

# Teaching Economic Principles Interactively: A Cannibal's Dinner Party

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I begin my economics principles classes by telling students that:

“Taking this course is like being invited to dinner at a cannibal’s house. You may be a diner, you may be dinner, or you may be both.”

Astronomers study matter and energy in the universe. Geologists study rocks and minerals. Particle physicists study subatomic particles. Botanists study plants and zoologists study animal life. Those who study economics and other social sciences are in the peculiar position of belonging to the class of objects that they study.

Alfred Marshall defined economics as “a study of mankind in the ordinary business of life” and according to Lionel Robbins, economics studies “how people choose to use limited or scarce resources in attempting to satisfy their unlimited wants.” An economics classroom is a natural laboratory for the study of “mankind in the ordinary business of life.” Introspection and personal experience can inform a student’s thinking about economics in a way that is not possible for astronomy, geology, physics, botany, or even zoology.

I regularly teach introductory Principles of Microeconomics to a class of 500 or more students. In these classes, I exploit the advantages of a classroom as a self-referential laboratory by two devices. One of these is the use of classroom market experiments. Each week, students meet in groups of 35-50 with a teaching assistant who conducts a market experiment that is designed to illustrate a major economic concept. Students’ transactions and profits are recorded and profits count in a minor way toward students’ grades. Results of the experiment are posted on the web and students are given homework assignments that explore the relation between experimental results and an economic theory that

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purports to predict the results of this experiment. Students also attend large lecture sections in which the instructor discusses the economic theory that relates to the experiment they have just conducted. Lectures are also used to explore applications of this theory and related real world field observations.

In my lecture classes, I use an additional mechanism to promote interactive learning. Students are asked to purchase hand-held radio-frequency transmitters, “clickers.” During the lecture, questions are posted on a screen. Student responses are recorded and a bar graph showing the distribution of students’ answers is displayed immediately after answers are collected. Some of the questions are simple checks on whether students have understood the concepts being discussed. Other questions gather data about students’ preferences and opinions, which can then be organized and presented to illustrate the concepts being studied. I also use the clickers to conduct in-class “games” that motivate economic models of social interaction.

When students are asked to apply economic reasoning to their own behavior and to outcomes that they themselves have observed and recorded, they are impelled to view economics not as a body of received doctrines to be memorized and spouted back, but as a kit of tools that work reasonably well to organize the facts of their experience.

## 1 Classroom Experiments

We use a textbook, *Experiments with Economic Principles: Microeconomics* [2], which I coauthored with Professor John H. Miller of Carnegie Mellon University. This text includes fourteen experiments, each of which is designed to illustrate a central concept of economic theory and which provides the core motivation for a week’s classroom discussions and readings.<sup>1</sup> Each chapter contains instructions for the week’s experiment, a discussion of the related theory, a section for “lab notes” where the results of the experiment are recorded, and a homework section that requires students to compare the predictions of the relevant theory to the results of the week’s experiment.

The textbook includes experiments on the following topics: supply and demand (buyers and sellers of “apples” meet in a simple trading pit market), shifts in supply curves and demand curves (fishermen come to the local fish market, where the total number of fish caught varies from one day to the next), the effects of a sales tax, a market in which sale of “drugs” is illegal but enforcement is imperfect, a labor market with a minimum wage, a market in which each transaction imposes an externality on all participants, a “restaurant market” in which firms with fixed costs and limited capacity decide whether to enter or exit an industry, markets with monopoly, oligopolies, and cartels, a market with

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<sup>1</sup>At UCSB, where we are on a quarter system, we cover only nine of these chapters.

network externalities as in fax machines or computer operating systems, an experiment illustrating comparative advantage in trade between nations. There is also a “lemons market” for used cars, with asymmetric information and adverse selection, an experiment in which auctions are conducted, and finally one with bilateral bargaining.

## 1.1 A restaurant experiment

To give you an idea of how these experiments work, let me tell you about our experiment on entry and exit with fixed and variable costs. In this experiment, students are given an opportunity to open a restaurant. In order to open a restaurant, one must pay a fixed cost of \$20. Restaurant operators must pay this fixed cost regardless of the number of customers they attract. The restaurants are small. Each restaurant has only four stools and can serve up to four customers. The “variable cost” of preparing and serving a meal is \$5 per customer.

We induce a demand curve for restaurant meals by assigning a “buyer value” to each student in class and allowing each student to buy at most one meal. A restaurant customer’s profit is the difference between his buyer value and the price that he pays for a meal. If the number of students in class is divisible by four, equal numbers of students are assigned buyer values of \$24, \$18, \$12, and \$8.<sup>2</sup> Figure 1 shows the resulting demand curve for a class of thirty-two students.

In this experiment, there are two or more rounds of play and each round consists of two stages. In Stage 1, students decide whether to open a restaurant. In Stage 2, customers shop among restaurants and decide whether and where to purchase a meal. After a round of play is completed, we run one or more additional round. The additional rounds are repetitions of the first round, except that participants will now have observed the results of the previous round(s).

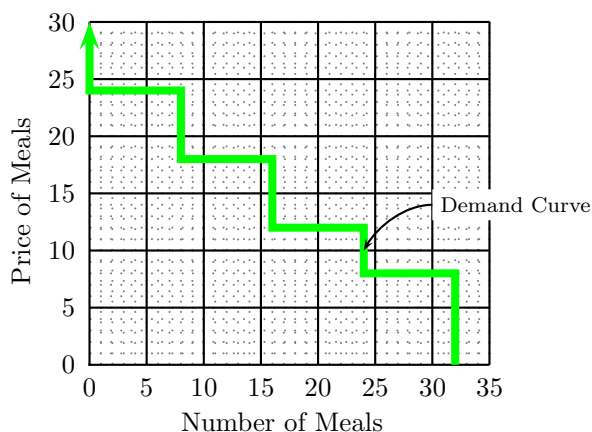
Before students decide whether to open a restaurant, we ask by show of hands, how many people there are with each buyer value and we record this information on the blackboard. Students are asked in a predetermined order, whether they want to open a restaurant. At the time that a student is asked, she knows the number of restaurants that have already been opened as well as the number of students who are left to be asked. Once a student announces that she will open a restaurant, she is committed to pay the fixed cost and cannot exit the industry until the round is over.

The decision problem is an interesting one for students. They know (or will soon learn) that if too many restaurants enter, there will be excess capacity and prices will be driven so low that entrants will not be able to recover their fixed

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<sup>2</sup>If the number is not divisible by four, any leftover students are assigned a buyer Value of \$8.

**Figure 1: Demand for Restaurant Meals**



costs. On the other hand, they know that if the number of entrants is small, they will be able to sell meals at high prices and will enjoy a profit after paying their fixed and variable costs.

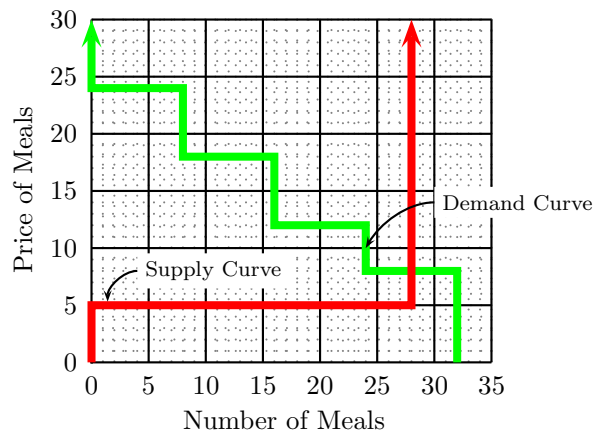
Stage 2 begins after all students have declared whether or not they will open restaurants. Restaurants post prices for meals and customers shop for the best price available. Restaurants are permitted to change their posted prices at any time and customers may bargain freely with restaurants over the price they will pay. When a restaurant and a customer agree to a sale, the customer signs the restaurant's registry sheet and records the price paid. Each restaurant is limited by its capacity to sell no more than four meals.

If a restaurant sells four meals, its total costs will be \$40. This is the sum of the \$20 fixed cost plus the variable costs of \$5 each for four meals. In order to recover all of its costs, a restaurant must be able to sell four meals for at least an average of \$10 per meal. But if too many restaurants are open, it will not be possible for all of them to find customers willing to pay at least \$10. For example, with the demand curve shown in Figure 1 only twenty-four consumers would be willing to pay at least \$10 for a meal. If more than six restaurants are open, they will not all be able to sell four meals at \$10 or more. Some of them will surely lose money. In fact, competitive theory predicts that if more than six restaurants open, they will all lose money. To see why this is the case, we notice that the additional cost to a restaurant of selling an extra meal is only

\$5. Rather than not sell a meal, restaurants will be eager to sell at any price above \$5. So long as there are more than six restaurants, competitive pressure is likely to force the price of all meals sold to a level below \$10.

This is illustrated in Figure 2 where we draw the demand curve and the supply curve for the case where seven restaurants are open. The supply curve reflects the fact that at any price above \$5, each of the seven restaurants would want to supply four meals, so the total supply would be twenty-eight meals. We see that in this case the supply curve crosses the demand curve at a price of \$8. The competitive prediction is that each of the seven restaurants will sell four meals at \$8 per meal. Restaurants will have total costs of \$40 and total revenue of \$32. Thus each restaurant loses \$8. Restaurant owners are all worse off than they would have been if they had not opened a restaurant, but by selling at the market price they make the best of a bad lot. Although the price of a meal is less than the average total cost of \$10, it is more than the variable cost of \$5. Thus instead of losing the entire \$20 fixed costs, their losses are “only” \$8.

**Figure 2: Short Run with “Too Many” Restaurants**



Typically the first time this experiment is run in a classroom, there will be at least one (and often two or three) more restaurants than can profitably be sustained. Just as the theory predicts, most meals are sold at prices below \$10 and almost all restaurants lose money.

After a round of the experiment is completed, we calculate and report the profits or losses of each restaurant. We then repeat the experiment, starting

with no open restaurants. Once again we allow students to decide whether or not to open a restaurant. With their experience from the previous session, most students are able to figure out how many restaurants can operate profitably. If all students understood the economics of the situation and if they all believed that the others understood, then the first  $k$  students to be asked would open restaurants where  $4k$  is the largest number of meals that can be sold for \$10 or more. The remaining students would choose not to open restaurants, since they would suffer losses if they did so.

Able students often assume everyone else in the class will understand the situation and nobody will open a restaurant after the critical capacity is reached. This assumption is usually wrong. Students who assume the others will all act wisely are frequently disappointed to see someone join the industry even when there is no more room to do so profitably.

After the experiment is completed, students are asked to graph the demand curve and the short run supply curves corresponding to the number of restaurants opened in each session. They then are asked to find the long run equilibrium number of restaurants such that nobody has an incentive either to enter or exit the market. They are also assigned to read a journal article “Why Restaurants Fail” [4] which reports results of a study of restaurant failure rates and reasons for failure.

When students have completed this experiment, they should have first-hand knowledge of the concepts of fixed and variable costs, and of the difference between average costs and marginal costs. Moreover, they will have experienced an environment where the prospect of profits attracts new entrants and the experience of losses reduces the number of firms in an industry. They will also have direct experience with the distinction between long and short run equilibrium in the industry. I believe that most students who have experienced this experiment have a much better understanding of these notions than students who have been drilled on the mysteries of drawing U-shaped cost curves.

## 2 Clicker Questions

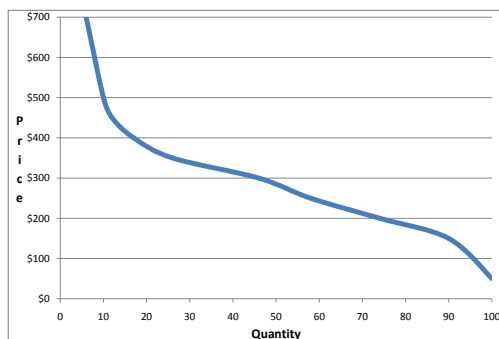
I have found class room clickers to be a very effective way to maintain two-way contact with students in large classes of four hundred or more students as well as in classes of twenty-five or thirty. The questions that I ask with clickers can be roughly sorted into three distinct types. These are (i) surveys of students’ opinions and characteristics, (ii) questions that measure students’ comprehension of course concepts, and (iii) classroom games and markets.

## 2.1 Classroom surveys

In the winter of 2006, I asked students “Do you own an iPod?” About 25 percent of them said “yes”. In the winter of 2007, I asked the same question. At this time, 75 percent reported owned iPods. In the fall of 2007, about 82 percent replied that they owned iPods. In the fall of 2007, I also asked whether students owned iPhones. Only about 12 percent were iPhone-owners.

After asking students whether they owned iPods, I asked the following question. “What is the most you would be willing to pay to have an iPod if you didn’t have one and couldn’t get one any cheaper than this price?”<sup>3</sup> The software produces an Excel spreadsheet showing the distribution of willingnesses to pay for iPods. After class, I performed a few simple manipulations in Excel to produce a demand curve for iPods, which I show the students in the next lecture. The demand curve derived from the responses of students in January 2006 is shown in Figure 3.

Figure 3: Demand Function for iPods



I posted a link to an Excel file with the distribution of willingnesses to pay on the class website. This information is given in Table 1.

Students are asked to use the information in Table 1 to answer the following question

“Imagine that you are in charge of price-setting for Apple. Construct a table with the prices found in Table 1 in the first column, the total quantity demanded at each price in the second column and

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<sup>3</sup>Some clicker systems accept direct numerical inputs. Others accept only a small number of multiple choices. In the latter case, one asks students to choose from one of several price intervals. I have had satisfactory results from asking this question using either type of system.

Table 1: Distribution of Willingness to Pay for iPod

Willingness to Pay	Percent of Students
\$700+	6
\$500	4
\$450	2
\$400	5
\$350	9
\$250	12
\$200	16
\$150	16
\$50	10

total revenue in the third column. Assuming that the cost of producing and distributing an iPod is \$50 per unit, in the fourth column of your table, enter the total cost of producing the quantity demanded. Finally, assuming that costs are \$50 per unit, in the last column of your table, calculate the profit achieved at each price. Which price maximizes revenue? Which price maximizes total profits?"

Students who perform this exercise successfully will produce a table that looks like Table 2. Inspection of Table 2 shows that revenue is maximized at a price of \$200 and that profits are maximized at a price of \$250.

Table 2: Demand, Revenue, and Profit

Price	Quantity Demanded	Total Revenue	Cost if per unit cost \$50	Profit if unit cost \$50
\$700+	6	\$4200	\$300	\$3900
\$500	10	\$5000	\$500	\$4500
\$450	12	\$4200	\$600	\$3600
\$400	17	\$6800	\$850	\$5950
\$350	26	\$9100	\$1300	\$7800
\$300	46	\$13800	\$2300	\$11500
\$250	58	\$14500	\$2900	\$11600
\$200	74	\$14800	\$3700	\$11100
\$150	90	\$13500	\$4500	\$9000
\$50	100	\$5000	\$5000	\$0

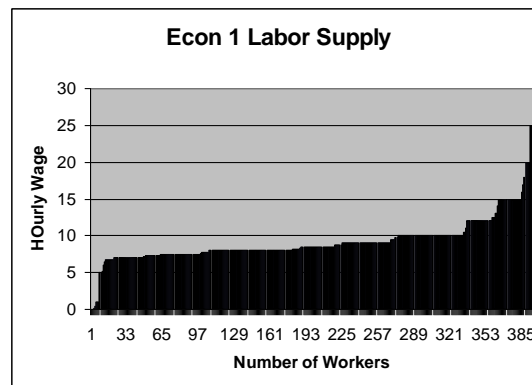
The demand curve that we constructed is the demand curve for 100 people whose willingnesses to pay had the same distribution as that in our class. If our

class could be taken as a representative sample of the population at large, then in a population of 100 million, the quantities, revenues, and profits, would be one million times larger than those we found. But the profit maximizing price would be the same as the one we found.

In January 2007, when the movie “Borat” was very popular, I asked the following question. “How much would you be willing to pay to attend a live performance by Sacha Baron Cohen (Borat) here in our lecture hall?” Much as with the iPod question, I showed them a graph of the demand curve derived from their responses and gave them an Excel spreadsheet with the distribution of willingnesses to pay. Students were asked to find the revenue-maximizing ticket price and the resulting revenue. In class we discussed the fact that this class was only a sample of the entire student body. We estimated a demand curve for the student body at large and we discussed the fact that the lecture hall had a limited capacity. We estimated the highest price at which the lecture would be sold out, based on the information from our class.

Before discussing labor markets, I asked students “What is the lowest hourly wage at which you would accept a 10 hour per week job in retail sales during the school year?” We used this data to construct the labor supply curve which is found in Table 4.

**Figure 4:**



In the winter of 2007, a student doing an honors paper conducted a clicker survey in which class members were asked if they had a part-time job during the school year. Students were also asked about their major, their class year, their gender, and whether they had to pay at least part of their tuition themselves. Those who had part-time jobs were asked to state their hourly wage as well as the

distance that they had to commute to work and the time they spent commuting. This student prepared an interesting report relating student characteristics to whether they had a part time job. She also re-calibrated the distribution of wage rates to allow for the time spent commuting.

## **2.2 Questions that measure comprehension**

During a typical lecture, I ask three or four multiple-choice questions that are intended to determine whether a student has understood recently discussed material. Sometimes these questions will be at the beginning of class and will concern major points of the previous lecture. Sometimes they will be in the middle of the class period and are designed to determine whether the students have understood what has just been discussed. After the question has been asked, students are immediately told the right answer and are shown a histogram of the distribution of responses in the class. They then see a “Why is that?” slide that explains the correct answer.

These questions serve several useful purposes. They tell the students what I think they should have learned. This helps them to focus their study. They tell me how many students have learned what I think they should have learned. This helps me to determine when I need to spend more time on a topic. (I am frequently surprised in either direction. Sometimes they know more and sometimes less than I would have expected.) Seeing the histogram with the proportions of students who knew the answer is very informative for students. Missing a question that most of the other students get right is a warning, but is also a form of encouragement. “How hard can this be if eighty-five percent of the class knows the answer?”. Aside from these informational reasons, breaking up the lecture for clicker questions serves as a snooze-alarm and as a device to help students to maintain attention.

## **2.3 Congested Highways and other Classroom games**

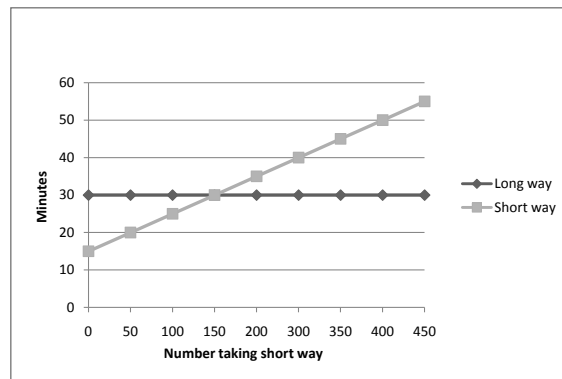
Classroom clickers allow us to play interactive games in the classroom with instant feedback.

### **2.3.1 A Traffic Congestion Game**

The course includes a unit on externalities, with an experiment in which production generates pollution. This experiment demonstrates the effectiveness of a “Pigovian tax” as a method of achieving efficiency. In this unit, we discuss traffic congestion as an example of negative externalities. Students are asked to read a brief article entitled “The economics of traffic congestion” by Richard Arnott and Kenneth Small. [1] This article presents a simple, but illuminating, example known as the Pigou-Downs-Knight paradox. In this example, a large

number of commuters must drive from their homes in one village to their jobs at a factory some miles away. There are two alternative routes. One route is a direct, but narrow roadway. Because of congestion, the amount of time that it takes each commuter to get to work increases as with the number of commuters who use it. The other route is a more circuitous, but much wider highway. The time required to travel from home to work on the wider highway is the same regardless of the number of commuters who use it. If the narrow, but direct, route is uncrowded, the trip takes much less time than does the circuitous route. If everyone used the direct route, it would take longer to go directly than to take the circuitous route. If no tolls are charged on either road, drivers can be expected to allocate themselves so that the expected amount of time spent on either road is about the same. In equilibrium, those who take the direct road are no better off than those who take the roundabout route. This is not an efficient outcome. If the number of commuters on the direct route is restricted, then those allowed to take the direct road will all be better off than they would be taking the longer route and those who are not allowed to take the direct road would be no worse off than they were before the restrictions were put in place. We discuss the fact that efficiency can be achieved by charging appropriate congestion fees to those who drive on the congested route.

**Figure 5: Commuting time on two routes**



This discussion leads into an interesting and informative classroom game that can be performed in class with clickers. This classroom game follows a research design devised for laboratory economics experiments by John Hartman [3]. Students play a game in which they choose which of two ways to go to work. It always takes 30 minutes to go to work by the long way. On any day, the amount of time required to get to work by the direct route will be  $15 + X/10$

where  $X$  is the number of people who choose this route. Students are asked to press button A if they plan to go the short way and B if they plan to go the long way. We run this game for seven rounds, simulating days of commuter decisions. After each round, students are told the number who of students who chose the short way on the preceding round and they are also told the amount of time that it took to commute to work by each route. Although they know the outcome of the previous round, when students make their current selections they do not know the choices that the other students are making simultaneously. Students are asked to try to minimize their time spent travelling to work. I typically award a modest monetary prize to the two or three students who spent the least total amount of time commuting over the period.

**Figure 6: Number Choosing Direct Route**

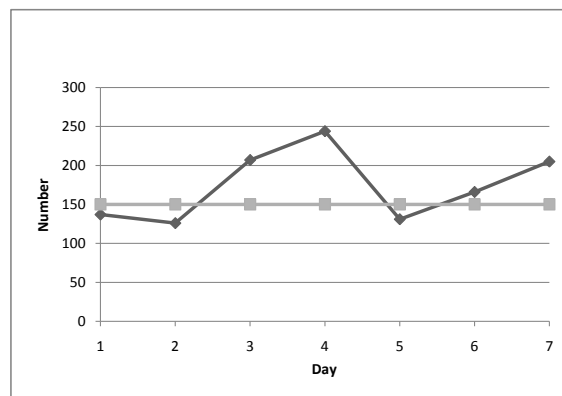
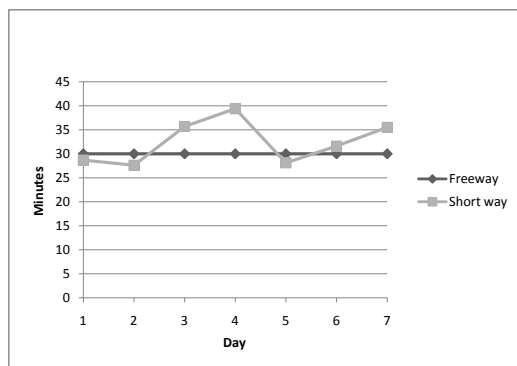


Figure 5 shows the commuting time on each route as a function of the number of people who chose to take the short route. This class had a total of about 300 people in attendance. We see from Figure 5 that the time needed to commute will be the same by either of the two routes if the number choosing the direct route is 150.

Figure 6 shows the number of students who chose to take the direct route in each of the seven rounds of the experiment. Figure 7 shows the amount of time required to commute by the direct route in each round. It is interesting to see that this number does not seem to converge to equilibrium in a straightforward way, but fluctuates above and below equilibrium. When the number of students on the direct route is smaller than 150, those who take this route have shorter commuting time than those who do not. All though the number of iterations is small, there seems to be a pattern in which students move to

Figure 7: Commuting Time Results



the route that travels faster, but repeatedly overshoot equilibrium, generating traffic fluctuations.

This result mirrors findings of Hartman who ran many laboratory experiments, each of which included twenty rounds of play. Instead of converging to equilibrium, the number of persons taking the direct route continued to oscillate around the equilibrium level, indicating that achieving coordination of commuting decisions is not so easily accomplished when people have to guess about each others' plans.<sup>4</sup>

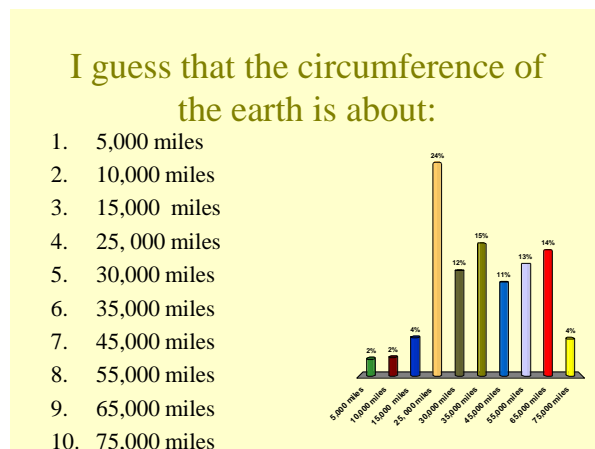
## 2.4 The wisdom of crowds?

The clicker technology offers an entertaining way to introduce students to facts about economics and geography, while teaching them a useful lesson about the formation of consensus. We can ask students to make their best guess about such a fact and display a graph showing the distribution of guesses in the class. After students have seen this distribution, we can ask them to make another guess.

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<sup>4</sup>In a further treatment, Hartman introduces a monetary toll on use of the direct route. In addition to reducing congestion and increasing efficiency, this toll has another interesting effect. Because Hartman designs his experiment so that different people have different values of time, the use of a toll stabilizes traffic patterns and eliminates the fluctuations observed without tolls. The toll solves the coordination problem by sorting commuters so that those with the highest values of time use the direct route and pay a toll.

Figure 8:



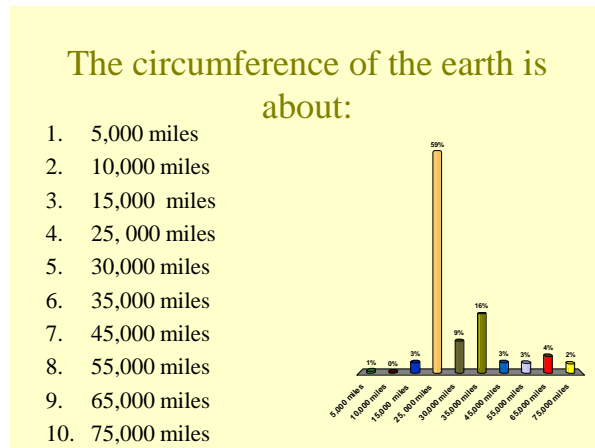
Sometimes this procedure results in rapid and broad consensus on the correct answer. When I asked students to guess the circumference of the earth (with options in five thousand mile intervals), the results were as shown in Figure 8. The most common single answer was the correct answer of twenty-five thousand miles. However, only twenty four percent of the students gave this answer, while more than percent made guesses of greater than fifty thousand miles. The results of the second round of questioning are seen in Figure 9.

After students had seen the distribution of results on the first round, a widely-held consensus emerged in the second round. Sixty-nine percent now guessed 25,000 miles and only nine percent had guesses exceeding fifty-thousand miles

So how good is the wisdom of crowds for finding answers to other questions? How different would the result be if fewer have learned the correct answer? I asked the class to estimate the distance as the crow flies from Paris to Vienna. The distribution of responses from the first round of questioning is seen in Figure 10

The answers are broadly dispersed, with the modal answer of 700-800 miles receiving twenty-four percent of the votes. The correct answer, which is 642 miles, lies in a range chosen by eighteen percent of the students. We repeated this question, three times, displaying the range of answers each time. The results of the third round of questioning are shown in Figure 11. A fairly widely-held consensus emerged, with sixty two percent of the class choosing the interval 700-800 miles, although twenty percent of the students opt for the “correct” interval 600-700 miles. The crowd did not settle on the correct interval, but it

Figure 9:



did converge substantially on an answer that is “nearly write.” Answers that are far from correct have become quite infrequent after two iterations.

Figure 10:

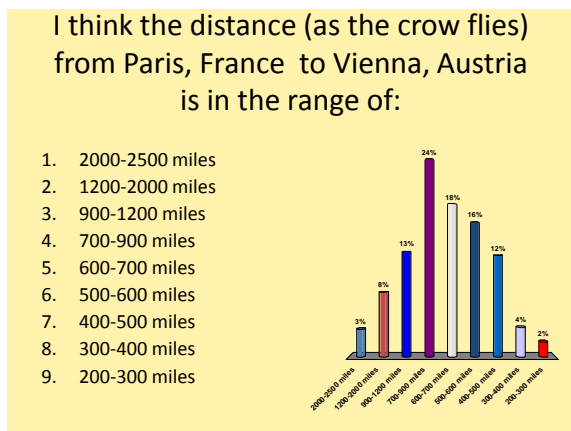
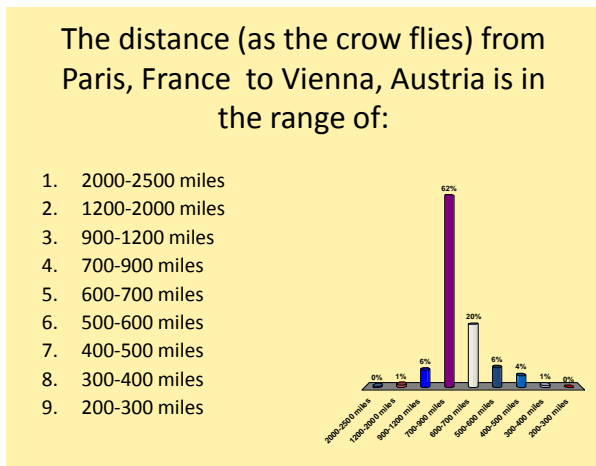


Figure 11:



### 3 Conclusion

All college instructors must wonder from time to time, “Why should an able student come to class, especially if he or she has access to a good textbook? What is it that I can tell them that isn’t in the book?” In small classes, there is an opportunity for personal contact with the instructor and the possibility to ask questions. In large classes, the possibility for personal contact is much limited. The questions that can be handled must be largely those that puzzle large numbers of students. But such questions are the ones that a good textbook can anticipate and answer.

It seems to me that classroom meetings should concentrate on activities that are not replicated in the textbooks. One reason that students come to class is to meet other students. Classroom market experiments are well-suited to this end as students barter and trade with each other and often strike up lasting acquaintances.

One can read about trades and bargaining in a textbook, but a classroom market experiment allows students the chance to experience trading. One can read about price elasticity and shifting supply and demand curves in the textbooks, but the eyes sometimes grow weary and the ideas don’t sink in. A short classroom discussion of these concepts, followed by a question requiring a clicker response can help to focus the mind. Better yet, applying economic ideas to study data generated by one’s own responses and those of one’s classmates can make it very clear that economics applies directly to ourselves and the world around us.

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