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An Experiment to Summarize the Principles of Microeconomics

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AN EXPERIMENT TO SUMMARIZE THE PRINCIPLES OF MICROECONOMICS

by

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ABSTRACT

I present a classroom experiment designed to help students learn (1) decision-making using marginal analysis; (2) the prediction of the price; (3) the decentralized determination of a price U6he dargket (3435a ralde;]TJT*[pand(36) the dabilty of ra cloapetitverdargketto hcreat da Pa

1. INTRODUCTION

Experiments are now recognized as being a useful tool to assist students learn the material presented in the classroom: the benefit is confirmed by Gremmen and Potters (1997). It is supposed that this learning advantage comes about because the experiments integrate class material with the student's own experience. I present below two linked experiments which I use in my classes to help students master six important ideas taught in an undergraduate class in microeconomic principles, viz. (1) decision-making using marginal analysis; (2) the prediction of the price; (3) the decentralized determination of a price by the market; (4) specialization; (5) the gains from trade; and (6) the ability of a competitive market to create a Pareto-efficient outcome.

There is an interesting history behind the use of market-based experiments in teaching.[1] Chamberlin's (1948) market experiment is generally considered the first laboratory experiment in economics. In Chamberlin's setting, students are divided between buyers and sellers; each buyer is dealt a card marked with a value and each seller is dealt a card marked with a cost. Students are encouraged to trade. Each buyer may buy one unit: if he buys, he earns the difference between the value he was dealt and the contract price he negotiates. Similarly, each seller may sell up to one unit: if she sells, she earns the difference between the contract price and the cost she was dealt. Because different buyers receive different values, a market demand curve may be constructed by ranking individual buyer values from highest to lowest; the market demand at a given price is the number of buyers with a value at or above the given price. Similarly, because sellers receive different costs, a market supply schedule may be constructed by ranking individual seller costs from lowest to highest, and the market supply at any given price is the number of sellers with a cost at or below the given price. The competitive price and quantity occurs at the intersection of the constructed market demand and supply curves. In Chamberlin's set-up, the market has little structure: students roam the classroom seeking a trading partner, form pairs and then bargain over a bilateral trade.[2] In Chamberlin's structure, each buyer knows only his own value and each seller knows only his own cost, so that it is not possible for either party to calculate "the equilibrium price". In addition, the experiment lasts only 10 minutes with each buyer or seller dropping out when he achieves a trade: buyers and sellers therefore have little opportunity to gain experience. Chamberlin noted that the quantity exchanged in the experiment tended to exceed the competitive quantity. He attributed this to the decentralized nature of trading. A buyer with a high value may meet a seller with a cost which is less than the buyer's value but which exceeds the "competitive price." They may negotiate a contract although this trade is not predicted at the competitive outcome. Overall, Chamberlin felt that his experiment failed to confirm the market outcome and he used the experiment to motivate his graduate course in monopolistic competition.

One of the graduate students participating in Chamberlin's experiment was Vernon Smith. Starting teaching in 1955, Smith

> "taught Principles of Economics, and found it a challenge to convey basic microeconomic theory to students. Why/how could any market approximate a competitive equilibrium? I resolved that on the first day of class the following semester, I would try running a market experiment that would give the students an opportunity to experience an actual market, and me the opportunity to observe one."[3]

or Smith’s design in which students start with different values and costs is inappropriate, as the design favors a buyer being dealt a high value or a seller receiving a low cost. In my experiment there are three goods (“clothes”, “food” and “housing”) in addition to the numeraire, and each student is assigned one of three symmetrical technologies. A student with Technology A can manufacture “clothes” at a cost of 1 (unit of numeraire per unit of clothes), can manufacture “food” at a cost of 2 (units of numeraire per unit of food) and can manufacture “housing” at a cost of 3 (units of numeraire per unit of housing). Similarly, a student with Technology B can manufacture “food” at a cost of 1, “housing” at a cost of 2 and “clothes” at a cost of 3; and a student with Technology C can manufacture “housing” at a cost of 1, “clothes” at a cost of 2 and “food” at a cost of 3. Because of the symmetry, each student faces similar opportunities. Trade is induced because a student who can manufacture one good at low cost finds it advantageous to trade with a student who can manufacture another good at low cost. Second, it is important that the experiment is given *after* the relevant theory has been discussed in class, so that a student feels that his/her performance is related to his/her mastery of the material presented in the classroom. This aspect means that the experiment should be used to validate the theory and not to motivate the theory. For similar reasons, I use the de-brief following the completion of the experiment to discuss how the student could have used the theory presented in class to his/her advantage. In doing so, I stress the usefulness of theoretical models to make predictions.

experimental design and the other objective is to provide an example of marginal analysis. In the Second Experiment, students can trade with each other in addition to producing goods: this part focuses on the competitive market. The innovation of the experiment as a teaching tool is its comprehensiveness: the students make consumption and production decisions.

The First Experiment is done by the students outside the classroom as assigned homework. The Second Experiment requires that students interact with each other, and this is facilitated by putting aside 90 minutes of classtime: at the end of this time, no student has indicated a wish to continue to seek trades. I have held the experiment in class sizes from 20 to 200 students. Although the experiment is designed for an introductory class in microeconomic principles, I also use the experiment in my intermediate microeconomic theory class and I have used it in my MA class: as I move to more advanced courses, there tends to be less variance in behavior and the outcomes more closely resemble the competitive outcome.[8]

This paper is organized as follows. Section 2 describes the First Experiment and Section 3 describes the Second Experiment. In each section I illustrate the experiment by showing the results from my Principles of Microeconomics class in Fall 2005 (180 students participating in the First Experiment and 184 students participating in the Second Experiment), and provide a discussion. Section 4 concludes.

2. FIRST EXPERIMENT: MARGINAL ANALYSIS

2.1 Description of experiment

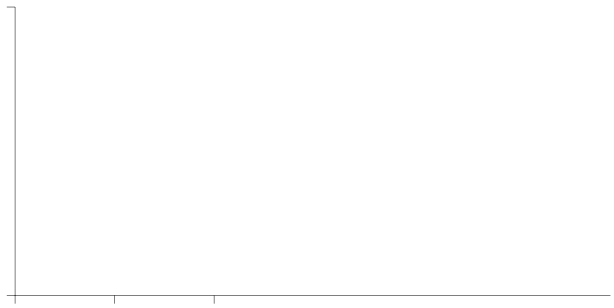
The formal instructions for the First Experiment are attached as Appendix A. Each student is given 100 units of "resources" which can be used to manufacture four goods, termed “clothes”, “food,” “housing” and “other things.”[9] In the Second Experiment, trade is induced by assigning different manufacturing technologies to different students. In order for the basic structure to be the same across experiments (enabling the gains from trade to be readily apparent) and for students to familiarize themselves with the technologies, the three technologies are introduced in the First Experiment. Table 1 describes the amount of "resources" which must be used to produce one unit of each type of good using each technology:

		Units of “resources” used to manufacture 1 unit of output using technology:		
		A	B	C
Output	clothes	1	3	2
	food	2	1	3
	housing	3	2	1
	“other things”	1	1	1

Table 1: the three technologies

2.2 Results

The highest possible score is 3.3. The actual distribution of scores for the First Experiment is shown in Chart 1.



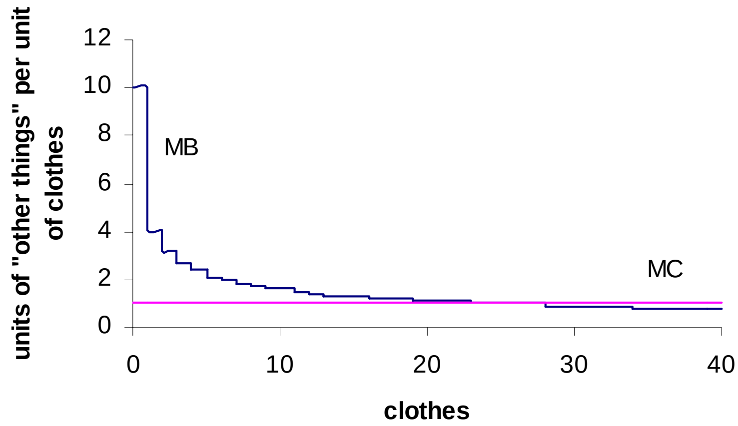


Figure 1: marginal benefit/marginal cost analysis

In the class de-brief, all students confirmed that they were choosing the quantities of clothes, food, housing and “other things” in order to maximize their total score, and that they realized that maximizing their total score is equivalent to maximizing their total benefit TB. For ease of presentation, I consider a student with Technology *A*. The student starts with 100 units of "resources" and 0 units of clothes, food, housing and "other things"; she must decide how many units of clothes to manufacture. Marginal analysis stresses that she does this by steadily increasing her production provided marginal benefit exceeds marginal cost. The marginal benefit

require that each student use her subject number in the First Experiment. I post a list with subject numbers and technologies on the course web-page as:

Student Name	Subject #	Technology
Adam Ainsel	1	A
Beatrice Bethoud	2	B
Charles Clarence	3	C
David Dolittle	4	A
Edward Englewert	5	B
Francine Frank	6	C
Georgina Grasington	7	A
...	...	...

5. For 20% of students, the score as calculated by the student in his Production Plan which he hands in differs from the score I calculate using his chosen quantities of clothes, food and housing. Therefore, because this is part the student's class grade, I calculate each

[redacted] EXPERIMENT: TRADE

[redacted] .1 *Description*

[redacted] cond Experiment are attached as Appendix B. As in the [redacted] 100 units of "resources" and each student has the same [redacted] ent. The difference between the experiments is that in [redacted] ed to trade. The incentive to trade arises because each [redacted] ity cost exceeding unity (units of resources per unit of [redacted] dent can access technologies where these good are [redacted] urces per unit of good). Similar to Chamberlin's [redacted] sroom seeking buyers and sellers, and prices are not [redacted]

[redacted] TB from her consumption of clothes, food, housing [redacted] s in the First Experiment (Equation (1)). In order to [redacted] he student's grade becoming excessive, a ceiling as [redacted] score S_2 in the Second Experiment is calculated [redacted]

[redacted] ;

Note that, in the calculation of the student's score, in the Second Experiment 138 is subtracted from *TB* whereas in the First Experiment 126 is subtracted: this is done to better balance the influence of the two scores in the contribution to the student's grade.

3.2 Results

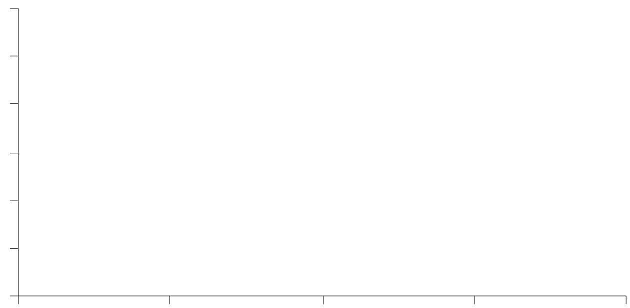
Under perfect competition, students with the least cost technology supply unlimited amounts at any price exceeding unity (units of resources per unit of good) , or the supply curve *S* for each good is perfectly elastic at a price of unity. The competitive equilibrium price is therefore unity. At the unit price, students consume between 23 and 28 units of clothes, food and housing. Students manufacturing goods make no profits and hence consume between 31 and 16 units of "other things". Hence, under perfect competition, each student would obtain a score of $S_2 = 6.2$. In fact, actual trades occur at various prices and students achieve lower or higher scores. The distribution of scores is shown in Chart 2.

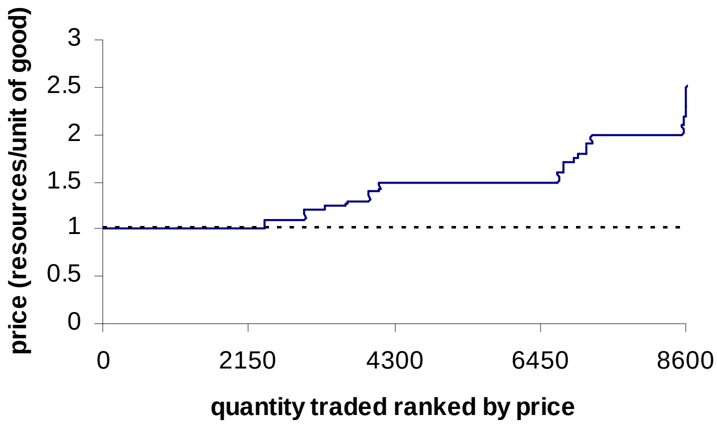
The median score is 4.6 but that there is considerable variation around the median. 18% of students actually achieved a lower Total Benefit in the Second Experiment than in the First Experiment.

3.3 Discussion

3.3.1 The power of prediction

Students often ask: “How can I know whether to buy or sell at the start of the experiment?” In the de-brief a student is usually able to tell me that he would have known what to do if he had known what the price is likely to settle at - he would “sell high” or sell aggressively to any student willing to buy at a price exceeding his marginal cost and he would “buy low” or buy from any student willing to sell at a price equal or below the predicted future





Mean price: 1.4 ; Median Price: 1.5 ; Standard Deviation: 0.37.

Chart 3: distribution of actual prices

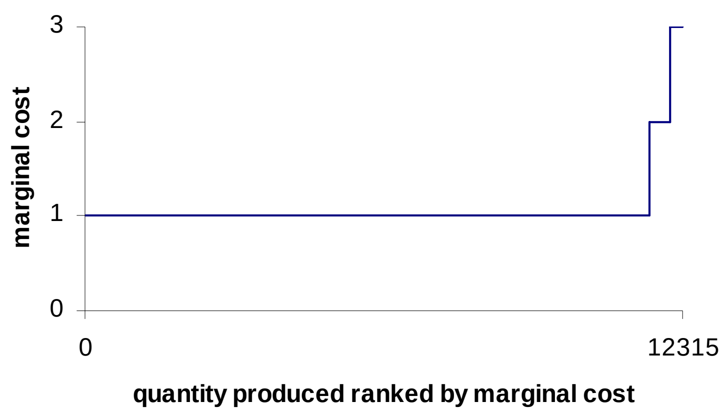
27% of the product traded is traded at the competitive price of unity. 75% of all trades are made at a price between 1 and 1.5. Casual observation suggests that most of the high-priced trades are made early on the first day and that the price "settles" at unity by the end of the experiment. I stress to students that most trades being made at a price exceeding the competitive price does not invalidate the prediction *per se*: the competitive model is an approximation. And it does predict what happens when the market "settles down" - approximately midway through the second class put aside for trading.

3.3.2 How price is determined in a market

At the end of the experiment, trades are being made at a price of unity. In the de-brief I ask students to reflect on how this price is not established by anybody but by everybody, or by the twin forces of demand and supply.

3.3.3 Specialization

Competitive theory predicts that specialization occurs with each good being made by the firms or individuals with the least cost technology. The least cost method of producing clothes, food or housing involves the use of 1 unit of resources per unit of output. This involves clothes being manufactured by students with Technology *A*, food being manufactured by students with Technology *B* and housing being manufactured by students with Technology *C*. Chart 4 shows that 95% of production is carried out at least cost.



Mean cost: 1.08; Median Cost: 1.00; Standard Deviation: 0.33

Chart 4: product specialization

3.3.4 The gains from trade:

Another important idea in the Principles of Microeconomics is the gains from trade: trade enables individuals to increase their well-being by being able to access product at a cost which is lower than that at which they could produce it.

Predicted Total Benefit	- with trade allowed:	175
	- with no trade allowed:	145.8
Predicted gain from trade:		29.2
Average of actual Total Benefits	- with trade allowed:	158.9
	- with no trade allowed:	138.6
Average actual gain from trade:		20.3
Standard deviation of actual gains:		28.4

Table 2: gains from trade.

Table 2 shows the gains from trade by comparing the Total Benefit obtained in the Second Experiment (trade allowed) with the Total Benefit obtained in the First Experiment (no trade allowed). There is a large increase in the students' predicted and actual Total Benefit as a consequence of trade.

3.3.5 The ability of the competitive market to create a Pareto-efficient outcome.

Probably the most important idea in a Principles of Microeconomics class is that of Adam Smith's Invisible Hand. At the Pareto-efficient outcome there is specialization in production with each good being manufactured by the individuals who have the technology with least cost. The output is distributed so that each individual consumes between 23 and 28 units of clothes, food and housing. Therefore, at the Pareto-efficient outcome between 69 and 84 units of clothes, food and housing are produced per subject. Units not consumed are exchanged, or between 46 and 56 units are traded per subject.[16] Table 3 shows that the actual quantities manufactured and the actual quantities traded are approximately the efficient quantities. In consequence, although the actual level of surplus gained is less than the efficient level, a large part of the potential surplus is gained.

Production: units of clothes, food and housing manufactured per subject:

students how the slips and log are completed for a fictional sequence of transactions, using production slips, trade slips and the log which have been copied onto transparencies for overhead projection. E.g. “I have subject number 250 and Technology A. I manufacture 10 units of food. I meet subject number 420 and agree to buy 17 units of clothes at a price of 1.3 (units of resources per unit of clothes). I meet subject number 370 and agree to sell 5 units of food at a price of 2.1 (units of resources per unit of food). I manufacture 5 units of housing. I meet subject 372 and agree to buy 13 units of housing at a price of 1.6 (units of resources per unit of housing).” After reading each transaction I and that any student who has mislaid his subject number must see me. I also bring in a large quantity of production slips, trade slips and extra logs.

6. Many students make mistakes in recording their logs. I therefore recreate the production and trade flows by entering the data from the production and trade slips into a spreadsheet. First I sort the production and trade slips into separate piles, and number them so that if a student queries a transaction I can readily find it. I then enter the data into a spreadsheet as:

PRODUCTION					
(1) Transaction #	(2) Subject #	(3) Technology	(4) Quantity Produced	(5) Product Type	
1	17	B	18	F	
2	4	A	9	C	
3	23	B	12	H	
...	...	...	...	...	
TRADE					
(1) Transaction #	(2) Seller #	(3) Buyer #	(4) Quantity Exchanged	(5) Product Type	(6) Price
1	17	4	8	F	1.6
2	23	17	4	H	1.7
3	4	17	4	C	1.3
...	..	...	...	...	...

I copy the trade date, interchanging Columns (2) and (3) so that Column (2) now lists the buyer and Column (3) now lists the seller, and paste below the original trade data as:

PRODUCTION					
(1) Transaction #	(2) Subject #	(3) Technology	(4) Quantity Produced	(5) Product Type	(6) Cost (per unit)
1	17	B	18	F	1
2	4	A	9	C	1
3	23	B	12	H	2
...	...	...	...	...	
TRADE					
(1) Transaction #	(2) Seller #	(3) Buyer #	(4) Quantity sold	(5) Product Type	(6) Price (per unit)
1	17	4	8	F	1.6
2	23	17	4	H	1.7
3	4	17	4	C	1.3
...	..	...	...	...	...
(1) Transaction #	(2) Buyer #	(3) Seller #	(4) Quantity bought	(5) Product Type	(6) Price (per unit)
1	4	17	8	F	1.6
2	17	23	4	H	1.7
3	17	4	4	C	1.3
...	...	...	...	...	...

Using the spreadsheet above, I create the spreadsheet below. In particular, quantity (Column (5)) is either quantity sold pre-multiplied by -1 (to reflect that a sale lowers the quantity owned of the good) or quantity produced or quantity bought. The resource change (Column (8)) is calculated as:

- quantity x price/cost

where the negative sign is introduced because a sale is associated with the gain of resources and production or a purchase is associated with the loss of resources.

[redacted]

[redacted]

[redacted] 24 ... ...

numbers are entered in a new spreadsheet to facilitate the calculation of the total benefit and the score for each subject.[17]

Subject #	clothes	food	housing	other	total	score
4	5	8	0	83.4	134.1	0
...	...	...	...	...	...	...
17	4	10	4	82.8	154.4	2.7
...	...	...	...	...	...	...
23	0	0	8	82.8	111.1	0
...	...	...	...	...	...	...

7. It typically takes me (or my Teaching Assistant) 15 hours to complete the spreadsheet for the Second Experiment with 200 students (it is much quicker for fewer students).

4. CONCLUSION

I use two linked experiments to illustrate six important principles of microeconomics. I find that students enjoy the experiments and the feedback I receive confirms that they are a useful learning experience. The experiments differ from other class experiments in their comprehensiveness.

APPENDIX A

FIRST EXPERIMENT: INSTRUCTIONS FOR STUDENTS WITH TECHNOLOGY A[18]

These instructions are for students with Technology A. If you have Technology B or C, please read the correct instructions.

This is an experiment in economic decision-making. The instructions are simple and, if you follow them carefully, you may earn points towards your grade.

Out of the 100 possible points used to calculate your final grade, 90 points come from your scores in the midterm and final exams, and 10 points come from your scores in this experiment and in the next experiment. You cannot earn a negative score in this experiment, and hence participating in the experiment cannot cause your score to be lower than if you do not participate.

Your "total benefit" *TB* depends on the goods you own as

EXAMPLES OF CALCULATING THE CONTRIBUTION TO YOUR GRADE

EXAMPLE 1: Your production is:

Clothes:	15	units
Food:	23	units
Housing:	9	units

To produce these outputs, you use up (15x1) + (23x2) + (9x3) = 88 "resources". Therefore, you have remaining 100-88 = 12 "resources" which you use to produce 12 “other things”.

TB is calculated as

$$TB \ = \ 10\sqrt{15} \ + \ 10\sqrt{23} \ + \ 10\sqrt{9} \ + \ 12 \ = \ 128.7 \,.$$

Your score is

$$\frac{1}{6} \qquad\qquad\qquad\qquad .$$

APPENDIX: VALUES OF x AND $10\sqrt{x}$[19]

x:	$10\sqrt{x}$
1	10.0
2	14.1
3	17.3
4	20.0
5	22.4
6	24.5
7	26.5
8	28.3
9	30.0
10	31.6
11	33.2
12	34.7
13	36.1
14	37.4
15	38.7
16	40.0
17	41.2
18	42.4
19	43.6
20	44.7
21	45.8
22	46.9
23	48.0
24	49.0
25	50.0
26	51.0
27	52.0
28	53.0
29	53.9
30	54.8
31	55.7
32	56.6
33	57.5
34	58.4
35	59.2
36	60.0
37	60.8
38	61.6
39	62.4
40	63.2

PRODUCTION PLAN: TO BE HANDED IN

SUBJECT #: ________________

TECHNOLOGY: ________________

Name: ________________

My production plan is:

Clothes : ____ units.

Food : ____ units.

Housing : ____ units.

I am using the "resources" left over after the manufacture of the above quantities of clothes, food and housing to manufacture "other things".

I calculate my "total benefit" as: _____ .

I calculate my score in this experiment as: _____ .

APPENDIX B

SECOND EXPERIMENT: INSTRUCTIONS FOR STUDENTS WITH TECHNOLOGY A[20]

Your subject number and technology for this experiment are the same as the ones assigned to you for the First Experiment. They are shown on the course web-page, or you can get them by asking the instructor.

The instructions shown below are for students with Technology A. If you have Technology B or C, please read the correct instructions.

When recording production or trades, you must use your subject number which has been assigned to you: using a number which has not been assigned to you could affect the score of another student.

This is an experiment in economic decision-making. The instructions are simple and, if you follow them carefully, you can earn points towards your grade.

Out of the 100 possible points used to calculate your final grade, 90 points come from your scores in the midterm and final exams, and 10 points come from your scores in the last experiment and from this experiment. Note that it is possible for your total score from the two experiments to exceed 10, e.g., you could score 3.3 in the first experiment and 8 in the second experiment making your total score from both experiment as 11.3 out of 10. You cannot earn a negative score in this experiment, and hence participating in the experiment cannot cause your score to be lower than if you do not participate.

Your "total benefit" *TB* depends on the goods you own as

[redacted]

You start with 100 units of "resources". You can acquire clothes, food, housing and "other things" by manufacture, or by trade with somebody else.

Manufacture

is a signed production slip. The official record of a trade is a trade slip signed by both you and the student with whom you trade. I will calculate your score using only official records.

A log is provided at the end of these instructions to help you keep track of your decisions. Some production and trade slips are attached: please see the instructor if you need more

Class-time on ____________________ and ____________________ is put aside for you to trade. Production and trade slips completed during these sessions should be handed in during these sessions. At the start of class on ____________________ you must return your Final Outcome sheet giving your final ownership of clothes, food, housing, and "resources". At the same time all outstanding production and trade slips must be handed in.

HOW TO RECORD A PRODUCTION DECISION

A sample production slip looks like:

PRODUCTION SLIP: SUBJECT USING TECHNOLOGY A
Subject # (1)________ manufactures (2)_____ units of (3)___________.
Signature: (4)__________________.

You record the manufacture of clothes, food or housing by completing the spaces on the production slip as:

(1) write your subject number.
(2) write the number of units manufactured.
(3) write the product (i.e., clothes, food or housing) manufactured.
(4) write your signature.

If a production slip is completed in a class trading session, it is to be handed to the instructor at the end of the session. Otherwise it is to be handed in when the Final Outcome sheet is handed in.

To keep track of your decisions, you should update your log.

EXAMPLE OF PRODUCTION:

Your subject number is 450 and the last entry in your log looks like:

HOW TO RECORD A TRADE

A sample trade slip appears as:

TRADE SLIP
Subject # (1)________ sells to Subject (2)________
(3)_____ units of (4)___________
at a price of (5)_____ (units of "resources" per unit of good sold)
Signature of seller: (6)________________ Signature of buyer: (7)________________

A trade is recorded when both buyer and seller complete the spaces on the same trade slip as:

(1) write the subject number of the seller of the clothes, food or housing.
(2) write the subject number of the buyer of the clothes, food or housing.
(3) write the number of units of clothes, food or housing sold.
(4) write the goods (i.e., clothes, food or housing) sold.
(5) write the agreed price (units of "resources" per unit of good sold).
(6) write the seller's signature.
(7) write the buyer's signature.

If a trade slip is completed in a class trading session, it should be handed to the instructor at the end of the session. Otherwise it is to be handed in when the Final Outcome sheet is handed in.

Note: only one trade slip is handed-in for each transaction. The seller and the buyer do NOT each complete a separate trade slip.

Note: the price recorded in (5) is the price *per unit* sold and NOT the total resources transferred.

To keep track of your decisions, you should update your log.

EXAMPLE OF BUYING:

Your subject number is 450 and the last entry in your log looks like:

					Holding after action			
					Clothes	*Food*	*Housing*	*"Resources*
.....								
13.	*Sell*	4	*housing*	for *7* "resources"	*10*	*15*	*10*	*71*

You agree to buy 6 units of clothes from Subject 125 at a price of 1.4 (units of

EXAMPLES OF CALCULATING YOUR SCORE

EXAMPLE 1:The last entry in your log looks like:

	Action	Holding after action Clothes	Food	Housing	"Resources"
....					
14.	*Buy* *6* *clothes* for *8.4* "resources"	*16*	*15*	*10*	*62.6*

You use the remaining 62.6 resources to manufacture 62.6 "other things." Your "total benefit" *TB* is calculated as

$$TB \; = \; 10\sqrt{16} \; + \; 10\sqrt{15} \; + \; 10\sqrt{10} \; + \; 62.6 \; = \; 172.9$$

Your score is

$$\frac{1}{6}(172.9 - 138) \; = \; 5.8$$

EXAMPLE 2: The last entry in your log looks like:

	Action	Holding after action Clothes	Food	Housing	"Resources"
......					
16.	*Sell* *8* *housing* for *13* "resources"	*3*	*21*	*20*	*21.6*

You use the remaining 21.6 resources to manufacture 21.6 "other things." Your "total benefit" *TB* is calculated as

$$TB \; = \; 10\sqrt{3} \; + \; 10$$

FINAL OUTCOME: TO BE HANDED IN

SUBJECT #: ________________

Name: ________________

Student I.D. #: ________________

I calculate my final outcome as:

Clothes	:	____	units.
Food	:	____	units.
Housing	:	____	units.

I am using any “resources” left over after my manufacturing and trading decisions to manufacture “other things”. I calculate my final amount of “other things” as:

“Other things” : ____ units.

I calculate my "total benefit" as: _____ .

I calculate my score in this experiment as: ____ .

APPENDIX: VALUES OF x AND $10\sqrt{x}$[21]

x:	$10\sqrt{x}$
1	10.0
2	14.1
3	17.3
4	20.0
5	22.4
6	24.5
7	26.5
8	28.3
9	30.0
10	31.6
11	33.2
12	34.7
13	36.1
14	37.4
15	38.7
16	40.0
17	41.2
18	42.4
19	43.6
20	44.7
21	45.8
22	46.9
23	48.0
24	49.0
25	50.0
26	51.0
27	52.0
28	53.0
29	53.9
30	54.8
31	55.7
32	56.6
33	57.5
34	58.4
35	59.2
36	60.0
37	60.8
38	61.6
39	62.4

LOG

	Action	*Holding after action*			
		Clothes	*Food*	*Housing*	*"Resources"*
	START	0	0	0	100
1.	___________ ______ ______ for _____ "resources"	______	______	______	________
2.	___________ ______ ______ for _____ "resources"	______	______	______	________
3.	___________ ______ ______ for _____ "resources"	______	______	______	________
4.	___________ ______ ______ for _____ "resources"	______	______	______	________
5.	___________ ______ ______ for _____ "resources"	______	______	______	________
6.	___________ ______ ______ for _____ "resources"	______	______	______	________

EXAMPLE OF PRODUCTION SLIP

PRODUCTION SLIP: SUBJECT USING TECHNOLOGY A

Subject # (1)________ manufactures (2)_____ units of (3)__________.

Signature: (4)_________________.

EXAMPLE OF TRADE SLIP

TRADE SLIP

Subject # (1)________ sells to Subject (2)________

(3)_____ units of (4)__________

at a price of (5)_____ (units of "resources" per unit of good sold)

Signature of seller: (6)_______________ Signature of buyer: (7)_______________

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1. In addition to Chamberlin (1948) and Smith (1962, 1964), Joseph (1965) and Joseph and Saunders (1970) report a class experiment which is similar to Chamberlin's design.

10. Note that the objective is linear and separable in *x* (the numeraire) and so an analysis based on consumer and producer surplus is appropriate.

11. The values of are rounded to one decimal and, in order to be consistent with the

17. If a student’s final quantity of clothes, food or housing is negative (i.e. the student’s sales