For our immediate concern with price discrimination, the first thing to note is that those buyers with the most elastic demands and therefore those who pay the lowest prices tend to be those from census blocks with typically low incomes or high education levels. Thus, the coefficients on the two income variables imply that the price rises sharply as the median household income of the buyer's census block increases above \$80,000. The price is also notably higher for someone likely to have less than a high school education and falls significantly for those with a college degree. The interpretation of these factors is straightforward. Those with relatively high incomes have high search costs because the value of their time is high. Hence, they are willing to pay a high price for a car rather than spend more time seeking a better deal. Similarly, those with little education are willing to pay a higher price, all else equal, because they find searching difficult.

SZS pay particular attention to the race and gender effects. Because the race variable is the percentage of the census block of a specific race, one may take this as an estimate of the probability that the buyer from that block is also of that race. Thus, if we set either %Black or %Hispanic to 100, the coefficient will indicate the price differential paid by a black or Hispanic buyer relative to a white person. The data therefore indicate that Hispanic and black car buyers pay 1.1% and 1.5% more, respectively, than do white buyers.

Turning to the gender variable (which is assigned primarily on a name basis), the initial estimate suggests that women pay 0.2% more for a new car than do men. SZS feel that this may underestimate the gender effect because often a brother, father, boyfriend, or husband is present in those cases in which the buyer is recorded officially as a woman. They therefore look separately at the purchase of minivans for which 98 percent of the buyers are married couples relative to the purchase of compact and sporty cars for which only 48 percent of the buyers are married couples. The female price premium essentially disappears for the case of minivans but rises to over four-tenths of a percent for compact car purchases.

Given an average car price of \$23,000, the price premia that SZS estimate for minorities (\$253–\$345) and women (\$98) translate into nontrivial dollar amounts. It is natural to ascribe these extra charges to racial and gender bias. SZS however suggest that it is not so much bias on the part of dealers as it is the case that the race and gender variables capture the further measure of search cost difficulty. Recall that the authors also have data indicating whether or not the buyer used the Internet service, Autobytel, to submit their purchase request. For this group of buyers—just under 3 percent of all buyers—search costs should be decidedly smaller. Thus, this group of buyers should pay a lower price, all else equal. More importantly, if the premium paid by women and minorities is due mainly to search costs, then use of Autobytel should be particularly helpful to these buyers.

Table 5.4 below shows the effects that SZS estimate for the impact of Autobytel use both by itself and when it is interacted with each of the important buyer groups. Here, SZS also include the market research firm's race assignment (Hispanic or Asian) to supplement the census block data so as to get as complete an estimate of the internet effect as possible.

Clearly, the use of Autobytel's Internet service helps reduce prices. Most notably though, these effects are particularly important for women and minorities. The coefficients above suggest that for those black and Hispanic buyers who used Autobytel, the earlier premiums they paid of 1.1 to 1.5 percent are virtually eliminated. For women who use this service, the effect is smaller but still very significant.

In short, the SZS results confirm our analysis that consumers with high search costs have less elastic demands and therefore end up paying higher prices. In the case of car buyers, this includes in particular those with higher incomes and less education. It also includes minority and female buyers. As a result, it is particularly these buyers who benefit from use of an Internet-based car-buying service.

Table 5.4 Impact of internet use (Autobytel) on actual car prices paid

Variable	*Estimated Coefficient*	*Standard Error*
Autobytel	−0.88	0.045†
Autobytel Franchise	−0.46	0.015†
Autobytel *%Black	−0.12	0.0028†
— *%Hispanic	−0.02	0.0038†
— *%Asian	−0.007	0.0033†
— *Hispanic	−0.57	0.15†
— *Asian	0.14	0.16
— *Female	−0.12	0.058

*Significant at 5% level.
†Significant at 1% level.

Summary

We started this chapter with a discussion of prescription drug price differentials that seem not to be related to costs. In a well-functioning market, such differentials can only occur if there is something that allows a firm with market power to set different prices to different groups of consumers. We showed that a firm with monopoly power can increase its profits if the firm can figure out a way to separate its consumers by type and charge different prices to the different types. Our analysis has concentrated on third-degree price discrimination or group pricing, in which the firm offers different prices to different consumer groups, but leaves it up to consumers to determine how much they will purchase at the quoted prices. This is often referred to as linear pricing.

In order to implement third-degree price, discrimination the firm has to solve two problems. First, it needs some observable characteristic by which it can identify the different groups of consumers: the identification problem. Second, the firm must be able to prevent consumers who pay a low price from selling to consumers offered a high price: the arbitrage problem. Provided that both problems can be overcome, there is then a simple principle that guides the monopolist in setting prices. Set a high price in markets in which elasticity of demand is low and a low price in markets in which elasticity of demand is high. When the firm makes a single homogeneous product, this implies that different groups of consumers will be paying different prices for the same good. If the firm sells differentiated products, it implies that the prices of different varieties will vary by something other than the difference in their marginal production costs.

Recent empirical evidence on new car purchases provides support for the hypothesis that the negotiated auto price will vary inversely with the buyer's elasticity which, in turn, varies inversely with the buyer's search costs. Buyers whose search costs are low either because they are well educated, have a low opportunity cost of time or, in particular, use Internet buying programs tend to pay significantly lower net prices for new cars. This last mechanism is particularly important for minorities and women who otherwise tend to pay 0.2 to 1.5 percent more for a new care relative to other groups.

While third-degree price discrimination or group pricing is undoubtedly profitable, it is less clear that it is socially desirable. Again there is a simple principle that can guide us. For third-degree price discrimination to increase social welfare it is necessary, but not sufficient, that it lead to an increase in output. This makes intuitive sense. After all, we know that under uniform pricing or nondiscrimination a monopolist makes profit by restricting output. If price discrimination leads to increased output it might reduce the monopoly distortion. This is, however, a tall order, usually requiring some very restrictive conditions regarding the shapes of the demand functions in the different markets. For example, it is a condition that is *never* satisfied when demands are linear and the same markets are served with and without price discrimination.

The qualification regarding the same markets being served is, however, important. There may be cases in which group price discrimination has the beneficial effect of encouraging the monopolist to serve markets that would otherwise have been left unserved. For example, markets populated by very low income groups might not be supplied if the monopolist were not able to set discriminatory prices. When price discrimination leads the monopolist to serve additional markets, the likelihood that it increases social welfare is greatly increased.

We conclude by noting one limitation of focusing on third-degree price discrimination. Restricting the monopolist to simple, linear forms of price discrimination is qualitatively the same as allowing it to charge a monopoly price in each of its separate markets. Yet we know that in any given market, charging a monopoly price reduces the surplus. The monopolist knows this too and, therefore, cannot help but wonder if a more complicated—that is, a nonlinear pricing strategy—might permit the monopolist to capture more of the potential surplus as profit. It is to this question that we turn in the next chapter.

Problems

1. TRUE or FALSE: Price discrimination always increases economic efficiency relative to what would be achieved by a single, uniform monopoly price.

2. A nearby pizza parlor offers pizzas in three sizes: small, medium, and large. Its corresponding price schedule is: \$6, \$8, and \$10. Do these data indicate that the firm is price discriminating? Why or why not?

3. A monopolist has two sets of customers. The inverse demand for Group 1 is described by $P = 200 - X$. For Group 2, the inverse demand is $P = 200 - 2X$. The monopolist faces constant marginal cost of 40.
   a. Show that the monopolist's total demand, if the two markets are treated as one is:
   $$\begin{array}{ll} X = 0; & P \geq 200 \\ X = 200 - P; & 100 < P \leq 200 \\ X = 300 - (3/2)P; & 0 < P \leq 100 \end{array}$$
   b. Show that the monopolist's profit maximizing price is $P = 120$ if both groups are to be charged the same price. At this price, how much is sold to members of Group 1 and how much to members of Group 2? What is the consumer surplus of each group? What are total profits?

4. Now suppose that the monopolist in #3 can separate the two groups and charge separate, profit-maximizing prices to each group
   a. What will these prices be? What is consumer surplus? What are total profits?
   b. If total surplus is consumer surplus plus profit, how has price discrimination affected total surplus?

5. Suppose that Coca-Cola uses a new type of vending machine that charges a price according to the outside temperature. On "hot" days—defined as days in which the outside temperature is 25 degrees Celsius or higher—demand for vending machine soft drinks is: $Q = 300 - 2P$. On "cool" days—when the outside temperature is below 25 degrees Celsius—demand is: $Q = 200 - 2P$. The marginal cost of a canned soft drink is 20 cents.
   a. What price should the machine charge for a soft drink on "hot" days? What price should it charge on "cool" days?
   b. Suppose that half of the days are "hot" and the other half are "cool." If Coca-Cola uses a traditional machine that is programmed to charge the same price regardless of the weather, what price should it set?
   c. Compare Coca-Cola's profit from a weather-sensitive machine to the traditional, uniform pricing machine.

6. Return to the final example of section 5.5, in which the demand for AIDS drugs was $Q_N = 100 - P$ in North America and $Q_S = \alpha 100 - P$ in Sub-Saharan Africa. Show that with marginal $cost = 20$ for such drugs, it must be the case that $\alpha > 0.531$ if the drug manufacturer is to serve both markets while

charging the same price in each market. (HINT: Calculate the total profit if it serves only North America and then calculate the total profit if it serves both markets. Then determine the value of α for which the profit from serving both markets is at least as large.)

7. Frank Buckley sells his famous bad tasting but very effective cough medicine in Toronto and Montreal. The demand functions in these two urban areas, respectively, are: $P_T = 18 - Q_T$ and $P_M = 14 - Q_M$. Buckley's plant is located in Kingston, Ontario, which is roughly midway between the two cities. As a result, the cost of producing and delivering cough syrup to each town is: $2 + 3Q_i$ where $i = T, M$.
   a. Compute the optimal price of Buckley's cough medicine in Toronto and Montreal if the two markets are separate.
   b. Compute the optimal price of Buckley's medicine if Toronto and Montreal are treated as a common market.

8. The Mount Sunburn Athletic Club has two kinds of tennis players, Acers and Netters, in its membership. A typical Ace has a weekly demand for hours of $Q_A = 6 - P$. A typical Netter has a weekly demand of $Q_N = 3 - P/2$. The marginal cost of a court is zero and there are one thousand players of each type. If the MSAB charges the same price per hour regardless of who plays, what price should it charge if it wishes to maximize club revenue?

References

Deneckere, R., and R. P. McAffee. 1996. "Damaged Goods," *Journal of Economics and Management Strategy* 5 (Summer): 149–74.

Leslie, P. 2004. "Price Discrimination in Broadway Theatre," *Rand Journal of Economics* 35 (Autumn): 520–41.

Quon, B., R. Firszt, and M. Eisenberg. 2005. "A Comparison of Brand Name Drug Prices between Canadian-Based Internet Pharmacies and Major U.S. Drug Chain Pharmacies," *Annals of Internal Medicine*, 143: 397–403.

Philips, L. 1983. *The Economics of Price Discrimination*. Cambridge: Cambridge University Press.

Pigou, A. C. 1920. *The Economics of Welfare*. London: MacMillan.

Schmalensee, R. 1981. "Output and Welfare Implications of Monopolistic Third-Degree Price Discrimination," *American Economic Review* 71 (March): 242–47.

Scott Morton, F., F. Zettelmeyer, and J. Silva-Risso. 2003. "Consumer Information and Discrimination: Does the Internet Affect the Pricing of New Cars to Women and Minorities?" *Quantitative Marketing and Economics* 1 (March): 65–92.

Skinner, B., and M. Rovere. (2008). *Seniors and Drug Prices in Canada and the United States*. Fraser Alert, Fraser Institute, Canada.

Stiglitz, J. 1977. "Monopoly, Nonlinear Pricing, and Imperfect Information: The Insurance Market," *Review of Economic Studies* 44 (October): 407–30.

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

Shih, J., and C. Mai, and J. Liu. 1988. "A General Analysis of the Output Effect under Third-Degree Price Discrimination," *Economic Journal* (March): 149–58.

Appendix

DISCRIMINATORY AND NONDISCRIMINATORY PRICING

Let a monopolist supply two groups of consumers with inverse demand given by:

$$
\begin{aligned}
P_1 &= A_1 - B_1 Q_1 \\
P_2 &= A_2 - B_2 Q_2 \qquad (5.A1)
\end{aligned}
$$

We assume that $A_1 > A_2$ so that group 1 is the "high demand" group whose demand is the less elastic at any given price. Inverting the inverse demands gives the direct demands at some price P:

$$Q_1 = (A_1 - P)/B_1;\ Q_2 = (A_2 - P)/B_2 \tag{5.A2}$$

Aggregate demand is:

$$Q = Q_1 + Q_2 = \frac{A_1B_2 + A_2B_1}{B_1B_2} - \frac{B_1 + B_2}{B_1B_2}P \tag{5.A3}$$

Of course, this holds only for any price less that A_2. Aggregate inverse demand for the two groups, again for any price less than A_2 is:

$$P = \frac{A_1B_2 + A_2B_1}{B_1 + B_2} - \frac{B_1B_2}{B_1 + B_2}Q \tag{5.A3}$$

The marginal revenue associated with this aggregate demand is:

$$MR = \frac{A_1B_2 + A_2B_1}{B_1 + B_2} - 2\frac{B_1B_2}{B_1 + B_2}Q \tag{5.A4}$$

Without loss of generality, assume that marginal cost is zero. Equilibrium aggregate output Q^U and price P^U with uniform pricing is then:

$$Q^U = \frac{A_1B_2 + A_2B_1}{2B_1B_2};\quad P^U = \frac{A_1B_2 + A_2B_1}{2(B_1 + B_2)} \tag{5.A5}$$

Substituting this price into the individual demands then gives equilibrium output in each market

$$Q_1^U = \frac{(2A_1 - A_2)B_1 + A_1B_2}{2B_1(B_1 + B_2)};\ Q_2^U = \frac{(2A_2 - A_1)B_2 + A_2B_1}{2B_2(B_1 + B_2)} \tag{5.A6}$$

With third-degree price discrimination, marginal revenue equals marginal cost for each group. Hence:

$$Q_1^D = \frac{A_1}{2B_1};\ Q_2^D = \frac{A_2}{2B_2}. \tag{5.A7}$$

Comparison of (5.A6) and (5.A7) confirms that 1) $Q_1^D < Q_1^U$; and 2) $Q_2^D > Q_2^U$.

6

Price Discrimination and Monopoly: Nonlinear Pricing

If you buy the *New Yorker* magazine at the newsstand, you will pay $4.99 per issue, or $234.53 if you buy all forty-seven issues. If instead you purchase an annual subscription you will pay $69.99 for forty-seven issues—a savings of approximately 70 percent over the newsstand price. Similarly, if you are a baseball fan you know that the price per ticket on a season pass is much less than the price per ticket on a game-by-game basis. When you go grocery shopping you find that a 24-pack of Coca-Cola costs less on a price-per-can basis than a six-pack or than a single can. These are all examples of price discrimination that reflect quantity discounts—the more you buy the cheaper it is on a per-unit basis.

Quantity discounting is just a way of saying that firms are employing *nonlinear* prices. The price per unit is not constant but rather varies with some feature of the buying arrangement depending, perhaps, on the consumer's income, value of time, the quantity bought or other characteristics. Such a pricing strategy differs from the linear price discrimination methods discussed in Chapter 5. The goal of nonlinear pricing is to allow the seller to convert as much of the individual consumer's willingness to pay into revenues and profits as possible. We shall see that such techniques are generally more profitable than third-degree price discrimination or linear pricing, precisely because they permit the seller to set a price closer to willingness to pay *of each consumer*. As a result, nonlinear pricing helps the monopolist to earn more profit.

The design and implementation of nonlinear pricing strategies are this chapter's focus. We explore how and under what circumstances a firm with market power can implement such pricing schemes and examine their welfare properties. Traditionally, nonlinear pricing is divided into two general categories: first-degree price discrimination and second-degree price discrimination or, as Shapiro and Varian (1999) categorize them, personalized pricing and menu pricing. See both Pigou (1920) and Philips (1983) for an elaboration of price discrimination categories.

6.1 FIRST-DEGREE PRICE DISCRIMINATION OR PERSONALIZED PRICING

First-degree, or perfect price discrimination is practiced when the monopolist is able to charge the maximum price each consumer is willing to pay for *each* unit of the product sold. Suppose that you have inherited five antique cars, each a classic Ford *Model T*, and that you want to sell them to finance your college education. They are of no other value to you. Your market research tells you that there are several collectors interested in buying a *Model T*. When you rank these collectors in terms of their willingness to pay for a car, you estimate that the keenest collector is willing to pay up to $10,000, the second up to $8,000, the third up to $6,000, the fourth $4,000, and the fifth $2,000. First-degree price discrimination means that you are able sell the first car for $10,000, the second for $8,000, the third for $6,000, the fourth for $4,000, and the fifth car for $2,000. The revenue from such a discriminatory pricing policy is $30,000. Not surprisingly, this strategy is also called personalized pricing.

What if, on the other hand, you chose to sell your antiques at the same, uniform price? It is easy to calculate that the best you can do is to set a price of $6,000 at which you sell three cars for a total revenue (and profit) of $18,000. Any higher or lower price generates lower revenues. In short, under uniform pricing your highest possible revenue is $18,000 while successful first-degree price discrimination yields a much higher revenue of $30,000. Why? Very simply because first-degree price discrimination enables you to extract the entire surplus that selling your car generates. No consumer surplus remains if you can successfully discriminate to this extent whereas with a uniform price the keenest buyer has consumer surplus of $4,000 and the second keenest buyer has consumer surplus of $2,000.

Because first-degree price discrimination, or personalized pricing, redirects surplus from consumers to the firm, it should be expected to increase the monopolist's profit-maximizing output. In fact, as we shall see, with first-degree price discrimination the monopolist chooses the socially efficient output: the output that would be achieved under perfect competition. In our *Model T* example, no mutually beneficial trades are left unmade: all five cars are sold. By contrast, with uniform pricing only three cars are sold leaving two of the cars in the "wrong" hands: there are two potential buyers who value the cars much more highly than you do.

The same is true in more general cases. For a monopolist able to practice first-degree price discrimination, selling an additional unit never requires lowering the price on other units. Each additional unit sold generates additional revenue exactly equal to the price at which it is sold. Hence, with first-degree price discrimination marginal revenue is equal to price. Accordingly, for such a monopolist, the profit maximizing rule that marginal revenue equals marginal cost yields an output level at which price equals marginal cost as well. As we know, this is the output level that would be generated by a competitive industry.

6.1

Practice Problem

Suppose that a monopoly seller knows that his or her demand curve is linear, and knows that at a price of $40, five units can be sold, while at a price of $25, 10 units are sold.

a. If each potential consumer buys only one unit, what is the reservation price of the consumer with the greatest willingness to pay?
b. Suppose that the monopolist discovers that the demand curve worked out in (a) applies only to the first unit a consumer buys and that, in fact, each consumer will buy a second unit at a price $8 below the price at which they purchase just one. How many units will be sold at a price of $34? (Use whole dollar amounts.)

At first glance it might seem that first-degree discrimination is little more than a theoretical curiosity. How could a monopolist ever have sufficient information about potential buyers and the ability to prevent arbitrage so as to effectively implement a pricing scheme in which a different, personalized price is charged to each buyer and for each unit bought? The problems of identification and arbitrage prevention seem insurmountable. However, in some cases the monopolist seller may indeed have the ability to achieve the personalized pricing outcome. A tax accountant knows the financial situation of his or her clients. Management consultants typically negotiate their fees with individual clients. Another example, rather closer to home, is the fees paid by students who apply to any of the (expensive) private universities in the United States. When they apply for financial aid, they are required to complete a detailed statement of financial means. The universities of course can use this information, as well SAT scores and other data, to determine the aid to be granted and so the net tuition that each prospective student is required to pay. Look around you. If you break down the total tuition on a per class basis, chances are that many of your classmates are paying a different fee for this class than you are!

Of course, the accountant, consultant, and university examples are somewhat special because often the fee is set *after* the customer has contracted to purchase the service. What we now consider is whether there are pricing strategies that permit the seller to achieve the same effect even when fees must be announced in advance. The answer is yes, in some circumstances. One such strategy is a *two-part* pricing scheme. Another is *block pricing*. We discuss each in turn.

Reality Checkpoint

The More *You* Shop the More *They* Know

Before Facebook, could sell shares in the company on the public stock markets, it had to reveal its business model showing its assets and sources of income. Advertising revenue of course tops the bill, but it is really access that Facebook sells. Facebook makes money by selling ad space to companies that want to reach a targeted audience. Advertisers choose key words or characteristics for focus such as relationship status, location, activities, favorite books, and employment. Then, Facebook runs the ads for the targeted groups within its millions of users. If you reveal a taste for wine, live in certain neighborhoods, and host parties, then the local liquor store can place an ad on your page.

Of course, Facebook is not alone. Other e-commerce retailers such as Amazon.com and Wine.com constantly track your purchases. This allows them to tailor both ads and special promotional offers to their individual consumers. Third-party trackers are also important. NebuAd, for example, contracts with Internet service providers to monitor user activities in e-mail, web searches, and Internet purchases. All this information is collected and sold to advertisers with a view to creating more effective advertising. Health product promotions can be more appropriately aimed at those of the right age, gender, and with a specific history of web searches. Different vacation package offerings can be shown to different consumers again depending on age, location, and Internet history. Spokeo gathers data both for advertising and for reselling to others such as potential employers. Indeed, one of its services invites women, for a fee, to submit their boyfriends' e-mail address and offers in return to provide the information necessary for a woman to find out if "He's Cheating on You." Whatever one's relationships status on Facebook, however, there is no doubt that each of our cyber selves is intimately known.

Source: Shapiro and Varian. 1999. *Information Rules: A Strategic Guide to the Internet Economy*, Harvard Business School Press: Boston.
L. Andrews, "Facebook is Using You," *New York Times* February 5, 2012, p SR7.

6.1.1 Two-Part Pricing

A two-part pricing scheme is a pricing strategy that consists of: 1) a fixed fee, such as a membership fee, that entitles the consumer to buy the good or service but which is independent of the quantity that the buyer actually purchases; and 2) a price or usage fee charged for each unit the consumer actually buys. Many clubs use such two-part pricing. They charge a flat annual fee for membership in the club (which is sometimes differentiated by age or some other member characteristic), and additional per-unit fees to use particular facilities or buy particular goods or services. Country clubs, athletic clubs, and discount shopping clubs are all good examples of organizations that use this kind of pricing. A related example of two-part pricing is that used by theme parks under which a flat fee is charged to enter the park and additional fees (sometimes set to zero) are charged on a per ride or per amusement basis.[1]

To see how two-part pricing can work to achieve first-degree price discrimination, let us consider a ski resort in Colorado owned and operated by a local monopolist. Assume that the resort's clients are of two types, old and young. A typical old client's inverse demand curve to use the resort's ski lifts is:

$$P = V_O - Q_O \tag{6.1}$$

while from each young client has the inverse demand curve:

$$P = V_Y - Q_Y \tag{6.2}$$

Reality Checkpoint

Call Options

Nonlinear pricing is an increasingly common feature of everyday life. Consider the packages available for cell phone service offered by the four major providers in the US, AT&T/Cingular, Verizon, Sprint/Nexus, and T-Mobile. Virtually all of these involve some variant of two-part pricing and quantity discounts. Family plans, for example, offer two lines for a fixed monthly fee. After that, each minute of calling is free up to a specified maximum. Low level plans offer something like 700 minutes for free at a monthly fee of, say, \$70 while higher use plans offer roughly twice as many free monthly minutes for a fee of about \$90. There is also a 3,000 minute plan that usually sells for about \$150. Additional phones can be added to a family plan at a fee of \$10 per month. There are also single line plans and even pay-as-you-go plans. The latter are essentially calling card plans that sell say, 30 minutes or 90 minutes of phone time for \$15 or \$25, respectively. They are clearly for those who cannot be induced to make more than a few calls even with a hefty discount.

Sources: L. Magid, "BASICS: Plain Cellphones Can Overachieve, with a Little Help," *New York Times*, January 25, 2007, p. c14; and "The Bottom Line on Calling Plans," *Consumer Reports*, February, 2004, pp. 11–18.

[1] Versions of such a scheme are used, for example, at parks such as Disney World. See Oi (1971) for the seminal discussion. As Ekelund (1970) notes, much modern analysis was anticipated by the work of 19th century French economist and engineer, Jules Dupuit. Varian (1989) provides an extensive survey of the price discrimination strategies discussed in this chapter.

where Q_i is the number of ski lift rides bought by a client of type i (O or Y), P is the price per lift ride and V_i is the maximum amount a client of type Q_i will pay for just one lift ride. We assume that young clients are willing to pay more for a given number of lift rides than are old clients, i.e., $V_O < V_Y$. After all, they are younger and probably fitter. We further assume that the ski resort owner incurs a marginal cost of c dollars per lift ride taken plus a fixed cost F of operating the resort each day. That is, the daily total cost function for the resort is:

$$C(Q) = F + cQ \tag{6.3}$$

where Q is the number of lift rides sold and taken.

This example is illustrated in Figure 6.1. The demand curve for a typical skier starts at V_i and declines with slope -1 until it hits the quantity axis. The constant marginal cost curve is a horizontal line through the value c.

We assume that the ski resort owner can identify the true type of each skier, perhaps by checking their IDs, and can prevent arbitrage, perhaps by selling the different types of skier ski lift rides of different colors. Suppose first that the owner employs third-degree price discrimination. Entry to the resort is free, the resort owner sets a price per ski lift ride to each type of skier, and the skiers decide how many lift rides to buy at that price.

We simply apply the principles that we developed in Chapter 5. The resort owner maximizes profit using the usual two-stage process. First equate marginal revenue with marginal cost for each type of skier to identify the quantity of lift rides that the owner wants to sell to each type of skier. Second, identify the prices that can be charged for these quantities from the demand functions in equation (6.1) and equation (6.2).

Using the standard "twice as steep" rule, we know from equations (6.1) and (6.2) that the relevant marginal revenues are:

$$\text{Young}: MR_Y = V_Y - 2Q_Y$$

$$\text{Old}: MR_O = V_O - 2Q_O \tag{6.4}$$

Setting marginal revenue equal to marginal cost c the profit-maximizing output—number of lift rides—to be sold to each type of skier is:

$$\text{Young}: MR_Y = V_Y - 2Q_Y = c \Rightarrow Q_Y = \frac{V_Y - c}{2}$$

$$\text{Old}: MR_O = V_O - 2Q_O = c \Rightarrow Q_O = \frac{V_O - c}{2} \tag{6.5}$$

Substituting these quantities into the demand functions gives the profit-maximizing price per lift ride for each type of skier:

$$\text{Young}: P_Y = V_Y - \frac{V_Y - c}{2} = \frac{V_Y + c}{2}$$

$$\text{Old}: P_O = V_O - \frac{V_O - c}{2} = \frac{V_O + c}{2} \tag{6.6}$$

Because by assumption $V_o < V_Y$ we have the result, as we found in Chapter 5, that the high-demand group—in this case the young skiers—pay more per unit than the low-demand group—the older skiers. Profit from each type of skier with this pricing policy is:

$$\begin{aligned} \text{Young}: \pi_Y &= (P_Y - c)Q_Y = \frac{(V_Y - c)^2}{4} \\ \text{Old}: \pi_O &= (P_O - c)Q_O = \frac{(V_O - c)^2}{4} \end{aligned} \tag{6.7}$$

These are the areas *bdhi* and *fgjk*, respectively, in Figure 6.1.

For example, if V_o is \$12, V_Y is \$16, and c is \$4, then the optimal prices per ski lift ride are \$10 to each young skier and \$8 to each old skier. Young skiers each buy six lift rides and old skiers each buy four lift rides. Under this strategy, the resort owner earns a profit of (\$10 − \$4)*6 = \$36 from each young skier and (\$8 − \$4)*4 = \$16 from each old skier. If there were 100 old and 100 young skiers per day, the ski resort owner would earn a profit of \$5,200 each day less any fixed costs F that are incurred.

To see that the ski resort owner can improve on this outcome, first note that at the prices given by equation (6.6) every client of the ski resort enjoys some consumer surplus. Each young skier has consumer surplus given by the triangle *abd* in Figure 6.1(a) and each old skier has consumer surplus given by area *efg* in Figure 6.1(b). These areas are, by standard geometric techniques:

$$\begin{aligned} \text{Young}: CS_Y &= (V_Y - P_Y)Q_Y = \frac{1}{2}(Q_Y)^2 = \frac{(V_Y - c)^2}{8} \\ \text{Old}: CS_O &= (V_O - P_O)Q_O = \frac{1}{2}(Q_O)^2 = \frac{(V_O - c)^2}{8} \end{aligned} \tag{6.8}$$

In our numerical example, each young client has consumer surplus of \$18 and each old client has consumer surplus of \$8. This is a measure of the surplus that the resort owner has failed to extract. The owner will clearly prefer any pricing scheme that appropriates at least some, or even better, all of this surplus.

One possibility is for the resort owner to switch to a nonlinear pricing scheme that has two parts—a cover charge that allows skiers to enter the resort and an additional charge for every lift ride bought. This pricing design is often referred to as a two-part tariff. Each

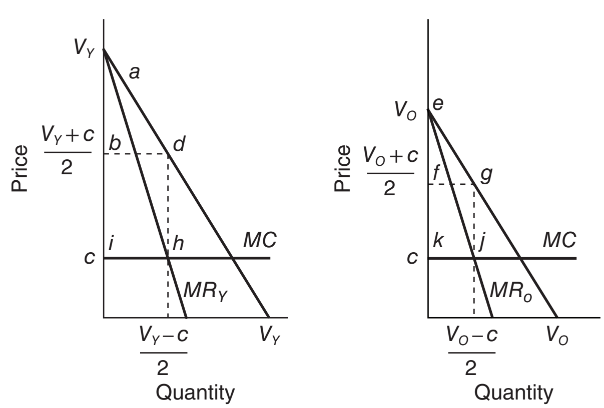

Figure 6.1 No price discrimination
Not price discriminating leaves both types of consumers with consumer surplus that the monopolist would like to convert to profit.

old skier is charged an entry fee $E_O = \frac{(V_O - c)^2}{8}$, whereas each young skier is charged an entry fee of $E_Y = \frac{(V_Y - c)^2}{8}$. The entry fee is the first, fixed part of the two-part tariff. The second part is the price per lift ride to each type of skier, which is either P_O or P_Y. In our numerical example, each old skier is charged an entry fee of \$8 and each young skier is charged an entry fee of \$18. Lift rides are sold at \$8 each to the old skiers and \$10 each to the young skiers. Checking IDs on entry to the resort and when using the ski lifts solves both arbitrage and identification problems.[2] Moreover, the skiers will still be willing to patronize the resort. Paying the entry fee reduces their surplus to zero but does not make it negative. The surplus is a measure of their willingness to pay. Finally, because the entry fee is independent of the number of lift rides each skier actually buys, each customer will also continue to buy the same number of lift rides as before. Because the entry fee is equal to the consumer surplus each skier previously enjoyed under the discriminatory but linear pricing policy, the immediate effect of this two-part tariff is to extract the entire consumer surplus and to convert it into profit for the resort owner. This implies a profit increase of E_O per old skier and E_Y per young skier. Again, in our example, this represents a profit increase of \$8 per old skier and \$18 per young one.

While the entry fees and unit prices we have calculated certainly increase the resort owner's profit, they are far from the best that the resort owner can do. By *reducing* the price of a lift ride the resort owner increases the potential consumer surplus each skier has. This permits the resort owner to increase the entry fees to extract this additional surplus, further increasing profit. The profit-maximizing two-part pricing scheme is illustrated in Figure 6.2. It has the following properties[3]:

1. Set the price per unit (per lift ride) equal to marginal cost c.
2. Set the entry fee for each type of client equal to that client's consumer surplus at the price given by 1.

In our ski resort example, the price per lift ride is set at c no matter the type of skier. The areas of the triangles *abd* and *efg* describe the consumer surplus at this price for young skiers and for old skiers, respectively. These areas are $CS_O = \frac{1}{2}(V_O - c)^2$ and $CS_Y = \frac{1}{2}(V_Y - c)^2$. As a result, the ski resort owner can now increase the entry fee to CS_O for old skiers and CS_Y for young skiers.

Under this optimal pricing scheme, the profit per lift ride from each skier is zero, because lift rides are sold at cost. This pricing strategy has the advantage of encouraging the skiers to purchase many lift rides, thereby yielding more consumer surplus. In turn, the resort owner can appropriate that surplus by imposing the optimal entry fee. The funds generated by the entry fees *are* profit, indeed, they are the resort owner's only source of profit in our

2 We assume that the cost of falsifying IDs and make-up to age a skier is more than the surplus young skiers lose by paying the higher price.

3 To see why these properties hold, denote the fixed portion of the two-part tariff for a particular type of consumer as T and the user charge as p. Express the demand curve for this type of consumer in inverse form, $p = D(q)$ and assume that the firm's total cost function is $C(q)$. The monopolist's problem is to choose the production level for this type of consumer, q^*, implying a price $p^* = D(q^*)$, that maximizes profits, $\Pi(q)$, where $\Pi(q)$ is given by: $\Pi(q) = \int_0^q D(x)dx - C(q)$. Standard calculus then reveals that maximizing this profit always requires setting a price or user charge equal to marginal cost, and a fixed charge T equal to the consumer surplus generated at that price.

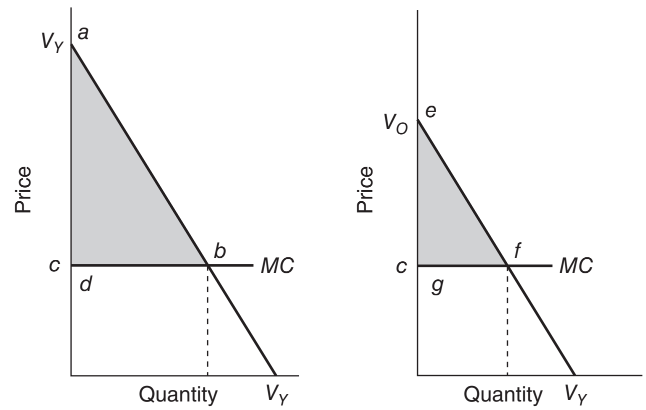

Figure 6.2 First-degree price discrimination with a two-part tariff
The monopolist sets a unit price to each type of consumer equal to marginal cost. The monopolist then charges each consumer an entry or membership fee equal to the resulting consumer surplus.

example. Total profit has, therefore, been increased to:

$$\Pi_f = n_O \frac{(V_O - c)^2}{2} + n_Y \frac{(V_Y - c)^2}{2} - F \tag{6.9}$$

where n_O is the number of old skiers and n_Y is the number of young skiers per day.

In our example, the price per lift ride is set at \$4. Old skiers purchase eight rides and young skiers twelve rides. The entry fee, and profit per old skier, is now \$32 while the entry fee and profit per young skier is \$72. This is a considerable increase over the \$36 and \$16 profit earned without any fixed fee or even the \$54 and \$24 earned with the "wrong" two-part tariff. This is a hefty profit increase.[4]

While the increase in profit is sizable and important, the two-part tariff has had another result that is equally significant. Note that each client is now buying the quantity of lift rides, $V_O - c$ for the typical old client and $V_Y - c$ for the typical young one, that each would have bought if the lift rides had been priced competitively at marginal cost. The ability to practice first-degree price discrimination leads the monopolist to expand output to the competitive level. That is, the market outcome is now efficient. The total surplus is maximized—and that total surplus is claimed entirely by the monopolist.

6.2 **Practice Problem**

Consider an amusement park operating as a monopoly. Figure 6.3 shows the demand curve of a typical consumer at the park. There are no fixed costs. The marginal cost associated with each ride is constant. It is comprised of two parts, each also a constant. There is the cost per ride of labor and equipment, k, and there is the cost per ride of printing and collecting tickets, c. A management consultant has suggested two alternative pricing policies for the park. Policy A: Charge a fixed admission fee, T, and a fee per ride of r. Policy B: Simply charge a fixed admission fee, say T', and a zero fee per ride.

4 It is also easy to show that the ski resort owner's profit would be smaller than that achieved by the two-part tariff if a uniform, linear pricing policy were adopted. We leave you to show this for yourselves.

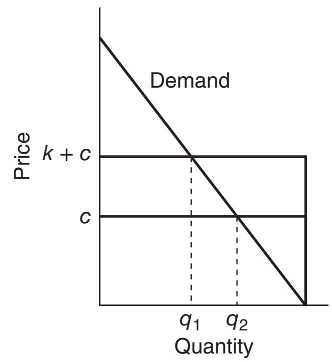

Figure 6.3 Diagram for the amusement park problem

a. For Pricing Policy A, show on the graph the admission fee, T, and the per ride price, p, that will maximize profits.
b. For Pricing Policy B, show on the graph the single admission fee, T', that will maximize profits.
c. Compare the two policies. What are the relative advantages of each policy? What determines which policy leads to higher profits?

6.1.2 Block Pricing

There is a second nonlinear pricing strategy by which the ski resort owner can achieve the same level of profit. This scheme is block pricing. Using this type of pricing a seller *bundles* the quantity that he or she is willing to sell with the total charge wished to be set for that quantity. In our ski resort example, the owner sets a pricing policy of the form "Entry plus X ski lift rides for Y dollars." In order to earn maximum profit and appropriate all potential consumer surplus, two simple rules determine the optimal block-pricing strategy:

1. Set the number of ski lift rides offered to each consumer type equal to the amount that type of consumer would buy at competitive pricing, that is, the quantity bought at a price equal to marginal cost;
2. Set a fixed charge for each consumer type at the total willingness to pay for the quantity identified in (1).

Let's examine how this would work in our ski resort example. Applying rule 1, we know that each young client would buy $V_Y - c$ lift rides and each old client would buy $V_O - c$ lift rides if the lift rides were priced at marginal cost. The total willingness to pay for these quantities by young and old clients respectively is the area under the relevant demand curve at these quantities. These are:

$$\begin{aligned} \text{Young}: WTP_Y &= \frac{1}{2}(V_Y - c)^2 + (V_Y - c)c = \frac{1}{2}(V_Y^2 - c^2) \\ \text{Old}: WTP_O &= \frac{1}{2}(V_O - c)^2 + (V_O - c)c = \frac{1}{2}(V_O^2 - c^2) \end{aligned} \tag{6.10}$$

Applying rule 2, we then have the following pricing policy. Offer each old client entry plus $V_O - c$ lift rides for a total charge of $\frac{1}{2}(V_O^2 - c^2)$ dollars and each young client entry plus $V_Y - c$ lift rides for a total charge of $\frac{1}{2}(V_Y^2 - c^2)$ dollars.

How would we implement this strategy in our ski resort example? One way would be to ID each client at entry to the resort, then offer each young client a package of "Entry plus a block of $V_Y - c$ lift rides for a total charge of $\frac{1}{2}(V_Y^2 - c^2)$ dollars" and offer each old client a package of "Entry plus a block of $V_O - c$ lift rides for a total charge of $\frac{1}{2}(V_O^2 - c^2)$ dollars." Profit from a customer of type i is the charge WTP_i minus the cost of the rides, $c(V_i - c)$, or $\frac{1}{2}(V_Y - c)^2$ from each young client and $\frac{1}{2}(V_O - c)^2$ from each old client, exactly as in the two-part pricing system.

In our example, this amounts to offering each young skier a package of "Entry plus twelve ski lift rides for \$120" and each old skier a package of "Entry plus eight ski lift rides for \$64." Profit from each young skier package is $\$120 - 48 = \$72$ and from each old skier package is $\$64 - 32 = \$32$ as in the two-part pricing strategy.

Before leaving this section, we can point out a further interesting feature of the two types of first-degree price discrimination that we have discussed. Both the two-part tariff and the block pricing schemes result in the ski resort owner selling each old client entry plus $V_O - c$ lift rides for a total charge of $\frac{1}{2}(V_O^2 - c^2)$ and each young client entry plus $V_Y - c$ lift rides for a total charge of $\frac{1}{2}(V_Y^2 - c^2)$. Therefore, in each case, the average price paid per lift ride by an old client is $\frac{1}{2}(V_O^2 - c^2)/(V_O - c) = \frac{1}{2}(V_O + c)$. Similarly, each young client pays an average price per lift ride of $\frac{1}{2}(V_Y + c)$. You can easily check from equation (6.6) that these are exactly the same prices per lift ride that would be levied if the ski resort owner were to apply third-degree price discrimination. Yet the profit outcome is different.

The reason that first-degree and third-degree price discrimination lead to very different profits, despite the fact that the average price is the same in each case, lies in the very different nature of the two pricing schemes.[5] Recall that each point on a demand function measures the marginal benefit that a consumer obtains from consuming that unit. The quantity demanded equates marginal benefit with the marginal cost to the consumer of buying the last unit where, of course, marginal cost to the consumer is just the price for that last unit. With third-degree price discrimination, or linear pricing, the price paid for the last unit (indeed, every unit) is greater than marginal cost, which is how the resort owner makes profit with this pricing scheme. More importantly, while the price charged for the last lift ride sold under third degree price discrimination is equal to its marginal benefit, the price charged for every other lift ride sold is less than its marginal benefit: there is money (willingness to pay) "left on the table." By contrast, with the nonlinear two-part pricing scheme the ski resort owner sets the unit price of a lift ride to marginal cost, greatly increasing the owner's sales of ski rides. This creates consumer surplus, but the fixed charge

[5] That average prices are the exactly same under the two pricing schemes is, of course, a result of our assumption that demand functions are linear. But this does not alter the fact that first-degree price discrimination is much more profitable than third-degree price discrimination or no price discrimination.

converts this consumer surplus into profit: there is no money "left on the table." With block pricing a buyer is not offered a price per unit. Rather, quantity and total charge are bundled in a package of "X units for a total charge of Y dollars," with the package being designed to extract the total willingness to pay for the X units. Again, there is no money "left on the table."

6.2 SECOND-DEGREE PRICE DISCRIMINATION OR MENU PRICING

First-degree price discrimination, or personalized pricing, is possible for the ski resort owner for two reasons. First, the resort's different types of customers are distinguishable by means of a simple, observable characteristic. Secondly, the resort owner has the ability to deny access to those not paying the entry charge designed for them. Not all services can be marketed in this way. For example, if instead of a ski resort the monopoly seller is a refreshment stand located in a campus center then limiting access by means of a cover charge is not feasible.

Even in the ski resort case, first-degree discrimination by means of a two-part tariff is not possible if the difference in consumer willingness to pay is attributable to some characteristic that the resort owner cannot observe. For example, suppose that what differentiates high-demand and low-demand clients is not age but income. In our numerical example, the ski resort will now find that any attempt to implement the first-degree price discrimination scheme of charging high-income patrons an entry fee of \$72 and low-income patrons an entry fee of \$32 is not likely to succeed. Every client would claim to have low income in order to pay the lower entry charge and there is no obvious (or legal) method by which the resort owner can enforce the higher fee.

What about the block pricing strategy of offering entry plus twelve ski lift rides for \$120 and entry plus eight ski lift rides for \$64? Will that work? Again, the answer is no. It is easy to show that high income clients are willing to pay up to \$96 for entry plus eight ski lift rides. Thus they derive \$32 of consumer surplus from the (eight rides, \$64) package but no consumer surplus from the (twelve rides, \$120) package. They will prefer to pretend to be low income in order to pay the lower charge and enjoy some surplus rather than confess to being high income, even though this means that they get fewer lift rides.

The monopolist could, of course, decide to limit entry only to high-income clients by setting the entry charge at \$72 or offering only the (twelve rides, \$120) package but this loses business (and profit) from low-income clients. Suppose, for instance, that there are N_O low-income clients and N_Y high-income clients. The profit from selling to only the high-income clients is $\$72N_Y$. Setting the lower entry fee or offering only the (eight rides, \$64) package in order to attract both types of client gives profit of $\$32(N_Y + N_O)$. Clearly, the latter strategy is more profitable if $32N_O > 40N_Y$. In other words, if the ratio of low-income to high-income clients (N_O/N_Y) is more than 1.25:1 (the per skier profit difference divided by profit per young skier) the policy of setting the higher entry fee or offering only the (twelve rides, \$120) package generates less profit than offering just the lower entry fee or the (eight rides, \$64) package to all customers.

The point is that once we reduce either the seller's ability to identify different types of buyers or to prevent arbitrage among them (or both), complete surplus extraction by means of perfect price discrimination is no longer possible. Both the two-part and block pricing mechanisms can still be used to raise profit above that earned by linear pricing but they cannot earn as much as they did previously. Solving the identification and arbitrage problem has now become costly. It is still possible that the monopolist can design a pricing scheme that will induce customers to reveal who they are and keep them separated by their purchases, but the only way to do this incurs some cost—a cost reflected in less surplus extraction. Such a pricing scheme is called second-degree price discrimination, or menu pricing.

Second-degree price discrimination is most usually implemented by offering quantity discounts targeted to different consumer types. To see how it works, let's continue with our ski resort example illustrated in Figure 6.4 for the numerical example. Again, the high-demand customers have (inverse) demand $P_h = 16 - Q_h$ and the low-demand customers have (inverse) demand $P_l = 12 - Q_l$. Now, however, the ski resort owner has no means of distinguishing who is who because the source of the difference between consumers is inherently unobservable. All the owner knows is that two such different types of consumer exist and they both wish to frequent the ski resort.

Any attempt to implement a differentiated two-part tariff will not work in this case. Both types of customer will claim to be low-demand types when entering the resort in order to pay the lower entry fee of $32. Only *after* they are in the resort will the different consumers reveal who they are. Because the price per ski lift ride is set at marginal cost of $4, the high-demand customers will buy twelve rides and reveal themselves to be high demanders whereas the low-demand customers will buy eight rides and reveal themselves as such.

You might be tempted to think that the resort owner could implement first-degree price discrimination using the following strategy. When entering the resort, skiers are allowed to purchase some defined maximum number of ski lift rides. If they pay an entry charge of $32 they will be allowed to purchase up to eight ski lift rides, while if they pay $72 they will be allowed to purchase up to twelve rides. Yet this approach will not work either, and for the same reason that the block pricing strategy of offering (twelve rides, $120) and (eight rides, $64) packages failed. High-demand customers again have every reason to pretend to be low-demand customers and pay an entry charge of only $32, thereby buying eight ski lift rides at $4 each for a total expenditure of $64. Because, as can be seen from Figure 6.4(a), their total willingness to pay for the eight ski lift rides is $96, high-demand consumers will enjoy a surplus of $32 from this deception. By contrast, they will enjoy no surplus if they pay the entry charge of $72 and buy twelve rides because their total expenditure will be then $120, which exactly equals their willingness to pay for twelve ski lift rides. As a result, it remains the case that the high-demand customers are better off by pretending to be low-demand even though this constrains the number of ski lift rides that they can buy.

While unsuccessful, the idea of offering different entry and lift ride combinations as different packages does contain the hint of a strategy that the ski resort owner can use to increase profit. The point is to employ a variant on the *block pricing* strategy described earlier. The difference is that, because there is no easy way to identify and separate the different types of customers, the block pricing strategy itself must be designed to achieve this purpose. This imposes a new constraint or cost on the resort owner and so will not yield as much profit as first-degree price discrimination. However, it will substantially improve on simply offering all customers a ($64, eight lift rides) package that yields a profit of $32 from each.

To see how one might use block pricing to achieve the identification and separation necessary for price discrimination let us start with the low-demand customers. The ski resort owner knows that these customers are willing to pay a total of $64 for eight lift rides. In other words, the resort owner can offer a package of entry plus eight lift rides at

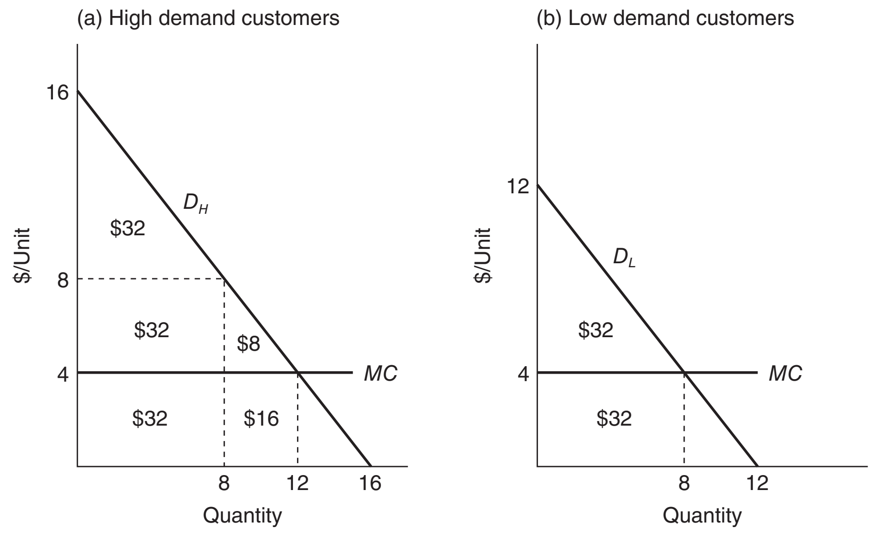

Figure 6.4 Second-degree price discrimination
Low demand customers are willing to pay $64 for entry plus 8 drinks. High demand customers are willing to pay up to $96 for entry plus 8 drinks, and so get $32 surplus from the 8-drinks, $64-package. They will therefore be willing to buy a 12-drinks, $88-package, which also gives them a $32 surplus.

a price of $64 for the package. This package will be attractive to low-demand customers, effectively extracting the $32 surplus from each of them. The problem is that high-demand customers will also be willing to buy this package because their willingness to pay for entry and eight lift rides is $96. While the resort owner also gets $32 in profit from the high-demand customers buying this package, those customers themselves still enjoy a surplus of $96 − $64 = $32.

The resort owner's optimal strategy at this point is to offer a second package targeted to high-demand consumers. The owner knows that the high-demand customers are willing to pay a total of $120 for entry plus twelve lift rides. Yet the owner also knows that he cannot charge $120 for twelve lift rides because the high-demand customers will not be willing to pay this much, given that they can buy the (eight rides, $64) package and enjoy a consumer surplus of $32. For an alternative package to be attractive to high-demand consumers it has to be what economists call *incentive compatible* with the (eight rides, $64) package. This means that any alternative package must also allow the high-demand customers to enjoy a surplus of at least $32.

A package that meets this requirement but that also generates some additional profit for the club owner is a package of entry plus twelve lift rides for a total charge of $88. We know that the high-demand customers value entry plus twelve lift rides at $120. By offering this deal at a price of $88, the resort owner permits these customers to get $32 of surplus when they buy this package, just enough to get them to switch from the (eight rides, $64) package.[6] And while the high-demand consumers get a $32 surplus on this package, the

[6] We are working in round numbers to keep things neat. What the ski resort owner might actually do is price the package of entry plus twelve lift rides at $87.99 to ensure that the high-demand customers will strictly prefer this to the (eight rides, $64) package.

resort owner's profit is also higher than it is on the (eight rides, \$64) package. On the latter, the owner earns \$32, but on the new package, the owner earns $\$88 - (\$4 \times 12) = \$40$. Of course, the low-demand customers will not buy the (twelve rides, \$88) package because their maximum willingness to pay for twelve lift rides is only \$72. Nevertheless, the resort owner still earns \$32 from these consumers by continuing to sell them the (eight rides, \$64) package. So, the resort owner's total profit is increased.

The two menu options have been carefully designed to solve the identification and arbitrage problems by inducing the customers themselves to reveal who they are through the purchases they make. The resort owner now offers a menu of options, entry and eight lift rides for \$64 or entry and twelve lift rides for \$88, designed to separate out the different types of customers served. For this reason, this strategy is often referred to as *menu pricing*. It has one very important feature. Note that as before, the average price per lift ride of the (eight rides, \$64) package is \$8. However, the average price per lift ride of the (twelve rides, \$88) package is \$7.33. The second package thus offers a *quantity discount* relative to the first.

Quantity discounts are common. Movie theaters, restaurants, concert halls, sports teams, and supermarkets all make use of them. It is cheaper to buy one huge container of popcorn than many small ones. Wine sold by the glass is more expensive per unit than wine sold by the bottle. A 24-pack of Coca-Cola is cheaper than twenty-four individual bottles. It is cheaper per game to buy a season's subscription to your favorite football team's home games than to buy passes to each individual game. As we have just seen, a full-day pass at a ski resort will reflect a lower price per run than will a half-day lift ride. In these and many other cases, the sellers are using a quantity discount to woo the high-demand consumers.

There is another twist to consider. What if the ski resort owner now decides to offer a lower number of lift rides, say seven, in the package designed for the low-demand customers? The maximum willingness to pay for entry plus seven lift rides by a low-demand customer is \$59.50, so this new package will be (seven rides, \$59.50). The profit it generates from each customer is \$31.50, which is 50 cents less than the (eight rides, \$64) package. But now consider the high-demand customers. Their maximum willingness to pay for seven rides is \$87.50, so buying this new package gives them consumer surplus of \$28. As a result, the ski resort owner can increase the price of the twelve lift-ride package. Rather than pricing it so that it gives the high-demand customers \$32 of consumer surplus, the owner can now price it so that it gives them only \$28 of surplus. In other words, the price of the second package (entry plus 12 lift rides) can now be raised to $\$120 - 28 = \$92$, increasing the owner's profit from each such package to \$44.

The example illustrates the importance of the incentive compatibility constraint. Any package designed to attract low-demand customers constrains the ability of the monopolist to extract surplus from high-demand customers. Again, this is because the high-demand customers cannot be prevented from buying the package designed for low-demand customers, and thus will always enjoy some consumer surplus from doing so. As a result, the monopolist will find it more profitable to reduce the number of units offered to low-demand customers because this will allow the price charges for the package targeted to the high-demand customers to be increased. There may even be circumstances in which the monopolist would prefer to push this logic to the extreme and not serve low-demand customers at all because of the constraint serving them imposes on the prices that can be charged to other customers.

Whether or not the monopolist has an incentive to serve the low-demand consumers will depend on the number of low-demand consumers relative to high-demand ones. The fewer low-demand consumers there are relative to high-demand ones, the less desirable it is to serve low-demand consumers because any effort to do so imposes an incentive compatibility constraint on the extraction of surplus from high-demand ones.

When we extend our analysis to a more general case with more than two types of consumers the profit-maximizing second-degree price discrimination, or menu pricing, scheme will exhibit some key features. In particular, if consumer willingness to pay can be unambiguously ranked by type then any optimal second-degree price discrimination scheme will:

1. Extract the entire consumer surplus of the lowest demand type served but leave some consumer surplus for all other types;
2. Contain a quantity that is less than the socially optimal quantity for all consumer types other than the highest-demand type;
3. Exhibit quantity discounting.

Second-degree discrimination enhances the ability of the monopolist to convert consumer surplus into profit, but does so less effectively than first-degree discrimination. With no costless way to distinguish the different types of consumers, the monopolist must rely on some sort of block pricing scheme to solve the identification and arbitrage problems. However, the incentive compatibility constraints that such a scheme must satisfy restrict the firm's ability to extract all of the consumer surplus. Instead, the firm is forced to make a compromise between setting a high charge that loses sales to low-demand buyers, and a low charge that foregoes the significant surplus that can be earned from the high-demand buyers. And contrary to what many consumers may think, the lower price charged for a larger quantity is entirely unrelated to scale economies. If in our example the ski resort owner has no fixed costs there are no economies of scale. Nevertheless, the owner finds it profitable to offer a quantity discount to high-demand customers.

6.3 **Practice Problem**

Assume that the customers a monopolist serves are of two types, low-demand customers whose inverse demand is $P_l = 12 - Q_l$ and high-demand customers whose demand is $P_h = 16 - Q_h$. However, the monopolist does not know which type of customer is which. The production costs are \$4 per unit.

a. Complete the Table below for this example.
b. Assume that there are the same numbers of high-demand and low-demand customers. What is the profit-maximizing number of units that should be offered in the package aimed at the low-demand customers?
c. Now assume that there are twice as many low-demand customers as high-demand customers. What is the profit-maximizing pair of packages for the monopolist?
d. The monopolist is considering offering two packages, one containing six units and the other twelve units. What are the charges at which these packages will be offered? What is the ratio of high-demand to low-demand customers above which it will be better for the monopolist to supply only the high-demand customers?

Low-Demand Customers			*High-Demand Customers*			
Number of Units in the Package	*Charge for the Package**	*Profit per Package*	*Consumer Surplus from Low-Demand Package*	*Maximum Willingness to Pay for 12 units*	*Charge for Package of 12 Units*	*Profit from each Package of 12 Units*
0	0	0	0	$120.00		$72.00
1	$11.50		$4.00	$120.00	$116.00	
2		$14.00	$8.00	$120.00		$64.00
3						
4	$40.00	$24.00		$120.00		
5	$47.50	$27.50	$20.00	$120.00	$100.00	$52.00
6	$54.00			$120.00		$48.00
7	$59.50	$31.50	$28.00	$120.00	$92.00	$44.00
8	$64.00	$32.00	$32.00	$120.00	$88.00	$40.00
9						
10	$70.00	$30.00	$40.00	$120.00		
11						
12	$72.00		$48.00	$120.00	$72.00	

*This is the low-demand customer's maximum willingness to pay for the number of units in the package.

6.3 SOCIAL WELFARE WITH FIRST- AND SECOND-DEGREE PRICE DISCRIMINATION

One way to understand the welfare effects of price discrimination is to consider a particular consumer group i. Suppose each consumer in this group has inverse demand:

$$P = P_i(Q) \tag{6.11}$$

Assume also that the monopolist has constant marginal costs of c per unit. Now let the quantity that each consumer in group i is offered with a particular pricing policy be Q_i. Then the total surplus—consumer surplus plus profit—generated for each consumer under this pricing policy is just the area between the inverse demand function and the marginal cost function up to the quantity Q_i, as illustrated in Figure 6.5.

The pricing policy chosen by the firm affects the quantity offered to each type of consumer, and it alters the distribution of total surplus between profit and consumer surplus. The first effect has an impact on welfare, whereas the second effect does not imply a change in total welfare, but rather a transfer of surplus between consumers and producers. As a result, *price discrimination increases (decreases) the social welfare of consumer group* i *if it increases (decreases) the quantity offered to that group*.

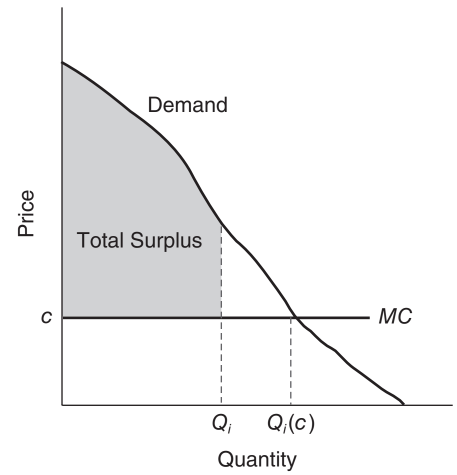

Figure 6.5 Total surplus
When the total quantity consumed is Q_i total surplus is given by the shaded area. Total surplus is maximized at quantity $Q_i(c)$.

It follows immediately that first-degree price discrimination always increases social welfare even though it extracts all consumer surplus. With this pricing policy we have seen that the monopoly seller supplies each consumer group with the socially efficient quantity (the quantity that would be chosen if price were set to marginal cost). Hence first-degree discrimination always increases the total quantity to a level [$Q_i(c)$ in Figure 6.5] that exceeds that which would have been sold under uniform pricing.

With second-degree price discrimination matters are not so straightforward. As we have seen, this type of price discrimination leads to high-demand groups being supplied with quantities "near to" the socially efficient level. However, we have also seen that the seller will want to restrict the quantity supplied to lower-demand groups and, in some cases, not supply these groups at all. The net effect on output is therefore not clear a priori.

The impact on social welfare of second-degree price discrimination can nevertheless be derived using much the same techniques that we used in Chapter 5. By way of illustration, suppose that there are two consumer groups with demands as illustrated in Figure 6.6 (i.e., Group 2 is the high-demand group). In this figure, P^U is the nondiscriminatory uniform price, and Q_1^U and Q_2^U are the quantities sold to each consumer in the relevant group at this price. By contrast, Q_1^s and Q_2^s are the quantities supplied to the two groups with second-degree price discrimination.[7] We define the terms:

$$\Delta Q_1 = Q_1^s - Q_1^U; \quad \Delta Q_2 = Q_2^s - Q_1^U \tag{6.12}$$

In the case illustrated we have $\Delta Q_1 < 0$ and $\Delta Q_2 > 0$. This tells us that an upper limit on the increase in total surplus that follows from second-degree price discrimination is the area G minus the area L. This gives us the equation:

$$\Delta W \leq G - L = (P_U - MC)\Delta Q_1 + (P_U - MC)\Delta Q_2 = (P_U - MC)(\Delta Q_1 + \Delta Q_2) \tag{6.13}$$

[7] Because Group 2 is the high-demand group, we know that $Q_2^s = Q_2(c)$.

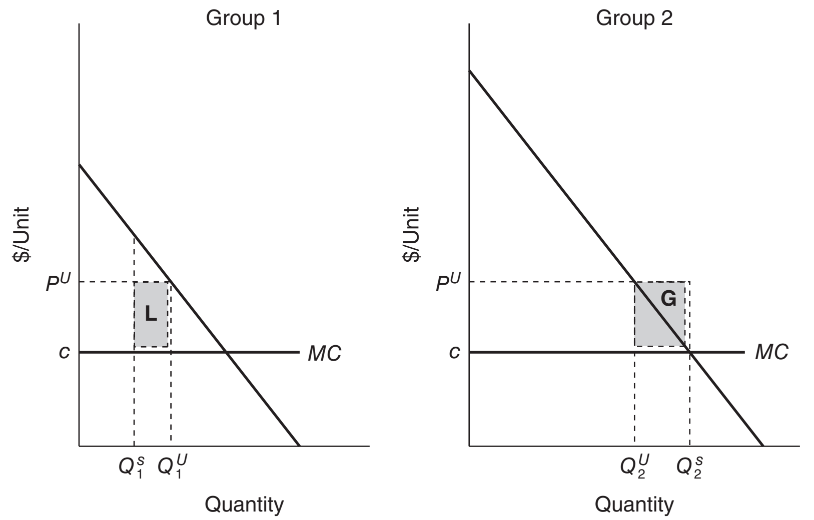

Figure 6.6 Impact of second-degree price discrimination on welfare
An upper limit on the change in total surplus that arises from second-degree price discrimination is the upper limit on the gain, *G*, minus the lower limit on the loss, *L*.

Extending the analysis to *n* markets, we then have:

$$\Delta W \leq (P_U - MC)\sum_{i=1}^{n} \Delta Q_i \tag{6.14}$$

It follows that for $\Delta W \geq 0$ it is necessary that $\sum_{i=1}^{n} \Delta Q_i \geq 0$. In other words, a necessary condition for second-degree price discrimination to increase welfare is that it increases total output when compared to uniform pricing.

We know from the previous chapter that this requirement is generally not met in the case of third-degree price discrimination and linear demands because then the monopolist supplies the same total quantity as with uniform pricing, so third-degree price discrimination does not increase welfare. By contrast, it could be the case that second-degree price discrimination leads to an increase in the quantity supplied to both markets and this would increase social welfare. In the ski resort owner's case, for example, this will be the case if there are equal number of high-demand and low-demand customers. (You are asked to show this in the end-of-chapter problem 7.)

6.4 EMPIRICAL APPLICATION: PRICE DISCRIMINATION AND MONOPOLY VERSUS IMPERFECT COMPETITION

We have set our discussion of price discrimination in both the current and previous chapter in the framework of a monopolized market. Yet as students frequently point out, many of the discriminatory practices we describe are observed in markets that are far from monopolies such as airlines, restaurants, hotels, and even theme parks. Of course, in each of these cases, the firms employing price discrimination tactics have to have some degree of market power even though they do confront rival sellers. Perfectly competitive firms by definition must take the market price as given and therefore cannot manipulate that price in any way or extract any additional surplus. Imperfectly competitive firms, though, do have discriminatory power. Moreover, it turns out that it is precisely in a setting of imperfect competition that there is additional pressure for firms to price discriminate beyond the surplus extraction consideration that motivates a pure monopolist.

When firms are imperfect rivals, the nature of that competition will often result in discriminatory prices as part of their competitive strategy. This point, first emphasized by Borenstein (1985), can be illustrated with a simple example. Consider a monopolist who owns the only two surfboard shops in Minnesota—one in Minneapolis and the other in St. Paul. The proximity of the two towns is such that transport costs are not a factor for any consumer in choosing which store to patronize. The $2N$ potential customers are evenly distributed between the two towns and each is willing to pay as much as V for a surfboard. However, while consumers are alike in their willingness to pay, they are different in one other respect. Half of the consumers are inexplicably loyal to their town's shop. That is, one-fourth of the consumers will always buy from the Minneapolis store and one-fourth will always buy from the St. Paul store so long as the price is less than V, and without regard to the price at the other shop. The remaining N consumers are just the opposite. While willing to pay as much as V, these consumers always shop wherever the price is lowest.

A little economic reasoning should convince you that our hypothetical monopolist will set a price of V at both shops and serve all the $2N$ customers. Clearly the price cannot be higher than this or no customer will buy the product. However, there is no need to reduce the price. The first set of consumers will not consider the price at any location other than their local store. The second group will look for a lower price but, because the price is V at each shop, this group also splits evenly between the two stores. The monopolist would then make a total profit of $2(V - c)N$ divided evenly between the two stores. No amount of price discrimination can increase this value.

Now consider what would happen if the two stores are instead owned by two different firms, firm 1 and firm 2. Each store has $N/2$ customers who are totally locked-in to that shop and who the store would like to charge V. There may, however, be competition for the second group of consumers who care about price. If firm 1 in Minneapolis charges V to this group, firm 2 in St. Paul can attract all their patronage by charging a price \$1 lower, i.e., by charging $V - 1$. In response, the Minneapolis store might lower its price to $V - 2$, which would induce further cuts in St. Paul and so on. Ultimately, then, competition for the N price-conscious consumers pushes prices closer to marginal cost at both stores. The question is whether each store can somehow prevent this competition from spilling over to its locked-in consumers. The answer of course is that, yes, firm 1 and firm 2 can each continue to charge their intensely loyal customers a high price provided two familiar conditions are met. These are the identification and no-arbitrage conditions we derived in Chapter 5. If the non—price-sensitive consumers can be identified and separated in a meaningful way from the price-conscious ones, then each store can continue to charge these consumers V for a surfboard while selling at price c to everyone else.

It is important to emphasize that it is competition—imperfect as it is—that leads to the differential pricing strategy. Again, had the market been monopolized, no price discrimination would have emerged. The price would have been V to all consumers. This is what we mean when we say that imperfectly competitive markets create an additional force evoking discriminatory prices. Price discrimination permits competing actively for those consumers who perceive alternatives to the firm's product while still charging a high price to those that do not. In our example, there is only one other store, so the pricing is bifurcated. Some customers pay V while others pay c. We might expect that if there had instead been three or four stores, there might be fewer locked-in consumers as some might regard another Minneapolis or another St. Paul store an acceptable substitute. In this case, we might see more and more complicated price breaks.

The foregoing intuition lies at the heart of the paper by Stavins (2001), which examines the influence of competition on the use of discriminatory pricing in the airline industry. For this purpose, she looked at price and other information for 5,804 rides over twelve different routes on a specific Thursday in September, 1995. Selecting a single day is useful because it eliminates any price differentials due to flying on other days of the week, especially weekend days. A September choice also avoids both peak summer and winter demand periods. The key characteristics that Stavins (2001) looks at are: 1) whether a Saturday night stay-over was required and 2) whether a 14-day advance purchase was required.

As discussed in Chapter 5, each of these restrictions serves as a means for airlines to identify and separate customers based on how they value their time and their need for flexibility. Prices for rides requiring a Saturday night stay-over or that had to be purchased 14 days prior to departure should sell for less than other rides. The hypothesis to be tested is that the price discount on these restricted rides gets bigger the more competition there is on the route. Stavins (2001) constructs a Herfindahl-Hirschman Index *HI* for each route to serve as a rough measure of that market's competitive pressure.

To test this hypothesis, Stavins (2001) runs two sets of regressions. The first of these serves to confirm that ride restrictions do indeed translate into discriminatory price differentials. It takes the basic form:

$$p_{ijk} = \beta_0 + \beta_1 R_{ijk} + \beta_2 HI_i + \beta_3 S_{ij} + \beta_4 First_{ijk} + \beta_5 Days_{ijk} + \beta_6 Z_i + \varepsilon_{ijk} \tag{6.15}$$

Here, p_{ijk} is the (log of the) price of the *k*th ride sold by airline *j* in city-pair market *i*. R_{ijk} is a dummy variable equal to 1 if there was a restriction on the flight (Saturday night stay-over or pre-purchase requirement) and 0 otherwise. HI_i is the Herfindahl-Hirschman Index for the *i*th market. S_{ij} is the market share of airline *i* in market *j*. $First_{ijk}$ is a dummy variable equal to 1 if the ride was for first-class fare and 0 otherwise. $Days_{ijk}$ is the number of days prior to departure that the fare for that ride was last offered. Z_i is a vector of other market *i* characteristics such as average income and population. The error term ε_{ijk} is assumed to be normally distributed with a mean of 0.

If ride restrictions serve as a means of implementing price discrimination then the coefficient β_1 on R_{ijk} should be negative. This would imply that passengers flying the same flight on the same airline paid lower prices if they accepted a requirement that they stay over Saturday night or that they purchase the ride in advance.

However, simply finding that β_1 is negative only shows that price discrimination occurs. It does not tell us if there is any connection between the extent of such discrimination and the degree of competition in the market. To test this hypothesis, Stavins (2001) runs regressions of the basic form:

$$\begin{aligned} p_{ijk} = {} & \beta_0 + \beta_1 R_{ijk} + \beta_2 HI_i + \beta_3 (HI_i x R_{ijk}) + \beta_4 S_{ij} \\ & + \beta_5 First_{ijk} + \beta_6 Days_{ijk} + \beta_7 z_i + \varepsilon_{ijk} \end{aligned} \tag{6.16}$$

This is exactly the same as the previous regression except that it now includes the interactive term $(HI_i x R_{ijk})$, the product of the concentration index and the restricted travel variables.