Price Discrimination and Resale: A Classroom Experiment

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Abstract

This paper presents a classroom experiment designed to illustrate key concepts of third-degree price discrimination. By participating as buyers and sellers, students actively learn (1) how group pricing differs from uniform pricing, (2) how resale between buyers limits a seller's ability to price discriminate, and (3) how preventing price discrimination might reduce welfare. The exercise challenges sellers to set optimal prices against unknown demand curves, using a concrete story of pharmaceutical pricing to American and Mexican consumers. By working through profit calculations for themselves, students eventually arrive at the optimal seller prices in three different settings: uniform pricing, price discrimination to two groups, and price discrimination to two groups who can resell to each other. The experimental design encourages students to converge reliably to the theoretical predictions, and students find the exercise to be both interesting and illuminating. Classroom discussion can focus on real-world examples of price discrimination, as well as regulatory policy questions in industrial organization and international trade.

Keywords: price discrimination, monopoly, pharmaceutical market, classroom experiments

JEL Classification: A22, D21, D43, L40

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1. Introduction

Price discrimination represents a potentially exciting topic in a variety of undergraduate and MBA level courses. Price discrimination is commonplace in diverse consumer markets familiar to students: pharmaceuticals, airlines, restaurants, computer software, and movies. The theory of price discrimination is important to the analysis of public-policy questions, such as debates over international pharmaceutical pricing: whether Americans should be allowed to import pharmaceuticals from Canada, and international initiatives to make AIDS treatments affordable to African citizens. However, students find this topic relatively challenging, especially computing optimal prices and understanding welfare effects.

Our interest in the pedagogy of price discrimination is motivated by both its broad applicability and the difficulty of teaching the concept. Typically, the presentation of price discrimination follows a discussion of monopoly power and its welfare-reducing effects. Under the monopoly model, price discrimination may be welfare enhancing, a result which can be both interesting and confusing to the student. Our exercise provides students with an active learning experience with this concept, as they play the roles of buyers and sellers.[1] We have used it with success in principles of microeconomics, intermediate microeconomics, undergraduate industrial organization, and MBA-level courses in international trade and managerial economics.

Previous classroom innovations for teaching price discrimination (Zillante et al., 2005; Hudson and Lusk, 2004)[2] have focused on second-degree price discrimination. By contrast, our classroom experiment illustrates the principle of third-degree price discrimination (group

[1] For a general introduction to using experiments in teaching, see Holt (1999) or Bergstrom and Miller (1999).
[2] Hudson and Lusk develop a Web-based experiment. Zillante *et al.* present a classroom experiment of second-degree price discrimination and a variation of third-degree price discrimination in the context of parking-lot permits. Our experiment, on the other hand, directly addresses the concept of third-degree price discrimination. Furthermore, our design depends less on a specific context than does that of Zillante *et al*.

pricing).[3] Our experiment features the sale of pharmaceuticals by a firm to two countries with different demand schedules. The firm, a monopolist for this drug, first posts a single price to sell the drug to both countries via uniform pricing (Treatment I). Next, the market is segmented, and the firm announces a different price to each country (Treatment II). Finally, we repeat Treatment II but allow resale between buyers of the two countries (Treatment III). Thus, the experiment allows the students to understand: (1) the logic behind third-degree price discrimination, (2) the difference from uniform pricing, (3) why resale impedes the ability to discriminate, and (4) why price discrimination may increase welfare.

In our experiment, students gain an understanding of the key issues in price discrimination through first hand experience. By working through the monopolist problem in cases with and without discrimination, the student learns about optimal pricing, increased monopoly profits and the more advanced topic of welfare analysis. In addition, the context of our experiment, the pharmaceutical market, captures several key issues related to price discrimination: antitrust, international trade, and innovation.

Classroom experiments are not the only effective pedagogical method available to the teaching economist. However, there is increasing formal (and anecdotal) evidence that experiments are a powerful teaching tool. For example, Gremmen and Potters (1997), Frank (1997) and Emerson and Taylor (2004) measure the effect of using hand-run experiments on student's learning and find a positive and significant effect. Ball, Eckel and Rojas (2006) implement a wireless-based system to run classroom experiments and find significant improvements in students' grades. Using this particular experiment in our own classes, we

[3] Pigou (1920) was the first to detail the three different types of price discrimination (first, second and third) and made the conjecture that if output decreases welfare may also diminish. The term 'group pricing' is due to Shapiro and Varian (1999). Shapiro and Varian also renamed first-degree price discrimination as 'personalized pricing' and second-degree as 'versioning.' We find these names to be evocative and convenient for students, especially as second-degree and third-degree discrimination cannot really be ranked in any meaningful way.
[5] <http://www.u.arizona.edu/~dreiley/papers/PriceDiscriminationGame.html>.

have found students much more interested in the topic and more likely to ask challenging questions. In general, the whole classroom experience is much more lively and exciting than without the experiment. We feel confident that the experiment will be useful to other teachers and students as well.

The remainder of our paper proceeds as follows. Section 2 describes the design and procedures. The typical classroom results are shown in Section 3. Section 4 provides suggestions for post-experimental class discussion, and Section 5 outlines possible extensions. The Appendix provides suggested instructions for students as well as notes on implementation for the instructor.

2. Experimental Design

For the experiment, we organize the class into one or more isolated (non-interacting) *identical* markets, which we call 'worlds'. Each 'world' consists of one firm and eight consumers for a homogeneous pharmaceutical product. This multiple-worlds innovation speeds convergence by students to the theoretically predicted prices, because we publicly announce the results for each identical world.

Each student takes the role of either a consumer or a firm. A firm consists of a number of students who cooperatively make decisions. Flexibility in the number of students per firm guarantees a role to every student in the class and makes the class learning experience less dependent on any single student's performance. Three treatments correspond to different market institutions, each played for several rounds until behavior converges to the theoretical prediction. The instructor publicly announces the new trading institutions at the beginning of each treatment.

We have prepared a spreadsheet which records and performs the calculations needed for the game. The spreadsheet automatically adjusts to the necessary size given the number of

"worlds" in the classroom calculates the equilibrium for any parameter values set by the instructor. Graphs also become available as data is entered in each round. [5]

2.1. Demand and Cost Structure

The pharmaceutical firm in each 'world' produces with a constant marginal cost of 1 (and no fixed cost). Consumers have demand induced by a set of eight playing cards. Each world gets four cards with values 3, 4, 5, and 6 from a red-backed deck, plus four cards with values 7, 8, 9, and 10 from a blue-backed deck. We randomly deal one card to each buyer. The numeric value of the card represents the player's private valuation for a single unit of the pharmaceutical. For the purposes of price discrimination, the back of the card will identify the country of the buyer: blue-card consumers live in the United States, while red-card consumers live in Mexico.[6] The instructor does not mention the significance of the colors until the second treatment.

Buyers may buy at most one unit per round of the game. A student who buys a unit earns a surplus equal to the difference between the face value of their card and the posted price. A student who decides not to purchase records zero earnings. The seller's profit equals the markup (price minus $1) times the number of units sold. The seller does not have capacity constraints and can hence sell all units demanded. We encourage students to maximize their earnings, and to write them on a record sheet at the end of each round.

To make the game more interesting and realistic, we do not reveal the demand schedules to sellers; they must guess prices and determine their optimal profits by trial and error.[7] Since playing cards are being used for the experiment, everyone will know that the

[6] The USA-Mexico framing works particularly well in places like Tucson, Arizona, where students are familiar with the idea of trips to Mexico to purchase drugs at lower prices. Instructors are encouraged to change the identities of the countries to suit their locations; for example, instructors in Minnesota may prefer to use USA-Canada.

[7] Revealing the demand conditions to the students does not substantially change the results of the experiment and may be an option particularly if class time is an issue.

consumer's willingness to pay is between 2 and 10. We also allow sellers to use non-integer prices, but the instructor may choose to speed up the game by restricting prices to whole dollar amounts. To make the task easier for sellers, we publicly announce that the economies are identical (i.e., that for each world the supply and demand conditions are the same), and we keep a complete history of results (prices, quantities, profits) for each world tabulated at the front of the room, which can be done using our spreadsheet. By comparing results for different prices across worlds, sellers learn their optimal prices more quickly. We find that sellers converge to near the optimum within about four rounds even when they are choosing a pair of prices against two unknown demand curves. Table 1 shows the actual demand, seller outcomes, and consumer welfare for treatments I and III while table 2 does the same for treatment II. Both tables highlight the optimum outcomes predicted by theory.

One caveat with this experiment is that buyers may lose interest because their task is not as demanding as the firm's, and thus miss out on the great potential for active learning in this game. However, we find that all students benefit from the table of previous results displayed at the front of the room. In addition, we emphasize in each period to all of our buyers that they should think and write down what prices they would choose if they were the seller, even though these prices don't "count" for the game. We have developed several variations of the game to deal with this depending on the preferences of the instructor.

2.2 Treatments

Treatment I (Uniform Pricing): The seller announces a single price for the good. Any buyers wishing to purchase at this price do so by raising their hands. We do not require buyers to purchase when they can obtain positive surplus by doing so, and indeed sometimes we find a buyer or two will withhold demand for a couple of periods, in hopes of getting the seller to lower the future price. This can make it harder to achieve the exact theoretical

prediction for the market, but it makes the game more interesting for the buyers.[8] Buyers then record their earnings privately, and the instructor computes and displays the sellers' earnings at the front of the room. This trading process repeats for several periods until each firm converges to (or near) its optimal uniform price.

Treatment II (Price Discrimination): The instructor announces the meaning of the colors on the backs of the cards. The seller is now allowed to charge a different price for each market. First, the seller begins each round by announcing two prices, one for red card holders (Mexicans) and one for blue card holders (Americans). Second, the Mexicans decide whether to purchase. Third, the Americans decide whether to purchase. Earnings are recorded as before, and the game proceeds for several rounds until prices converge.

Treatment III (Resale): In this treatment, consumers may resell the good between markets. The game proceeds as in Treatment II except that after the purchases in both countries, students can attempt to make trades among themselves. This resale opportunity is announced in advance of the first round of Treatment III. We specifically recommend that the Mexicans purchase before the Americans so that the Americans will have some idea what their post-market purchase opportunities will be. When Mexicans publicly purchase first, they can feel more confident that Americans will wait to buy from them instead of the firm. This helps drive home the point that price discrimination becomes unprofitable with resale. Each buyer is limited to purchasing at most one unit, and may choose either to consume or to resell a purchased unit.[9]

2.3 Predictions

[8] Instructors who prefer faster convergence to the exact theoretical prediction can choose to tell buyers that they must purchase the good if they can earn positive surplus from doing so.

[9] We have tried a version of the classroom game in which individual consumers are permitted to purchase more than one unit for resale. The rules are a bit harder to explain to the students, but in the end we get the same basic result: the introduction of resale causes an eventual return to uniform pricing.

Table 1 presents information regarding the demand schedule, the sellers' outcomes and welfare measures for the first treatment.[10] Given our parameters, the profit-maximizing price in the first treatment is a monopoly price of 6.[11] Assuming that indifferent buyers always purchase, the price results in sales of 5 units for a profit of 25 each round. In the second treatment—as illustrated by Table 2—the profit-maximizing prices are 7 for the U.S. market and 4 for the Mexico market, giving a total profit of 33 and total quantity of 7 units.[12] In the third treatment, the resale option drives the monopolist to set prices in both markets equal to the uniform price, which reduces Mexican consumer surplus to zero.[13]

3. Classroom Experiences

We have implemented the experiment primarily with students having no previous exposure (in that class, at least) to the concept of price discrimination.[14] In general, we have observed consistent results and little variability across classes with the typical outcomes as follows. In Treatment I, the price converges to the monopoly level after about four rounds.

[10] Theoretical predictions for Treatment III (price discrimination with resale) are identical to those of Treatment I, since the seller will (eventually) be motivated to set a uniform price to both American and Mexican consumers.

[11] Note that the profit-maximizing quantity in our setting produces a marginal revenue slightly higher than marginal cost. Some instructors might prefer to have them be exactly equal, for more direct agreement with standard textbook treatments. One could do this by changing the MC from 1 to 2, for example. However, to get exact equality of MC and MR in a discrete-demand setting, one must give up uniqueness: two different prices produce the same maximum profit. We find that having unique predictions improves the experiment.

[12] The instructor can explicitly tell buyers to buy even if they are indifferent; our experience, however, is that the equilibrium is realized even if some buyers do not purchase when they are indifferent.

[13] To see this, note that charging the Mexicans less than the Americans leads to an incentive for all the Mexicans to buy and resell to Americans, all of whom have higher values. In practice, we find that different resale trades take place at different prices, but at any resale price between the lowest American value (7) and the highest Mexican value (6) all eight buyers will have an incentive to trade with each other. In the first round or two of Treatment III we usually observe such resale behavior which costs the seller profits because the seller ends up selling only four units at the lower of his two prices. Since each buyer is limited to one unit, any purchase for reselling purposes does not increase total quantity, but rather shifts quantity to the lower price. As a result, the monopolist would make at least as much profit by charging the highest uniform price that sells the same number of units. Therefore, a profit-maximizing monopolist should set a uniform price , exactly as in Treatment I.

For completeness, we should also consider whether the seller could do better by charging a higher price to the Mexicans than to the Americans. Clearly the optimal American price is $7 (see Table 2). Charging a price of more than $7 would result in zero demand by Mexicans, so the outcome is the same as if the seller had charged a uniform price of $7. Therefore, the seller can do no better than to charge a uniform price.

[14] We have also implemented the experiment with students who have already been assigned a textbook discussion of price discrimination. We find that the experiment engages the students in either case. Previous experience appears to speed convergence slightly.

Table 3 shows an example of the convergence of seller prices in four different worlds to monopoly pricing during the first treatment.[15] Typically, in the first round, people are still learning the mechanics of the game and how to incorporate the information they observe from other worlds. In the second and third rounds, students move towards a good estimate of the profit maximizing price. By the fourth and fifth rounds, they have usually come quite close to the optimum. More worlds tend to speed convergence.

In Treatment II, the sellers recognize quickly that they should charge different prices to the two markets. After the sellers learn about the differences in demands between the two markets, the prices eventually converge toward the optimal levels (typically in three to four rounds; see Table 4 for an example). In Treatment III, both the buyers and sellers have to learn. After some rounds in which the buyers learn to make deals and change their initial demand, the seller eventually realizes that it is optimal to charge a uniform price to both markets (see Table 5).

4. Post-Experiment Class Discussion

The game tends to motivate students for a discussion of the theory of price discrimination. Here we provide some suggestions for a discussion, ideally to take place immediately following the game. Students should already have a feel for the idea of 3rd degree price discrimination from the game, and the student's understanding will be clarified by contrasting the definition of 3rd degree price discrimination with the definitions of 1st and 2nd degree price discrimination. This discussion then leads neatly into the necessary conditions for 3rd degree price discrimination by asking what conditions allowed the monopolist to use 3rd degree price discrimination but not 1st or 2nd degree price

[15] While the instructor might ideally like to see all worlds converging to the same theoretical predictions, time does not necessarily permit many rounds. Furthermore, in our experience, students have already learned the point before all worlds converge to the exact theoretical prediction.

discrimination. The experiment provides concrete examples of the three necessary conditions: (1) there must be multiple consumer types with different demands , (2) the firm must be able to observe the type (card color) of each consumer in setting separate prices, and (3) resale must not be possible across markets (as illustrated by Treatment III). For example, one might ask the students why price discrimination would not have been possible without the ability to observe the consumers' card backs (countries).

By contrast, the conditions for 1st and 2nd degree price discrimination are not satisfied. For instance, in order to use 1st degree price discrimination (personalized pricing), the firm would have to observe not just the card color but the number on each card. In order to use second-degree price discrimination (versioning or quantity discounts), consumers would have to have different demands for quality or quantity; but in the experiment we have consumers each with single-unit demand for a homogeneous good. If instead of (2), the firm only knew that some cards had different numbers, then the firm could not have prevented the Americans from purchasing at the lower price.

Perhaps the most interesting theoretical point is the potential for price discrimination to enhance welfare.[16] . A good leading question is whether it was "right" for the firm to price differently in poor and rich markets. At first, the word "discrimination" may cause students to assume negative effects on welfare. However, a discussion of what happened to Mexican consumers in each treatment will clarify the welfare-improving effects. Since Mexicans go from zero to positive consumer surplus, it is clear to students that the poor nation's welfare was enhanced.

We recommend asking students to compute the total change in surplus for themselves (see Tables 1 and 2). In this exercise, total consumer surplus decreases from 10 to 9 (Mexicans' welfare increases from 0 to 3 while Americans' surplus decreases from 10 to 7)

[16] The sign of the welfare change depends on the relative price elasticity of the demands across markets.

and firm profits increase from 25 to 33, so total social welfare increases from 35 to 42. The discussion can also highlight the fact that total welfare improves with respect to the welfare obtained under a non-discriminating monopolist, but not with respect to the welfare obtained in perfect competition or 1st degree discrimination.

The pharmaceutical market provides a rich context in which to consider policy applications. These policy areas include antitrust policy, R&D, and international trade. In antitrust policy, a basic discussion would involve the question of whether the government should break up the monopoly. While rationale for breaking a monopoly is the welfare loss, price discrimination can be a mitigating force. One type of price discrimination occurs in the pharmaceutical industry in the form of government programs (e.g. Medicare and Medicaid).

The government grants patents, thus forming monopolies, because the R&D needed to invent pharmaceuticals is quite substantial and firms will only invest if profit can be assured. Price discrimination increases the firm's profits and hence the returns to innovation. This can be complemented with a discussion on how reselling the product in the pharmaceutical market can be a problem. Re-exportation of cheaper drugs from Canada and developing countries to the US or Europe can reduce the incentive for R&D.

Firms, however, have devised three strategies to reduce the problem of re-exportation. Drugs can be launched earlier in more developed nations and later in poorer ones (Danzon, Wang, and Wang, 2003). A second strategy takes the form of quantity limits to the poorer nations (MacDonald, 2004), while a third strategy is for the firm to put forward a single

(high) international price, and then negotiate confidential discounts in the countries where it would like to charge lower prices (Danzon and Towse, 2003).

5. Implementation, Extensions, and Variations

The design we present is flexible enough to be implemented in different subjects and different class sizes (see Appendix). The instructor may also wish to customize the experiment by with one of several variations: alternate welfare effects, different pricing schemes, allowing for multiple-unit resale, or changing the context. For clarity in discussing variations, in this section we refer to the game structure that appears in section 2 as the baseline game.

In a microeconomic-principles class, the instructor may want to focus more on the mechanics of the exercise and how profit and welfare are calculated, and perhaps exclude the resale treatment. An intermediate microeconomics instructor, however, may want to challenge their students by asking them what parameter configurations can produce other results, such as a decrease in welfare under price discrimination. In undergraduate industrial organization and MBA courses, discussion might play a larger role, including additional examples relevant to the interest (or experience) of the students.

As noted earlier, the baseline game parameters predict that price discrimination will increase total (producer plus consumer) welfare relative to uniform pricing. If one wishes to emphasize that welfare may be either increased or decreased by price discrimination, an instructor could modify the demand structure of the two markets. One possibility is to decrease the willingness to pay of the poorest American (blue 7) from 7 to 5, which results in a lower predicted total welfare in Treatment II than in Treatment I. In this case, the total welfare at the profit-maximizing prices is 37 in Treatment I and only 36 in Treatment II.[19]

[19]Naturally, there are many other distributions of buyer values that have the effect of decreasing total welfare

Just as with total welfare, the effects of price discrimination on consumer welfare are also ambiguous. In the baseline game, consumer welfare decreases from 10 under uniform pricing to 9 under price discrimination (Tables 1 and 2), with some transfer of surplus from American consumers to Mexican consumers and the firm. By contrast, there are alternative distributions of values for which consumer welfare unambiguously increases under price discrimination. For instance, replacing the red 6 with a red 8 in the baseline deck has the effect of increasing consumer welfare from 7 in Treatment I to 11 in Treatment II for the respective profit-maximizing prices.[20]

The change in the parameters of the game that we suggest, however, should not have a major impact in the dynamic of the game as the incentive of profit maximization is the same as in the parametrizations presented earlier in the paper.

For smaller class sizes, an instructor may find it easier to break a class up into worlds of seven students as opposed to nine students. One possibility is to take out the blue 7 and the red 3. This simpler version of the game will likely converge more quickly, and the positive effects of price discrimination are more striking. Then the predicted profit-maximizing price in the first treatment shuts out the Mexican consumers completely, but price discrimination in the second treatment gives them all an opportunity to purchase the good. The American consumers should be unaffected by price discrimination in this scenario. Thus, price discrimination makes no one worse off, but makes both the seller and the Mexican consumers better off. This example may be useful if an instructor is looking for a quick demonstration where price discrimination is unambiguously "good" for everyone.

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under price discrimination, some of which imply much starker welfare effects. This example was chosen for its similarity to the baseline demand distribution.

[20] Some instructors may want to add another treatment where competition is introduced, reducing the scope for price discrimination. A discussion of this variation is beyond the scope of this paper, however, because it would bring up other concepts in oligopoly.

If you find that consumers do not stay very engaged in the game, we recommend switching students' roles or reshuffling cards after each treatment. This alleviates the problem of a student always having a low value and never participating in the market; the drawback is the loss of continuity between treatments. Also, using tokens or poker chips to represent the pharmaceutical product seems to help consumers feel that their role is more substantial and helps maintain their concentration. Another option is to give the students material incentives to maximize surplus, such as candy or bonus points. The unfairness of the distribution of cards can be alleviated by reshuffling between rounds or treatments. A more radical departure from the game is to eliminate the consumers altogether and replace them with "robots".

In summary, our game gives instructors a powerful tool for helping students understand the effects of price discrimination and resale on consumers and producers. Though simple and easy to administer, it also provides many options for instructors wishing to explore various nuances of the theory and its public-policy applications.

References

Ball, Sheryl, Catherine Eckel and Christian Rojas (2006), "Technology Improves Learning in Large Principles of Economics Classes: Using Our WITS", *American Economic Review* Papers and Proceedings, 96, 2.

Bergstrom, T. and J. Miller (1999): *Experiments with Economic Principles: Microeconomics*, McGraw-Hill/Irwin.

Danzon, P.M., A. Towse (2003): "Differential Pricing for Pharmaceuticals: Reconciling Access, R&D and Patents." *International Journal of Health Care Finance and Economics*, 3, 183–205.

Danzon, P. M., Y. R. Wang and L. Wang (2003): "The Impact of Price Regulation on the Launch Delay of New Drugs: Evidence from Twenty Five Countries in the 1990s." Working Paper, The Wharton School.

Emerson, Tisha L.N. and Beck A. Taylor (2004). "Comparing Student Achievement across Experimental and Lecture-Oriented Sections of a Principles of Microeconomics Course," Southern Economic Journal 70(3):
672-93 (January).

Frank B., (1997). "The impact of classroom experiments on the learning of economics: an empirical investigation" Economic Inquiry Oct 1997 v35 n4 p763(7) p 1.

Gremmen, H., & Potters, J. (1997). "Assessing the efficacy of gaming in economic education." Journal of Economic Education, Fall. 291-303.

Holt, C. A. (1999): "Teaching Economics with Classroom Experiments" *Southern Economic Journal* 65(3), 603-610.

Hudson, D. and J. Lusk (2004): "What you don't Know Can Cost you: A Web-Based Experiment in Price Discrimination." *Review of Agricultural Economics* 26 (3), 392-403.

MacDonald, J. A. "Importing Drugs, Exporting Scarcity: Canadian Pharmacies See Problems Emerging From Cross-Border Trade, Suppliers' Limits." *Hartford Courant*. September 12, 2004.

McNeil, D.G. (2004): "Plan to Battle Aids Worldwide Is Falling Short." New York Times, March 28, 2004, 1.1.

Pigou, A. C. (1920): *Economics of Welfare*, 1st ed., London, McMillan.

Shapiro, C. and H. Varian (1999): *Information Rules*. Harvard Business School Press.

Zillante, A., S. Stafford, J. Michael, J. Heath, G. Buchholtz, K. Guthrie and Julia Heath (2005) "The campus parking game: a demonstration of price discrimination and efficiency" *Southern Economic Journal*, 71, 668-682.

Table 1. Demand Schedule, and Corresponding Seller Outcomes and Consumer Welfare under Uniform Pricing (Treatments I and III)

Price	*# of Units Demanded*	*Total Revenue*	*Marginal Revenue*	*Seller Profit*	*Consumer Welfare*	*Total Welfare*
10	1	10	10	9	0	9
9	2	18	8	16	1	17
8	3	24	6	21	3	24
7	4	28	4	24	6	30
6	**5**	**30**	**2**	**25**	**10**	**35**
5	6	30	0	24	15	39
4	7	28	-2	21	21	42
3	8	24	-4	16	28	44

Note: Row in **bold** denotes predicted profit-maximizing outcome.

Table 2. Demand Schedule, and Corresponding Seller Outcomes and Consumer Welfare under Price Discrimination without Resale (Treatment II)

	Price	*# of Units Demanded*	*Total Revenue*	*Marginal Revenue*	*Seller Profit*	*Consumer Welfare*	*Total Welfare*
USA	10	1	10	10	9	0	9
	9	2	18	8	16	1	17
	8	3	24	6	21	3	24
	7	**4**	**28**	**4**	**24**	**6**	**30**
Mex	6	1	6	6	5	0	5
	5	2	10	4	8	1	9
	4	**3**	**12**	**2**	**9**	**3**	**12**
	3	4	12	0	8	6	14

Note: Rows in **bold** denote predicted profit-maximizing outcome.

Table 3: Sample Results from a Classroom Experiment with 4 Worlds, Treatment I (Uniform Pricing)

Round	*World*	*Price*	*Quantity Sold*	*Profit*
1	A	7	4	24
	B	**6**	**5**	**25**
	C	8	2	14
	D	4	5	15
2	A	5	6	24
	B	5	6	24
	C	**6**	**5**	**25**
	D	6	4	20
3	A	4	7	21
	B	**6**	**5**	**25**
	C	**6**	**5**	**25**
	D	7	2	12
4	**A**	**6**	**5**	**25**
	B	**6**	**5**	**25**
	C	5	6	24
	D	6.5	4	22

Note: Rows in **bold** denote profit-maximizing choices.

Table 4: Sample Results from a Classroom Experiment with 4 Worlds for Treatment II (Price Discrimination)

Round	*World*	*US Price*	*US Quantity*	*Mexico Price*	*Mexico Quantity*	*Profit*
1	A	7	4	3	2	28
	B	**7**	**4**	**4**	**3**	**33**
	C	6	4	5	2	28
	D	6	4	3	4	28
2	A	7	4	5	2	32
	B	8	1	4	3	16
	C	7	4	4	2	30
	D	6.5	4	4	2	28
3	**A**	**7**	**4**	**4**	**3**	**33**
	B	7	0	4	3	9
	C	7	4	5	2	32
	D	6.5	4	3	4	30
4	A	7	3	3	4	26
	B	6	4	4	3	29
	C	7	4	5	2	32
	D	7	3	3.5	3	25.5

Note: Rows in **bold** denote profit-maximizing choices.
US buyers in world B were actively engaged in collective bargaining with their seller; rounds 2, 3, and 4 demonstrate the buyers' boycott and its effects.

Table 5: Sample Results from a Classroom Experiment with Four Worlds for Treatment III (Discriminatory Pricing with Resale)

Round	*World*	*US Price*	*US Quantity*	*Mexico Price*	*Mexico Quantity*	*Profit*
1	A	6	2	5	2	18
	B	**6**	**4**	**6**	**1**	**25**
	C	7	1	6	1	11
	D	5	2	3	4	16
2	A	4	4	4	3	21
	B	6	4	6	0	20
	C	***4.99***	***4***	***5***	***4***	***31.96***
	D	4	3	3	4	17
3	A	7	3	6	0	18
	B	4	4	4	3	21
	C	7	0	6	3	15
	D	5	4	5	0	16

Note: Row in **bold** denotes legitimate realized profit-maximizing outcome.
Row in ***bold italics*** denotes illegal results obtained in an improperly run round. Apparently the seller misunderstood the order of events during the round (though as seen above this slip was suspiciously advantageous to him). Instead of announcing both US and Mexican prices before taking Mexican orders, the seller announced only a Mexican price, took Mexican orders, after that announced a US price that undersold the potential Mexican suppliers, and finally took US orders. The resale period for this world was thus mooted. This point was immediately clarified and did not occur again in any world.

Appendix: Suggestions for the Instructor and Student Instructions

Preparation before Class

To identify the high and low demand buyers, you will need at least two decks of cards of different colors, for example red and blue. Modify instructions accordingly if you have other colors. Separate from the red deck four sets of cards, each with the numbers 3, 4, 5 and 6. Separate from the blue deck four sets of cards, each with the numbers 7, 8, 9 and 10. With these cards, create four different sets of cards containing the numbers 3 through 10. Each of these four sets will then have four red cards (with numbers 3 through 6) and four blue cards (with numbers 7 through 10). Each of these four sets will be the reservation values of the buyers in each world.

Two decks of cards should hence allow you to create four worlds, each with eight buyers (with numbers 3 through 10) and one seller. To allow more students to be sellers, you can group two or three students as a single seller and let them together come up with the price decision each round. Add more decks for bigger classes. You can assign assistants to help distribute instructions or collect information. A simple formula to figure out the set-up of a given class is class size divided by 9 then to distribute the remainder to be in the seller firms or assistants. The experiment can accommodate different class sizes. For example, if you have 66 students in a class you can have: 7 worlds, with 3 worlds having 2 students as the seller or you could have 6 worlds with each seller composed of 3 students.

We recommend that you project the results of each market in every round to the whole class. We have developed a spreadsheet that allows you to register prices, quantities and sellers' profits in each world. This spreadsheet has built-in formulas that automatically calculate the sellers' profits. In addition, the spreadsheet creates tables and graphs that can be used for later class discussion.

Running the Experiment

The experiment can be run in approximately 40 minutes. Depending on the length of the class, discussion can either be conducted after the experiment or it can be delayed for the next session. Separate the worlds (groups), and assign students the roles of buyers, sellers or assistants. Read the general instructions for buyers and sellers as well as the instructions for the first game. Make sure that everyone understands the exercise and ask if anyone has questions. Next, deal a card to each of the buyers of each world. Do not mention the fact that some cards are red and some are blue and, if asked, say that the colors do not matter at this point in the game. Begin the first round of trading according to the instructions. At the end of each round, record the outcome (prices, quantities, and profits) of each world, make sure everyone in the class notices these results, and then begin the next round. For each treatment, read aloud the instructions for sellers and buyers for that treatment. Repeat rounds of that treatment until prices converge to predicted values or until five rounds, whichever comes first. Since buyers who get cards with a number 3 or 4 have limited interaction ability, we recommend that at the beginning of each treatment you reshuffle the cards in each market. Also, make sure that sellers do not interact with buyers and display the results of all markets only after every world has finished trading.

Instructions

We are going to set up a market in which some people will be buyers of pharmaceuticals, and others will be sellers. One seller and a group of 8 buyers represent an independent 'world'.

Buyers: Each buyer will be given a numbered playing card. Please hold your card so that others do not see the number. The number on each card represents the dollar value of the utility (in dollars) that you receive if you purchase a unit of the product. You are only allowed to buy one unit. The dollar amount that you earn from each unit purchased is the face value of your card minus the price at which you purchase. You have the option of not purchasing, but then you will have earnings of zero. The game will be played for several rounds, please record your earnings for each round.

Sellers: To each group of buyers, there should be assigned one group of sellers, referred to hereafter as "The Seller," consisting of 1 to 3 people. The seller acts as a single unit selling to a group of buyers, so that the exact number of people in the seller group is not important. Individuals in the seller group should come to a consensus on their pricing decisions each round.

The seller may sell as many units as are requested by consumers. The seller will be required to sell at a price that is no lower than Marginal Cost, which is $1. Earnings on the sale of each unit are calculated as the difference between the price negotiated and $1. The seller should record earnings for each round.

First Game

First, the seller announces one price at which the buyers in that world may purchase. The seller may choose a price in dollars and cents (whole-dollar increments are fine but not required). Then, each buyer wishing to purchase at the announced price should raise her hand and record the purchase price and her earnings, which will be her card value minus the seller's stated price for that round.

The seller should count and record the number of buyers purchasing at the quoted price, and then calculate the resulting profits. This is done for a number of rounds.

Second Game

Now we are going to set up a market in which some people will be Mexican buyers of pharmaceuticals, and others will be US buyers. Buyers with red cards are residents of Mexico, and buyers with blue cards are residents of the US. The game proceeds as before, except that now the seller announces two prices (one for each nation) and Mexican buyers will be given the opportunity to purchase first. After Mexican buyers have made their purchases US buyers are given the opportunity to raise their hands and purchase. Buyers and sellers will then record their earnings. Again, this is played for a few rounds.

Third Game

Proceed as in the second game, with the difference that now buyers have the option of reselling their unit to other buyers after the seller has concluded transactions with both the Mexicans and the Americans (remember Mexicans buy first, then Americans). If a buyer buys a unit from the seller and resells his/her unit to another buyer, earnings are calculated as the difference between the two prices (price sold to another buyer minus the original seller price). Otherwise, earnings are calculated as before: the difference between the price at which unit was purchased (whether it was from seller or another buyer) and the card number. To summarize this game:

a. Seller quotes two prices
b. Mexicans buy, Americans buy
c. Americans and Mexicans trade units (if desired)
d. Buyers and seller record earnings.

NOTE: You may purchase a unit even if the quoted price is higher than your card number; however, if you do so and cannot resell the unit at a higher price (or at least as high) you will incur a loss.

Buyer's Record Sheet

Game 1

Round	**Price Paid**	**Earnings:** •(Card # – Price) if purchased •0 if no purchase	*Price you would charge next period if you were the seller*
1			
2			
3			
4			
5			

Game 2

Round	**Price Paid**	**Earnings:** •(Card # – Price) if purchased •0 if no purchase	*Prices you would charge next period if you were the seller*	
			USA	*Mexico*
6				
7				
8				
9				
10				

Game 3

Round	**Price Paid**	**Earnings:** •(Card # – Price) if consumed •(Price sold – Price paid) if resold •0 if no purchase	*Prices you would charge next period if you were the seller*	
			USA	*Mexico*
11				
12				
13				
14				
15				

TOTAL EARNINGS	

Seller's Record Sheet

Game 1

Round	Price	Quantity Sold	Revenue	Unit Cost	Total Cost	Profit
1				1		
2				1		
3				1		
4				1		
5				1		

Game 2

Round	USA Price	USA Quantity	Mexico Price	Mexico Quantity	Total Revenue	Unit Cost	Total Cost	Profit
6						1		
7						1		
8						1		
9						1		
10						1		

Game 3

Round	USA Price	USA Quantity	Mexico Price	Mexico Quantity	Total Revenue	Unit Cost	Total Cost	Profit
11						1		
12						1		
13						1		
14						1		
15						1		

TOTAL EARNINGS	