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While the term "dismal science" was originally used by to describe economics because of the negative outcomes associated with human behavior or the Malthusian theory of population (Schneider, 2018), more recently that negative description has been used to describe the methods in which economics is taught (Sheridan et al., 2014). Movement away from traditional "chalk and talk" delivery has the potential to be beneficial to instruction in any discipline. It is likely that one field of instruction with the greatest need for movement to other teaching methods is economics (###).

One alternative teaching method with the potential for significant benefits to students and instructors is the use of classroom experiments. Through these experiments, instructors and students create and collect data on students' economic decision making in a controlled environment (Li & Wong, 2018). Such experiments provide students with opportunities to test the validity of economic theories and provide a range of potential benefits to students and instructors.

These experiments provide students with the opportunity to connect with theoretical concepts from a firsthand perspective (Emerson, 2014). Doing so is likely to increase students' motivation to learn given that they see the topics as more than just theoretical constructs. The use of classroom experiments prompts students to see the subject matter as a tool for solving real-life problems (Hawtrey, 2007). By working on classroom experiments, potentially in small groups, students teach each other and learn from each other (Sheridan et al., 2014). Furthermore, featuring classroom experiments provides another means of engaging students, which facilitates student learning (Atwood et al., 2023) and makes the course work more stimulating to students (Ball, Eckel, & Rojas, 2006). This type of active approach is entirely different from more traditional teaching methods. By using classroom experiments to force students to be more active, their mindsets change, and they are more likely to take ownership of the concepts, resulting in improved long-term retention of the material (Emerson & Hazlett, 2012).

In addition to the benefits mentioned above, classroom experiments also are associated with other quantifiable benefits. Ball et al. (2006) found that this type of interactive learning resulted in higher grades and better results on students' evaluations of teaching, which is typically an element of the promotion and tenure process. Guest (2015) found that they use of games was associated with positive impacts on attainment. Lin's (2020) study indicated that the level of activity required for classroom experiments made class meetings more entertaining and resulted in improved attendance at class meetings.

Despite the range of benefits noted above, the use of classroom experiments by economics instructors has been surprisingly limited. The vast majority of instruction takes place in a traditional lecture format (Sheridan et al., 2014). The "chalk and talk" method – or more recently

the PowerPoint and talk method – while less than optimal, remains the most common approach used by economics instructors to undergraduates (Garnett, 2015; Jones 2015). While there has been some increase in the usage of classroom experiments over the years, they are utilized by only a small percentage of economics instructors and typically only for a limited range of topics (Guest, 2015; Sherstyuk et al., 2016; Van Long, 2010).

Why has there been such limited adoption of classroom experiments in economics? Some instructors likely consider the additional time cost associated with preparing and developing such activities as too large, making these activities not worth the effort (Goffe & Kauper, 2014). Some existing classroom experiments require instructors to purchase software or items used as elements of the experiment (Emerson & Hazlett, 2012; Guest 2015;). Such purchases may be problematic for instructors teaching multiple sections or with limited financial resources. In other cases, instructors may consider experiments that are a bit more intricate (Gruyer, N. & Toublanc, N. Rojas, 2010; Von Blackenburg & Neubert, 2015; Economics-games.com) to be too complex for their students. While such experiments hold substantial value for more advanced students, these activities may provide less value to students in principles classes. As such, instructors of principles sections may be less likely to incorporate these activities into their classes.

Based on the conditions described above, the goal of this paper is to assemble a set of classroom experiments that covering the most substantial topics typically included in principles of microeconomics course work. It is important that this proposal limits two types of costs to the instructor – monetary cost and time cost. Regarding money cost, the listing developed here will focus on experiments that utilize materials that are commonly found on college campuses. While a monetary cost certainly does exist from an economic perspective, instructors should be able to acquire the items at no cost or limited cost to themselves. Regarding time cost, this paper will efficient experiments that can be completed within one class period or a portion of one class period. Further, we will include detail instructions as well as modifications for the experiments, reducing the preparation time required of instructors.

This paper advocates the use of experiments run on paper as opposed to computerized experiments for various reasons. Hand-run activities offer pedagogical advantages including higher levels of student-to-student interaction (Carter & Emerson, 2012) and higher levels of student engagement in general (Hazlet, 2006). In addition, computerized experiments may create issues related to hardware requirements (Balkenborg & Kaplan, 2009) or capacity of computer labs (Ball et al., 2006). More importantly, computerized activities may be less efficient because additional rounds of activity may be delayed by the actions of the student who is slowest to act (Goffe & Kauper, 2014). As such, a focus on hand-run activities likely would be appropriate for a maximum class size of 75 students (Hazlet, 2006).

Perhaps the biggest challenge associated with these types of classroom experiments is the level and type of incentives that the instructor should offer. Effectively every economics textbook features a foundational assumption that incentives matter in any decision-making scenario. For classroom experiments, grade incentives may be necessary to ensure that students engage in

these activities in a serios manner. However, Dickie (2006) noted that experiments that did not include grade incentives resulted in a greater increase in test scores than experiments that did include such incentives. This somewhat surprising result was likely due to the fact that the outcomes of classroom experiments do not depend entirely on the students' mastery of the course materials; trading skills and random cooperation with other participants can also play a role.

While instructors should use discretion regarding the decision to use incentives, we suggest a hybrid approach. For each topic, the results of the classroom experiment should be scaled so that the student who obtained the highest outcome receives 10 points. For each activity, all other students have the opportunity to increase their scores to the maximum of 10 points by completing a follow-up assignment evaluating each experiment and its connection to the relevant economic concept as in Ball et al. (2006). This retrospective opportunity gives students the opportunity to analyze the connection to theory again and establishes an incentive structure for the experiments that is meaningful but not overwhelming. The instructor can use the total points for all classroom experiments and retrospective analyses across the semester as a moderate level of extra credit points to be added to other assessments or as a small portion of the semester grade.

We have assembled a list of illustrative classroom experiments for ten significant topics commonly included in principles of economics classes. These experiments are hands-on activities as opposed to computerized simulations. The activities generally would work well for class with 30 to 70 students. In order to manage the level of activity during class meetings, it is likely that instructors would find it helpful to have assistant from a student worker, graduate assistant, colleague, or other individual at each meeting when an activity is taking place.

Comparative Advantage

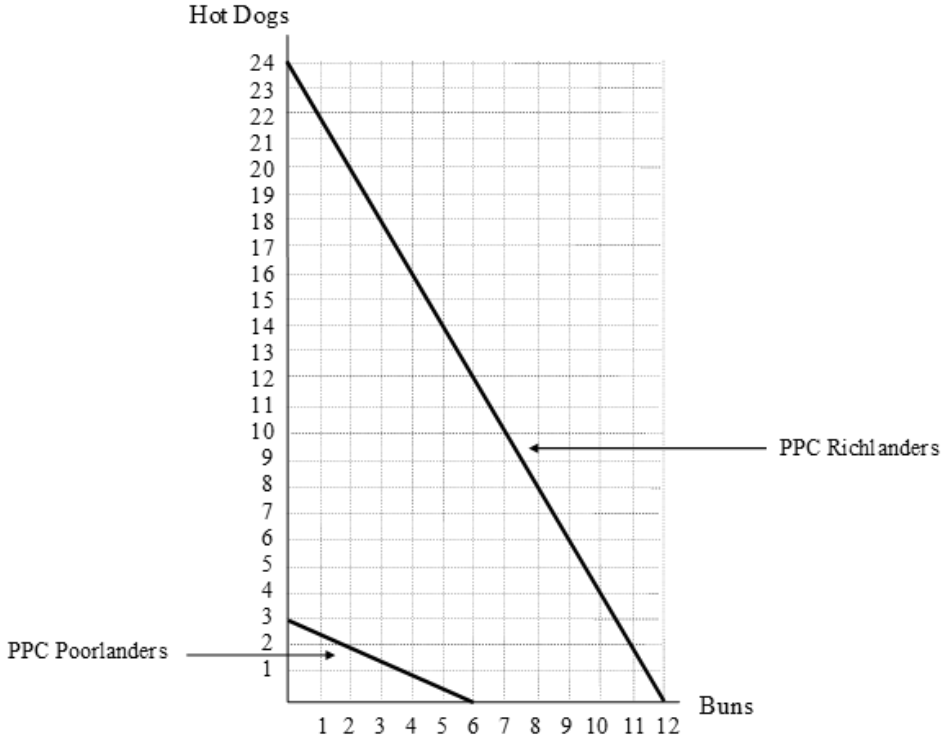
The concept of comparative advantage is a powerful concept that is not obvious to many students. Bergstrom and Miller (1999) provided an experiment that demonstrates the possibility of mutually beneficial trade when specialized production is based on comparative advantage. We recommend a modified version as detailed below. For our version, the instructor should prepare tally sheets like the version included as Appendix A; a quantity of tally sheets equal to one half of the class enrollment will be sufficient. The instructor should also prepare trading slips for the goods that will be traded like the version included as Appendix B and Appendix C, using paper of two different colors for each of the different goods if possible. The quantity of slips needed for each good will depend on the class enrollment, the instructors' choice of group size, and the instructor's choice of number of rounds. For a class of 40 students, a total of 300 hot dog slips and 200 slips for buns slips should be more than sufficient. It is advisable to cut the slips in advance. It also would be helpful to bring a stapler to the class meeting. Lastly, a tablet would work well for recording results but a different type of computing device or even a legal pad would suffice.

To begin the process, the instructor breaks the class up into groups of two to three students. These groups will make decisions regarding production and trade. Forming the class into such

groups promotes interaction between students, yielding more student-led learning than individual decision makers. The instructor will designate 25% of the groups as citizens of Richland and 75% of the groups as citizens of Poorland. Group sizes can be adjusted to meet these ratios. Each group represents one individual citizen.

For the first round, each group will decide how many hot dogs and now many buns it wants to produce. The instructor can provide information regarding the options using a graph such as Figure 1 or by using a table with the same information. In this first round, citizen groups will not conduct any trade. As such, each citizen group's consumption will be equal to its production. In this experiment, hot dogs and buns will be considered perfect complements. Each citizen group's utility will be equal to whichever good has the lower quantity of production, which also will be their quantity of consumption. Hopefully, these instructions will lead the groups to realize that these two goods are perfect complements. Therefore, they will choose equivalent production and consumption levels of eight hot dogs and eight buns for each group in Richland and two hot dogs and two buns for each group in Poorland. Each group will note the quantity of each good produced in the first row of their tally sheet, similar to the version included as Appendix A. It is relevant to note that the utility is not divided by the number of students in the group; each student receives the resulting level of utility. If the results do not imply maximum utility associated with equivalent production and consumption, it may be necessary to repeat this initial round.

Figure 1.



In the second round, each group will act as a single decision maker again, determining how many hot dogs and now many buns the group wants to produce. Once again, the instructor can provide information regarding production options using a graph such as Figure 1 or a table with the same information. Before the groups make their selections, the instructor should inform the groups that they will be allowed to trade hot dogs and buns to other groups from either Richland or Poorland. Each citizen group's utility will be equal to whichever good – hot dogs or buns – has the lesser quantity after all trades have taken place. These quantities will represent the consumption for the citizen group. Again, in this round, the utility for the group is not divided by the number of students in the group; each student receives the total level of utility achieved by the group.

Once each group has determined the amount of each good that they wish to produce, the instructor or an assistant can distribute the appropriate number of slips for each good. After the slips have been distributed to the groups, then groups can move around the room to trade with other groups in order to improve their well-being. Groups can only make trades for whole numbers of hot dogs for whole numbers of buns; no fractions are allowed. Since trading is taking place in this round, production and consumption are not likely to be the same. Once again, each citizen group's utility will be equal to whichever good has the lower quantity of consumption. One member of each group should record the production before trade and the consumption after trade on the group's tally sheet. The group will then submit the slips for each good to the instructor or an assistant, who will record the citizen group's country – either Richland or Poorland – and the group's total level of utility after trade. Stapling the slips of each group together is likely to be helpful. Results will be recorded on the tablet or other device by the instructor or an assistant.

Before trade, we expected to observe consumption of eight hot dogs and eight buns for each group in Richland. Likewise, we expected to observe consumption of two hot dogs and two buns for each group in Poorland. If the groups from each country traded strategically based on comparative advantage, we would hope to observe consumption of 12 hot dogs and 12 buns for each group in Richland and three hot dogs and three buns for each group in Poorland. Since optimal decision making would lead to larger absolute increases in consumption for Richland groups than for Poorland groups, any incentives for this exercised cannot be based on absolute increases. Instead, the winning group or groups will be those that have increased their utility by the greatest percentage. Both the Richland groups and the Poorland groups have the ability to increase their consumption of both goods by 33%. If the instructor is going to incentivize participation and performance for this experiment, using percentage increase as the criteria is the better option.

One final item for instructors to consider regarding this experiment is the number of iterations. If the class is allowed to make trades for only one round, it is likely that some groups will not expand their consumption as much as possible. It also is possible that some groups will make trades that are less than optimal for themselves. Given these potential outcomes, the instructor has two options. The first option is to repeat the experiment with additional rounds of trading. Doing so can allow students in the class to realize for themselves the potential benefits of

production and trade based on comparative advantage. The second option is to use the suboptimal results of some groups coupled with the utility-maximizing results of other groups to highlight the potential benefits of trade based on comparative advantage for the class. In doing so, it would be advisable for the instructor to anonymize the group names. A modified version of Figure 1 above that contrasts the potential consumption options for each country without trade and the potential consumption options for each country with trade could be useful in this regard.

Supply & Demand

double auction with fictional good (Hazlett, 2006)
EconPort M&M reverse auction
Emerson and Taylor (2004)

Market Limits

Dickie, M. (2006). Do classroom experiments increase learning in introductory microeconomics? *The Journal of Economic Education, 37*(3), 267-288. https://doi.org/10.3200/JECE.37.3.267-288

Elasticity

Introducing elasticity to economics students adds nuance to their understanding of supply and demand. Hill (2001) created a classroom exercise that builds upon the creation of market demand curves to illustrate the concepts of price elasticity of demand, income elasticity, and cross-price elasticity. Instructors will begin by having four products available for students to buy. In her example, she uses Snickers bars, cartons of milk, cans of Coca-Cola, and packs of Twinkies, though her main recommendation is to select products that appeal to college students and are somewhat reasonable in price. There are three rounds of purchases made by the students before they work in groups to create market demand and then elasticity calculations.

Each student is given a sheet of paper with instructions that include three sections, one for each round. In each section there is a column of the available products and their associated price for that round, a column for the student's individual quantities, and a column for market quantities. In the first round, each student has a "budget" of $5 that they can use to purchase the goods listed. For simplicity's sake in the first round, each item has a price of $1. Students can decide the quantity of each good they would like, which may be zero units. However, they must spend exactly $5 in total. In the second round, students have the same $5 budget, but the price of one good doubled from $1 to $2. Without regard to previous purchases, students must list the quantities they would purchase with their $5 given the change in one price. For the third round, all prices revert to $1, but students now have a larger budget, potentially $8, to purchase their desired quantities of each good.

After finishing the third round of purchases, students gather in small groups to sum their individual quantities into market demand and graph them for each of the three scenarios. Students can use a simple price elasticity of demand formula to calculate a value for the second round in comparison to the first round. Then, using a simple income elasticity formula, they can calculate a value for the third round. Lastly, students can calculate cross-price elasticity

comparing the first and second rounds when there was a price change for one good but not the other. Ideally this experiment is done in class after covering the introduction to supply and demand but could serve as an introduction to elasticity before formal presentation of the elasticity topics. Instructors will likely need to circulate among the groups while they calculate elasticities, to help students apply the formulas to their data. After discussion in the small groups, the class comes back together to discuss the patterns they found. Students will often come to their own conclusions about things like substitute and complementary goods, and even what the signs of the elasticity values would be. While other methods of calculating elasticity (such as using the midpoint method) might be introduced later, this exercise allows students in a basic way to apply what they have already learned about supply and demand to understand its relationship to elasticity.

Production Costs

Diminishing marginal return is a critical concept within the discussion of production costs. We recommend a modified version of the experiment detailed by Hedges (2004). To prepare for this version of the experiment, the instructor will need to obtain two empty containers such as copy paper boxes, a full tape dispenser, and at least 40 tennis balls. While the initial items on this list should be easy to acquire from an office on campus, a bit more effort will be needed to collect the tennis balls. It is advisable to begin collecting discarded tennis balls a few weeks in advance from a tennis complex on campus or in the instructor's neighborhood. On the day of the experiment, the instructor will put the tennis balls in one of the containers leaving the other container empty. The two containers should be placed approximately 20 feet apart in an area of the classroom with an unobstructed walking path. The instructor will place the tape dispenser next to the empty container.

To begin the experiment, the students are divided into two groups. Each group will select one student to participate in the first round of the experiment. The groups will alternate turns throughout all rounds of the experiment. In the first round, each group's representative will retrieve one tennis ball from the first container, walk toward the second container, place a piece of tape around circumference of the ball, and deposit that ball into the second container. This process represents the production of a final product, the taped tennis ball. The student will repeat this process as many times as possible within one minute. If a student drops a ball or misses the container, that is considered a loss during production. After each student completes a round, the instructor will tally the number of taped tennis balls successfully transferred to the second container and maintain a tally sheet using Excel or a similar resource. (This is also a good time for the instructor or an assistant to begin removing tape from the "completed" tennis balls.) Each member of the group whose representative had more production receives 10 points for the round and members of the group whose representative had less production receives no points. In the event of a tie, both groups receive five points for the round.

The second round of the experiment continues in the same manner, but in this round each group selects two students to complete the same tasks simultaneously. It would be prudent to allow each group time to discuss who their representatives will be and what strategies they might want

to utilize. One student must remain at the tape dispenser and perform only the task of taping the tennis balls while the other student walks back and forth to retrieve one tennis ball per trip. The instructor adds the total for each group to the tally sheet. The scoring works in the same manner for the second round with the students in the group with higher production receiving 10 points and the students in the group with less production receiving no points.

The process continues in the same manner with three students representing each group in the third round, four students representing each group in the fourth round, and five students representing each group in the fifth round. In each round one student from each team will remain at the tape dispenser with the other students walking back and forth to retrieve additional tennis balls. (If it becomes clear that there are not enough tennis balls for a later round, the instructor can reduce the time limit imposed on each group.) The instructor maintains the tallies for each round with the expectation that the production will increase but do so at a decreasing rate. The instructor should display the results of each success round for both teams via projector. In this way, this experiment will provide students with evidence of the law of diminishing marginal returns.

Perfect Competition
[still needed]

Monopoly
Oxoby, R. J. (2001). A monopoly classroom experiment. *The Journal of Economic Education*, 32(2), 160-168. https://www.tandfonline.com/doi/abs/10.1080/00220480109595181

Monopolistic Competition
To illustrate how firms exiting a monopolistically competitive market will lead to an equilibrium, we propose an experiment that has not been detailed in the existing literature. For this activity, the instructor will need one or two decks of playing cards depending on the class size. Alternatively, the instructor could print two sets of 50 slips of paper with two different colored fonts for each set. The instructor should also print out tally sheets for the group that are similar to version listed as Appendix C. The only other required preparation will be some form of record keeping materials. A spreadsheet on a tablet would be ideal, but a different type of computing device or even a legal pad would suffice.

The class will be divided into teams of two to three students. Each of these groups will function as a firm making the decision to exit an industry or remain in that same industry. In the basic form described below, a total of 20 groups would be ideal for the experiment. Each firm has costs that total $100. Total revenues for the industry will be $80 multiplied by the initial number of firms, with revenues divided evenly among all firms. With a class of 20 student groups, total revenues for the industry will be $1,600 and each firm will have an economic loss of $20. All dollar amounts represent daily figures, and each round of the experiment will represent the groups making a decision for that day.

To start the experiment, the instructor informs all groups in the class of the amount of the economic loss for each firm. Each group records their losses for the first day. The instructor or an assistant will give each group one red playing card and one black playing card. The first decision for each group will relate to the second day of operations. If the group wants to remain in business, they will place their red playing card face down in front of them on the table or desk. If the group wants to exit the industry, they will place their black playing card face down in front of them on the table or desk. Once each of the groups has made their decision, the instructor or an assistant will walk around to check the decision of each group and determine the total number of groups still in business. In this experiment, the industry's total revenues will not change each day. As such, the revenues of $1,600 for a 20-group exercise, will be divided among the firms that remained in business. The instructor will compute profits for each of the remaining firms and announce that total to the class. Each group will record its daily profit or loss on their tally sheet; the instructor should keep a record of each groups profits or losses to verify the amounts and avoid incorrect listings by any groups.

Once record keeping is complete for each group's decisions regarding entry and exit for the second day, the instructor will repeat the process giving each remaining group the opportunity to exit the industry or remain in business. In addition, groups that exited previously will have an opportunity to reenter the industry if they wish to do so. Again, if a group wants to operate in the industry, they will place their red playing card face down in front of them. If they do not want to operate within the industry, they will place their black playing card face down in from of them. Instructors can choose to repeat the process as many times as they see fit. We expect that a minimum of five iterations will be necessary for the exit and potential reentry of groups to move the toward a zero-profit result for all groups.

Once the instructor chooses to cease the iterations of the experiment, the instructor or an assistant will total the losses and potential profits recorded in all rounds for each firm. It is likely that the last round will see firms that exited with no profit or loss and firms that remained with profits or losses very close to zero. Regarding potential incentives for this exercise, the "winning" groups are likely to be those who, recognizing that economic losses were likely for firms in this industry, exited in one of the first rounds. Doing so, would limit the total losses for such groups. It should be noted that it would be possible for a single group or a limited number of groups to obtain substantial profits if all other groups exit, allowing substantial profits for the few that remain.

In order to provide an incentive for groups to attempt to minimize losses, we recommend an incentive for the "winning" groups. It may be challenging to find one group in each class with the smallest total losses. As such, we recommend awarding credit – or bonus points if that is the instructor's preference – to the half of groups that had the lowest total losses. If several groups had equivalent losses, instructors could use their discretion in reward slightly more or less than 50% of all groups.

Oligopoly

An experiment that effectively illustrates the interdependence of oligopolistic firms is found in

Ryan and Doyle-Portillo (2014). For the modified version of this experiment that we recommend, the instructor should prepare by cutting or obtaining slips of paper that are approximately three inches by three inches. A total number of slips ten times the size of the class should be sufficient. A tally sheet or computer spreadsheet to record results is the only other requirement.

In the first round of the experiment, the class is divided into teams of two students. Each team is given two minutes to decide if they want to submit a slip of paper that is blank except for their names or slip of paper that is marked with an 'X'. The payout for the exercise is dependent upon the total number of marked slips that are submitted. If only one team submits a marked slip, the students on that team receive 10 points each. If two teams submit marked slips, the students on those teams receive 9 points each. If three teams submit marked slips, the students on those teams receive 8 points and so on. The process proceeds such that if eleven or more teams submit marked slips, then no students receive any points. However, if no teams submit a marked slip within the two minutes, all students will receive 5 points and the game ends. However, if any team submitted marked slips, then the instructor notifies the class how many marked slips without revealing the names of the students who have done so. At that point, all teams receive a one-minute extension in which all teams submit additional slips, allowing them to provide a marked slip if they have not done so previously. The instructor makes the class aware of the rules above before the first round of the experiment begins. If the classroom experiment is structured in this manner, we expect that no teams will submit marked slips. If any team did so, the students on other teams will penalize them by submitting their own marked slips in retaliation, effectively enforcing collusion.

An advantage of this experiment is that in later rounds it can be adjusted to include obstacles to collusion. To represent an unstable demand curve, the instructor can repeat the experiment with increased payouts for teams who submit marked slips (i.e. 20, 18, 16, 14, etc.). If the remaining elements of the game remain the same, collusion is still the likely result based on the one-minute extension in which teams can respond in a retaliatory manner. Regarding a larger number of firms as an obstacle to collusion, Ryan and Portillo (2014) grouped the results of two classes together. Such a grouping could be challenging for various reasons. As such, we suggest eliminating teams and directing each student to submit slips individually. Effectively, this change will double the number of "firms" in the oligopolistic industry. While some students may be more tempted to break the tacit agreement, it is likely that collusion will be the result once again because of enforcement via the one-minute extension. Lastly, this experiment allows the instructor to simulate an inability to detect price change as an obstacle by removing the information. All elements of the game remain the same, but the instructor makes no announcements while students are making their decisions. Students are likely to recognize that the lack of information makes it challenging or perhaps impossible to enforce collusion. As a result, the "firms" are likely to compete by submitting marked slips in an effort to obtain any points possible.

Resource Markets

Mounts & Vaughan (2000) monopsony with auction => pricing & quantity

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Appendix A

Richland-Poorland Tally Sheet

Group Number: _____

Names of Students in Group: _____

_____

_____

_____

	Column #1	**Column #2**	**Column #3**	**Column #4**
	Hot Dog Output	**Bun Output**	**Hot Dog Holdings**	**Bun Holdings**
Round 1 Select from table Col. #3 = Col. #1 Col. #4 = Col. #2				
Round 2 Select outputs from table; holdings based on results of trade				
Round 3 Select outputs from table; holdings based on results of trade				
Round 4 Select outputs from table; holdings based on results of trade				

Appendix B

1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog
1 Hot Dog	1 Hot Dog

Appendix C

1 Bun	1 Bun
1 Bun	1 Bun
1 Bun	1 Bun
1 Bun	1 Bun
1 Bun	1 Bun
1 Bun	1 Bun
1 Bun	1 Bun
1 Bun	1 Bun
1 Bun	1 Bun

Appendix D

Daily Profits or Losses

Group Number: _____

Names of Students in Group: _____

_____

_____

_____

	Profit/Loss
Day 1	
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	
Day 7	
Day 8	
Day 9	
Day 10	
Total	