, but can be higher or lower in any given round. In fact, for each round, there are a finite number of possible surpluses: $\{\$10, \$20, \$30, \$40, \$50, \$60, \$70, \$80, \$100, \$110, \$120, \$150, \$160, \$200\}$.

In the last remaining 4-good treatment (4-good free-form spin the wheel), each trader must have exactly two low-surplus goods, and two-high surplus goods, though the order is random. As a result, there are exactly three potential surplus levels per round $\{\$40, \$70, \$100\}$.

In 1-good treatments, offers are unidimensional trading-prices. In 4-good treatments, offers are a list of the goods included in a bundle that is on offer in addition to a price for the entire bundle. A bundle may include anywhere from one to four goods. There are no restrictions on which goods may be included.

In any given round of alternating offer treatments and for any given pair of traders, the computer selects randomly one of the two traders to make the first offer. The responder can accept or reject such an offer. If a trader accepts the first offer, the round is concluded for the pair that this trader belongs. If the first offer is rejected, the other trader has the opportunity to make a counter-offer. This alternating process continues until one of the pair of traders makes an offer that the other trader accepts. An important difference between the 1-good and the 4-good alternating offer treatments is that in the case of the former a proposer can issue a single offer whereas in the latter a trader can issue multiple offers in any given stage. Of course, a responder can accept, at most, a single offer. A time limit is given for proposing and for responding. In stage 1 a proposer is given 30 seconds and a responder is given 10 seconds. By contrast, in stages 2-8 a proposer is given 15 seconds and a responder is given 5 seconds. In the case of any given pair of traders, a bargaining stage encompasses the proposer's offer and the responder's decision to accept or reject.

Unlike the alternating offers setup, free form treatments are considerably less structured. In any given round, traders are allowed to exchange messages and, simultaneously, offers with their

partners. Traders can issue as many messages or offers to their partners as they like without waiting for their partner to respond. Offers do not expire across bargaining stages and may be accepted at any time. Time limits are comparable to those that apply in the case of the alternating offers treatments: 40 seconds for stage 1, and 20 seconds for all remaining stages. Bargaining automatically advances to the next stage once a stage concludes without agreement.

1.2. Outcome Variables and Hypothesis

Let $i \in \{1,2,\dots\}$ denote session, $t \in \{1,2,\dots,10\}$ denote bargaining round, $j \in \{1,2,\dots J_{it}\}$ denote bargaining pair (J_{it} is the number of pairs in bargaining period t of session i), and $r \in \{1,2,\dots,8\}$ denote bargaining stage.

Let $s_{itj} \in [\$0, \$200]$ denote the potential surplus for pair j in round t of session i. Let d_{itjr} be a dummy variable that takes the value "1" if pair j in round t of session i successfully trades in stage r, and "0" otherwise. Let $D_{itj} = \sum_r d_{itjr}$. Trade takes place when $D_{itj} = 1$, and fails to take place otherwise. Finally, let R_{itj} denote the stage in which a trade occurred for pair j in round t of session i, and let it equal "0" in the event that no trade occurred.

At this stage, we presage our results by pointing out that no negative-surplus trades occurred. It should be noted that in 8 out of a total of 2,395 incentivized subject interactions an efficient trade took place at a price that implied negative earnings for one of the two traders. In three of the 8 cases the losses were sufficiently large (i.e., greater than $7) so as to bankrupt participants. A bankrupt participant is suspended from subsequent rounds of the same session. This requires another to be forced to sit out as the session continues with an even number of players. This second participant was randomly selected at the beginning of each round of any given session.

Conditional on this fact, and given the goal of the experiment, we had no interest in the actual trade price when a trade occurred, despite the availability of such data.

Our primary outcome variable of interest is efficiency, e_{itj}, which we define as follows for any pair j of round t of session i:

$$e_{itj} = \left(\frac{11 - R_{itj}}{10}\right) D_{itj}\, s_{itj} \; if \; s_{itj} > 0$$

It is the percentage of potential surplus realized once the discount factor has been applied, and taking into account the possibility that the traders may fail to trade. Note that e_{itj} is undefined when the potential surplus is zero.

Hypothesis: Efficiency will be higher in 4-good treatments than in 1-good treatments that use the same bargaining protocol (i.e., alternating and free-form).

Looking ahead to the econometric testing, under certain specifications, we will need to test our primary hypothesis by comparing efficiency that has been aggregated at the round level or session

level. In these situations, there are two ways of calculating average efficiency: weighted and unweighted means.

To explain the difference, we begin by arbitrarily reordering the pairs in each round of each session so that the first $\tilde{J}_{it} \leq J_{it}$ pairs are the ones for whom the surplus is strictly positive, $s_{itj} > 0$, and therefore for whom efficiency is defined. This is without loss of generality.

In the case of round-level aggregation:

$$\bar{e}_{it}^{u} = \frac{1}{\tilde{J}_{it}} \sum_{j=1}^{\tilde{J}_{it}} e_{itj}\,, \qquad \bar{e}_{it}^{w} = \frac{1}{\sum_{j=1}^{\tilde{J}_{it}} s_{itj}} \sum_{j=1}^{\tilde{J}_{it}} s_{itj} e_{itj}$$

The unweighted average assigns each pair in the round an equal weight. The weighted average assigns each pair a weight that is equal to the potential surplus for the pair. This is equivalent to defining average efficiency for the round as the total surplus realized across all pairs divided by the total potential surplus across all pairs.

Equivalently, in the case of session-level aggregation:

$$\bar{e}_{i}^{u} = \frac{1}{\sum_{t=1}^{6} \tilde{J}_{it}} \sum_{t=1}^{6} \sum_{j=1}^{\tilde{J}_{it}} e_{itj}\,, \qquad \bar{e}_{i}^{w} = \frac{1}{\sum_{t=1}^{6} \sum_{j=1}^{\tilde{J}_{it}} s_{itj}} \sum_{t=1}^{6} \sum_{j=1}^{\tilde{J}_{it}} s_{itj} e_{itj}$$

In each case, both weighted and unweighted averages are valid; we therefore report both.

1.3. PROCEDURE

The experimenter script and the experimental instructions are in the experimental materials appendix which follows section 3. Here, we briefly describe the most salient features of the recruitment and implementation procedures.

The experimental sessions took place at the Monash University Laboratory for Experimental Economics (MonLEE) on the Clayton campus of Monash University in Melbourne, Australia. Subjects were predominantly undergraduate students from Monash University. They were recruited from a database of individuals who expressed interest in participating in economic experiments that is maintained by MonLEE. No subject participated more than once. We conducted 30 sessions employing a total of 528 subjects. Each session involved between 8 and 24 subjects as summarized in Table 2.1.1a of the next section.

Our experiments concentrated first on the first four key treatments of Table 2.1.1b. These are 1.1, 1.2, 2.1, and 2.2. Within each cluster of four consecutive sessions within the first 16 sessions, assignment of each of the first four treatments to each of the sessions in the cluster was random. By the conclusion of the 16th session, we determined that we had sufficient observations for

statistical inference. Sessions 17 and 18 were added to introduce parity between the number of subjects involved in alternating offer treatments.

We then run four consecutive sessions of 4.1 followed by four consecutive sessions of 5.1. At this point we noted that one of the results of 4.1 was, on the margin, statistically insignificant. For this reason, we decided to run one more session of each open chat treatment. The order was random.

Upon arrival at the lab subjects earned an attendance fee of $10. This has two components, a show-up fee of $3 and a participation fee of $7. Any positive earnings that subjects made by trading one or more goods during an experiment were added to this $7, whereas any negative earnings were subtracted from this $7. If a subject made a loss in excess of $7 in any given round, then their participation in subsequent rounds of the session was suspended and the participant only received their show-up fee of $3.

At the beginning of a session subjects were given written instructions. These instructions were also read aloud in an effort to make the rules of the game common knowledge. Following this step, subjects were given the opportunity to ask questions in private. The experiment then commenced. Throughout a session, subjects interacted only through the MonLEE computer network running an application written using the *z-Tree* experimental package (Fischbacher, 2007). Following the 10^{th} round of any given session; subject earnings were determined, subjects were paid privately, and their participation in the experiment was then concluded.

2. EMPIRICAL RESULTS

2.1. DESCRIPTIVE STATISTICS

We ran 34 sessions involving 606 subjects. Tables 2.1.1a and 2.1.1b provide relevant details, including a breakdown of the allocation across treatments. All sessions except the 4 good one by one were conducted during Monash University's teaching semesters during 2017-2019. The 4 good one by one were conducted at the University of Queensland during September/October 2021. Variation in the number of subjects across sessions was largely driven by subject availability.

Table 2.1.1a: Sessions: Details

Session	Date	Goods	Structure	Subjects
1	2017-08-01	1	Open chat	8
2	2017-08-01	4	Open chat: Basic	10
3	2017-09-12	4	Alternating	20
4	2017-09-19	1	Alternating	24
5	2017-09-21	4	Open chat: Basic	22
6	2017-09-25	1	Alternating	24
7	2017-09-25	1	Open chat	20
8	2017-09-26	4	Alternating	24
9	2017-10-03	4	Alternating	14
10	2017-10-03	1	Alternating	24
11	2017-10-05	1	Open chat	24
12	2017-10-05	4	Open chat: Basic	22
13	2017-10-12	4	Open chat: Basic	20
14	2017-10-25	1	Open chat	24
15	2017-10-26	4	Alternating	16
16	2017-10-21	1	Alternating	22
17	2017-10-22	4	Alternating	12
18	2017-10-27	4	Alternating	10
19	2018-11-09	4	Open chat: Coin toss	14
20	2018-11-23	4	Open chat: Coin toss	14
21	2018-11-27	4	Open chat: Coin toss	10
22	2018-12-04	4	Open chat: Coin toss	20
23	2019-02-27	4	Open chat: Spin the wheel	12
24	2019-03-08	4	Open chat: Spin the wheel	14
25	2019-03-15	4	Open chat: Spin the wheel	16
26	2019-03-22	4	Open chat: Spin the wheel	14
27	2019-04-03	4	Open chat: Coin toss	24
28	2019-05-03	4	Open chat: Spin the wheel	26
29	2019-05-10	4	Open chat: Basic	12
30	2019-05-16	1	Open chat	12
31	2021-09-15	4	Alternating, one-by-one	18
32	2021-10-05	4	Alternating, one-by-one	20
33	2021-10-06	4	Alternating, one-by-one	20
34	2021-10-07	4	Alternating, one-by-one	20

Table 2.1.1b: Sessions: Summary

Treatment	Sessions	Subjects
1 good, alternating	4	94
1 good, open chat	5	88
4 goods, alternating	6	96
4 goods, open chat, basic	5	86
4 goods, open chat, coin toss	5	82
4 goods, open chat, spin the wheel	5	82
4 goods, alternating, one-by-one	4	78

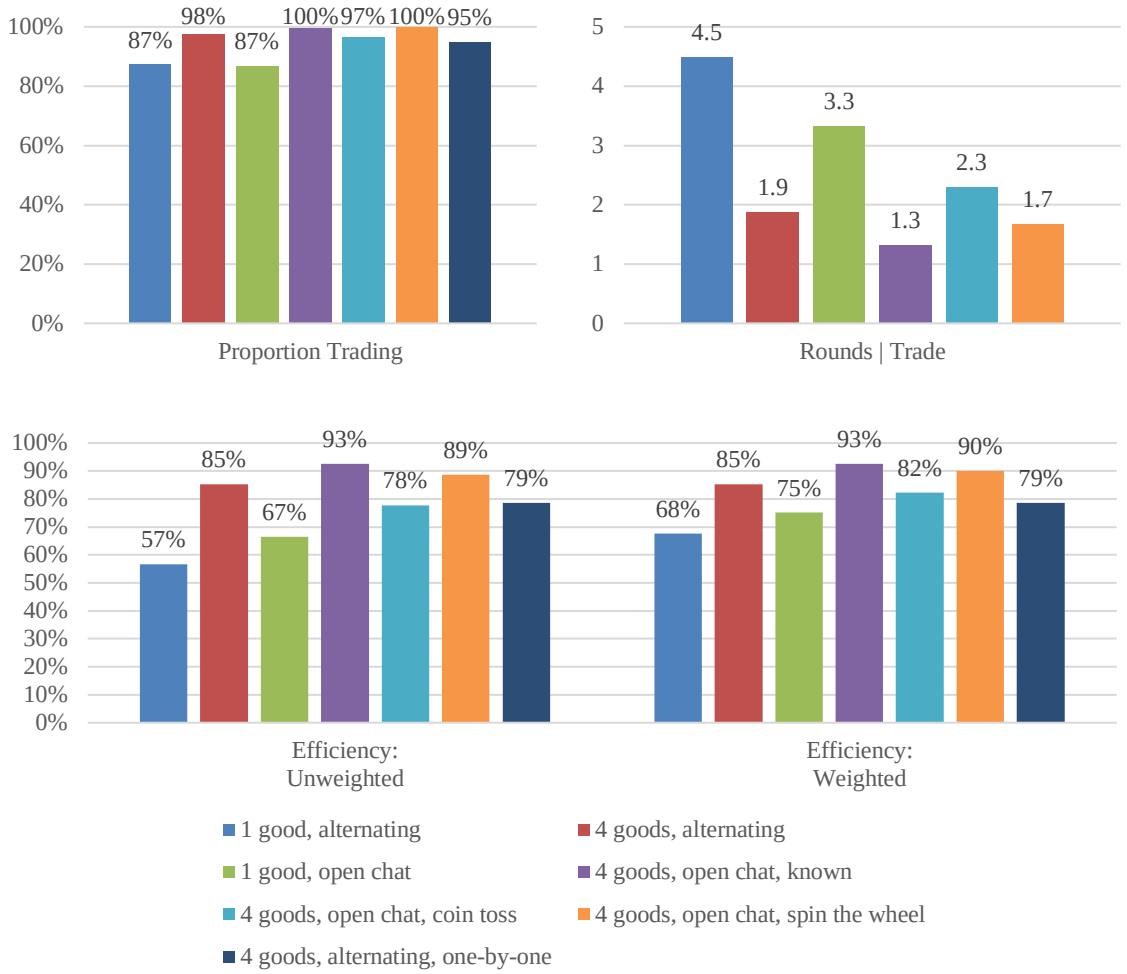
The primary summary statistics are shown in Table 2.1.2, and in Figure 2.1.1. Note that these summary statistics define an observation as a specific pair in a specific period in a specific session, which we refer to as a unique matching.

Table 2.1.2: Means and SDs for Primary Variables where Observations are Matchings

Treatment	Surplus	# Obs	% Trading	Bargain Rounds	Efficiency: Unweighted	Efficiency: Weighted
1 good, alternating	0	71	0%	N/A	N/A	N/A
	40	142	81%	5.1 (2.1)	47% (30%)	N/A
	200	69	100%	3.4 (2.2)	76% (22%)	N/A
	Pooled	282	87%	4.5 (2.3)	57% (30%)	68% (0%)
4 goods, alternating		284	98%	1.9 (1.4)	85% (21%)	85% (21%)
1 good, open chat	0	64	0%	N/A	N/A	N/A
	40	133	80%	3.6 (2.3)	59% (36%)	N/A
	200	62	100%	2.8 (2.0)	82% (20%)	N/A
	Pooled	259	87%	3.3 (2.3)	67% (34%)	75% (0%)
4 goods, open chat, known		258	100%	1.3 (0.9)	93% (17%)	93% (0%)
4 goods, open chat, coin toss (average)		241	97%	2.3 (1.7)	78% (25%)	82% (0%)
4 goods, open chat, spin the wheel	40	79	100%	2.2 (1.6)	85% (20%)	N/A
	70	79	100%	1.8 (1.2)	85% (17%)	N/A
	100	85	100%	1.1 (0.3)	95% (14%)	N/A
	Pooled	243	100%	1.7 (1.2)	89% (18%)	90% (0%)
4 goods, alternating, one-by-one		234	95%	N/A	79% (24%)	79% (0%)
All		1,801	95%	2.3 (1.9)	79% (27%)	82% (0%)

Figures in parentheses denote standard deviations. In pooled data, "% Trading" shows the percentage trading conditional on a strictly positive surplus. "Bargain Stages" refers to the stages taken to agree on a trade conditional on a trade occurring.

Figure 2.1.1: Means of Key Variables where Observations are Matchings



Percentages are expressed as proportions to maintain a single vertical axis. "Proportion trading" is conditional on the potential surplus being positive.

The data have several notable features.

First, 4-good treatments result in higher levels of average efficiency as compared to their 1-good counterparts.

Second, the difference in efficiency between corresponding 1-good and 4-good treatments is partially due to failure to trade in 1-good treatments when surplus is positive; and partially due to the fact that subjects typically take a greater number of bargaining stages in 1-good than 4-good treatments to reach an agreement, therefore incurring a higher discount factor.

Third, the increase in efficiency that is observed as the protocol switches from alternating offers to free form bargaining is consistent with an expansive literature documenting the role of cheap talk in promoting coordination (e.g., Charness 2000, Charness and Dufwenberg 2006). Of course, such matters extend beyond the scope of inquiry of our study.

These remarks are all based on comparisons of the point values of sample means. In the next section, we conduct formal inference.

In the main paper, in anticipation of the statistical inference, we report sample means *where observations are at the session level*. For the readers' convenience, we reproduce Table 3 of the paper as Table 2.1.3, and Table 4 of the paper as Table 2.1.4.

Naturally, the *matching* level results of Table 2.1.2 and the *session* level results of the following Tables will exhibit differences.

Table 2.1.3: Efficiency (Percent of Total Surplus Realized)

Treatment Description (Treatment number)	Efficiency
1 good, free-form (2)	73.7%
4 goods, free-form, deals, i.i.d. (6)	82.9%
4 goods, free-form, deals, known-frequencies (7)	90.1%
4 goods, free-form, deals, known-surplus (5)	93.5%

These sample means treat each session as an observation. This corresponds to Table 3 in the main paper. P-values are from a t-test.

Table 2.1.4: Efficiency and Fraction Trading

Treatment Description (Treatment number)	Efficiency	*p*-value rel. to corr. 1g. treat.	Fraction trading	*p*-value rel. to corr. 1g. treat.
1g. structured (1)	67.2%		87.2%	
1g. free-form (2)	73.7%		86.7%	
4g. struct., 1-by-1, known-surp. (3)	78.4%	0.034	94.9%	0.048
4g. struct., deals, known-surp. (4)	85.7%	0.007	97.5%	0.021
4g. free-form, deals, known-surp. (5)	93.5%	0.001	99.6%	0.002
4g. free-form, deals, i.i.d. (6)	82.9%	0.021	96.7%	0.004
4g. free-form, deals, known-freq. (7)	90.1%	0.003	100.0%	0.002

These sample means treat each session as an observation. This corresponds to Table 4 in the main paper. P-values are from a t-test.

As we discuss in the paper, incentives for posturing in 1 good but not in 4 good treatments explain the markedly lower efficiency in the former. Posturing can manifest in a number of different ways. In free form treatments, this will lead to delays in reaching a deal and includes misrepresenting one's own cost or value. Tables 5 and 6 of the paper present relevant evidence. We reproduce them below as Tables 2.1.5 and 2.1.6.

Table 2.1.5: Percent of Surplus Realized by Period

Treatment Description (Treatment number)	% Realized Surplus in Each Period								% Missed Surplus
	1	2	3	4	5	6	7	8	
1g. structured (1)	9.5	12.8	10.9	10.4	10.9	12.8	8.1	11.8	12.8
1g. free-form (2)	22.1	19.5	11.8	10.8	7.2	3.6	3.1	8.7	13.3
4g. struct., 1-by-1, known-surp. (3)	39.2	23.7	12.3	5.7	3.6	2.5	1.8	1.0	10.1
4g. struct., deals, known-surp. (4)	52.6	23.3	7.2	4.8	1.9	1.4	1.7	0.5	6.7
4g. free-form, deals, known-surp. (5)	80.0	10.1	1.7	1.5	1.0	0.9	0.0	0.0	4.8
4g. free-form, deals, i.i.d. (6)	37.1	25.5	12.1	5.2	3.8	1.9	1.4	2.0	11.0
4g. free-form, deals, known-freq. (7)	61.7	18.0	8.1	4.5	1.2	0.0	0.6	0.6	5.3

Note that the percent not trading in Table 2.1.5 is of all subject matchings, and so that is why, for instance, the 13.3% number for the 1 good free-form treatment is 0.4% different from the 86.3% eventually trading of Table 2.1.4. Table 2.1.4 considers each session as an observation, and then averages across sessions.

Table 2.1.6: Fraction of Declarations That Are Untrue in Free-Form Treatments

Treatment Description (Treatment number)	Periods								Avg.
	1	2	3	4	5	6	7	8	
1g. structured (1)	$^{97}/_{385}$	$^{24}/_{85}$	$^{13}/_{52}$	$^{14}/_{37}$	$^{6}/_{24}$	$^{2}/_{22}$	$^{1}/_{10}$	$^{2}/_{15}$	25.2%
4g. free-form, deals, known-surp. (5)	$^{4}/_{199}$	$^{0}/_{2}$	$^{0}/_{1}$	n.a.	n.a.	n.a.	n.a.	n.a.	2.0%
4g. free-form, deals, i.i.d. (6)	$^{83}/_{431}$	$^{2}/_{6}$	$^{3}/_{4}$	$^{0}/_{1}$	$^{0}/_{1}$	n.a.	n.a.	n.a.	19.9%
4g. free-form, deals, known-freq. (7)	$^{8}/_{439}$	$^{0}/_{4}$	n.a.	n.a.	$^{0}/_{1}$	$^{0}/_{1}$	n.a.	n.a.	1.8%

In each fraction, the numerator is the number of untrue declarations, while the denominator is the number of total declarations

As we discuss in the paper, determining what subjects declare in chats is generally clear. However, at times, making such determinations may require subjective judgement. To limit the role of subjectivity we have adopted the following rules in how we process exchanges between subjects:

Rule 1: We define a message to begin when a subject starts typing in the chat box and to end when the subject hits "ENTER" and the message is transmitted to their trade partner.

We adopt this rule because, on occasion, a participant will send multiple messages before their partner responds. Under the circumstances, this rule promotes consistency in how exchanges are processed.

Rule 2: A declaration, or a potential root of an indirect declaration, may reside within a message (as defined by Rule 1) if this message includes at least one number. The number may be written using either Arabic numerals or text. A declaration may either be direct or indirect. The former state the declared value or cost explicitly. The latter either imply the declared value or cost or deliver the declaration using more than a single message (see rule 3).

Examples of direct declarations: “Honestly sitting on a $40 value” (session 1, round 1, group 1), “value is 40” (session 7, round 2, group 5), “40” (session 7, round 3, group 2), are all interpreted as direct declarations that the subject’s value is 40.

Example of an indirect (implied) declaration: “if you can’t go lower than 40 then don’t bother” (session 11, round 4, group 3). Here we consider that the buyer is declaring a value of 40.

Rule 3: In instances where messages that satisfy rule 2 (by containing a number) are unclear, the message is considered as a potential root of an indirect declaration and the adjoining messages are also considered to decipher what message a subject is intended to convey.

Example of an indirect declaration using more than a single message (from session 11, round 5, group 2): Consider the buyer’s declaration root “whats not 200”. What information this may convey is unclear. In this light, we consider this message a potential root of an indirect declaration and examine the adjoining messages in conjunction with the declaration root. The complete sequence is: Seller: “what do you have”, Buyer: “whats not 200”, Seller “40?”, Buyer: “yea”. The indirect declaration by the buyer here is 40 even though the number 40 was not explicitly stated by this buyer.

2.2. Formal Inference

2.2.1. Inferential Strategy

These data are organized at three levels: session, round, and pair (of traders). Unlike conventional hierarchical data, these data involve overlapping layers, because the pairs are repeatedly drawn randomly from the same people in each session. The dimensionality of possible pairs means that there is no parsimonious or tractable way to capture the statistical dependence between the data when presented at the level of the pair.

This means that the conventional suite of models, such as clustering and multi-level modeling, requires arbitrary additional assumptions if they are to be deployed, and the results—specifically the implied standard errors—are likely to be highly sensitive to the precise arbitrary assumption settled upon.

In light of this, we consider three inferential strategies.

Strategy 1: Only use first-round data. In principle, the first round involves pairing with no history-based dependence in the data. In fact, this is not true, since the subjects play four practice rounds prior to the first real round, presenting us with a quandary: either we use unincentivized data (first practice round), or we use partially-contaminated data (first real round). We take the latter option, and simply ignore the contamination resulting from practice rounds. To account for the within-session dependence, we use session-level clusters, which is likely to be a reasonable approximation of the data-generating process since we only sample one round.

Setting aside the issue of the practice round contamination, the main advantage of this approach is that it requires minimal assumptions on the nature of dependence across observations. However, it involves ignoring 83% of the data, which lowers power. In addition, it brings into question the representativeness of the data from the first round. This is an important concern because as subjects experience successive inventivised rounds over time they are likely to benefit from learning effects that will result in the kind of mature behaviour that is of interest to this study.

Strategy 2: Session-level aggregation. This is a hyper-conservative approach that involves using one observation per session, resulting from averaging variables across all rounds and pairs in that session.

The main advantage of this approach is that it requires no arbitrary dependence assumptions. However, it involves an even greater decline in the number of observations than strategy 1, severely compromising power. Yet, since it incorporates data from all rounds, it potentially yields more representative insights.

Strategy 3: Round-level aggregation with a simple dependence model. This approach entails calculating the sample means for each round in each session (i.e., averaging across pairs in the round), and then clustering standard errors at the session level as a rudimentary model of dependence across rounds. This yields an intermediate number of observations (since most sessions involve more pairs per round than the total number of rounds).

The main advantage of this approach is that, if the dependence model is a reasonable approximation of the data-generating process, it results in six times as much data as strategy 2. Moreover, it uses data from all rounds, potentially allowing us to correct for learning effects. However, the drawback is that the dependence model is potentially a poor approximation of reality.

None of the three strategies is without flaws.

2.2.2. Choice of Statistical Tests

In all tests, we have two treatments. The data are unpaired. We therefore deploy three types of statistical tests in the *ex post* inference.

1. A conventional unpaired t-test.
2. A Matt-Whitney test.
3. A linear regression with session-level clusters.

In the case of the round-level data (strategy 3), we included round dummies.

Tests 1 and 3 are parametric, allowing us to conduct ex ante power calculations. We did not conduct pilots designed to inform power calculations, and so we targeted an equal number of observations across treatment pairs, and then conducted power calculations after conventional inference to evaluate the design, rather than to assist in the design.

The theory predicts the sign but not the magnitude of the treatment effect. Therefore, in our power calculations, we arbitrarily use a 20% treatment effect as our benchmark.

For the unpaired t-test, we used the following formula for power calculations:

$$\hat{\rho}_{\mu} = \Pr\left(t_{m_0+m_1-2} > t^{2.5\%}_{m_0+m_1-2} - \frac{0.2}{\sqrt{\frac{\hat{\sigma}_0^2}{m_0} + \frac{\hat{\sigma}_1^2}{m_1}}} \right)$$

where (m_0, m_1) are the sample sizes of the control and treatment, respectively, $(\hat{\sigma}_0, \hat{\sigma}_1)$ are the respective sample standard deviations, and $t^{2.5\%}$ is the 2.5% critical value from a t-table.

For the clustered regressions, we used the following formula:

$$\hat{\rho}_{\beta} = \Pr\left(t_{dof} > t^{2.5\%}_{dof} - \frac{0.2}{\sigma_{\hat{\beta}}} \right)$$

Where dof denotes degrees of freedom, and $\sigma_{\hat{\beta}}$ is the standard error of the regression coefficient of the treatment dummy.

2.2.3. Results

The primary results are shown in Table 2.2.3.1. They paint a highly homogenous picture that strongly supports the main hypothesis in the paper.

All treatment effects are roughly comparable to those reported in the descriptive statistics (Table 2.1.2), meaning that they are economically large. The estimated treatment effects are also statistically significant at conventional levels and beyond in virtually all cases.

We also estimate the power of each test in detecting a 20% treatment effect, using the standard errors estimated from the sample. The average power exceeds 95%.

The reason that the p-values are so small and the power is so high even in the session-level tests, which involve as few as 10 observations, is that the between-session variation (across treatments) is extremely large compared to the within-session variation, i.e., the estimated standard errors are very small.

In results that we omitted in the interests of parsimony, we note that the coefficients on the round dummies in the round-level clustered regressions are all small in magnitude and statistically insignificant. This is likely because the four practice rounds allowed the subjects to refine their strategy sufficiently prior to the real rounds.

Table 2.2.3.1: Primary Statistical Tests: Unweighted (Top) and Weighted (Bottom)

Test	Bargaining	Data Type	Test type	# Obs	Treat. Effect	P-Value	Power
1	Alternating	Period 1	Clustered reg.	83	26%	0.003	0.79
2	Alternating	Session	t-test	10	29%	0.002	0.98
3	Alternating	Session	MW test	10	-	0.011	-
4	Alternating	Period	Clustered reg.	60	29%	< 0.001	0.98
5	Open, known	Period 1	Clustered reg.	77	23%	0.002	0.91
6	Open, known	Session	t-test	10	29%	< 0.001	0.99
7	Open, known	Session	MW test	10	-	0.009	-
8	Open, known	Period	Clustered reg.	60	29%	< 0.001	0.99
9	Open, coin	Period 1	Clustered reg.	75	6%	0.323	0.88
10	Open, coin	Session	t-test	10	14%	0.009	0.99
11	Open, coin	Session	MW test	10	-	0.016	-
12	Open, coin	Period	Clustered reg.	60	14%	0.004	0.99
13	Open, wheel	Period 1	Clustered reg.	75	23%	0.001	0.95
14	Open, wheel	Session	t-test	10	24%	0.001	1.00
15	Open, wheel	Session	MW test	10	-	0.009	-
16	Open, wheel	Period	Clustered reg.	60	24%	< 0.001	1.00
17	One by one	Period 1	Clustered reg.	74	20%	0.013	0.81
18	One by one	Session	t-test	8	22%	0.008	0.98
19	One by one	Session	MW test	8	-	0.021	-
20	One by one	Period	Clustered reg.	48	22%	< 0.001	0.98

Test	Bargaining	Data Type	Test type	# Obs	Treat. Effect	P-Value	Power
21	Alternating	Session	t-test	10	19%	0.013	0.96
22	Alternating	Session	MW test	10	-	0.011	-
23	Alternating	Period	Clustered reg.	60	19%	0.002	0.97
24	Open, known	Session	t-test	10	20%	0.001	0.99
25	Open, known	Session	MW test	10	-	0.009	-
26	Open, known	Period	Clustered reg.	60	22%	< 0.001	0.98
27	Open, coin	Session	t-test	10	9%	0.043	0.99
28	Open, coin	Session	MW test	10	-	0.047	-
29	Open, coin	Period	Clustered reg.	60	10%	0.029	0.99
30	Open, wheel	Session	t-test	10	16%	0.006	1.00
31	Open, wheel	Session	MW test	10	-	0.009	-
32	Open, wheel	Period	Clustered reg.	60	18%	0.001	0.99
33	One by one	Session	t-test	8	11%	0.069	0.96
34	One by one	Session	MW test	8	-	0.021	-
35	One by one	Period	Clustered reg.	48	11%	0.034	0.97

Round-level models include round dummies. Power refers to estimated power of detecting a 20% treatment effect.

3. SUMMARY

The data strongly support the main hypothesis, both in terms of simple comparisons of the unconditional means, and in terms of a wide range of parametric and non-parametric tests that tackle the dependence in the data in a variety of ways.

REFERENCES

Charness, Gary. 2000. "Self-Serving Cheap Talk: A Test of Aumann's Conjecture." *Games and Economic Behavior*, 33(2), 177-94.

Charness, Gary and Martin Dufwenberg. 2006. "Promises and Partnership." *Econometrica*, 74(6), 1579-601.

Fischbacher, U. 2007. "Z-Tree – Zurich Toolbox for Readymade Economic Experiments." *Experimental Economics*, 10, 171-78.

APPENDIX: EXPERIMENTAL MATERIALS

EXPERIMENTER SCRIPT

Announcements appear in quotes

1. Turn on computers. Prepare z-Tree code and leaves (start fewer leaves than needed. Others can be opened if required.) Distribute documents (explanatory statement, consent form, and receipt) and pens to cabins.
2. Prepare cabin cards. When expecting 24 students order cards so as to maximize physical space between subjects that stand in line next to each other (i.e., 1, 8, 2, 9, 3, 10 etc.)
3. Ask the students to form line.
4. Check ids, assign to cabin using cabin cards.
5. On the hour, post signs that "Experiment is in Progress" and lock door.
6. "Thank you for coming to today's experiment. You have so far received a total of three documents. One of them is a receipt – please set this aside for now. I will ask you to fill it out at the end of today's session. The explanatory statement is for your information, and you are welcome to keep that after today's session. Please read the consent form, tick the various boxes, sign, and date it. Once I collect all the consent forms we will be ready to start today's experiment. Today's date is _____. I will give you a few minutes to do so and then I will come around to collect it. If you have any questions please raise your hand and I will come to you".
7. Give students sufficient time and then collect consent forms.
8. "We are now ready to begin today's session. I will pass around the instructions. Once I distribute them to everyone, I will read them out loud. I do this for two reasons. First, to be absolutely certain that you have identical instructions. Second, to give you a sufficient opportunity to understand them. Please note that the instructions are printed on both sides of the document."
9. Distribute the instructions.
10. Calibrate z-Tree code with the correct number of participants.
11. Run z-Tree code.
12. "We have now concluded today's experiment. Please enter the total amount that you earned on the receipts. Once you have completed the receipts, I will administer a short questionnaire and then call you to come and receive payment. Please remain seated until your cabin number is called."
13. Has everyone completed the receipts? If yes, I will now run the questionnaire. Please note that once I begin running the questionnaire your total payoff will disappear from your screen. Has everyone completed their receipts?
14. As I call your cabin please come forward and bring your
    a. Receipts and
    b. Instructions
    c. The laminated cabin number card
    d. The pen

    You can keep the explanatory notes.

INSTRUCTIONS: SINGLE GOOD, ALTERNATING OFFER

Welcome and Introduction

Welcome to our study of decision making. If you read these instructions carefully and make good decisions, you can earn a considerable amount of money.

Kindly refrain from talking with other participants during the session. Also, it is an important requirement of this experiment that you **please turn your mobile phones to silent and abstain from using them during the experiment**.

By coming to this session, you have earned an attendance fee of $10. This has two components. A show up fee of $3 and a participation fee of $7. The participation fee is discussed further below.

The $10 attendance fee will be in addition to any amount that you earn based on your decisions. Once your earnings are determined you will be paid privately and your participation in this experiment will then be concluded.

If you have a question at any time, please raise your hand and I will approach you so that you can ask your question in private.

Setup

Today, we are going to set up a market in which some of you will be buyers and some of you will be sellers. In this market you will be given the opportunity to trade a commodity. We will not specify a name for the commodity; we will simply refer to it as a "unit".

Trading will occur in a sequence of trading rounds. The prices that you negotiate in each round will determine your earnings.

The experiment will consist of 10 rounds: 4 practice rounds followed by 6 real rounds.

The first 4 rounds will be practice and will not affect your earnings for the experiment.

The final 6 rounds will be real and will affect your earnings. At the end of the experiment, the computer will select one of the 6 real rounds at random and you will be paid based on your earnings in that round in cash.

Matching Rules

In every round, the computer will tell you whether you are a buyer or a seller for that round. During the practice rounds, you will experience both the role of a buyer as well as the role of a seller. Once we have completed the practice rounds, you will be assigned the role of either buyer or seller

and will remain in that role throughout the remainder of the session. You have a 50% chance of being a buyer, and a 50% chance of being a seller.

Each round, every buyer will be randomly matched with a seller. That means that each buyer is equally likely to be matched with each seller. The matching is independent every round, which means that being matched with a specific trader in one round has no effect on the likelihood of being matched with the same trader in a future round.

All matching is anonymous, meaning that you will never know the identity of whom you are matched with in any round.

Participation fee

At the start of each round, you will be given a $7 participation fee. Any positive earnings that you may make by trading the "unit" will be added to this $7, whereas any negative earnings will be subtracted from this $7. If you do not end up trading a unit, then you just keep your $7 participation fee.

Profit from trading

In each round, sellers and buyers will have the opportunity to exchange their unit.

Prior to the start of each round, sellers will be given a number known as their "cost" and buyers will be given a number known as their "value". The cost represents the minimum amount for which a seller can sell a unit without making a loss. The value represents the maximum amount for which a buyer can purchase a unit without making a loss.

Sellers earn money by selling a unit at a price that is above their cost. Seller earnings from the sale of a unit are the difference between the sale price and the cost. For example, if a seller has a cost of $100 and sells their unit for $140, the seller earns $140 – $100 = $40.

Buyers earn money by buying a unit at a price that is below their value. Buyer earnings from the purchase of a unit are the difference between the value and the purchase price. For example, if a buyer has a value of $150 and buys a unit for $100, the buyer earns $150 – $100 = $50.

If a seller sells a unit at a price that is less than their cost, they will make a loss. If a buyer buys a unit at a price that is greater than their value, they will make a loss. If you are at risk of making a loss, the computer will notify you and ask you to confirm.

If the seller and the buyer do not exchange the unit, they each earn a profit of $0 for that round.

How the seller's cost and the buyer's value for a unit are determined is described in the next section.

How are Costs and Values Determined?

Each round, for each seller, there is:

- a 50% probability that their cost will be $0
- a 50% probability that their cost will be $160

Each round, for each buyer, there is:

- a 50% probability that their value will be $40
- a 50% probability that their value will be $200

Given the probabilities above, there are 4 possible ways that a seller's cost will match with a buyer's value:

	Probability	Seller's cost	Buyer's value
a.	25%	0	40
b.	25%	0	200
c.	25%	160	40
d.	25%	160	200

Traders' costs/values are determined independently, meaning that knowing an individual trader's cost/value during a round tells you nothing about the cost/value of any other trader in that round, or any other round.

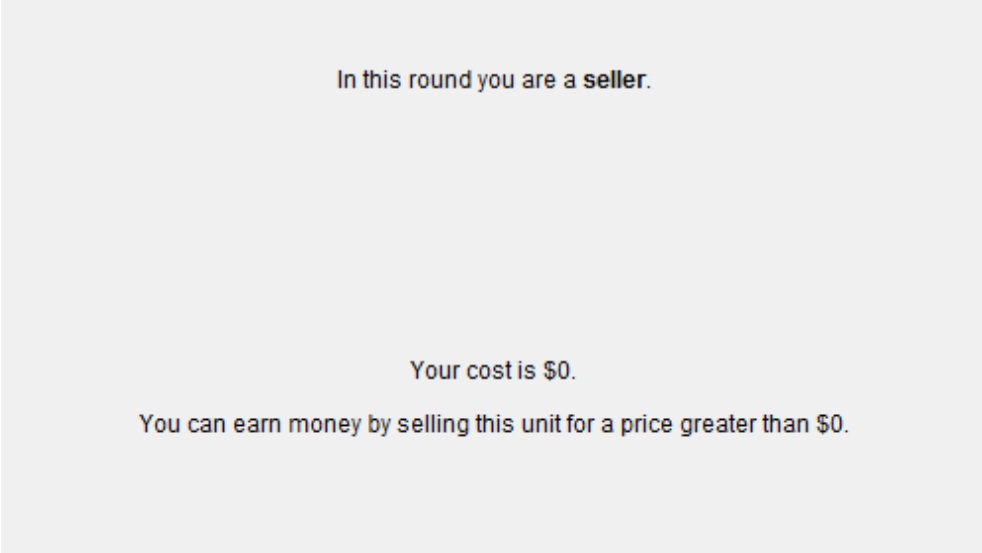
Sellers are only informed of their cost, and buyers are only informed of their value, meaning that neither side knows about the other.

So, if you are a seller and your cost is, say, $0 you will not know whether the buyer that you are matched with has a value of $40 or $200.

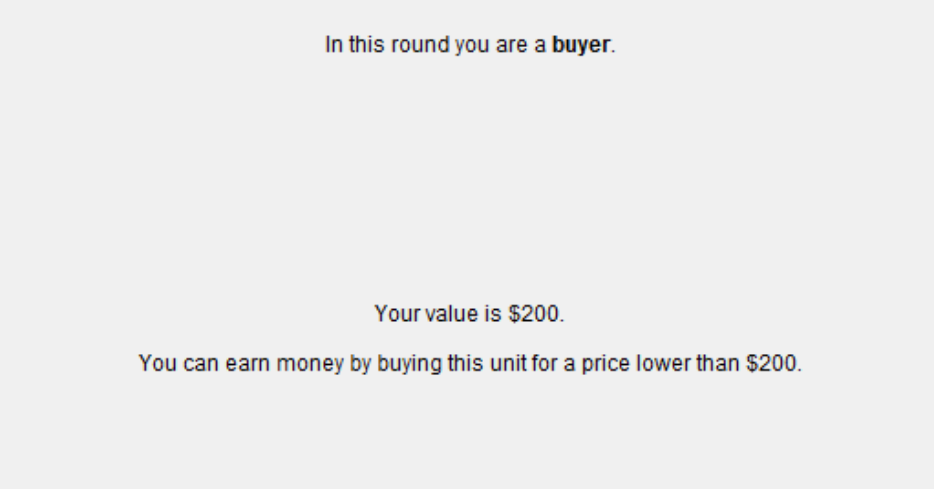
Similarly, if you are a buyer and your value is, say, $200 you will not know whether the seller that you are matched with has a cost of $0 or $160.

Naturally, you will never be compelled to either buy or sell a "unit". If a given pair of seller and buyer do not reach agreement on a price for a "unit" after 8 bargaining stages, bargaining is suspended. In this case each trader only receives their $7 participation fee.

A screenshot below shows a trader discovering that they are a seller, and learning their cost:



A screenshot below shows a trader discovering that they are a buyer, and learning their value:



How Much Money Can You and Your Partner Make?

When you and your partner are bargaining over a unit, the total money that you can make between you from successfully trading that unit is equal to the buyer's value minus the seller's cost. This follows from the way in which buyer and seller profits are calculated.

To understand this, we will examine one possible example. Consider a buyer with value $200 and a seller with cost $160. If they agree on a price $175 then the buyer will make $200 - $175 = $25 and the seller $175 - $160 = $15. Together they make $25 + $15 = $40. Alternatively, they could agree on a price $190 and then the buyer will make $200 - $190 = $10 and the seller $190 - $160 = $30. Again, together they make $10 + $30 = $40. Clearly, the total profit is the difference between the cost and the value: $200 - $160 = $40. The trade price merely determines how the total profit of $40 is divided between the buyer and seller.

Since in every round, each of the following 4 possibilities is equally likely, there are 4 possibilities regarding the total amount of profit that you and your partner can make:

	Probability	Seller's cost	Buyer's value	Combined buyer and seller profit if trade occurs	Combined buyer and seller profit if no trade occurs
a.	25%	0	40	$40 - $0 = $40	$0
b.	25%	0	200	$200 - $0 = $200	$0
c.	25%	160	40	$40 - $160 = -$120	$0
d.	25%	160	200	$200 - $160 = $40	$0

Any amount that you and your partner make is shared between you on the basis of the trading agreement that you make with your partner, which is done according to the mechanism described in the next section.

Trading Mechanism

After being matched with another trader and seeing your cost/value, you will have the opportunity to trade with your partner in a sequence of 8 bargaining stages. Bargaining stages consist of you and your partner making offers of trading prices for the unit. The computer will select one of you at random to make the first offer to their partner.

If the first offer is accepted, the round is over.

If the first offer is rejected, the other trader has the opportunity to make a counter-offer.

This alternating process continues until one of the pair of traders makes an offer that the other trader accepts.

If your partner makes you an offer, you can either accept it or you can reject it and counter-offer.

If you are randomly selected to make an offer in the first bargaining stage, you will have 30 seconds to complete your offer and submit it to your partner.

If you do not submit an offer within this 30 second window, bargaining advances to the next stage, and the right to make an offer is given to your partner.

If you are randomly selected to respond to an offer in the first bargaining stage, you will have 10 seconds to accept or reject your partner's offer.

If you accept their offer, bargaining ends.

If you reject their offer, then you are given the opportunity to make a counter-offer.

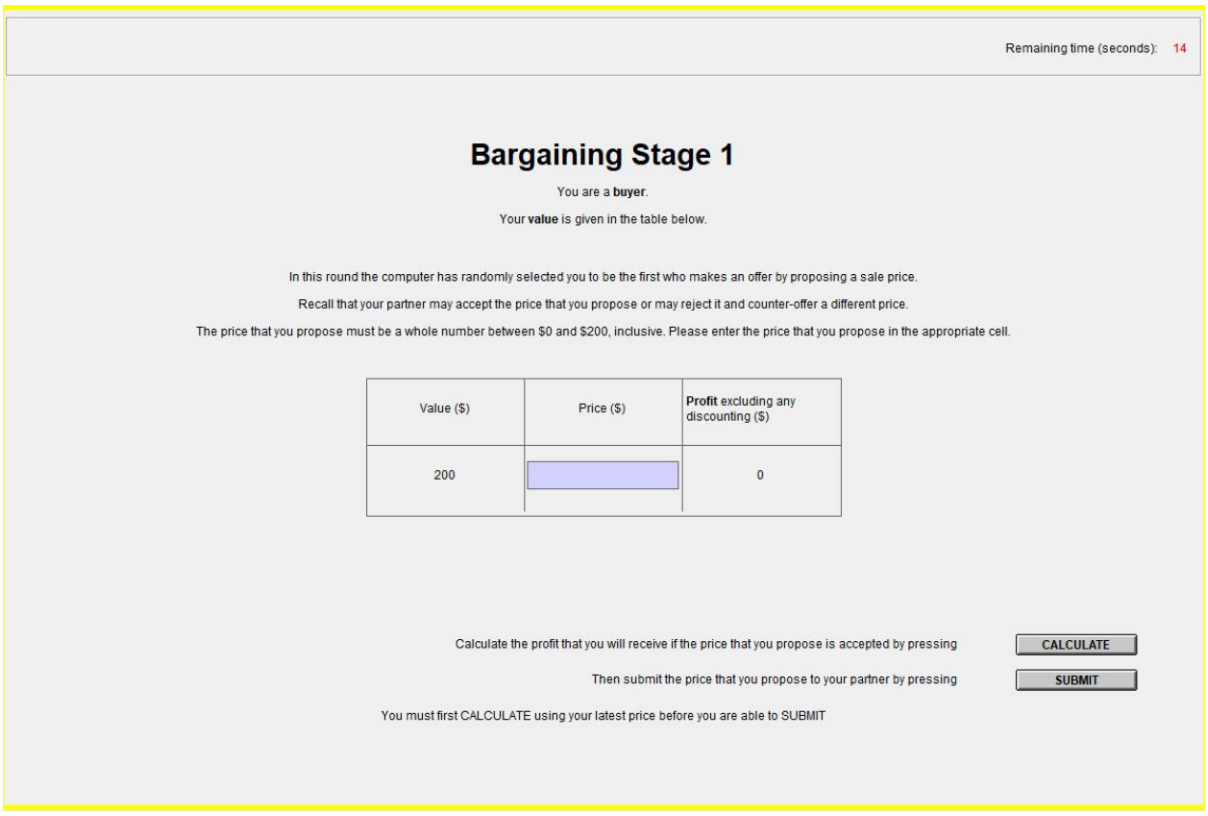
If you do not respond to your partner (accept or reject their offer) within this 10 second window, your inaction counts as a rejection but you are not given the right to make a counter-offer. Instead, bargaining advances to the next stage, and the right to make an offer reverts to your partner.

The procedure that we describe above for bargaining stage 1 works the same way for all subsequent bargaining stages (stages 2-8) but with one key difference. As we note above, in stage 1 a proposer is given 30 seconds and a responder is given 10 seconds. By contrast, in stages 2-8 a proposer is given 15 seconds and a responder is given 5 seconds.

If a given pair of seller and buyer do not reach agreement on a price for a "unit" after 8 bargaining stages, bargaining is suspended. In this case each trader only receives their $7 participation fee.

If it is your turn to make an offer during the bargaining stage, you can choose any price from $0 to $200, inclusive. The offer must be a whole number, so no fractions of dollars are allowed.

The screenshot below shows you a buyer considering what offer to make:



Once you have finished composing your offer, press the CALCULATE button to calculate how much profit you will make if your offer is accepted and then press the SUBMIT button to submit the offer to your trading partner.

Making a Loss and Exhausting Your $7

You will never be compelled to make a loss. If you make a decision that puts you at risk of making a loss, the computer will warn you with a pop-up message and ask for confirmation. The pop-up window will have two buttons: "OK" and "CANCEL". Press **"OK" to accept to make a loss** or **"CANCEL" to revise your decision.** If you agree to make a loss up to $7, this loss will simply be subtracted from your participation fee of $7. If you agree to make a loss that is greater than your $7 participation fee for that round, your participation in the experiment for all subsequent rounds will be suspended, and you will earn nothing beyond your show-up fee of $3, which you will receive after the conclusion of all the rounds in the experiment.

Time Limits and Trading Reductions

Each bargaining round is split into 8 stages. Once the 8 stages are complete, the round is over, and if you and your partner failed to accept an offer, each of you earns no profit from trading in that round.

Stage 1 lasts 40 seconds (30 seconds for the proposer, and 10 seconds for the responder). Each of stages 2 to 8 last 20 seconds (15 seconds for the proposer and 5 seconds for the responder). The top of the screen will indicate to you what stage you are in, and how much time you have left in that stage. Once a stage is complete, the next one will start immediately, until the last (8^{th}) stage is complete.

If you or your partner accept an offer during the first bargaining stage, your earnings for that round will be equal to the numbers shown on the screen.

If you or your partner accept an offer during the second bargaining stage or later, there will be a reduction on the profit that both players receive from trading (this reduction does not apply to the $7 participation fee, or the $3 show-up fee). This reduction will take the form of a percentage that will be deducted from your earnings and those of your partner. The table below specifies the reductions.

Bargaining stage	% of Your Earnings that You Lose
1	0%
2	10%
3	20%
4	30%
5	40%
6	50%
7	60%
8	70%
End of round	Round canceled for you and your partner (and you both earn no profit from trading)

For example, if it took until bargaining stage 2 for one of you to accept an offer, then each of you will lose 10% of your earnings.

Sequence of events

In each round, the sequence of decisions is as follows.

1. The computer randomly matches you with another trader.
2. You are randomly assigned your cost/value:
    - 50% chance of a cost of $0 and 50% chance of a cost of $160 if you are a seller.
    - 50% chance of a value of $40 and 50% chance of a value of $200 if you are a buyer.
3. The computer randomly selects one member of each pair of traders to make the first offer.
4. That trader makes an offer.
5. The other trader can accept or reject.
6. If the trader rejects, it becomes that trader's turn to make an offer.
7. The opportunity to make an offer keeps alternating until:
    a. one trader accepts an offer
    b. or 8 offers are rejected, which will suspend bargaining in that round
8. Earnings for that round are calculated, and a reduction may be applied depending on which bargaining stage the acceptance came in.
9. At the conclusion of the last real round, one of the 6 real rounds is selected at random and used to pay the participants.

Summary of Key Points

By way of providing a summary of the key points, we suggest that you return to the table of page 5 and consider:

1. What information a buyer/seller will have in each round
2. What are the possible combinations of costs and values
3. How, given a particular combination of cost and value, a price determined in a certain bargaining stage, that may involve a reduction, determines the profit that a buyer and a seller will make

INSTRUCTIONS: SINGLE GOOD, OPEN CHAT

Welcome and Introduction

Welcome to our study of decision making. If you read these instructions carefully and make good decisions, you can earn a considerable amount of money.

Kindly refrain from talking with other participants during the session. Also, it is an important requirement of this experiment that you **please turn your mobile phones to silent and abstain from using them during the experiment**.

By coming to this session, you have earned an attendance fee of $10. This has two components. A show up fee of $3 and a participation fee of $7. The participation fee is discussed further below.

The $10 attendance fee will be in addition to any amount that you earn based on your decisions. Once your earnings are determined you will be paid privately and your participation in this experiment will then be concluded.

If you have a question at any time, please raise your hand and I will approach you so that you can ask your question in private.

Setup

Today, we are going to set up a market in which some of you will be buyers and some of you will be sellers. In this market you will be given the opportunity to trade a commodity. We will not specify a name for the commodity; we will simply refer to it as a "unit".

Trading will occur in a sequence of trading rounds. The prices that you negotiate in each round will determine your earnings.

The experiment will consist of 10 rounds: 4 practice rounds followed by 6 real rounds.

The first 4 rounds will be practice and will not affect your earnings for the experiment.

The final 6 rounds will be real and will affect your earnings. At the end of the experiment, the computer will select one of the 6 real rounds at random and you will be paid based on your earnings in that round in cash.

Matching Rules

In every round, the computer will tell you whether you are a buyer or a seller for that round. During the practice rounds, you will experience both the role of a buyer as well as the role of a seller. Once we have completed the practice rounds, you will be assigned the role of either buyer or seller

and will remain in that role throughout the remainder of the session. You have a 50% chance of being a buyer, and a 50% chance of being a seller.

Each round, every buyer will be randomly matched with a seller. That means that each buyer is equally likely to be matched with each seller. The matching is independent every round, which means that being matched with a specific trader in one round has no effect on the likelihood of being matched with the same trader in a future round.

All matching is anonymous, meaning that you will never know the identity of whom you are matched with in any round.

Participation fee

At the start of each round, you will be given a $7 participation fee. Any positive earnings that you may make by trading the "unit" will be added to this $7, whereas any negative earnings will be subtracted from this $7. If you do not end up trading a unit, then you just keep your $7 participation fee.

Profit from trading

In each round, sellers and buyers will have the opportunity to exchange their unit.

Prior to the start of each round, sellers will be given a number known as their "cost" and buyers will be given a number known as their "value". The cost represents the minimum amount for which a seller can sell a unit without making a loss. The value represents the maximum amount for which a buyer can purchase a unit without making a loss.

Sellers earn money by selling a unit at a price that is above their cost. Seller earnings from the sale of a unit are the difference between the sale price and the cost. For example, if a seller has a cost of $100 and sells their unit for $140, the seller earns $140 – $100 = $40.

Buyers earn money by buying a unit at a price that is below their value. Buyer earnings from the purchase of a unit are the difference between the value and the purchase price. For example, if a buyer has a value of $150 and buys a unit for $100, the buyer earns $150 – $100 = $50.

If a seller sells a unit at a price that is less than their cost, they will make a loss. If a buyer buys a unit at a price that is greater than their value, they will make a loss. If you are at risk of making a loss, the computer will notify you and ask you to confirm.

If the seller and the buyer do not exchange the unit, they each earn a profit of $0 for that round.

How the seller's cost and the buyer's value for a unit are determined is described in the next section.

How are Costs and Values Determined?

Each round, for each seller, there is:

- a 50% probability that their cost will be $0
- a 50% probability that their cost will be $160

Each round, for each buyer, there is:

- a 50% probability that their value will be $40
- a 50% probability that their value will be $200

Given the probabilities above, there are 4 possible ways that a seller's cost will match with a buyer's value:

	Probability	Seller's cost	Buyer's value
a.	25%	0	40
b.	25%	0	200
c.	25%	160	40
d.	25%	160	200

Traders' costs/values are determined independently, meaning that knowing an individual trader's cost/value during a round tells you nothing about the cost/value of any other trader in that round, or any other round.

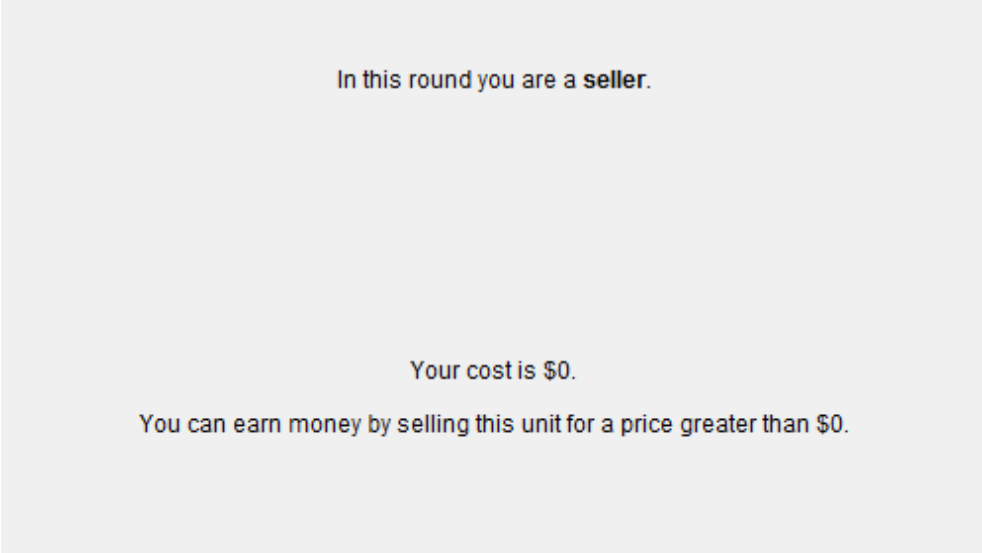
Sellers are only informed of their cost, and buyers are only informed of their value, meaning that neither side knows about the other.

So, if you are a seller and your cost is, say, $0 you will not know whether the buyer that you are matched with has a value of $40 or $200.

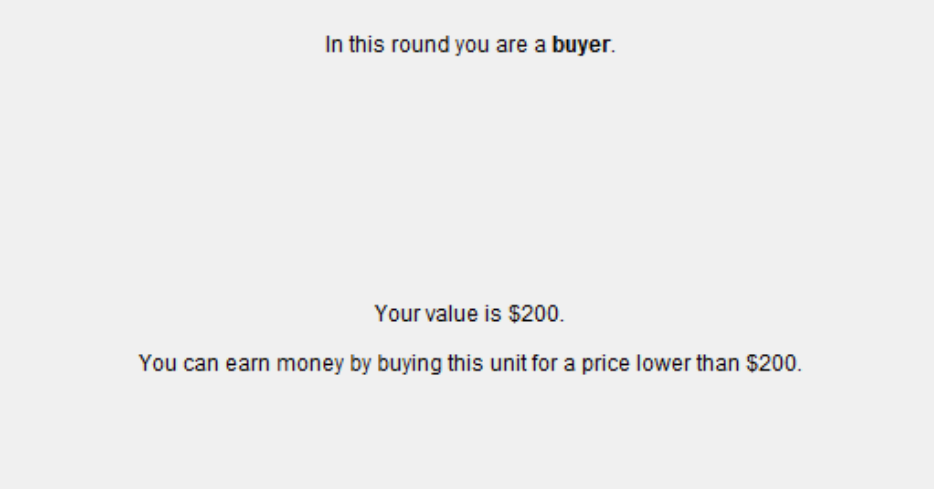
Similarly, if you are a buyer and your value is, say, $200 you will not know whether the seller that you are matched with has a cost of $0 or $160.

Naturally, you will never be compelled to either buy or sell a "unit". If a given pair of seller and buyer do not reach agreement on a price for a "unit" after 8 bargaining stages, bargaining is suspended. In this case each trader only receives their $7 participation fee.

A screenshot below shows a trader discovering that they are a seller, and learning their cost:



A screenshot below shows a trader discovering that they are a buyer, and learning their value:



How Much Money Can You and Your Partner Make

When you and your partner are bargaining over a unit, the total money that you can make between you from successfully trading that unit is equal to the buyer's value minus the seller's cost. This follows from the way in which buyer and seller profits are calculated.

To understand this, we will examine one possible example. Consider a buyer with value $200 and a seller with cost $160. If they agree on a price $175 then the buyer will make $200 - $175 = $25 and the seller $175 - $160 = $15. Together they make $25 + $15 = $40. Alternatively, they could agree on a price $190 and then the buyer will make $200 - $190 = $10 and the seller $190 - $160 = $30. Again, together they make $10 + $30 = $40. Clearly, the total profit is the difference between the cost and the value: $200 - $160 = $40. The trade price merely determines how the total profit of $40 is divided between the buyer and seller.

Since in every round, each of the following 4 possibilities is equally likely, there are 4 possibilities regarding the total amount of profit that you and your partner can make:

	Probability	Seller's cost	Buyer's value	Combined buyer and seller profit if trade occurs	Combined buyer and seller profit if no trade occurs
a.	25%	0	40	$40 - $0 = $40	$0
b.	25%	0	200	$200 - $0 = $200	$0
c.	25%	160	40	$40 - $160 = -$120	$0
d.	25%	160	200	$200 - $160 = $40	$0

Any amount that you and your partner make is shared between you on the basis of the trading agreement that you make with your partner, which is done according to the mechanism described in the next section.

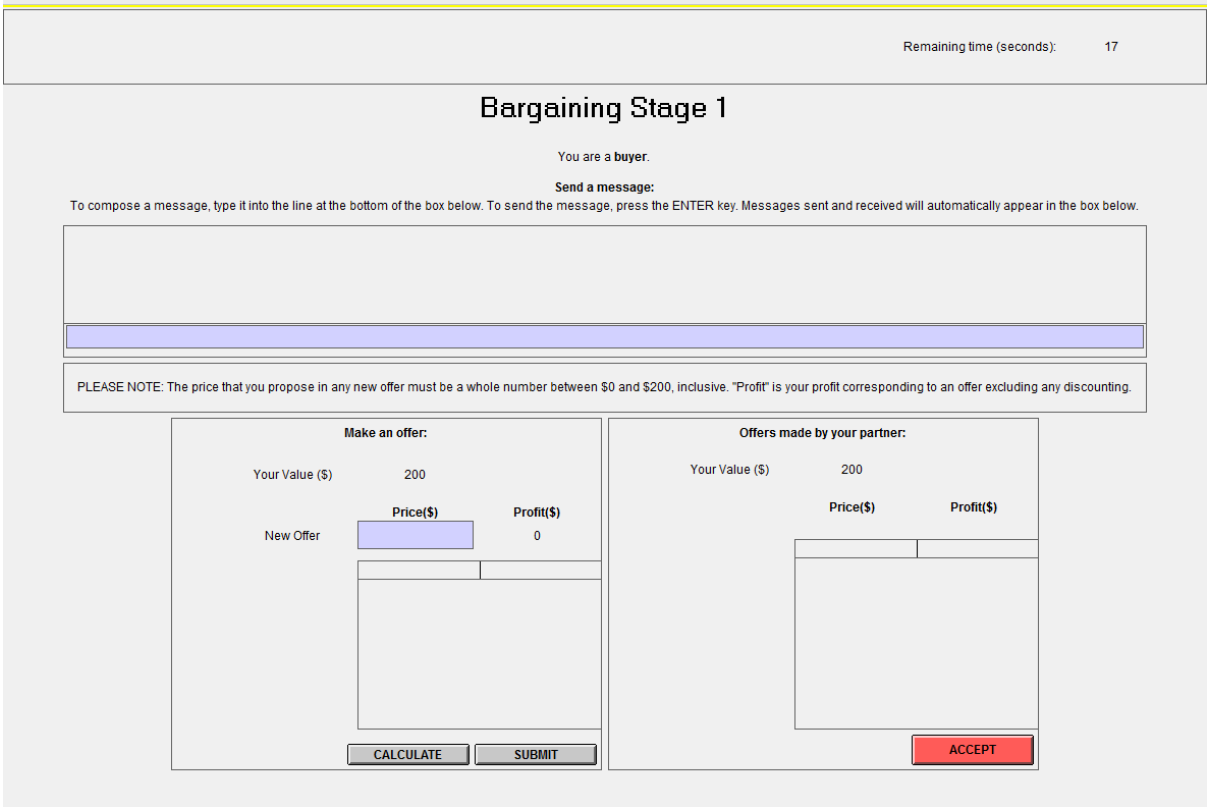
Trading Mechanism

After being matched with another trader and seeing your cost/value, you will have the opportunity to trade with your partner in a sequence of 8 bargaining stages. Bargaining stages consist of you and your partner making offers of trading prices for the unit.

During each bargaining stage, you and your partner are free to make offers at any time. Each of you is also free to accept an offer made by the other at any time. Once an offer is accepted, the round is over. You and your partner also have a time limit, which we will explain below.

When making an offer, you can choose any price from $0 to $200, inclusive. The offer must be a whole number, so no fractions of dollars are allowed.

The screenshot below shows you a buyer considering what offer to make:



Once you have finished composing your offer, press the CALCULATE button to calculate how much profit you will make if your offer is accepted and then press the SUBMIT button to submit the offer to your trading partner.

The offers that you make will appear on the left side of the screen. The most recent offer will be on top, and the older ones will be at the bottom.

Your partner is free to accept any of your offers at any point during the round. If your partner accepts an offer, the round ends immediately.

While you are making offers, your partner can also make offers. **Both of you can make as many offers as you like without waiting for the other person to respond.** Your partner's offers will appear on the right side of your screen, with the most recent ones at the top, and the older ones at the bottom.

The computer will automatically display the profit that you will earn from each offer if you accept it.

During a round, you and your partner will be able to chat with each other via a chat window. You can see this chat window at the top of the screenshot that appears on the previous page. You can send messages at any time, and can send as many messages as you like. However, we ask that you please observe the following rules:

- No threatening or abusive language

- No messages that reveal your identity, such as your name or your location in the lab.

Accepting an Offer

To accept an offer, highlight the offer by moving the mouse cursor over it, and then click on ACCEPT. The round will end immediately as soon as either you or your partner accepts an offer.

Making a Loss and Exhausting Your $7

You will never be compelled to make a loss. If you make a decision that puts you at risk of making a loss, the computer will warn you with a pop-up message and ask for confirmation. The pop-up window will have two buttons: "OK" and "CANCEL". Press **"OK" to accept to make a loss** or **"CANCEL" to revise your decision.** If you agree to make a loss up to $7, this loss will simply be subtracted from your participation fee of $7. If you agree to make a loss that is greater than your $7 participation fee for that round, your participation in the experiment for all subsequent rounds will be suspended, and you will earn nothing beyond your show-up fee of $3, which you will receive after the conclusion of all the rounds in the experiment.

Time Limits and Trading Reductions

Each bargaining round is split into 8 stages. Once the 8 stages are complete, the round is over, and if you and your partner failed to accept an offer, each of you earns no profit from trading in that round.

Stage 1 lasts 40 seconds, while each of stages 2 to 8 last 20 seconds. The top of the screen will indicate to you what stage you are in, and how much time is left until the end of the stage. Once a stage is complete, the next one will start immediately, until the last (8^{th}) stage is complete.

Offers do not expire and an offer made in one stage can be accepted in that stage or in any subsequent stage.

If you or your partner accept an offer during the first bargaining stage, your earnings for that round will be equal to the numbers shown on the screen.

If you or your partner accept an offer during the second bargaining stage or later, there will be a reduction on the profit that both players receive from trading (this reduction does not apply to the $7 participation fee, or the $3 show-up fee). This reduction will take the form of a percentage that will be deducted from your earnings and those of your partner. The table below specifies the reductions.

Bargaining stage	% of Your Earnings that You Lose
1	0%
2	10%
3	20%
4	30%
5	40%
6	50%
7	60%
8	70%
End of round	Round canceled for you and your partner (and you both earn no profit from trading)

For example, if it took until bargaining stage 2 for one of you to accept an offer, then each of you will lose 10% of your earnings.

Sequence of events

In each round, the sequence of decisions is as follows.

1. The computer randomly matches you with another trader.
2. You are randomly assigned your cost/value:
    - 50% chance of a cost of $0 and 50% chance of a cost of $160 if you are a seller.
    - 50% chance of a value of $40 and 50% chance of a value of $200 if you are a buyer.
3. Bargaining commences; you and your partner are free to make offers, accept offers, and chat.
4. Bargaining continues until:
    a. one trader accepts an offer
    b. or 8 bargaining stages are concluded, which will suspend bargaining in that round
5. Earnings for that round are calculated, and a reduction may be applied depending on which bargaining stage the acceptance came in.
6. At the conclusion of the last real round, one of the 6 real rounds is selected at random and used to pay the participants.

Summary of Key Points

By way of providing a summary of the key points, we suggest that you return to the table of page 5 and consider:

1. What information a buyer/seller will have in each round
2. What are the possible combinations of costs and values
3. How, given a particular combination of cost and value, a price determined in a certain bargaining stage, that may involve a reduction, determines the profit that a buyer and a seller will make

INSTRUCTIONS: FOUR GOODS, ALTERNATING OFFER

Welcome and Introduction

Welcome to our study of decision making. If you read these instructions carefully and make good decisions, you can earn a considerable amount of money.

Kindly refrain from talking with other participants during the session. Also, it is an important requirement of this experiment that you **please turn your mobile phones to silent and abstain from using them during the experiment**.

By coming to this session, you have earned an attendance fee of $10. This has two components. A show up fee of $3 and a participation fee of $7. The participation fee is discussed further below.

The $10 attendance fee will be in addition to any amount that you earn based on your decisions. Once your earnings are determined you will be paid privately and your participation in this experiment will then be concluded.

If you have a question at any time, please raise your hand and I will approach you so that you can ask your question in private.

Setup

Today, we are going to set up a market in which some of you will be buyers and some of you will be sellers. In this market you will be given the opportunity to trade commodities. We will not specify names for these commodities; we will simply refer to them as "units".

Trading will occur in a sequence of trading rounds. The decisions that you make in each round will determine your earnings.

The experiment will consist of 10 rounds: 4 practice rounds followed by 6 real rounds.

The first 4 rounds will be practice and will not affect your earnings for the experiment.

The final 6 rounds will be real and will affect your earnings. At the end of the experiment, the computer will select one of the 6 real rounds at random and you will be paid based on your earnings in that round in cash.

Matching Rules

In every round, the computer will tell you whether you are a buyer or a seller for that round. During the practice rounds, you will experience both the role of a buyer as well as the role of a seller. Once we have completed the practice rounds, you will be assigned the role of either buyer or seller

and will remain in that role throughout the remainder of the session. You have a 50% chance of being a buyer, and a 50% chance of being a seller.

Each round, every buyer will be randomly matched with a seller. That means that each buyer is equally likely to be matched with each seller. The matching is independent every round, which means that being matched with a specific trader in one round has no effect on the likelihood of being matched with the same trader in a future round.

All matching is anonymous, meaning that you will never know the identity of whom you are matched with in any round.

Participation fee

At the start of each round, you will be given a $7 participation fee. Any positive earnings that you may make by trading one or more "units" will be added to this $7, whereas any negative earnings will be subtracted from this $7. If you do not end up trading one or more units, then you just keep your $7 participation fee.

Profit from trading

In each round, sellers and buyers will have the opportunity to exchange up to 4 units.

For each unit, sellers will be given a number known as their "cost" and buyers will be given a number known as their "value". The cost represents the minimum amount for which a seller can sell that unit without making a loss. The value represents the maximum amount for which a buyer can purchase that unit without making a loss.

Sellers and buyers exchange units in bundles that include 1 to 4 units for one total price paid for the entire bundle.

Sellers earn money when they sell a bundle at a total price that is above the total cost of the units inside that bundle. Seller earnings from the sale of a bundle are the difference between the price of the entire bundle and the total of the costs of the units included in the bundle. For example, if a seller has a unit with cost of $20 and a unit with cost of $80, and sells a bundle that includes both units for a total price of $140, then the total cost of the units in the bundle is $20 + $80 = $100, and the seller earns $140 – $100 = $40.

Buyers earn money when they buy a bundle at a total price that is below the total value of the units inside that bundle. Buyer earnings from the purchase of a bundle are the difference between the total of the values of the units included in the bundle and the price of the entire bundle. For example, if a buyer's value for one unit is $90 and for another unit is $60, and buys a bundle that includes both units for a total price of $100, then the total value of the units in the bundle is $90 + $60 = $150, and the buyer earns $150 – $100 = $50.

EXAMPLE:

Consider a case in which a seller and a buyer have the following costs and values for the 4 units:

	Unit 1	Unit 2	Unit 3	Unit 4
Seller's cost ($)	A	B	C	D
Buyer's value ($)	E	F	G	H

The seller's costs of units 1, 2, 3, and 4 are A, B, C, and D, respectively.
The buyer's values of units 1, 2, 3, and 4 are E, F, G, and H, respectively.

Assume that the buyer and seller agree to exchange a bundle that includes only Unit 2 for a price $X. Their profit is calculated as follows:
Seller's profit=X-B
Buyer's profit=F-X

Alternatively, assume that the buyer and seller agree to exchange a bundle that includes Unit 1 and Unit 2 for a price $X. Their profit is calculated as follows:
Seller's profit=X-(A+B)
Buyer's profit=(E+F)-X

The calculations are similar in the case of bundles that include 3 or 4 goods.

If a seller sells a bundle at a price that is less than the total of the costs of the units inside the bundle, this seller will make a loss. If a buyer buys a bundle at a price that is greater than the total of the values of the units inside the bundle, this buyer will make a loss. If you are at risk of making a loss, the computer will notify you and ask you to confirm.

A seller and a buyer **can exchange at most ONLY ONE BUNDLE per round**. If they do not exchange a bundle, they each earn a profit of $0 for that round.

How the seller's cost and the buyer's value of each of the 4 units are determined is described in the next section.

How are Costs and Values Determined?

For each seller-buyer pair, there is a fixed number of possibilities for the combination of costs and values that can occur for each of their four units:

		Seller's cost	Buyer's value
a.	For one of the four units:	$0	$10
b.	For one of the four units:	$0	$50
c.	For one of the four units:	$40	$10
d.	For one of the four units:	$40	$50

Each of these 4 possibilities, (a), (b), (c), and (d) above, MUST OCCUR EXACTLY ONCE in any round. The order with which they occur within a round is random, and each possibility regarding the order in which (a), (b), (c), and (d) occur is equally likely. Hence, knowing this order in one round tells you nothing about how it may manifest in any other round. A list of all the equally likely possibilities is provided at the end of this document.

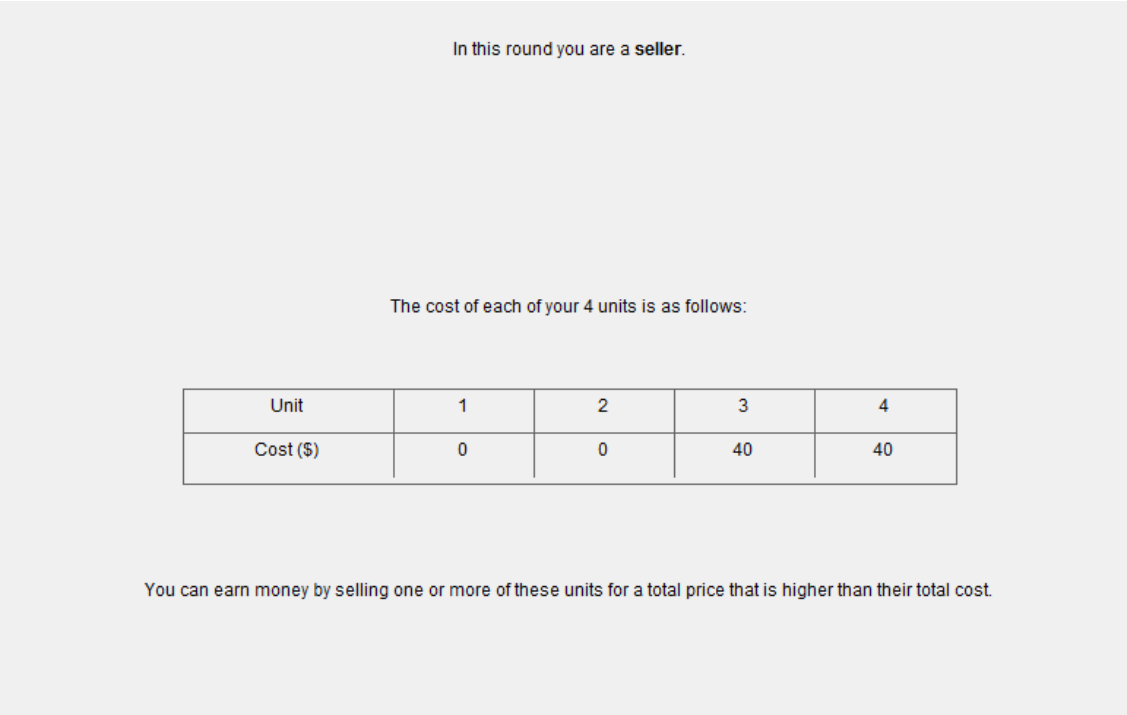
Sellers are only informed of their cost for each unit, and buyers are only informed of their value for each unit, meaning that neither side knows about the other. So, for a given unit, a seller cannot distinguish between combinations (a) and (b) above, because the seller is given the same information in each case (cost of $0); or between (c) and (d) (cost of $40). Similarly, for a given unit, a buyer cannot distinguish between (a) and (c), because the buyer is given the same information (value of $10) or between (b) and (d) (value of $50).

In other words:

In any round, sellers will have two units each with cost $0 and two units each with cost $40. However, they will not know which of their two $0s meets a buyer's $10 and which meets a buyer's $50. Similarly, they will not know which of their two $40s meets a buyer's $10 and which meets a buyer's $50.

In any round, buyers will have two units each with value $50 and two units each with value $10. However, they will not know which of their two $50s meets a seller's $0 and which meets a seller's $40. Similarly, they will not know which of their two $10's meets a seller's $0 and which meets a seller's $40.

A screenshot below shows a trader discovering that they are a seller, and learning their costs:



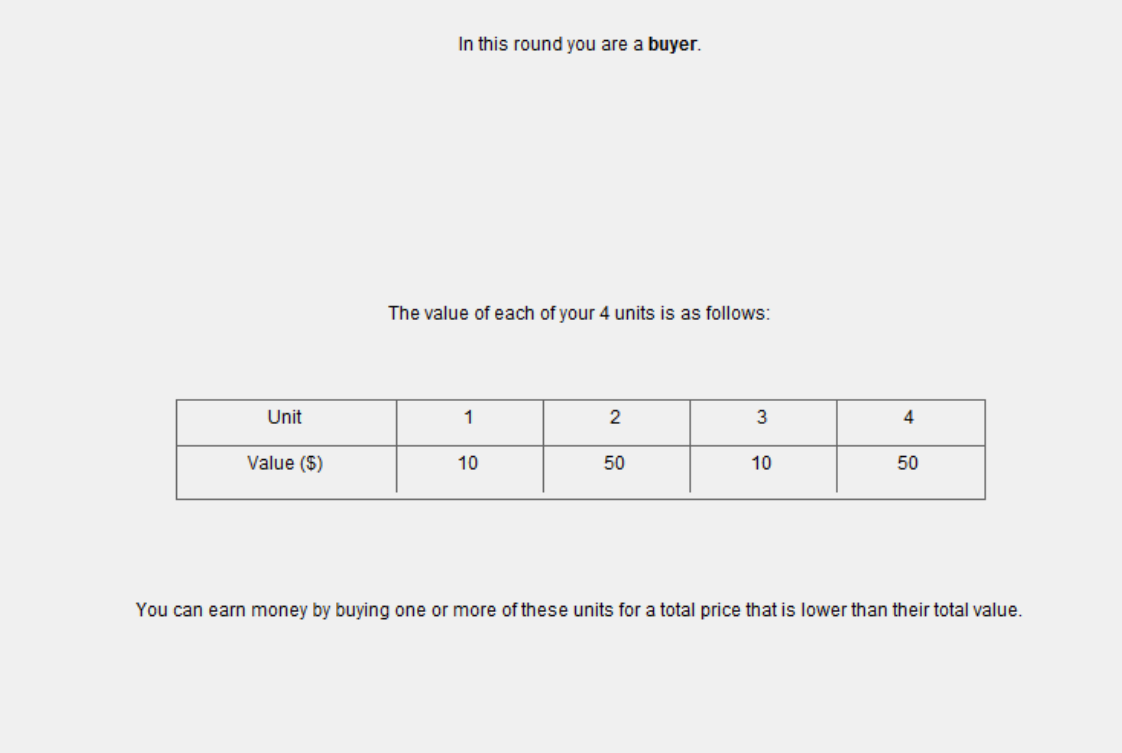
In this round you are a **seller**.

The cost of each of your 4 units is as follows:

Unit	1	2	3	4
Cost ($)	0	0	40	40

You can earn money by selling one or more of these units for a total price that is higher than their total cost.

A screenshot below shows a trader discovering that they are a buyer, and learning their values:



In this round you are a **buyer**.

The value of each of your 4 units is as follows:

Unit	1	2	3	4
Value ($)	10	50	10	50

You can earn money by buying one or more of these units for a total price that is lower than their total value.

How Much Money Can You and Your Partner Make?

When you and your partner are bargaining over a bundle of 1 to 4 units, the total money that you can make between you from successfully trading that bundle of 1 to 4 units is equal to the buyer's total value of the traded units minus the seller's total cost of the traded units. This follows from the way in which buyer and seller profits are calculated.

To understand this, we will examine an example with one unit. Consider a buyer with value \$50 and a seller with cost \$40. If they agree on a price \$43 then the buyer will make \$50 - \$43 = \$7 and the seller \$43 - \$40 = \$3. Together they make \$7 + \$3 = \$10. Alternatively, they could agree on a price \$48 and then the buyer will make \$50 - \$48 = \$2 and the seller \$48 - \$40 = \$8. Again, together they make \$2 + \$8 = \$10. Clearly, the total profit is the difference between the cost and the value: \$50 - \$40 = \$10. The trade price merely determines how the total profit of \$10 is divided between the buyer and seller.

This example was for one unit. When dealing with 4 units, the same principle applies: the total money that you and your partner can make is the total of how much you can make from each unit.

Since in every round, each of the following 4 possibilities occurs exactly once, there is a **fixed maximum total amount of profit** that you and your partner can make every round, and it is equal to \$70. To see why, consider the following table:

		Seller's cost	Buyer's value	Combined buyer and seller profit if traded	Combined buyer and seller profit if not traded
a.	For one of the four units:	\$0	\$10	\$10 - \$0 = \$10	\$0
b.	For one of the four units:	\$0	\$50	\$50 - \$0=\$50	\$0
c.	For one of the four units:	\$40	\$10	\$10 - \$40 = -\$30	\$0
d.	For one of the four units:	\$40	\$50	\$50 - \$40 = \$10	\$0

Hence, the **maximum** amount of combined buyer and seller earnings is \$10 + \$50 + \$0 + \$10 = \$70.

Therefore, depending on the choices that you and your partner make in every round, you can together make a maximum of \$70 between you.

Any amount that you and your partner make is shared between you on the basis of the trading agreement that you make with your partner, which is done according to the mechanism described in the next section.

Trading Mechanism

After being matched with another trader and seeing your costs/values, you will have the opportunity to trade with your partner in a sequence of 8 bargaining stages. Bargaining stages consist of you and your partner making proposals of trading prices for bundles of 1 to 4 units. The computer will select one of you at random to make the first proposal to their partner.

If the first proposal is accepted, the round is over.

If the first proposal is rejected, the other trader has the opportunity to make a counter-proposal.

This alternating process continues until one of the pair of traders makes a proposal that the other trader accepts.

If your partner makes you a proposal, you can either accept it or you can reject it and counter-propose.

If you are randomly selected to make a proposal in the first bargaining stage, you will have 30 seconds to complete your proposal and submit it to your partner.

If you do not submit a proposal within this 30 second window, bargaining advances to the next stage, and the right to make a proposal is given to your partner.

If you are randomly selected to respond to a proposal in the first bargaining stage, you will have 10 seconds to accept or reject your partner's proposal.

If you accept their proposal, bargaining ends.

If you reject their proposal, then you are given the opportunity to make a counter-proposal.

If you do not respond to your partner (accept or reject their proposal) within this 10 second window, your inaction counts as a rejection but you are not given the right to make a counter-proposal. Instead, bargaining advances to the next stage, and the right to make a proposal reverts to your partner.

The procedure that we describe above for bargaining stage 1 works the same way for all subsequent bargaining stages (stages 2-8) but with one key difference. As we note above, in stage 1 a proposer is given 30 seconds and a responder is given 10 seconds. By contrast, in stages 2-8 a proposer is given 15 seconds and a responder is given 5 seconds.

Proposal Structure

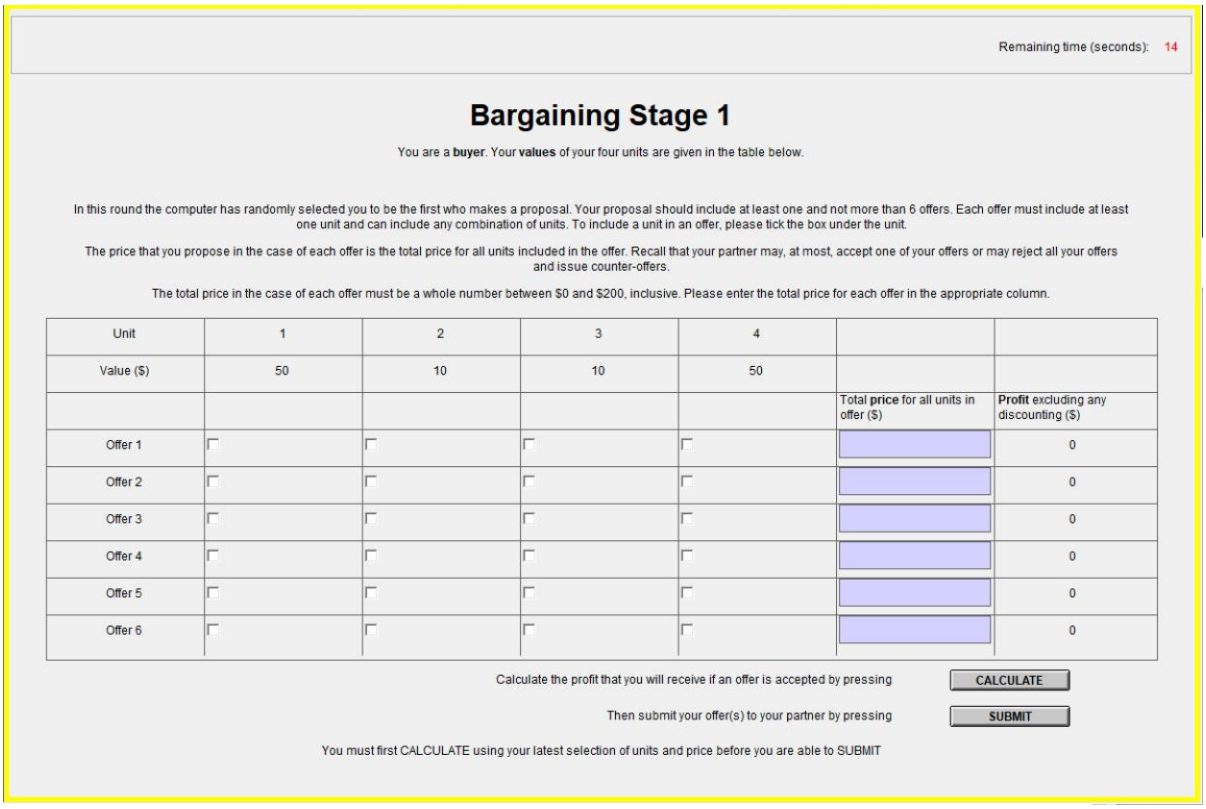
A proposal consists of 1 to 6 simultaneous offers of bundles to your trading partner. Your trading partner can either accept exactly 1 of those offers, meaning that the proposal is accepted, or they can reject all of them, meaning that the proposal is rejected. Accepting more than 1 offer is not permissible.

Each offer has two components:

1. A list of the units included in the bundle; a bundle must contain at least 1 unit, and at the most 4 units
2. A total price for **all the units** in the bundle, which must be a whole number between $0 and $200, inclusive.

If it is your turn to make a proposal during the bargaining stage, you can choose to make anywhere between 1 and 6 offers.

To make an offer, select the units that will be included in the bundle using the checkboxes, and determine the price. The screenshot below shows you a buyer considering what offer(s) to make.



Once you have finished composing your proposal, press the CALCULATE button to calculate how much profit you will make if any one of your offers is accepted and then press the SUBMIT button to submit the proposal to your trading partner.

Recall that the responder to a proposal can accept **at most ONLY ONE OFFER**.

Making a Loss and Exhausting Your $7

You will never be compelled to make a loss. If you make a decision that puts you at risk of making a loss, the computer will warn you with a pop-up message and ask for confirmation. The pop-up window will have two buttons: “OK” and “CANCEL”. Press **“OK” to accept to make a loss** or

"CANCEL" to revise your decision. If you agree to make a loss up to $7, this loss will simply be subtracted from your participation fee of $7. If you agree to make a loss that is greater than your $7 participation fee for that round, your participation in the experiment for all subsequent rounds will be suspended, and you will earn nothing beyond your show-up fee of $3, which you will receive after the conclusion of all the rounds in the experiment.

Time Limits and Trading Reductions

Each bargaining round is split into 8 stages. Once the 8 stages are complete, the round is over, and if you and your partner failed to accept an offer, each of you earns no profit from trading in that round.

Stage 1 lasts 40 seconds (30 seconds for the proposer, and 10 seconds for the responder). Each of stages 2 to 8 last 20 seconds (15 seconds for the proposer and 5 seconds for the responder). The top of the screen will indicate to you what stage you are in, and how much time you have left in that stage. Once a stage is complete, the next one will start immediately, until the last (8^{th}) stage is complete.

If you or your partner accept an offer during the first bargaining stage, your earnings for that round will be equal to the numbers shown on the screen.

If you or your partner accept an offer during the second bargaining stage or later, there will be a reduction on the profit that both players receive from trading (this reduction does not apply to the $7 participation fee, or the $3 show-up fee). This reduction will take the form of a percentage that will be deducted from your earnings and those of your partner. The table below specifies the reductions.

Bargaining stage	% of Your Earnings that You Lose
1	0%
2	10%
3	20%
4	30%
5	40%
6	50%
7	60%
8	70%
End of round	Round canceled for you and your partner (and you both earn no profit from trading)

For example, if it took until bargaining stage 2 for one of you to accept an offer, then each of you will lose 10% of your earnings.

Sequence of events

In each round, the sequence of decisions is as follows.

1. The computer randomly matches you with another trader.
2. You are randomly assigned your costs/values for the 4 units. A list of the 24 possible combinations is provided below.
3. The computer randomly selects one member of each pair of traders to make the first proposal.
4. That trader makes a proposal that includes 1 to 6 bundle offers.
5. The other trader can accept, at most, exactly one of the offers, or reject all of them.
6. If the trader rejects, it becomes that trader's turn to make a proposal.
7. The opportunity to make a proposal keeps alternating until
    a. one trader accepts an offer included in a proposal
    b. or 8 proposals are rejected, which will suspend bargaining in that round
8. Earnings for that round are calculated, and a reduction may be applied depending on which bargaining stage the acceptance came in.
9. At the conclusion of the last real round, one of the 6 real rounds is selected at random and used to pay the participants.

[List of all possible cost/value combinations on next page]

Possible cost/value combinations

Combination No.	Unit 1		Unit 2		Unit 3		Unit 4	
	Seller Cost	Buyer Value	Seller Cost	Buyer Value	Seller Cost	Buyer Value	Seller Cost	Buyer Value
1	$0	$10	$0	$50	$40	$10	$40	$50
2	$0	$10	$0	$50	$40	$50	$40	$10
3	$0	$10	$40	$10	$0	$50	$40	$50
4	$0	$10	$40	$10	$40	$50	$0	$50
5	$0	$10	$40	$50	$0	$50	$40	$10
6	$0	$10	$40	$50	$40	$10	$0	$50
7	$0	$50	$0	$10	$40	$10	$40	$50
8	$0	$50	$0	$10	$40	$50	$40	$10
9	$0	$50	$40	$10	$0	$10	$40	$50
10	$0	$50	$40	$10	$40	$50	$0	$10
11	$0	$50	$40	$50	$0	$10	$40	$10
12	$0	$50	$40	$50	$40	$10	$0	$10
13	$40	$10	$0	$10	$0	$50	$40	$50
14	$40	$10	$0	$10	$40	$50	$0	$50
15	$40	$10	$0	$50	$0	$10	$40	$50
16	$40	$10	$0	$50	$40	$50	$0	$10
17	$40	$10	$40	$50	$0	$10	$0	$50
18	$40	$10	$40	$50	$0	$50	$0	$10
19	$40	$50	$0	$10	$0	$50	$40	$10
20	$40	$50	$0	$10	$40	$10	$0	$50
21	$40	$50	$0	$50	$0	$10	$40	$10
22	$40	$50	$0	$50	$40	$10	$0	$10
23	$40	$50	$40	$10	$0	$10	$0	$50
24	$40	$50	$40	$10	$0	$50	$0	$10

This table shows that **the matchings of cost and value are always the same** but they may **occur in the case of different units.** All combinations have a cost $0 meeting a value $10, a cost $0 meeting a value $50, a cost $40 meeting a value $10, and a cost $40 meeting a value $50. However, across the various possible combinations, these matchings of cost and value occur at different units.

As an example, consider combinations (1) and (8) of the table:

- $0 meets a $10 in unit 1 of combination (1), but in unit 2 of combination (8)
- $0 meets a $50 in unit 2 of combination (1), but in unit 1 of combination (8)
- $40 meets a $10 in unit 3 of combination (1), but in unit 4 of combination (8)
- $40 meets a $50 in unit 4 of combination (1), but in unit 3 of combination (8)

Summary of Key Points

By way of providing a summary of the key points, we suggest that you return to the table of page 6 and consider:

1. What information a buyer/seller will have in each round
2. What are the combinations of costs and values for the four units
3. How, given a particular combination of traded units, a price determined in a certain bargaining stage, that may involve a reduction, determines the profit that a buyer and a seller will make

INSTRUCTIONS: FOUR GOODS, OPEN CHAT

Welcome and Introduction

Welcome to our study of decision making. If you read these instructions carefully and make good decisions, you can earn a considerable amount of money.

Kindly refrain from talking with other participants during the session. Also, it is an important requirement of this experiment that you **please turn your mobile phones to silent and abstain from using them during the experiment**.

By coming to this session, you have earned an attendance fee of $10. This has two components. A show up fee of $3 and a participation fee of $7. The participation fee is discussed further below.

The $10 attendance fee will be in addition to any amount that you earn based on your decisions. Once your earnings are determined you will be paid privately and your participation in this experiment will then be concluded.

If you have a question at any time, please raise your hand and I will approach you so that you can ask your question in private.

Setup

Today, we are going to set up a market in which some of you will be buyers and some of you will be sellers. In this market you will be given the opportunity to trade commodities. We will not specify names for these commodities; we will simply refer to them as "units".

Trading will occur in a sequence of trading rounds. The decisions that you make in each round will determine your earnings.

The experiment will consist of 10 rounds: 4 practice rounds followed by 6 real rounds.

The first 4 rounds will be practice and will not affect your earnings for the experiment.

The final 6 rounds will be real and will affect your earnings. At the end of the experiment, the computer will select one of the 6 real rounds at random and you will be paid based on your earnings in that round in cash.

Matching Rules

In every round, the computer will tell you whether you are a buyer or a seller for that round. During the practice rounds, you will experience both the role of a buyer as well as the role of a seller.

Once we have completed the practice rounds, you will be assigned the role of either buyer or seller and will remain in that role throughout the remainder of the session. You have a 50% chance of being a buyer, and a 50% chance of being a seller.

Each round, every buyer will be randomly matched with a seller. That means that each buyer is equally likely to be matched with each seller. The matching is independent every round, which means that being matched with a specific trader in one round has no effect on the likelihood of being matched with the same trader in a future round.

All matching is anonymous, meaning that you will never know the identity of whom you are matched with in any round.

Participation fee

At the start of each round, you will be given a $7 participation fee. Any positive earnings that you may make by trading one or more "units" will be added to this $7, whereas any negative earnings will be subtracted from this $7. If you do not end up trading one or more units, then you just keep your $7 participation fee.

Profit from trading

In each round, sellers and buyers will have the opportunity to exchange up to 4 units.

For each unit, sellers will be given a number known as their "cost" and buyers will be given a number known as their "value". The cost represents the minimum amount for which a seller can sell that unit without making a loss. The value represents the maximum amount for which a buyer can purchase that unit without making a loss.

Sellers and buyers exchange units in bundles that include 1 to 4 units for one total price paid for the entire bundle.

Sellers earn money when they sell a bundle at a total price that is above the total cost of the units inside that bundle. Seller earnings from the sale of a bundle are the difference between the price of the entire bundle and the total of the costs of the units included in the bundle. For example, if a seller has a unit with cost of $20 and a unit with cost of $80, and sells a bundle that includes both units for a total price of $140, then the total cost of the units in the bundle is $20 + $80 = $100, and the seller earns $140 – $100 = $40.

Buyers earn money when they buy a bundle at a total price that is below the total value of the units inside that bundle. Buyer earnings from the purchase of a bundle are the difference between the total of the values of the units included in the bundle and the price of the entire bundle. For example, if a buyer's value for one unit is $90 and for another unit is $60, and buys a bundle that

includes both units for a total price of $100, then the total value of the units in the bundle is $90 + $60 = $150, and the buyer earns $150 – $100 = $50.

EXAMPLE:

Consider a case in which a seller and a buyer have the following costs and values for the 4 units:

	Unit 1	Unit 2	Unit 3	Unit 4
Seller's cost ($)	A	B	C	D
Buyer's value ($)	E	F	G	H

The seller's costs of units 1, 2, 3, and 4 are A, B, C, and D, respectively.
The buyer's values of units 1, 2, 3, and 4 are E, F, G, and H, respectively.

Assume that the buyer and seller agree to exchange a bundle that includes only Unit 2 for a price $X. Their profit is calculated as follows:
Seller's profit=X-B
Buyer's profit=F-X

Alternatively, assume that the buyer and seller agree to exchange a bundle that includes Unit 1 and Unit 2 for a price $X. Their profit is calculated as follows:
Seller's profit=X-(A+B)
Buyer's profit=(E+F)-X

The calculations are similar in the case of bundles that include 3 or 4 goods.

If a seller sells a bundle at a price that is less than the total of the costs of the units inside the bundle, this seller will make a loss. If a buyer buys a bundle at a price that is greater than the total of the values of the units inside the bundle, this buyer will make a loss. If you are at risk of making a loss, the computer will notify you and ask you to confirm.

A seller and a buyer **can exchange at most ONLY ONE BUNDLE per round**. If they do not exchange a bundle, they each earn a profit of $0 for that round.

How the seller's cost and the buyer's value of each of the 4 units are determined is described in the next section.

How are Costs and Values Determined?

For each seller-buyer pair, there is a fixed number of possibilities for the combination of costs and values that can occur for each of their four units:

		Seller's cost	Buyer's value
a.	For one of the four units:	$0	$10
b.	For one of the four units:	$0	$50
c.	For one of the four units:	$40	$10
d.	For one of the four units:	$40	$50

Each of these 4 possibilities, (a), (b), (c), and (d) above, MUST OCCUR EXACTLY ONCE in any round. The order with which they occur within a round is random, and each possibility regarding the order in which (a), (b), (c), and (d) occur is equally likely. Hence, knowing this order in one round tells you nothing about how it may manifest in any other round. A list of all the equally likely possibilities is provided at the end of this document.

Sellers are only informed of their cost for each unit, and buyers are only informed of their value for each unit, meaning that neither side knows about the other. So, for a given unit, a seller cannot distinguish between combinations (a) and (b) above, because the seller is given the same information in each case (cost of $0); or between (c) and (d) (cost of $40). Similarly, for a given unit, a buyer cannot distinguish between (a) and (c), because the buyer is given the same information (value of $10) or between (b) and (d) (value of $50).

In other words:

In any round, sellers will have two units each with cost $0 and two units each with cost $40. However, they will not know which of their two $0s meets a buyer's $10 and which meets a buyer's $50. Similarly, they will not know which of their two $40s meets a buyer's $10 and which meets a buyer's $50.

In any round, buyers will have two units each with value $50 and two units each with value $10. However, they will not know which of their two $50s meets a seller's $0 and which meets a seller's $40. Similarly, they will not know which of their two $10's meets a seller's $0 and which meets a seller's $40.

A screenshot below shows a trader discovering that they are a seller, and learning their costs:

In this round you are a **seller**.

The cost of each of your 4 units is as follows:

Unit	1	2	3	4
Cost ($)	0	0	40	40

You can earn money by selling one or more of these units for a total price that is higher than their total cost.

A screenshot below shows a trader discovering that they are a buyer, and learning their values:

In this round you are a **buyer**.

The value of each of your 4 units is as follows:

Unit	1	2	3	4
Value ($)	10	50	10	50

You can earn money by buying one or more of these units for a total price that is lower than their total value.

How Much Money Can You and Your Partner Make

When you and your partner are bargaining over a bundle of 1 to 4 units, the total money that you can make between you from successfully trading that bundle of 1 to 4 units is equal to the buyer's total value of the traded units minus the seller's total cost of the traded units. This follows from the way in which buyer and seller profits are calculated.

To understand this, we will examine an example with one unit. Consider a buyer with value \$50 and a seller with cost \$40. If they agree on a price \$43 then the buyer will make \$50 - \$43 = \$7 and the seller \$43 - \$40 = \$3. Together they make \$7 + \$3 = \$10. Alternatively, they could agree on a price \$48 and then the buyer will make \$50 - \$48 = \$2 and the seller \$48 - \$40 = \$8. Again, together they make \$2 + \$8 = \$10. Clearly, the total profit is the difference between the cost and the value: \$50 - \$40 = \$10. The trade price merely determines how the total profit of \$10 is divided between the buyer and seller.

This example was for one unit. When dealing with 4 units, the same principle applies: the total money that you and your partner can make is the total of how much you can make from each unit.

Since in every round, each of the following 4 possibilities occurs exactly once, there is a **fixed maximum total amount of profit** that you and your partner can make every round, and it is equal to \$70. To see why, consider the following table:

		Seller's cost	Buyer's value	Combined buyer and seller profit if traded	Combined buyer and seller profit if not traded
a.	For one of the four units:	\$0	\$10	\$10 - \$0 = \$10	\$0
b.	For one of the four units:	\$0	\$50	\$50 - \$0=\$50	\$0
c.	For one of the four units:	\$40	\$10	\$10 - \$40 = -\$30	\$0
d.	For one of the four units:	\$40	\$50	\$50 - \$40 = \$10	\$0

Hence, the **maximum** amount of combined buyer and seller earnings is \$10 + \$50 + \$0 + \$10 = \$70.

Therefore, depending on the choices that you and your partner make in every round, you can together make a maximum of \$70 between you.

Any amount that you and your partner make is shared between you on the basis of the trading agreement that you make with your partner, which is done according to the mechanism described in the next section.

Trading Mechanism

After being matched with another trader and seeing your costs/values, you will have the opportunity to trade with your partner in a sequence of 8 bargaining stages. Bargaining stages consist of you and your partner making offers of trading prices for bundles of 1 to 4 units.

During each bargaining stage, you and your partner are free to make offers at any time. Each of you is also free to accept an offer made by the other at any time. Once an offer is accepted, the round is over. You and your partner also have a time limit, which we will explain below.

In what follows we first describe the offer structure, and then we describe how to accept an offer.

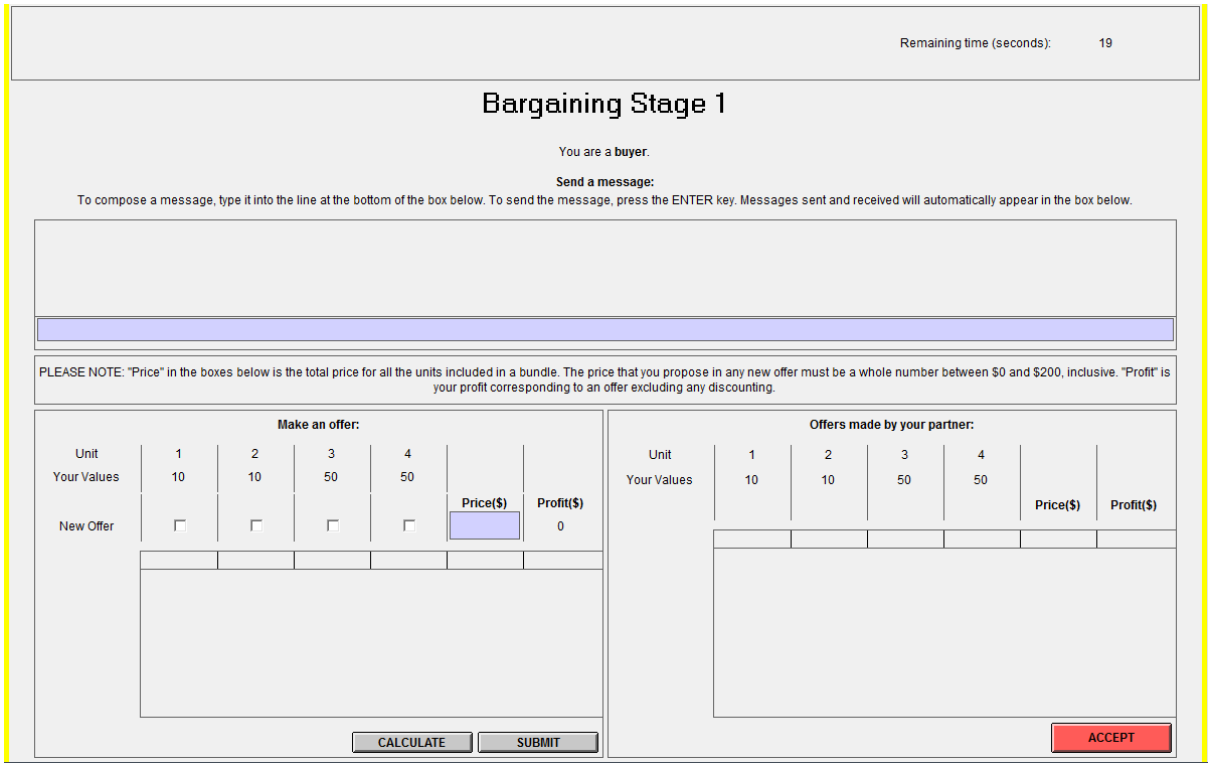
Offer Structure

Each offer has two components:

3. A list of the units included in the offer; an offer must contain at least 1 unit, and at the most 4 units
4. A total price for **all the units** in the offer, which must be a whole number between $0 and $200, inclusive.

To make an offer, select the units that will be included in the offer using the checkboxes, and enter the price.

The screenshot below shows you a buyer considering what offer to make:



Once you have finished composing your offer, press the CALCULATE button to calculate how much profit you will make if your offer is accepted and then press the SUBMIT button to submit the offer to your trading partner.

The offers that you make will appear on the left side of the screen. The most recent offer will be on top, and the older ones will be at the bottom.

Your partner is free to accept any of your offers at any point during the round. If your partner accepts an offer, the round ends immediately.

While you are making offers, your partner can also make offers. **Both of you can make as many offers as you like without waiting for the other person to respond.** Your partner's offers will appear on the right side of your screen, with the most recent ones at the top, and the older ones at the bottom.

The computer will automatically display the profit that you will earn from each offer if you accept it.

During a round, you and your partner will be able to chat with each other via a chat window. You can see this chat window at the top of the screenshot above. You can send messages at any time, and can send as many messages as you like. However, we ask that you please observe the following rules:

- No threatening or abusive language
- No messages that reveal your identity, such as your name or your location in the lab.

Accepting an Offer

To accept an offer, highlight the offer by moving the mouse cursor over it, and then click on ACCEPT. The round will end immediately as soon as either you or your partner accepts an offer.

Making a Loss and Exhausting Your $7

You will never be compelled to make a loss. If you make a decision that puts you at risk of making a loss, the computer will warn you with a pop-up message and ask for confirmation. The pop-up window will have two buttons: "OK" and "CANCEL". Press **"OK" to accept to make a loss** or **"CANCEL" to revise your decision.** If you agree to make a loss up to $7, this loss will simply be subtracted from your participation fee of $7. If you agree to make a loss that is greater than your $7 participation fee for that round, your participation in the experiment for all subsequent rounds will be suspended, and you will earn nothing beyond your show-up fee of $3, which you will receive after the conclusion of all the rounds in the experiment.

Time Limits and Trading Reductions

Each bargaining round is split into 8 stages. Once the 8 stages are complete, the round is over, and if you and your partner failed to accept an offer, each of you earns no profit from trading in that round.

Stage 1 lasts 40 seconds, while each of stages 2 to 8 last 20 seconds. The top of the screen will indicate to you what stage you are in, and how much time is left until the end of the stage. Once a stage is complete, the next one will start immediately, until the last (8^{th}) stage is complete.

Offers do not expire and an offer made in one stage can be accepted in that stage or in any subsequent stage.

If you or your partner accept an offer during the first bargaining stage, your earnings for that round will be equal to the numbers shown on the screen.

If you or your partner accept an offer during the second bargaining stage or later, there will be a reduction on the profit that both players receive from trading (this reduction does not apply to the $7 participation fee, or the $3 show-up fee). This reduction will take the form of a percentage that will be deducted from your earnings and those of your partner. The table below specifies the reductions.

Bargaining stage	% of Your Earnings that You Lose
1	0%
2	10%
3	20%
4	30%
5	40%
6	50%
7	60%
8	70%
End of round	Round canceled for you and your partner (and you both earn no profit from trading)

For example, if it took until bargaining stage 2 for one of you to accept an offer, then each of you will lose 10% of your earnings.

Sequence of events

In each round, the sequence of decisions is as follows.

1. The computer randomly matches you with another trader.
2. You are randomly assigned your costs/values for the 4 units. A list of all 24 possible combinations is provided below.
3. Bargaining commences; you and your partner are free to make offers, accept offers, and chat.
4. Bargaining continues until:
    a. one trader accepts an offer
    b. or 8 bargaining stages are concluded, which will suspend bargaining in that round
5. Earnings for that round are calculated, and a reduction may be applied depending on which bargaining stage the acceptance came in.
6. At the conclusion of the last real round, one of the 6 real rounds is selected at random and used to pay the participants.

[List of all possible cost/value combinations on next page]

Possible cost/value combinations

Combination No.	Unit 1		Unit 2		Unit 3		Unit 4	
	Seller Cost	Buyer Value	Seller Cost	Buyer Value	Seller Cost	Buyer Value	Seller Cost	Buyer Value
1	$0	$10	$0	$50	$40	$10	$40	$50
2	$0	$10	$0	$50	$40	$50	$40	$10
3	$0	$10	$40	$10	$0	$50	$40	$50
4	$0	$10	$40	$10	$40	$50	$0	$50
5	$0	$10	$40	$50	$0	$50	$40	$10
6	$0	$10	$40	$50	$40	$10	$0	$50
7	$0	$50	$0	$10	$40	$10	$40	$50
8	$0	$50	$0	$10	$40	$50	$40	$10
9	$0	$50	$40	$10	$0	$10	$40	$50
10	$0	$50	$40	$10	$40	$50	$0	$10
11	$0	$50	$40	$50	$0	$10	$40	$10
12	$0	$50	$40	$50	$40	$10	$0	$10
13	$40	$10	$0	$10	$0	$50	$40	$50
14	$40	$10	$0	$10	$40	$50	$0	$50
15	$40	$10	$0	$50	$0	$10	$40	$50
16	$40	$10	$0	$50	$40	$50	$0	$10
17	$40	$10	$40	$50	$0	$10	$0	$50
18	$40	$10	$40	$50	$0	$50	$0	$10
19	$40	$50	$0	$10	$0	$50	$40	$10
20	$40	$50	$0	$10	$40	$10	$0	$50
21	$40	$50	$0	$50	$0	$10	$40	$10
22	$40	$50	$0	$50	$40	$10	$0	$10
23	$40	$50	$40	$10	$0	$10	$0	$50
24	$40	$50	$40	$10	$0	$50	$0	$10

This table shows that **the matchings of cost and value are always the same** but they may **occur in the case of different units.** All combinations have a cost $0 meeting a value $10, a cost $0 meeting a value $50, a cost $40 meeting a value $10, and a cost $40 meeting a value $50. However, across the various possible combinations, these matchings of cost and value occur at different units.

As an example, consider combinations (1) and (8) of the table:

- $0 meets a $10 in unit 1 of combination (1), but in unit 2 of combination (8)
- $0 meets a $50 in unit 2 of combination (1), but in unit 1 of combination (8)
- $40 meets a $10 in unit 3 of combination (1), but in unit 4 of combination (8)
- $40 meets a $50 in unit 4 of combination (1), but in unit 3 of combination (8)

Summary of Key Points

By way of providing a summary of the key points, we suggest that you return to the table of page 6 and consider:

1. What information a buyer/seller will have in each round
2. What are the combinations of costs and values for the four units
3. How, given a particular combination of traded units, a price determined in a certain bargaining stage, that may involve a reduction, determines the profit that a buyer and a seller will make

INSTRUCTIONS: FOUR GOODS, COIN TOSS

Welcome and Introduction

Welcome to our study of decision making. If you read these instructions carefully and make good decisions, you can earn a considerable amount of money.

Kindly refrain from talking with other participants during the session. Also, it is an important requirement of this experiment that you **please turn your mobile phones to silent and abstain from using them during the experiment**.

By coming to this session, you have earned an attendance fee of $10. This has two components. A show up fee of $3 and a participation fee of $7. The participation fee is discussed further below.

The $10 attendance fee will be in addition to any amount that you earn based on your decisions. Once your earnings are determined you will be paid privately and your participation in this experiment will then be concluded.

If you have a question at any time, please raise your hand and I will approach you so that you can ask your question in private.

Setup

Today, we are going to set up a market in which some of you will be buyers and some of you will be sellers. In this market you will be given the opportunity to trade commodities. We will not specify names for these commodities; we will simply refer to them as "units".

Trading will occur in a sequence of trading rounds. The decisions that you make in each round will determine your earnings.

The experiment will consist of 10 rounds: 4 practice rounds followed by 6 real rounds.

The first 4 rounds will be practice and will not affect your earnings for the experiment.

The final 6 rounds will be real and will affect your earnings. At the end of the experiment, the computer will select one of the 6 real rounds at random and you will be paid based on your earnings in that round in cash.

Matching Rules

In every round, the computer will tell you whether you are a buyer or a seller for that round. During the practice rounds, you will experience both the role of a buyer as well as the role of a seller.

Once we have completed the practice rounds, you will be assigned the role of either buyer or seller and will remain in that role throughout the remainder of the session. You have a 50% chance of being a buyer, and a 50% chance of being a seller.

Each round, every buyer will be randomly matched with a seller. That means that each buyer is equally likely to be matched with each seller. The matching is independent every round, which means that being matched with a specific trader in one round has no effect on the likelihood of being matched with the same trader in a future round.

All matching is anonymous, meaning that you will never know the identity of whom you are matched with in any round.

Participation fee

At the start of each round, you will be given a $7 participation fee. Any positive earnings that you may make by trading one or more "units" will be added to this $7, whereas any negative earnings will be subtracted from this $7. If you do not end up trading one or more units, then you just keep your $7 participation fee.

Profit from trading

In each round, sellers and buyers will have the opportunity to exchange up to 4 units.

For each unit, sellers will be given a number known as their "cost" and buyers will be given a number known as their "value". The cost represents the minimum amount for which a seller can sell that unit without making a loss. The value represents the maximum amount for which a buyer can purchase that unit without making a loss.

Sellers and buyers exchange units in bundles that include 1 to 4 units for one total price paid for the entire bundle.

Sellers earn money when they sell a bundle at a total price that is above the total cost of the units inside that bundle. Seller earnings from the sale of a bundle are the difference between the price of the entire bundle and the total of the costs of the units included in the bundle. For example, if a seller has a unit with cost of $20 and a unit with cost of $80, and sells a bundle that includes both units for a total price of $140, then the total cost of the units in the bundle is $20 + $80 = $100, and the seller earns $140 – $100 = $40.

Buyers earn money when they buy a bundle at a total price that is below the total value of the units inside that bundle. Buyer earnings from the purchase of a bundle are the difference between the total of the values of the units included in the bundle and the price of the entire bundle. For example, if a buyer's value for one unit is $90 and for another unit is $60, and buys a bundle that

includes both units for a total price of $100, then the total value of the units in the bundle is $90 + $60 = $150, and the buyer earns $150 – $100 = $50.

EXAMPLE:

Consider a case in which a seller and a buyer have the following costs and values for the 4 units:

	Unit 1	Unit 2	Unit 3	Unit 4
Seller's cost ($)	A	B	C	D
Buyer's value ($)	E	F	G	H

The seller's costs of units 1, 2, 3, and 4 are A, B, C, and D, respectively.

The buyer's values of units 1, 2, 3, and 4 are E, F, G, and H, respectively.

Assume that the buyer and seller agree to exchange a bundle that includes only Unit 2 for a price $X. Their profit is calculated as follows:

Seller's profit=X-B

Buyer's profit=F-X

Alternatively, assume that the buyer and seller agree to exchange a bundle that includes Unit 1 and Unit 2 for a price $X. Their profit is calculated as follows:

Seller's profit=X-(A+B)

Buyer's profit=(E+F)-X

The calculations are similar in the case of bundles that include 3 or 4 goods.

If a seller sells a bundle at a price that is less than the total of the costs of the units inside the bundle, this seller will make a loss. If a buyer buys a bundle at a price that is greater than the total of the values of the units inside the bundle, this buyer will make a loss. If you are at risk of making a loss, the computer will notify you and ask you to confirm.

A seller and a buyer **can exchange at most ONLY ONE BUNDLE per round**. If they do not exchange a bundle, they each earn a profit of $0 for that round.

How the seller's cost and the buyer's value of each of the 4 units are determined is described in the next section.

How are Costs and Values Determined?

Each round, for each seller, for each unit, there is:

- 50% probability that their cost will be $0
- 50% probability that their cost will be $40

Each round, for each buyer, for each unit, there is:

- 50% probability that their value will be $10
- 50% probability that their value will be $50

Given the probabilities above, for each unit, there are 4 possible ways that a seller's cost will match with a buyer's value **in the case of any one of the four units**:

	Probability	Seller's cost	Buyer's value
a.	25%	0	10
b.	25%	0	50
c.	25%	40	10
d.	25%	40	50

This process for determining the seller cost and buyer value for each unit is repeated for each of the 4 units.

Traders' costs/values are determined independently in terms of units, rounds, and traders. This means that knowing an individual trader's cost/value for a unit during a round tells you nothing about the cost/value of any other unit belonging to any trader in that round, or any other round.

Sellers are only informed of their cost for their 4 units, and buyers are only informed of their value for their 4 units, meaning that neither side knows about the other.

So, if you are a seller and your cost for your first unit is, say, $0 you will not know whether the buyer that you are matched with has a value of $10 or $50 for their first unit.

Similarly, if you are a buyer and your value for your third unit is, say, $50 you will not know whether the seller that you are matched with has a cost of $0 or $40 for their third unit.

Naturally, you will never be compelled to either buy or sell any of your units. If a given pair of seller and buyer do not reach agreement on a price for a bundle of units after 8 bargaining stages, bargaining is suspended. In this case each trader only receives their $7 participation fee.

A screenshot below shows a trader discovering that they are a seller, and learning their costs:

In this round you are a **seller**.

The cost of each of your 4 units is as follows:

Unit	1	2	3	4
Cost ($)	0	0	40	40

You can earn money by selling one or more of these units for a total price that is higher than their total cost.

A screenshot below shows a trader discovering that they are a buyer, and learning their values:

In this round you are a **buyer**.

The value of each of your 4 units is as follows:

Unit	1	2	3	4
Value ($)	10	50	10	50

You can earn money by buying one or more of these units for a total price that is lower than their total value.

How Much Money Can You and Your Partner Make

When you and your partner are bargaining over a bundle of 1 to 4 units, the total money that you can make between you from successfully trading that bundle of 1 to 4 units is equal to the buyer's total value of the traded units minus the seller's total cost of the traded units. This follows from the way in which buyer and seller profits are calculated.

To understand this, we will examine an example with one unit. Consider a buyer with value \$50 and a seller with cost \$40. If they agree on a price \$43 then the buyer will make \$50 - \$43 = \$7 and the seller \$43 - \$40 = \$3. Together they make \$7 + \$3 = \$10. Alternatively, they could agree on a price \$48 and then the buyer will make \$50 - \$48 = \$2 and the seller \$48 - \$40 = \$8. Again, together they make \$2 + \$8 = \$10. Clearly, the total profit is the difference between the cost and the value: \$50 - \$40 = \$10. The trade price merely determines how the total profit of \$10 is divided between the buyer and seller.

This example was for one unit. When dealing with 4 units, the same principle applies: the total money that you and your partner can make is the total of how much you can make from each unit.

Since in every round, there are a fixed number of possibilities for the combinations of costs/values, there are also a fixed number of possibilities for the maximum total amount of profit. **On average, in each round it is equal to \$70**, though it may be higher or lower than this in a given round depending on what costs/values are randomly assigned. Here are a few examples:

Example 1

	Unit 1	Unit 2	Unit 3	Unit 4
Buyer's value	10	10	10	50
Seller's cost	40	0	0	40
Combined buyer and seller profit if traded (Buyer's value – Seller's cost)	-30	10	10	10
Maximum possible joint profit =10+10+10=30				

Example 2

	Unit 1	Unit 2	Unit 3	Unit 4
Buyer's value	10	50	10	50
Seller's cost	0	0	40	40
Combined buyer and seller profit if traded (Buyer's value – Seller's cost)	10	50	-30	10
Maximum possible joint profit =10+50+10=70				

Example 3

	Unit 1	Unit 2	Unit 3	Unit 4
Buyer's value	50	50	10	10
Seller's cost	0	0	40	40
Combined buyer and seller profit if traded (Buyer's value – Seller's cost)	50	50	-30	-30
Maximum possible joint profit =50+50=100				

Any amount that you and your partner make is shared between you on the basis of the trading agreement that you make with your partner, which is done according to the mechanism described in the next section.

Trading Mechanism

After being matched with another trader and seeing your costs/values, you will have the opportunity to trade with your partner in a sequence of 8 bargaining stages. Bargaining stages consist of you and your partner making offers of trading prices for bundles of 1 to 4 units.

During each bargaining stage, you and your partner are free to make offers at any time. Each of you is also free to accept an offer made by the other at any time. Once an offer is accepted, the round is over. You and your partner also have a time limit, which we will explain below.

In what follows we first describe the offer structure, and then we describe how to accept an offer.

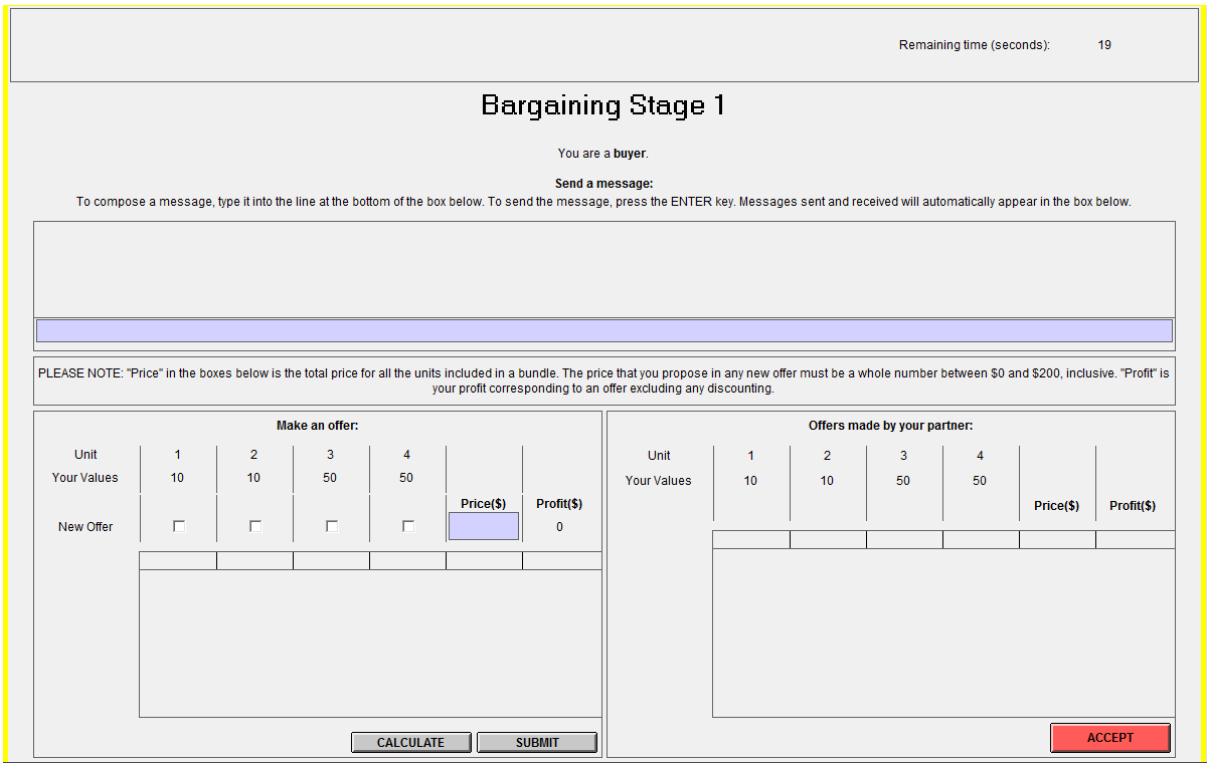
Offer Structure

Each offer has two components:

1. A list of the units included in the offer; an offer must contain at least 1 unit, and at the most 4 units
2. A total price for **all the units** in the offer, which must be a whole number between $0 and $200, inclusive.

To make an offer, select the units that will be included in the offer using the checkboxes, and enter the price.

The screenshot below shows you a buyer considering what offer to make:



Once you have finished composing your offer, press the CALCULATE button to calculate how much profit you will make if your offer is accepted and then press the SUBMIT button to submit the offer to your trading partner.

The offers that you make will appear on the left side of the screen. The most recent offer will be on top, and the older ones will be at the bottom.

Your partner is free to accept any of your offers at any point during the round. If your partner accepts an offer, the round ends immediately.

While you are making offers, your partner can also make offers. **Both of you can make as many offers as you like without waiting for the other person to respond.** Your partner's offers will appear on the right side of your screen, with the most recent ones at the top, and the older ones at the bottom.

The computer will automatically display the profit that you will earn from each offer if you accept it.

During a round, you and your partner will be able to chat with each other via a chat window. You can see this chat window at the top of the screenshot above. You can send messages at any time, and can send as many messages as you like. However, we ask that you please observe the following rules:

- No threatening or abusive language

- No messages that reveal your identity, such as your name or your location in the lab.

Accepting an Offer

To accept an offer, highlight the offer by moving the mouse cursor over it, and then click on ACCEPT. The round will end immediately as soon as either you or your partner accepts an offer.

Making a Loss and Exhausting Your $7

You will never be compelled to make a loss. If you make a decision that puts you at risk of making a loss, the computer will warn you with a pop-up message and ask for confirmation. The pop-up window will have two buttons: "OK" and "CANCEL". Press **"OK" to accept to make a loss** or **"CANCEL" to revise your decision.** If you agree to make a loss up to $7, this loss will simply be subtracted from your participation fee of $7. If you agree to make a loss that is greater than your $7 participation fee for that round, your participation in the experiment for all subsequent rounds will be suspended, and you will earn nothing beyond your show-up fee of $3, which you will receive after the conclusion of all the rounds in the experiment.

Time Limits and Trading Reductions

Each bargaining round is split into 8 stages. Once the 8 stages are complete, the round is over, and if you and your partner failed to accept an offer, each of you earns no profit from trading in that round.

Stage 1 lasts 40 seconds, while each of stages 2 to 8 last 20 seconds. The top of the screen will indicate to you what stage you are in, and how much time is left until the end of the stage. Once a stage is complete, the next one will start immediately, until the last (8^{th}) stage is complete.

Offers do not expire and an offer made in one stage can be accepted in that stage or in any subsequent stage.

If you or your partner accept an offer during the first bargaining stage, your earnings for that round will be equal to the numbers shown on the screen.

If you or your partner accept an offer during the second bargaining stage or later, there will be a reduction on the profit that both players receive from trading (this reduction does not apply to the $7 participation fee, or the $3 show-up fee). This reduction will take the form of a percentage that will be deducted from your earnings and those of your partner. The table below specifies the reductions.

Bargaining stage	% of Your Earnings that You Lose
1	0%
2	10%
3	20%
4	30%
5	40%
6	50%
7	60%
8	70%
End of round	Round canceled for you and your partner (and you both earn no profit from trading)

For example, if it took until bargaining stage 2 for one of you to accept an offer, then each of you will lose 10% of your earnings.

Sequence of events

In each round, the sequence of decisions is as follows.

1. The computer randomly matches you with another trader.
2. You are randomly assigned your costs/values for the 4 units.
3. Bargaining commences; you and your partner are free to make offers, accept offers, and chat.
4. Bargaining continues until:
    a. one trader accepts an offer
    b. or 8 bargaining stages are concluded, which will suspend bargaining in that round
5. Earnings for that round are calculated, and a reduction may be applied depending on which bargaining stage the acceptance came in.
6. At the conclusion of the last real round, one of the 6 real rounds is selected at random and used to pay the participants.

Summary of Key Points

By way of providing a summary of the key points, we suggest that you return to the examples of pages 6-7 and consider:

1. What information a buyer/seller will have in each round
2. What are possible combinations of costs and values for the four units
3. How, given a particular combination of traded units, a price determined in a certain bargaining stage, that may involve a reduction, determines the profit that a buyer and a seller will make

INSTRUCTIONS: FOUR GOODS, SPIN THE WHEEL

Welcome and Introduction

Welcome to our study of decision making. If you read these instructions carefully and make good decisions, you can earn a considerable amount of money.

Kindly refrain from talking with other participants during the session. Also, it is an important requirement of this experiment that you **please turn your mobile phones to silent and abstain from using them during the experiment**.

By coming to this session, you have earned an attendance fee of $10. This has two components. A show up fee of $3 and a participation fee of $7. The participation fee is discussed further below.

The $10 attendance fee will be in addition to any amount that you earn based on your decisions. Once your earnings are determined you will be paid privately and your participation in this experiment will then be concluded.

If you have a question at any time, please raise your hand and I will approach you so that you can ask your question in private.

Setup

Today, we are going to set up a market in which some of you will be buyers and some of you will be sellers. In this market you will be given the opportunity to trade commodities. We will not specify names for these commodities; we will simply refer to them as "units".

Trading will occur in a sequence of trading rounds. The decisions that you make in each round will determine your earnings.

The experiment will consist of 10 rounds: 4 practice rounds followed by 6 real rounds.

The first 4 rounds will be practice and will not affect your earnings for the experiment.

The final 6 rounds will be real and will affect your earnings. At the end of the experiment, the computer will select one of the 6 real rounds at random and you will be paid based on your earnings in that round in cash.

Matching Rules

In every round, the computer will tell you whether you are a buyer or a seller for that round. During the practice rounds, you will experience both the role of a buyer as well as the role of a seller.

Once we have completed the practice rounds, you will be assigned the role of either buyer or seller and will remain in that role throughout the remainder of the session. You have a 50% chance of being a buyer, and a 50% chance of being a seller.

Each round, every buyer will be randomly matched with a seller. That means that each buyer is equally likely to be matched with each seller. The matching is independent every round, which means that being matched with a specific trader in one round has no effect on the likelihood of being matched with the same trader in a future round.

All matching is anonymous, meaning that you will never know the identity of whom you are matched with in any round.

Participation fee

At the start of each round, you will be given a $7 participation fee. Any positive earnings that you may make by trading one or more "units" will be added to this $7, whereas any negative earnings will be subtracted from this $7. If you do not end up trading one or more units, then you just keep your $7 participation fee.

Profit from trading

In each round, sellers and buyers will have the opportunity to exchange up to 4 units.

For each unit, sellers will be given a number known as their "cost" and buyers will be given a number known as their "value". The cost represents the minimum amount for which a seller can sell that unit without making a loss. The value represents the maximum amount for which a buyer can purchase that unit without making a loss.

Sellers and buyers exchange units in bundles that include 1 to 4 units for one total price paid for the entire bundle.

Sellers earn money when they sell a bundle at a total price that is above the total cost of the units inside that bundle. Seller earnings from the sale of a bundle are the difference between the price of the entire bundle and the total of the costs of the units included in the bundle. For example, if a seller has a unit with cost of $20 and a unit with cost of $80, and sells a bundle that includes both units for a total price of $140, then the total cost of the units in the bundle is $20 + $80 = $100, and the seller earns $140 – $100 = $40.

Buyers earn money when they buy a bundle at a total price that is below the total value of the units inside that bundle. Buyer earnings from the purchase of a bundle are the difference between the total of the values of the units included in the bundle and the price of the entire bundle. For example, if a buyer's value for one unit is $90 and for another unit is $60, and buys a bundle that

includes both units for a total price of $100, then the total value of the units in the bundle is $90 + $60 = $150, and the buyer earns $150 – $100 = $50.

EXAMPLE:

Consider a case in which a seller and a buyer have the following costs and values for the 4 units:

	Unit 1	Unit 2	Unit 3	Unit 4
Seller's cost ($)	A	B	C	D
Buyer's value ($)	E	F	G	H

The seller's costs of units 1, 2, 3, and 4 are A, B, C, and D, respectively.

The buyer's values of units 1, 2, 3, and 4 are E, F, G, and H, respectively.

Assume that the buyer and seller agree to exchange a bundle that includes only Unit 2 for a price $X. Their profit is calculated as follows:

Seller's profit=X-B

Buyer's profit=F-X

Alternatively, assume that the buyer and seller agree to exchange a bundle that includes Unit 1 and Unit 2 for a price $X. Their profit is calculated as follows:

Seller's profit=X-(A+B)

Buyer's profit=(E+F)-X

The calculations are similar in the case of bundles that include 3 or 4 goods.

If a seller sells a bundle at a price that is less than the total of the costs of the units inside the bundle, this seller will make a loss. If a buyer buys a bundle at a price that is greater than the total of the values of the units inside the bundle, this buyer will make a loss. If you are at risk of making a loss, the computer will notify you and ask you to confirm.

A seller and a buyer **can exchange at most ONLY ONE BUNDLE per round**. If they do not exchange a bundle, they each earn a profit of $0 for that round.

How the seller's cost and the buyer's value of each of the 4 units are determined is described in the next section.

How are Costs and Values Determined?

Each round, two of the seller's units will have a cost of $0, and the remaining two will have a cost of $40. Each of the four units has an equal chance of having a cost of $0 versus $40.

Each round, two of the buyer's units will have a value of $10, and the remaining two will have a value of $50. Each of the four units has an equal chance of having a value of $10 versus $50.

Given the above, there are 4 possible ways that a seller's cost may match with a buyer's value **in the case of any one of the four units**:

	Seller's cost	Buyer's value
a.	0	10
b.	0	50
c.	40	10
d.	40	50

This process for determining the seller cost and buyer value for each unit is repeated for each of the 4 units, subject to the constraint that 2 of the 4 seller units have a cost of $0, and the remaining 2 have a cost of $40; and that 2 of the buyer units have a value of $10, and the remaining 2 have a value of $50.

Traders' costs/values are determined independently in terms of units (between traders), rounds, and traders. This means that knowing an individual trader's cost/value for a unit during a round tells you nothing about the cost/value of any unit belonging to any other trader in that round, or any unit belonging to any trader in any other round.

Sellers are only informed of their cost for their 4 units, and buyers are only informed of their value for their 4 units, meaning that neither side knows about the other.

So, if you are a seller and your cost for your first unit is, say, $0 you will not know whether the buyer that you are matched with has a value of $10 or $50 for their first unit.

Similarly, if you are a buyer and your value for your third unit is, say, $50 you will not know whether the seller that you are matched with has a cost of $0 or $40 for their third unit.

Naturally, you will never be compelled to either buy or sell any of your units. If a given pair of seller and buyer do not reach agreement on a price for a bundle of units after 8 bargaining stages, bargaining is suspended. In this case each trader only receives their $7 participation fee.

A screenshot below shows a trader discovering that they are a seller, and learning their costs:

In this round you are a **seller**.

The cost of each of your 4 units is as follows:

Unit	1	2	3	4
Cost ($)	0	0	40	40

You can earn money by selling one or more of these units for a total price that is higher than their total cost.

A screenshot below shows a trader discovering that they are a buyer, and learning their values:

In this round you are a **buyer**.

The value of each of your 4 units is as follows:

Unit	1	2	3	4
Value ($)	10	50	10	50

You can earn money by buying one or more of these units for a total price that is lower than their total value.

How Much Money Can You and Your Partner Make

When you and your partner are bargaining over a bundle of 1 to 4 units, the total money that you can make between you from successfully trading that bundle of 1 to 4 units is equal to the buyer's total value of the traded units minus the seller's total cost of the traded units. This follows from the way in which buyer and seller profits are calculated.

To understand this, we will examine an example with one unit. Consider a buyer with value $50 and a seller with cost $40. If they agree on a price $43 then the buyer will make $50 - $43 = $7 and the seller $43 - $40 = $3. Together they make $7 + $3 = $10. Alternatively, they could agree on a price $48 and then the buyer will make $50 - $48 = $2 and the seller $48 - $40 = $8. Again, together they make $2 + $8 = $10. Clearly, the total profit is the difference between the cost and the value: $50 - $40 = $10. The trade price merely determines how the total profit of $10 is divided between the buyer and seller.

This example was for one unit. When dealing with 4 units, the same principle applies: the total money that you and your partner can make is the total of how much you can make from each unit.

Since in every round, there are a fixed number of possibilities for the combinations of costs/values, there are also a fixed number of possibilities for the maximum total amount of profit. It can be either 40, 70, or 100. Here are three examples that cover the three possibilities regarding the maximum amount of profit:

Example 1

	Unit 1	Unit 2	Unit 3	Unit 4
Buyer's value	50	10	10	50
Seller's cost	40	0	0	40
Combined buyer and seller profit if traded (Buyer's value – Seller's cost)	10	10	10	10
Maximum possible joint profit =10+10+10+10=40				

Example 2

	Unit 1	Unit 2	Unit 3	Unit 4
Buyer's value	10	50	10	50
Seller's cost	0	0	40	40
Combined buyer and seller profit if traded (Buyer's value – Seller's cost)	10	50	-30	10
Maximum possible joint profit =10+50+10=70				

Example 3

	Unit 1	Unit 2	Unit 3	Unit 4
Buyer's value	50	50	10	10
Seller's cost	0	0	40	40
Combined buyer and seller profit if traded (Buyer's value – Seller's cost)	50	50	-30	-30
Maximum possible joint profit =50+50=100				

Note that another possibility is the same matching of goods as in one of the three above examples, but in a different order. For example, below you can see a reordering of Example 1, where Unit 1 and Unit 2 have switched places for both the buyer and the seller at the same time.

Example 4 (Reordering of Example 1)

	Unit 1	Unit 2	Unit 3	Unit 4
Buyer's value	10	50	10	50
Seller's cost	0	40	0	40
Combined buyer and seller profit if traded (Buyer's value – Seller's cost)	10	10	10	10
Maximum possible joint profit =10+10+10+10=40				

Any amount that you and your partner make is shared between you on the basis of the trading agreement that you make with your partner, which is done according to the mechanism described in the next section.

Trading Mechanism

After being matched with another trader and seeing your costs/values, you will have the opportunity to trade with your partner in a sequence of 8 bargaining stages. Bargaining stages consist of you and your partner making offers of trading prices for bundles of 1 to 4 units.

During each bargaining stage, you and your partner are free to make offers at any time. Each of you is also free to accept an offer made by the other at any time. Once an offer is accepted, the round is over. You and your partner also have a time limit, which we will explain below.

In what follows we first describe the offer structure, and then we describe how to accept an offer.

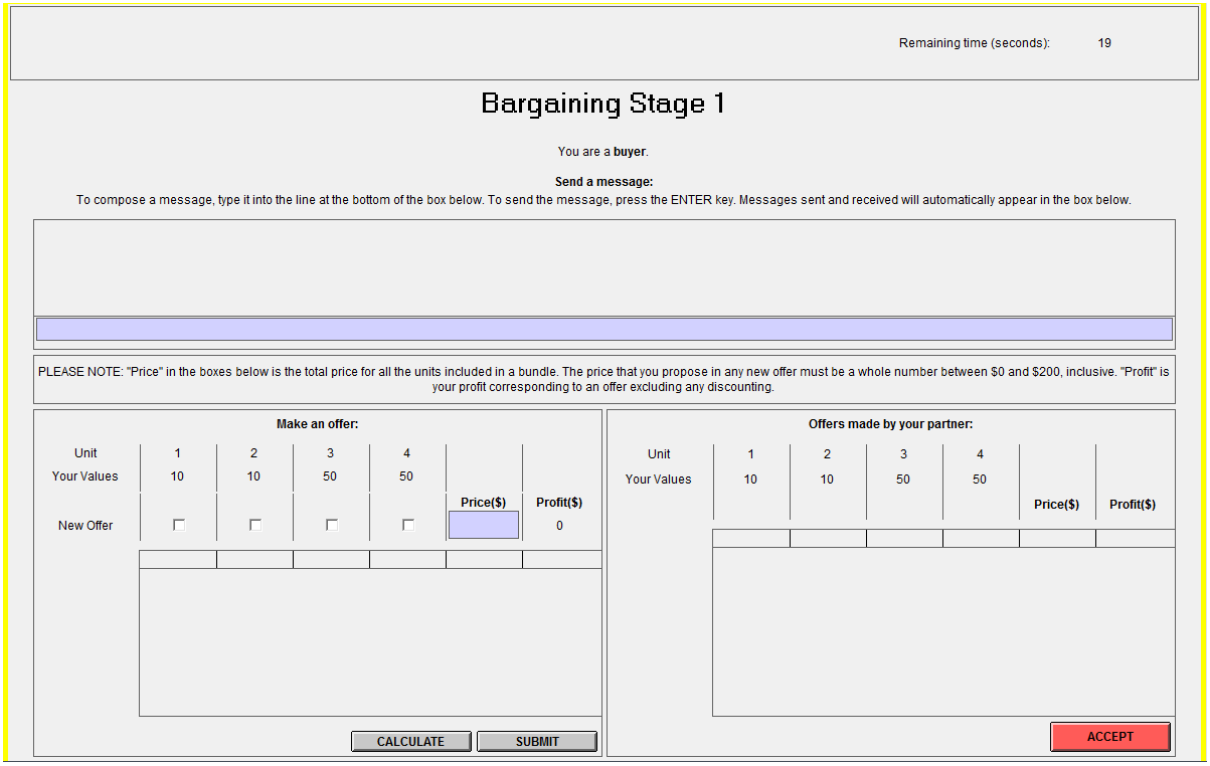
Offer Structure

Each offer has two components:

1. A list of the units included in the offer; an offer must contain at least 1 unit, and at the most 4 units
2. A total price for **all the units** in the offer, which must be a whole number between $0 and $200, inclusive.

To make an offer, select the units that will be included in the offer using the checkboxes, and enter the price.

The screenshot below shows you a buyer considering what offer to make:



Once you have finished composing your offer, press the CALCULATE button to calculate how much profit you will make if your offer is accepted and then press the SUBMIT button to submit the offer to your trading partner.

The offers that you make will appear on the left side of the screen. The most recent offer will be on top, and the older ones will be at the bottom.

Your partner is free to accept any of your offers at any point during the round. If your partner accepts an offer, the round ends immediately.

While you are making offers, your partner can also make offers. **Both of you can make as many offers as you like without waiting for the other person to respond.** Your partner's offers will appear on the right side of your screen, with the most recent ones at the top, and the older ones at the bottom.

The computer will automatically display the profit that you will earn from each offer if you accept it.

During a round, you and your partner will be able to chat with each other via a chat window. You can see this chat window at the top of the screenshot above. You can send messages at any time, and can send as many messages as you like. However, we ask that you please observe the following rules:

- No threatening or abusive language
- No messages that reveal your identity, such as your name or your location in the lab.

Accepting an Offer

To accept an offer, highlight the offer by moving the mouse cursor over it, and then click on ACCEPT. The round will end immediately as soon as either you or your partner accepts an offer.

Making a Loss and Exhausting Your $7

You will never be compelled to make a loss. If you make a decision that puts you at risk of making a loss, the computer will warn you with a pop-up message and ask for confirmation. The pop-up window will have two buttons: "OK" and "CANCEL". Press **"OK" to accept to make a loss** or **"CANCEL" to revise your decision.** If you agree to make a loss up to $7, this loss will simply be subtracted from your participation fee of $7. If you agree to make a loss that is greater than your $7 participation fee for that round, your participation in the experiment for all subsequent rounds will be suspended, and you will earn nothing beyond your show-up fee of $3, which you will receive after the conclusion of all the rounds in the experiment.

Time Limits and Trading Reductions

Each bargaining round is split into 8 stages. Once the 8 stages are complete, the round is over, and if you and your partner failed to accept an offer, each of you earns no profit from trading in that round.

Stage 1 lasts 40 seconds, while each of stages 2 to 8 last 20 seconds. The top of the screen will indicate to you what stage you are in, and how much time is left until the end of the stage. Once a stage is complete, the next one will start immediately, until the last (8^{th}) stage is complete.

Offers do not expire and an offer made in one stage can be accepted in that stage or in any subsequent stage.

If you or your partner accept an offer during the first bargaining stage, your earnings for that round will be equal to the numbers shown on the screen.

If you or your partner accept an offer during the second bargaining stage or later, there will be a reduction on the profit that both players receive from trading (this reduction does not apply to the $7 participation fee, or the $3 show-up fee). This reduction will take the form of a percentage that will be deducted from your earnings and those of your partner. The table below specifies the reductions.

Bargaining stage	% of Your Earnings that You Lose
1	0%
2	10%
3	20%
4	30%
5	40%
6	50%
7	60%
8	70%
End of round	Round canceled for you and your partner (and you both earn no profit from trading)

For example, if it took until bargaining stage 2 for one of you to accept an offer, then each of you will lose 10% of your earnings.

Sequence of events

In each round, the sequence of decisions is as follows.

1. The computer randomly matches you with another trader.
2. You are randomly assigned your costs/values for the 4 units.
3. Bargaining commences; you and your partner are free to make offers, accept offers, and chat.
4. Bargaining continues until:

    a. one trader accepts an offer
    b. or 8 bargaining stages are concluded, which will suspend bargaining in that round
5. Earnings for that round are calculated, and a reduction may be applied depending on which bargaining stage the acceptance came in.
6. At the conclusion of the last real round, one of the 6 real rounds is selected at random and used to pay the participants.

Summary of Key Points

By way of providing a summary of the key points, we suggest that you return to the examples of page 6-7 and consider:

1. What information a buyer/seller will have in each round
2. What are possible combinations of costs and values for the four units
3. How, given a particular combination of traded units, a price determined in a certain bargaining stage, that may involve a reduction, determines the profit that a buyer and a seller will make

INSTRUCTIONS: FOUR GOODS, ONE BY ONE

Welcome and Introduction

Welcome to our study of decision making. If you read these instructions carefully and make good decisions, you can earn a considerable amount of money.

Kindly refrain from talking with other participants during the session. Also, it is an important requirement of this experiment that you **please turn your mobile phones to silent and abstain from using them during the experiment**.

By coming to this session, you have earned an attendance fee of $10. This has two components. A show up fee of $3 and a participation fee of $7. The participation fee is discussed further below.

The $10 attendance fee will be in addition to any amount that you earn based on your decisions. Once your earnings are determined you will be paid privately and your participation in this experiment will then be concluded.

If you have a question at any time, please raise your hand and I will approach you so that you can ask your question in private.

Setup

Today, we are going to set up a market in which some of you will be buyers and some of you will be sellers. In this market you will be given the opportunity to trade commodities. We will not specify names for these commodities; we will simply refer to them as "units".

Trading will occur in a sequence of trading rounds. The decisions that you make in each round will determine your earnings.

The experiment will consist of 10 rounds: 4 practice rounds followed by 6 real rounds.

The first 4 rounds will be practice and will not affect your earnings for the experiment.

The final 6 rounds will be real and will affect your earnings. At the end of the experiment, the computer will select one of the 6 real rounds at random and you will be paid based on your earnings in that round in cash.

Matching Rules

In every round, the computer will tell you whether you are a buyer or a seller for that round. During the practice rounds, you will experience both the role of a buyer as well as the role of a seller.

Once we have completed the practice rounds, you will be assigned the role of either buyer or seller and will remain in that role throughout the remainder of the session. You have a 50% chance of being a buyer, and a 50% chance of being a seller.

Each round, every buyer will be randomly matched with a seller. That means that each buyer is equally likely to be matched with each seller. The matching is independent every round, which means that being matched with a specific trader in one round has no effect on the likelihood of being matched with the same trader in a future round.

All matching is anonymous, meaning that you will never know the identity of whom you are matched with in any round.

Participation fee

At the start of each round, you will be given a $7 participation fee. Any positive earnings that you may make by trading one or more "units" will be added to this $7, whereas any negative earnings will be subtracted from this $7. If you do not end up trading one or more units, then you just keep your $7 participation fee.

Profit from trading

In each round, sellers and buyers will have the opportunity to exchange up to 4 units.

For each unit, sellers will be given a number known as their "cost" and buyers will be given a number known as their "value". The cost represents the minimum amount for which a seller can sell that unit without making a loss. The value represents the maximum amount for which a buyer can purchase that unit without making a loss.

Sellers and buyers exchange units in bundles that include 1 to 4 units, using individual price associated with each unit in the bundle.

Sellers earn money by selling a unit at a price that is above their cost. Seller earnings from the sale of a unit are the difference between the sale price and the cost. For example, if a seller has a cost of $100 and sells their unit for $140, the seller earns $140 – $100 = $40.

Buyers earn money by buying a unit at a price that is below their value. Buyer earnings from the purchase of a unit are the difference between the value and the purchase price. For example, if a buyer has a value of $150 and buys a unit for $100, the buyer earns $150 – $100 = $50.

If the seller and the buyer do not exchange a unit, they each earn a profit of $0 for that unit.

A trader's earnings on a bundle are equal to the total of the profits they earn on each unit in that bundle.

EXAMPLE:

Consider a case in which a seller and a buyer have the following costs and values for the 4 units:

	Unit 1	Unit 2	Unit 3	Unit 4
Seller's cost ($)	A	B	C	D
Buyer's value ($)	E	F	G	H

The seller's costs of units 1, 2, 3, and 4 are A, B, C, and D, respectively.

The buyer's values of units 1, 2, 3, and 4 are E, F, G, and H, respectively.

Assume that the buyer and seller agree to exchange a bundle that includes only Unit 2 for a price $X. Their profit is calculated as follows:

Seller's profit=X-B

Buyer's profit=F-X

Alternatively, assume that the buyer and seller agree to exchange a bundle that includes Unit 1 for a price $X and Unit 2 for a price $Y. Their profit is calculated as follows:

Seller's profit=(X-A)+(Y-B)

Buyer's profit=(E-X)+(F-Y)

The calculations are similar in the case of bundles that include 3 or 4 goods.

If a seller sells a unit at a price that is less than its cost, this seller will make a loss on that unit. If a buyer buys a unit at a price that is greater than its value, this buyer will make a loss on that unit. If you are at risk of making a loss, the computer will notify you and ask you to confirm.

How the seller's cost and the buyer's value of each of the 4 units are determined is described in the next section.

How are Costs and Values Determined?

For each seller-buyer pair, there is a fixed number of possibilities for the combination of costs and values that can occur for each of their four units:

		Seller's cost	Buyer's value
a.	For one of the four units:	$0	$10
b.	For one of the four units:	$0	$50
c.	For one of the four units:	$40	$10
d.	For one of the four units:	$40	$50

Each of these 4 possibilities, (a), (b), (c), and (d) above, MUST OCCUR EXACTLY ONCE in any round. The order with which they occur within a round is random, and each possibility regarding the order in which (a), (b), (c), and (d) occur is equally likely. Hence, knowing this order in one round tells you nothing about how it may manifest in any other round. A list of all the equally likely possibilities is provided at the end of this document.

Sellers are only informed of their cost for each unit, and buyers are only informed of their value for each unit, meaning that neither side knows about the other. So, for a given unit, a seller cannot distinguish between combinations (a) and (b) above, because the seller is given the same information in each case (cost of $0); or between (c) and (d) (cost of $40). Similarly, for a given unit, a buyer cannot distinguish between (a) and (c), because the buyer is given the same information (value of $10) or between (b) and (d) (value of $50).

In other words:

In any round, sellers will have two units each with cost $0 and two units each with cost $40. However, they will not know which of their two $0s meets a buyer's $10 and which meets a buyer's $50. Similarly, they will not know which of their two $40s meets a buyer's $10 and which meets a buyer's $50.

In any round, buyers will have two units each with value $50 and two units each with value $10. However, they will not know which of their two $50s meets a seller's $0 and which meets a seller's $40. Similarly, they will not know which of their two $10's meets a seller's $0 and which meets a seller's $40.

Naturally, you will never be compelled to either buy or sell any of your units. There will be a maximum of 8 bargaining stages to trade units. After these 8 stages, bargaining is suspended. If traders do not reach agreement on any units after 8 bargaining stages, then each trader only receives their $7 participation fee.

A screenshot below shows a trader discovering that they are a seller, and learning their costs:

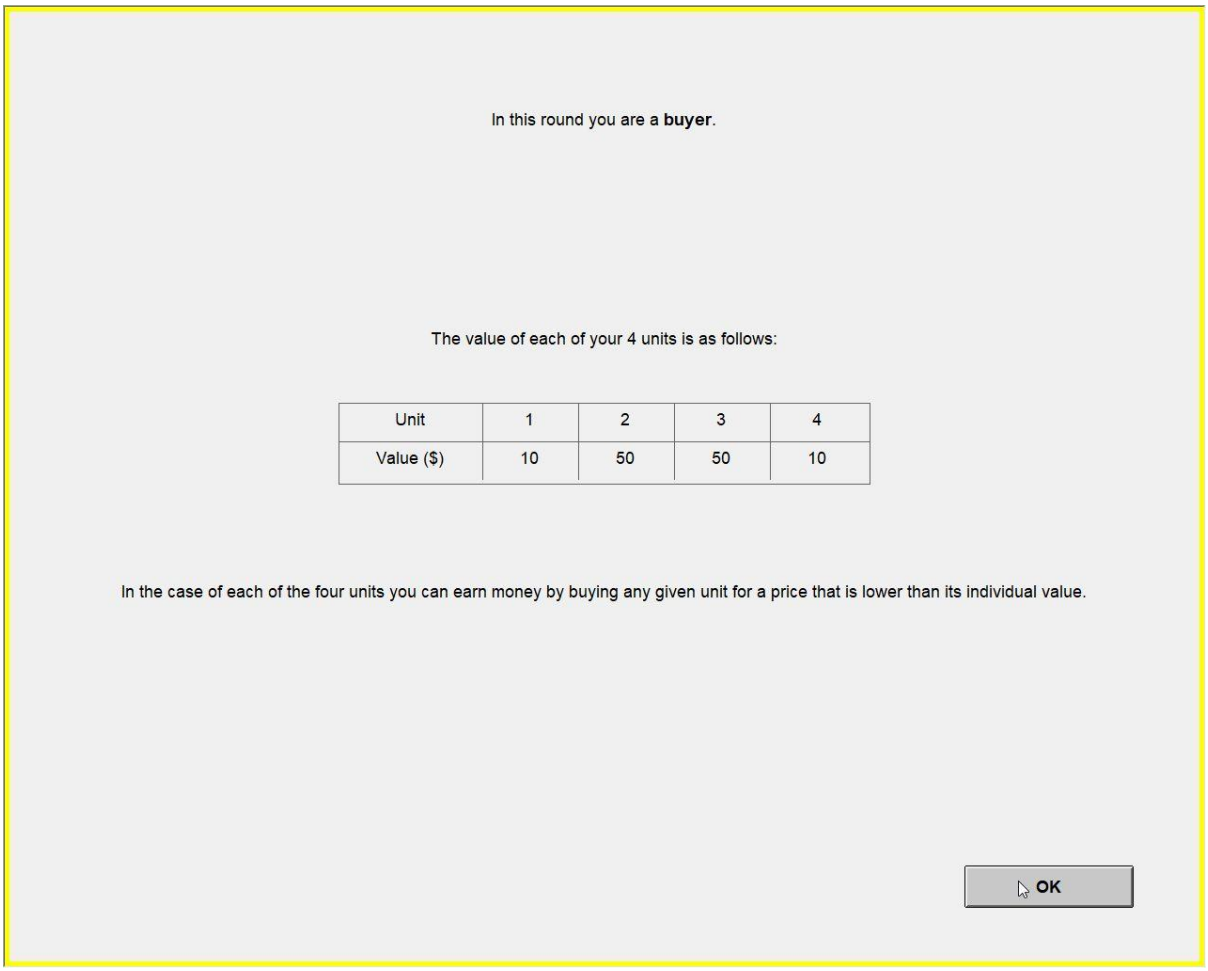
In this round you are a **seller**.

The cost of each of your 4 units is as follows:

Unit	1	2	3	4
Cost ($)	0	0	40	40

You can earn money by selling one or more of these units for a total price that is higher than their total cost.

A screenshot below shows a trader discovering that they are a buyer, and learning their values:



How Much Money Can You and Your Partner Make

When you and your partner are bargaining over 1 to 4 units, the total money that you can make between you from successfully trading that bundle of 1 to 4 units is equal to the buyer's total value of the traded units minus the seller's total cost of the traded units. This follows from the way in which buyer and seller profits are calculated.

To understand this, we will examine an example with one unit. Consider a buyer with value $50 and a seller with cost $40. If they agree on a price $43 then the buyer will make $50 - $43 = $7 and the seller $43 - $40 = $3. Together they make $7 + $3 = $10. Alternatively, they could agree on a price $48 and then the buyer will make $50 - $48 = $2 and the seller $48 - $40 = $8. Again, together they make $2 + $8 = $10. Clearly, the total profit is the difference between the cost and the value: $50 - $40 = $10. The trade price merely determines how the total profit of $10 is divided between the buyer and seller.

This example was for one unit. When dealing with 4 units, the same principle applies: the total money that you and your partner can make is the total of how much you can make from each unit.

Since in every round, each of the following 4 possibilities occurs exactly once, there is a **fixed maximum total amount of profit** that you and your partner can make every round, and it is equal to $70. To see why, consider the following table:

		Seller's cost	Buyer's value	Combined buyer and seller profit if traded	Combined buyer and seller profit if not traded
a.	For one of the four units:	$0	$10	$10 - $0 = $10	$0
b.	For one of the four units:	$0	$50	$50 - $0=$50	$0
c.	For one of the four units:	$40	$10	$10 - $40 = -$30	$0
d.	For one of the four units:	$40	$50	$50 - $40 = $10	$0

Hence, the **maximum** amount of combined buyer and seller earnings is $10 + $50 + $0 + $10 = $70.

Therefore, depending on the choices that you and your partner make in every round, you can together make a maximum of $70 between you.

Any amount that you and your partner make is shared between you on the basis of the trading agreement that you make with your partner, which is done according to the mechanism described in the next section.

Trading Mechanism

After being matched with another trader and seeing your costs/values, you will have the opportunity to trade with your partner in a sequence of 8 bargaining stages. Bargaining stages consist of you and your partner making offers of trading prices for 1 to 4 units. The computer will select one of you at random to make the first offer to their partner.

If the first offer for any unit(s) is accepted, bargaining for those units is over.

If the first offer is rejected, the other trader has the opportunity to make a counter-offer.

This alternating process continues until the two traders reach agreement on all 4 units or until 8 bargaining stages are concluded, whichever occurs first.

If your partner makes you an offer, for each of the individual units that are included in the offer, you can either accept it or you can reject it and counter-offer.

If you are randomly selected to make an offer in the first bargaining stage, you will have 30 seconds to complete your offer and submit it to your partner.

If you do not submit an offer within this 30 second window, bargaining advances to the next stage, and the right to make an offer is given to your partner.

If you are randomly selected to respond to an offer in the first bargaining stage, you will have 10 seconds to accept or reject your partner's offer.

If you accept their offer on all 4 units, bargaining ends.

If you reject their offer on at least 1 of the units, then you are given the opportunity to make a counter-offer.

If you do not respond to your partner (accept or reject their offer) within this 10 second window, your inaction counts as a rejection but you are not given the right to make a counter-offer. Instead, bargaining advances to the next stage, and the right to make an offer reverts to your partner.

The procedure that we describe above for bargaining stage 1 works the same way for all subsequent bargaining stages (stages 2-8) but with one key difference. As we note above, in stage 1 a proposer is given 30 seconds and a responder is given 10 seconds. By contrast, in stages 2-8 a proposer is given 15 seconds and a responder is given 5 seconds.

If a given pair of seller and buyer do not reach agreement on at least one "unit" after 8 bargaining stages, bargaining is suspended. In this case each trader only receives their $7 participation fee.

Offer Structure

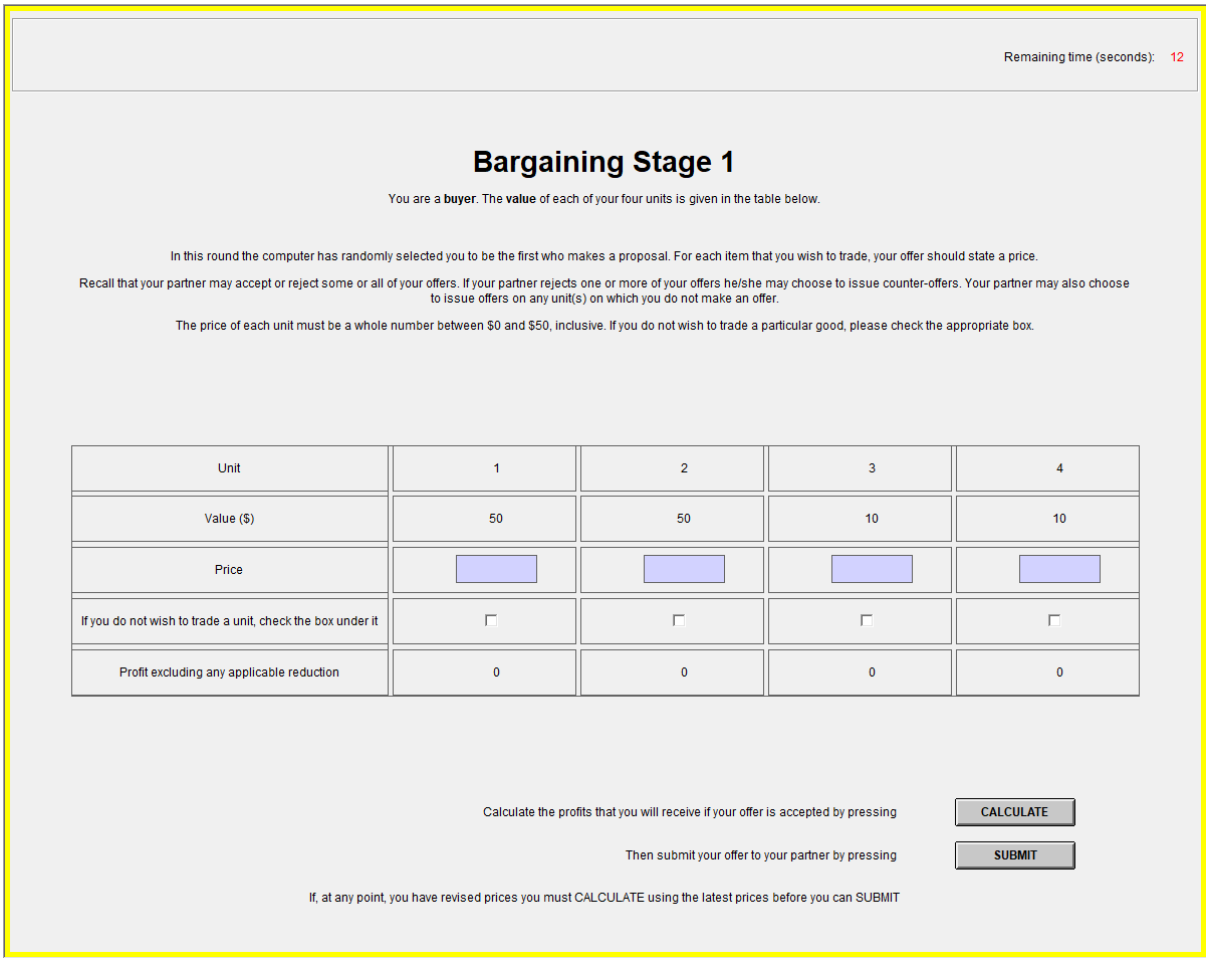
Each offer has two components:

5. A list of the units included in the offer; an offer must contain at least 1 unit, and at most 4 units.

6. A separate price for each unit included in the offer.

To make an offer, enter the price for each unit you wish to trade. If you do not wish to trade a unit, you must check the box that is under the price entry box.

The screenshot below shows you a buyer considering what offer to make:

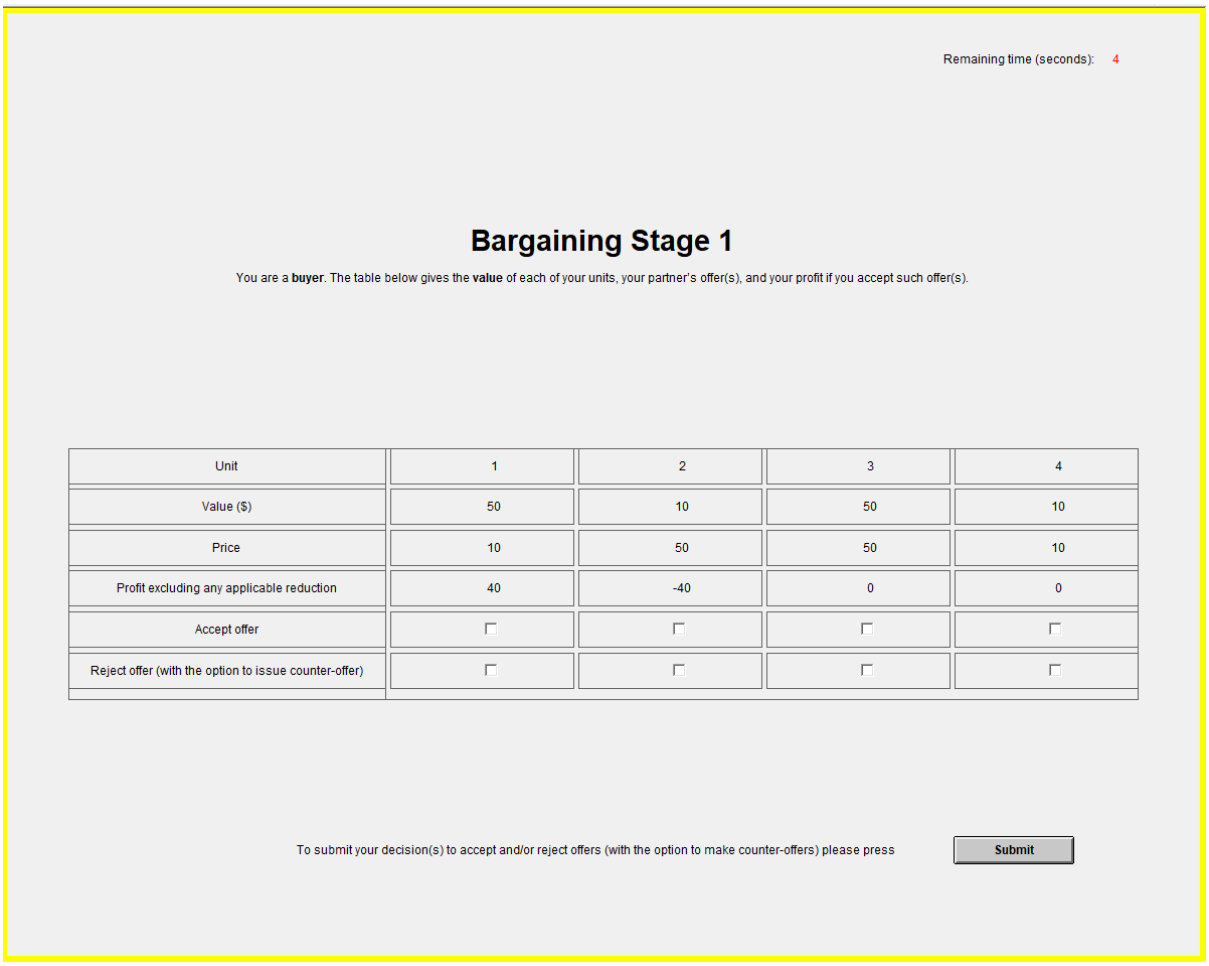


Once you have finished composing your offer, press the CALCULATE button to calculate how much profit you will make if your offer is accepted and then press the SUBMIT button to submit the offer to your trading partner.

Accepting an Offer

Your partner will make you offers consisting of 1 to 4 units each with a separate price, and an offer to not trade the remaining units. You can consider each part of the offer separately.

To accept an offer for an individual unit, check the "ACCEPT OFFER" box underneath it. To reject an offer for an individual unit, check the "REJECT OFFER" box underneath it. You can see both in the screenshot below.



Once you accept an offer for an individual unit, you and your partner can no longer make offers relating to that unit. Bargaining will only continue for the units where you and your partner have yet to accept an offer.

Making a Loss and Exhausting Your $7

You will never be compelled to make a loss. If you make a decision that puts you at risk of making a loss, the computer will warn you with a pop-up message and ask for confirmation. The pop-up window will have two buttons: "OK" and "CANCEL". Press **"OK" to accept to make a loss** or **"CANCEL" to revise your decision.** If you agree to make a loss up to $7, this loss will simply be subtracted from your participation fee of $7. If you agree to make a loss that is greater than your $7 participation fee for that round, your participation in the experiment for all subsequent rounds will be suspended, and you will earn nothing beyond your show-up fee of $3, which you will receive after the conclusion of all the rounds in the experiment.

Time Limits and Trading Reductions

Each bargaining round is split into 8 stages. Once the 8 stages are complete, the round is over, and if you and your partner failed to accept an offer on at least one of the units, each of you earns no profit from trading in that round.

Stage 1 lasts 40 seconds, while each of stages 2 to 8 last 20 seconds. The top of the screen will indicate to you what stage you are in, and how much time is left until the end of the stage. Once a stage is complete, the next one will start immediately, until the last (8^{th}) stage is complete.

If you or your partner accept an offer for a unit during the first bargaining stage, your earnings for that unit for that round will be equal to the numbers shown on the screen.

If you or your partner accept an offer for a unit during the second bargaining stage or later, there will be a reduction on the profit that both players receive from trading for that unit (this reduction does not apply to the $7 participation fee, or the $3 show-up fee). This reduction will take the form of a percentage that will be deducted from your earnings for that unit and those of your partner. The table below specifies the reductions.

Bargaining stage	% of Your Earnings that You Lose on that Unit
1	0%
2	10%
3	20%
4	30%
5	40%
6	50%
7	60%
8	70%
End of round	Round canceled for you and your partner (and you both earn no profit from trading that unit)

For example, if it took until bargaining stage 2 for one of you to accept an offer for a unit, then each of you will lose 10% of your earnings for that unit.

Sequence of events

In each round, the sequence of decisions is as follows.

1. The computer randomly matches you with another trader.
2. You are randomly assigned your costs/values for the 4 units.
3. The computer randomly selects one member of each pair of traders to make the first offer.
4. That trader makes an offer for anywhere from 1 to 4 of the units.
5. The other trader can accept or reject each of the 1 to 4 offers.
6. If the trader rejects an offer relating to a unit, it becomes that trader's turn to make an offer for that unit. Of course, if a trader does not make an offer on a given unit, then their partner will also have the opportunity to make an offer that unit.
7. The opportunity to make an offer keeps alternating until:
    a. For each of the 4 units, one trader accepts an offer
    b. or 8 bargaining stages are concluded, which will suspend bargaining in that round for any units that have not yet been traded
8. Earnings for that round are calculated, and a reduction may be applied to earnings on individual units depending on which bargaining stage the acceptance came in.
9. At the conclusion of the last real round, one of the 6 real rounds is selected at random and used to pay the participants.