Price Discrimination

Uniform Price vs Price Discrimination

Definition: A monopolist charges a **uniform price** if it sets the same price for every unit of output sold.

While the monopolist captures profits due to an optimal uniform pricing policy, **it can still extract greater profits and greater producer surplus with price discrimination.**

Definition: A monopolist **price discriminates** if it charges more than one price for the same good or service, e.g. different prices in movie theatres, airlines, etc.

Forms of Price Discrimination

Definition: A policy of **first degree (or perfect) price discrimination** prices each unit sold at the consumer's maximum willingness to pay. This willingness to pay is directly observable by the monopolist.

Definition: A policy of **second degree price discrimination** allows the monopolist to offer consumers a quantity discount.

Definition: A policy of **third degree price discrimination** offers a different price for each segment of the market (or each consumer group) when membership in a segment can be observed.

Conditions for Price Discrimination

To be able to adopt Price Discrimination,

- The firm must have some market power to price discriminate.
- The firm must have some information about buyers, e.g. their demand, willingness to pay (WTP), and PED.
  - Individual's demand (for 1st Degree)
  - Market's demand (for 2nd Degree)
  - Market's demand for each "separable" consumer group (for 3rd Degree)
- The firm must be able to prevent "arbitrage", i.e. resale.

1st Degree Price Discrimination

Definition: A policy of **first degree price discrimination** prices each unit sold at the consumer's maximum willingness to pay.

Definition: The consumer's maximum willingness to pay is called the consumer's **reservation price**.

We can think of the demand curve as a "willingness to pay" curve. If the monopolist can observe the willingness to pay of each customer, then the monopolist can "perfectly" price discriminate. **In other words, it can charge each consumer the highest price he/she is willing to pay for the product.**

1st Degree PD gives an efficient allocation of resource, i.e. there is no deadweight loss.

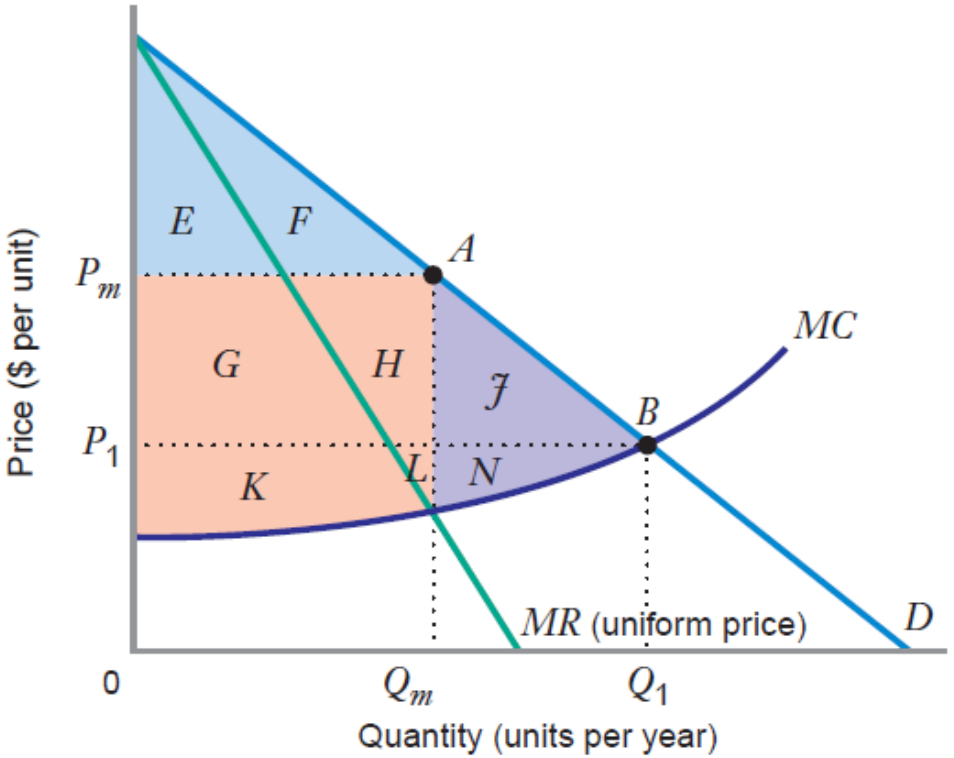


FIGURE 12.1 Monopoly with Uniform Pricing
A profit-maximizing monopolist charging a uniform price would choose the price P_m and sell Q_m. Its producer surplus would be the area $G + H + K + L$. However, some consumer surplus (area $E + F$) escapes the producer. In addition, the deadweight loss (area $J + N$) represents potential surplus that neither the producer nor consumers capture.

	Uniform Pricing	First-Degree Price Discrimination
Consumer surplus	$E + F$	zero 
Producer surplus	$G + H + K + L$	$E + F + G + H + J + K + L + N$
Total surplus	$E + F + G + H + K + L$	$E + F + G + H + J + K + L + N$
Deadweight loss	$J + N$	zero 

1st Degree Price Discrimination

LEARNING-BY-DOING EXERCISE 12.1

Capturing Surplus: Uniform Pricing versus First-Degree Price Discrimination

In this exercise we will see how a monopolist can capture more surplus with first-degree price discrimination than with a uniform price. Suppose a monopolist has a constant marginal cost $MC = 2$ and faces the demand curve $P = 20 - Q$, as shown in Figure 12.3. There are no fixed costs.

Problem

(a) Suppose price discrimination is not allowed (or is not possible). How large will the producer surplus be?

(b) Suppose the firm can engage in perfect first-degree price discrimination. How large will the producer surplus be?

1st Degree Price Discrimination

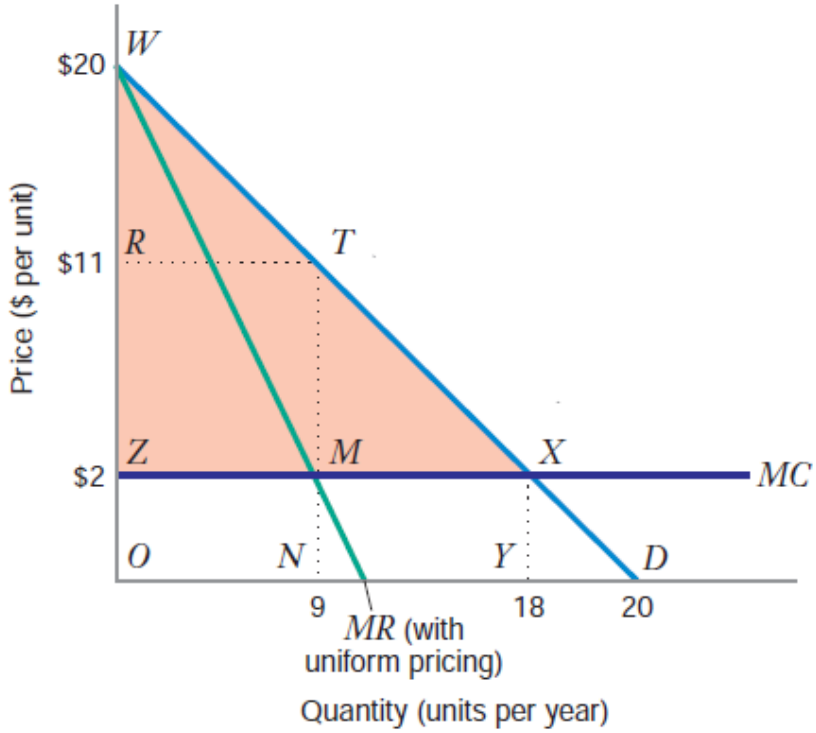


FIGURE 12.3 **Capturing Surplus: Uniform Pricing versus First-Degree Price Discrimination**
With uniform pricing, the firm produces 9 units (corresponding to the intersection of the marginal cost curve *MC* and the marginal revenue curve *MR*). It sells these units at a price of $11 per unit, capturing a producer surplus of $81 (area *RTMZ*). With perfect first-degree price discrimination, the firm produces 18 units (corresponding to the intersection of *MC* and the demand curve *D*), capturing a producer surplus of $162 (area *WXZ*).

2nd Degree Price Discrimination

Definition: A policy of **second degree price discrimination** allows the monopolist to charge a different price to different consumers. **While different consumers pay different prices, the reservation price of any one consumer cannot be directly observed.**

2nd Degree Price Discrimination often involves **quantity discount**, i.e. lower price for higher quantity. We will discuss two cases:

- Block Tariff
- Two-Part Tariff

Two-Part Tariff

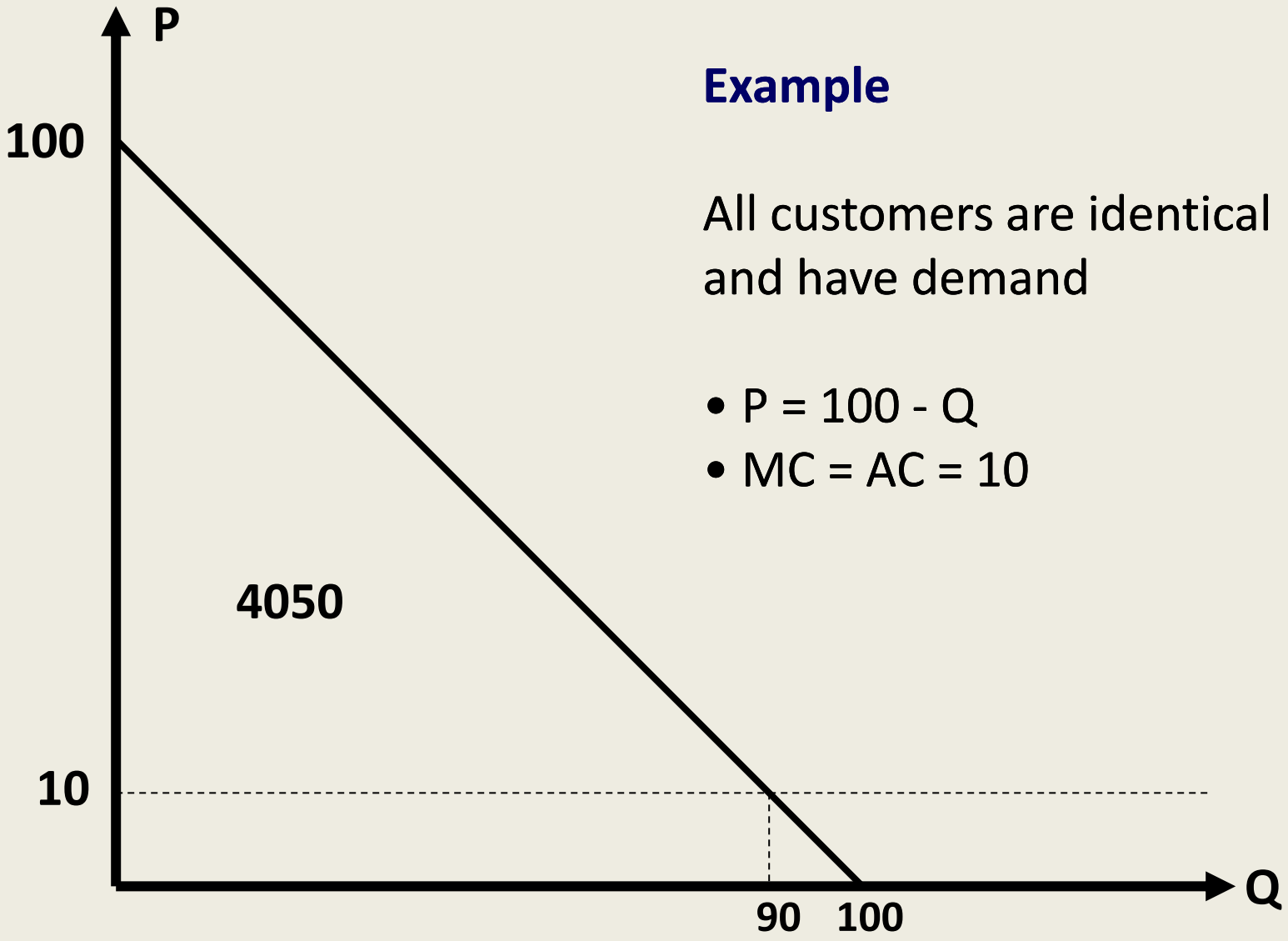
Definition: A monopolist charges a two-part tariff if it charges **a per-unit price plus a lump-sum price** (paid whether or not a positive number of units is consumed).

Per-Unit Price is also called "**Usage Charge**".
Lump-Sum Price is also called "**Subscription Charge**".

Generally, a two-part tariff charges buyers of a low quantity a higher average price than buyers of a high quantity.

Example: hook-up charge plus usage fee for a telephone

Two-Part Tariff (Identical Consumers)



Example

All customers are identical and have demand

- P = 100 - Q
- MC = AC = 10

Two-Part Tariff (Identical Consumers)

What is the optimal two-part tariff?

Two steps:

(1) maximize the benefits to the consumers by charging
PER-UNIT PRICE = MC = 10.

(2) capture this benefit by setting
LUMP-SUM PRICE = consumer benefits = 4050.

Two-Part Tariff (Identical Consumers)

Any higher usage charge would result in a dead-weight loss that could not be captured by the monopolist. Any lower usage charge would result in selling at less than marginal cost.

In essence, the monopolist maximizes the size of the "pie", then sets the lump-sum fee so as to capture the entire "pie" for itself.

The total surplus captured is the same as in the case of perfect price discrimination.

Two-Part Tariff (Identical Consumers)

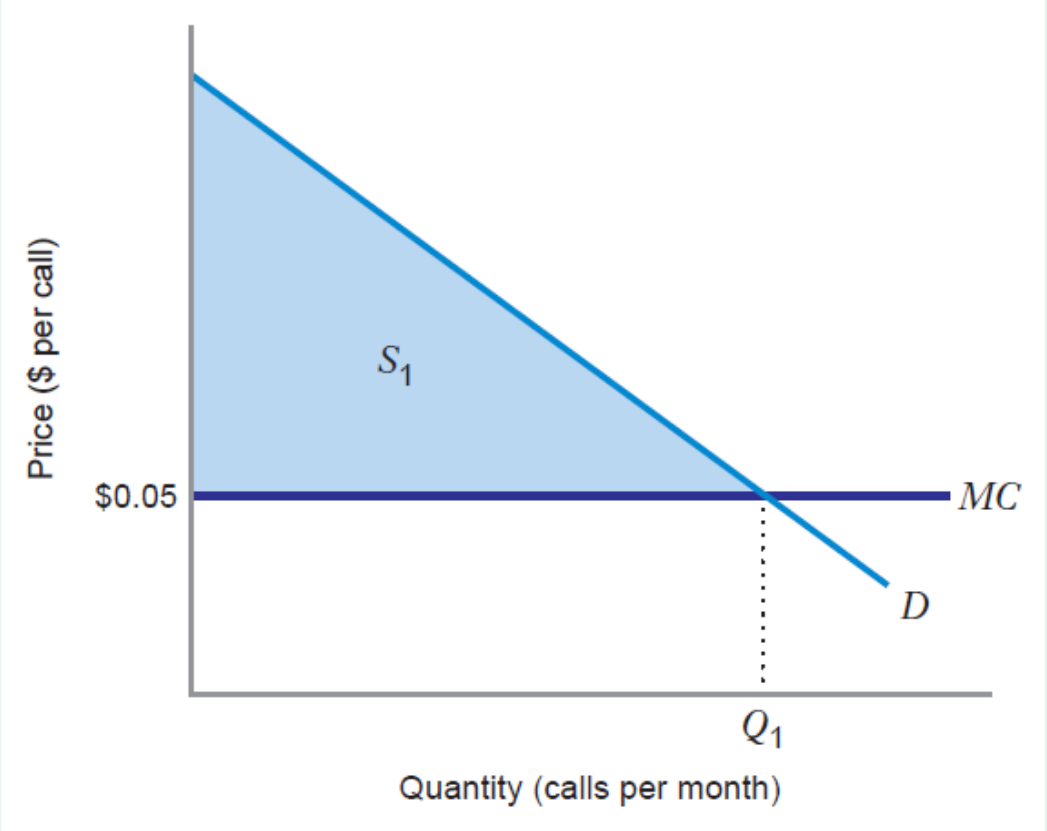


FIGURE 12.8 Subscriber and Usage Charges
Each consumer has the demand curve D for telephone service, and the telephone company incurs a marginal cost of $0.05 for each call. If the company sets a usage charge of $0.05 for each call, the consumer would make Q_1 calls each month and realize a consumer surplus of S_1. The telephone company could capture virtually all the consumer surplus by implementing a monthly subscription charge of slightly less than S_1 dollars.

Two-Part Tariff (Different Consumers)

For one type of consumers, the firm sets

- Per-unit price = P = MC
- Lump-sum price = consumer surplus

Now suppose there are two types of consumers:

- **The rich who have more willingness to pay.**
- **The poor who have less willingness to pay.**

Assume $CS_{Rich} > CS_{Poor}$.
i.e. Rich's consumer surplus > Poor's consumer surplus

Two-Part Tariff (Different Consumers)

When faced with two kinds of consumers, the firm cannot charge "lump-sum price" too high. Otherwise, consumers with lower consumer surplus will not pay. The firm may lose some customers.

For example,

If lump-sum price = CS_{Rich}, the poor will not buy.

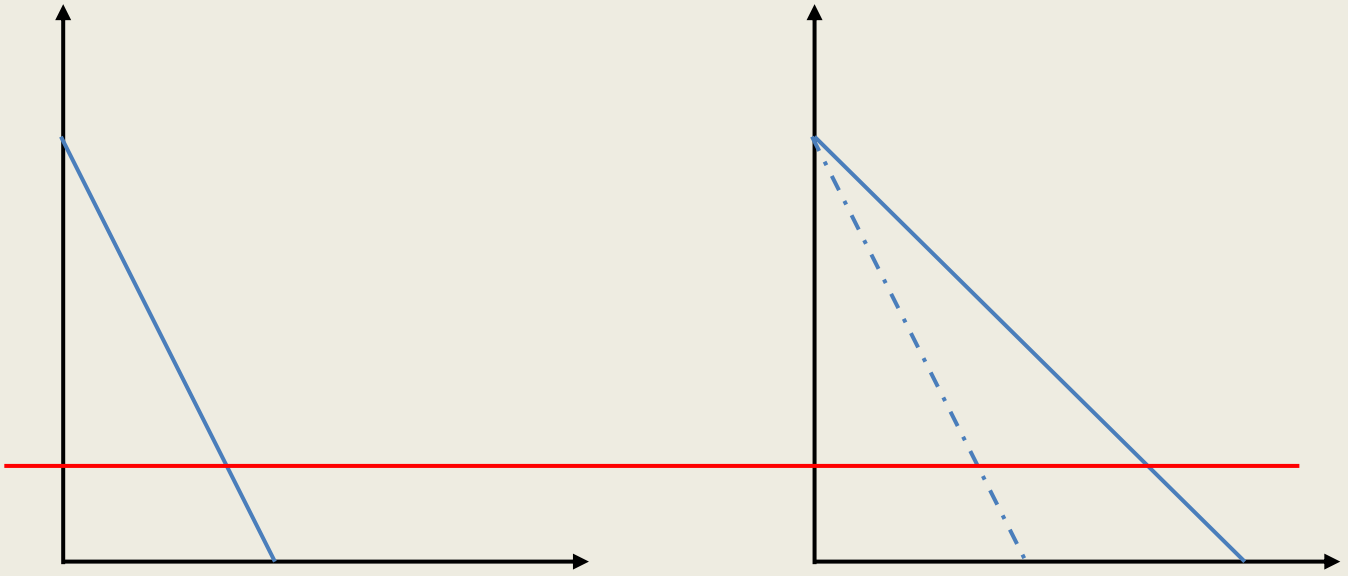
But profits may be lower.

If lump-sum price = CS_{Poor}, both will buy.

But profits may be lower.

Two-Part Tariff (Different Consumers)

Suppose P = MC and lump-sum price = CS_{Poor} at P = MC.



Two-Part Tariff (Different Consumers)

However, the firm can do better by striking the balance between profits from lump-sum price and per-unit price.

In other words, the firm can charge

- Per-unit price > MC

  Thus. it makes profits from selling products.

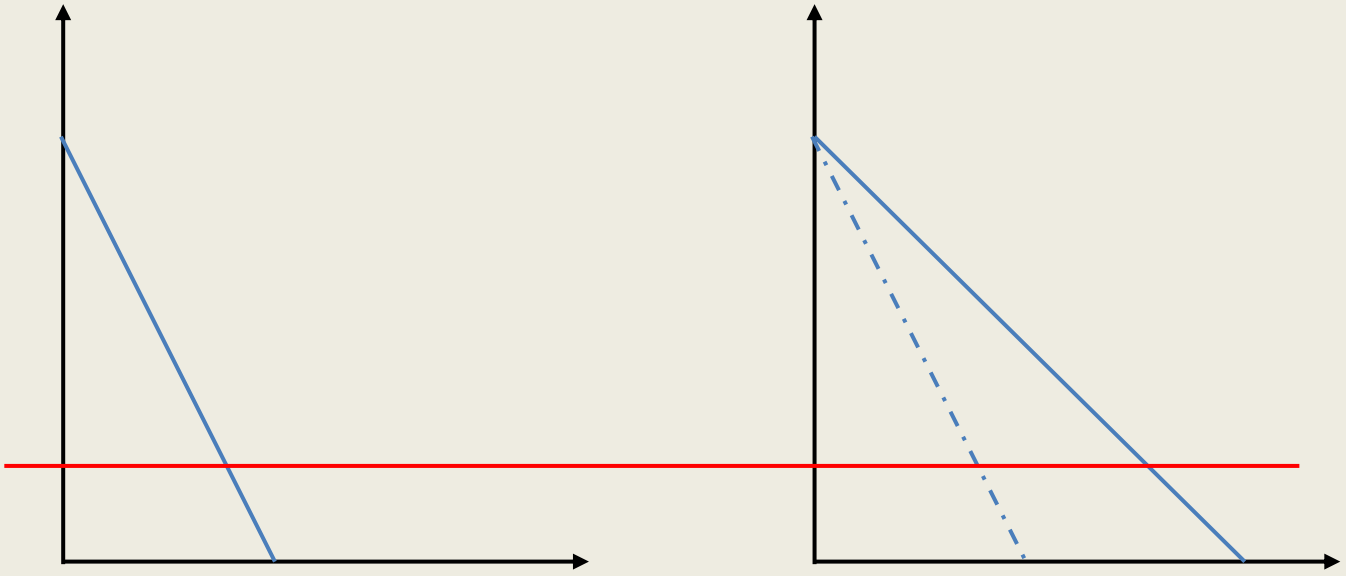
- Lump-sum price = CS_{Poor}

  Thus, it makes profits from serving both groups.

In reality, it may be more profitable to serve only one group of consumers. This depends on the number of each group.

Two-Part Tariff (Different Consumers)

Suppose P* > MC and lump-sum price = CS_{Poor} at P*.



Block Tariff

Definition: If a consumer pays one price for one block of output and another price for another block of output, the consumer faces a **block tariff.**

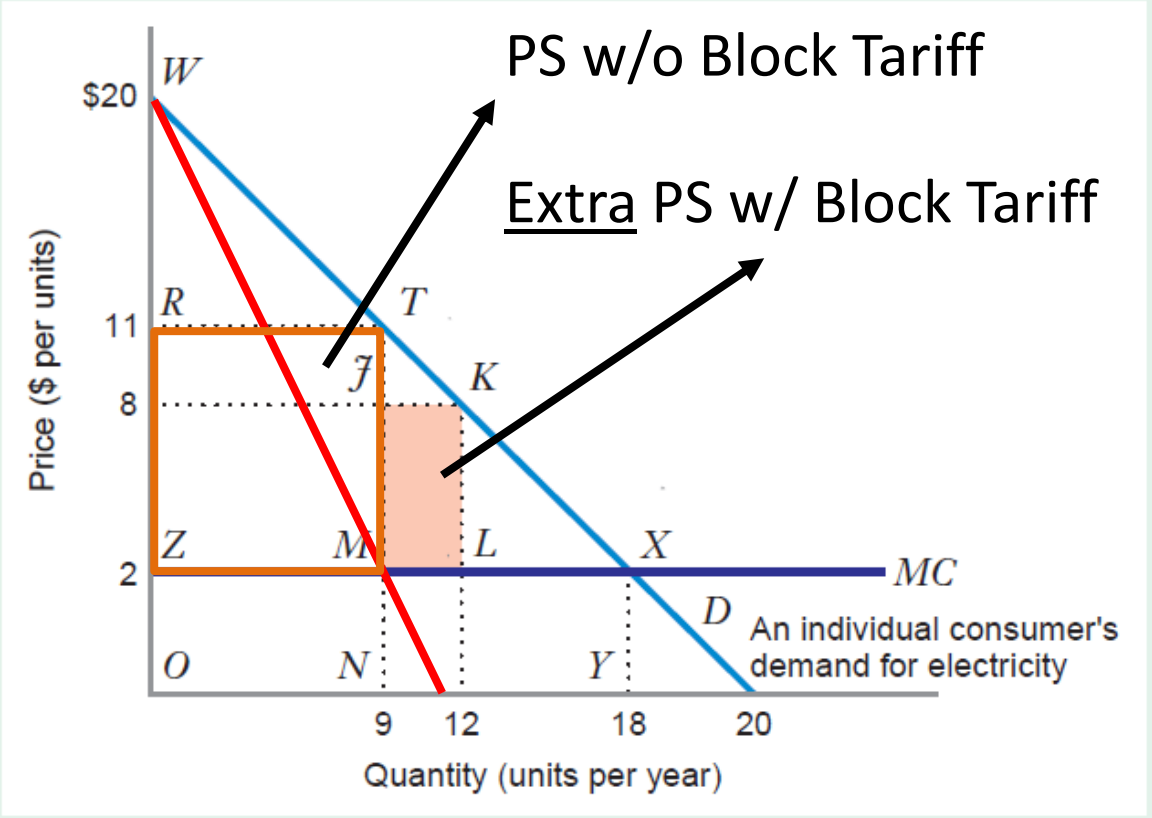
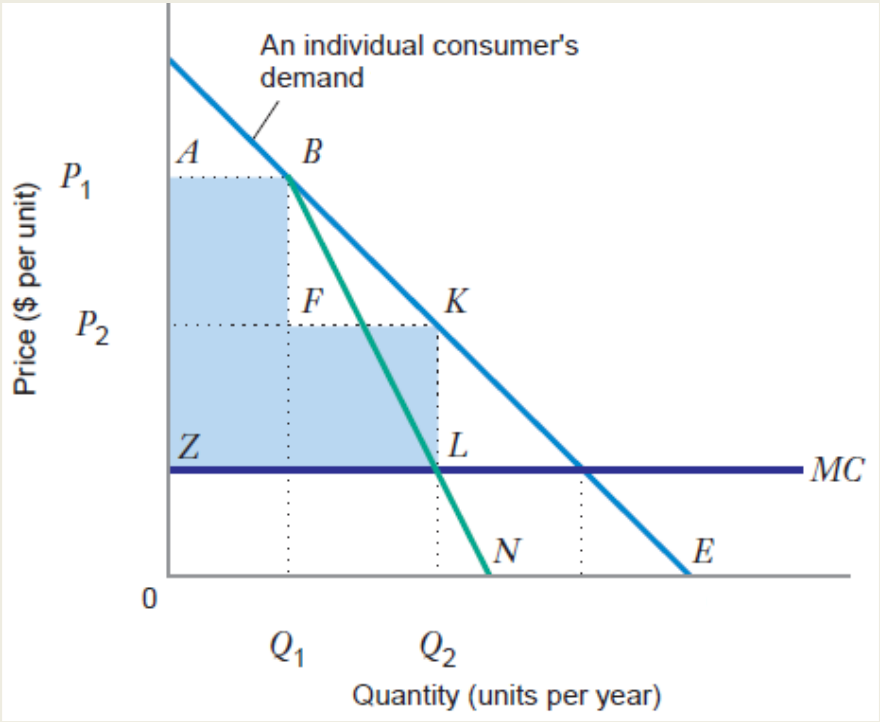


FIGURE 12.4 Uniform Pricing versus Second-Degree Price Discrimination
With uniform pricing, the firm captures a producer surplus of $81 (equal to area *RTMZ*). With a block tariff, the firm charges a price of $11 for the first 9 units a consumer purchases and a price of $8 for the three additional units. This example of second-degree price discrimination lets the firm capture a producer surplus of $99 (areas *RTMZ* + *JKLM*).

Block Tariff

For 2-Block Tariff, we need to find Q1, Q2, P1, P2 such that producer surplus is maximized.

That is, we try to maximize the shaded area.



If the monopolist could set a <u>different block price for **each customer**</u>, it would capture the same amount of surplus as a <u>perfectly price-discriminating monopolist</u>.

Block Tariff

Example 1

Let
Inverse Demand: $P = 20 - Q$
Marginal Cost: $MC = 2 = AC$

Assume that the monopolist wants to charge two different prices. What the two prices should it charge in order to maximize the producer surplus?

Block Tariff

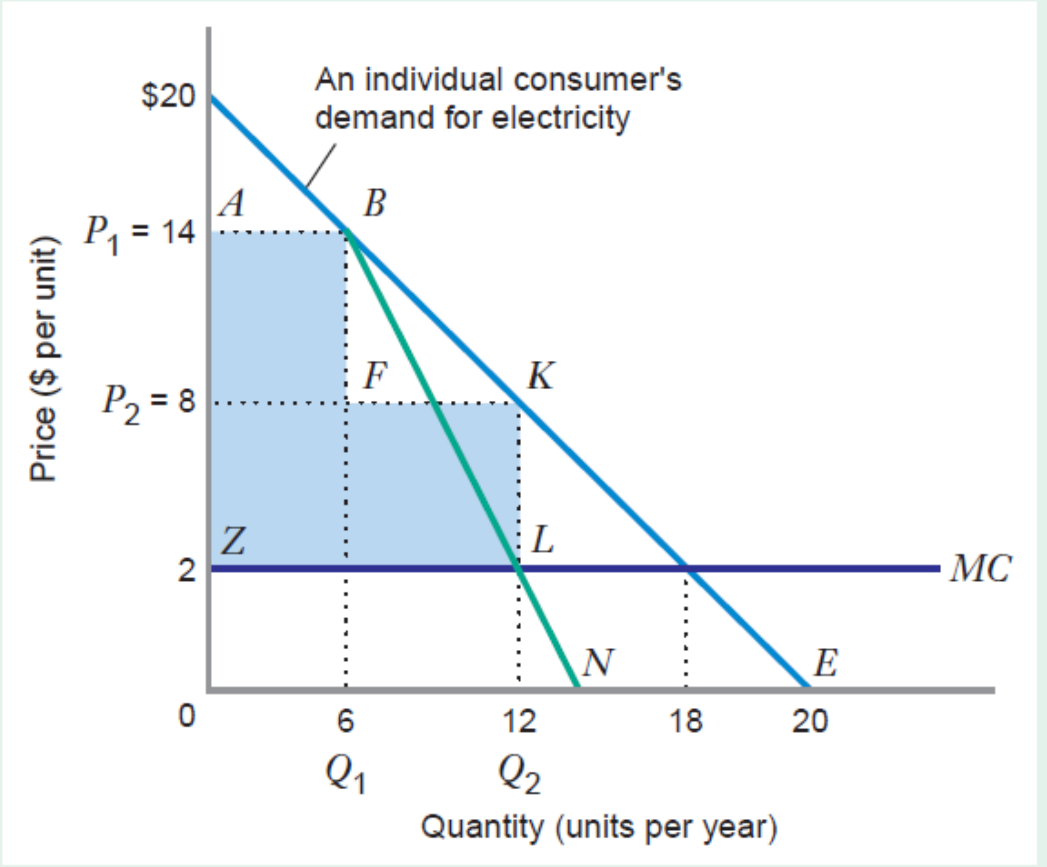


FIGURE 12.5 **Optimizing Producer Surplus with Second-Degree Price Discrimination**
With the optimal block tariff (assuming only two blocks), the firm sells 6 units at a price of $14 per unit and 6 additional units at a price of $8 per unit. This maximizes producer surplus at $108 (the shaded area *ABFKLZ*).

Block Tariff

Example 2

Let
Inverse Demand: $P = 100 - Q$
Marginal Cost: $MC = 10 = AC$

Assume that the monopolist wants to charge two different prices. What the two prices should it charge in order to maximize the producer surplus?

Answer: It should sell the first 30 units at $P = 70$ and another 30 units at $P = 40$. Total $Q = 60$.

Block Tariff

LEARNING-BY-DOING EXERCISE 12.3

Increasing Profits with a Block Tariff

Softco is a software company that sells a patented computer program to businesses. Each business it serves has the demand for Softco's product: $P = 70 - 0.5Q$. The marginal cost for each program is \$10. Assume there are no fixed costs.

Problem

(a) If Softco sells its program at a uniform price, what price would maximize profit? How many units would it sell to each business customer? How much profit would it earn from each business customer?

(b) Softco would like to know if it is possible to improve its profit by implementing block pricing. Suppose that Softco were to sell the first block at the price you determined in (a), and that the quantity for that block is the quantity you determined in (a). Find the profit-maximizing quantity and price per unit for the second block. How much extra profit would Softco earn from each of its business customers?

(c) Do you think Softco could earn even more profits with a set of prices and quantities for the two blocks different from those in part (b)? Explain.

3rd Degree Price Discrimination

Definition: A policy of **third degree price discrimination** offers a different price for each segment of the market (or each consumer group) when membership in a segment can be observed.

Example: Movie ticket sales to older people or students

Given that the whole market is segmented into sub-markets, the monopolist can set different P* and Q* for each sub-market in order to maximize its total profit, e.g. sub-market for students and sub-market for seniors.

3rd Degree Price Discrimination

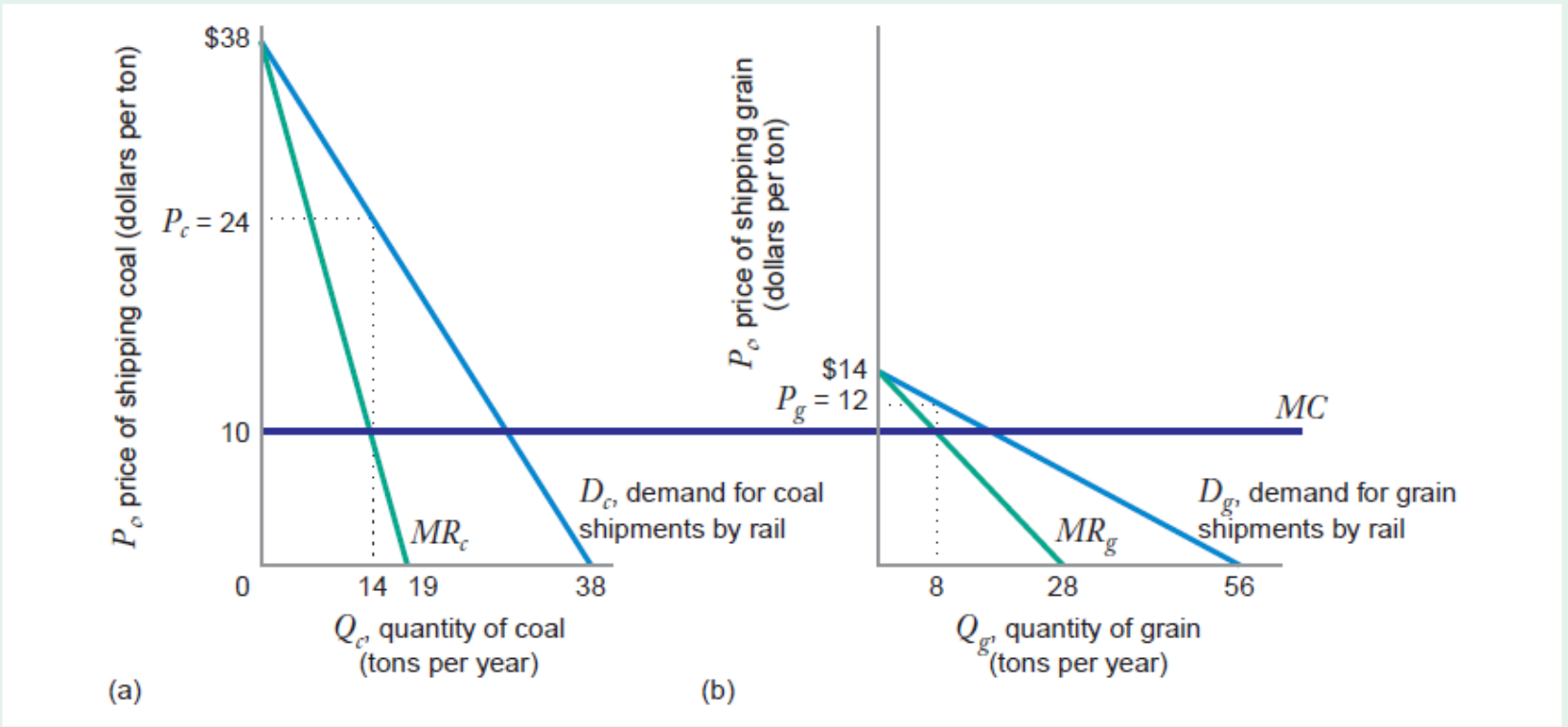


FIGURE 12.9 **Pricing Coal and Grain Transport by Rail: Third-Degree Price Discrimination**
The demand for rail transport of coal is much less price sensitive than the demand for rail transport of grain. Railroads can exploit this fact, using third-degree price discrimination to set a much higher profit-maximizing price for coal than for grain, even though the marginal costs of transporting the two goods are the same.

Example

Suppose the monopolist operates in two market segments, at the same constant marginal cost.

MC = AC = 20 in both segments

Mkt Segment 1: $P_1 = 100 - Q_1$

Mkt Segment 2: $P_2 = 80 - 2Q_2$

What P* and Q* should be in each market?

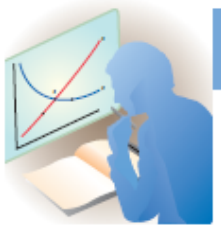
LEARNING-BY-DOING EXERCISE 12.4

Third-Degree Price Discrimination in Railroad Transport

Suppose a railroad faces the demand curves for transporting coal and grain shown in Figure 12.9. For coal, $P_c = 38 - Q_c$, where Q_c is the amount of coal moved when the transport price for coal is P_c. For grain, $P_g = 14 - 0.25Q_g$, where Q_g is the amount of grain shipped when the transport price for grain is P_g. The marginal cost for moving either commodity is \$10.

Problem Equate marginal revenue and marginal cost to find the profit-maximizing rates for coal and grain transport.

3rd Degree Price Discrimination



LEARNING-BY-DOING EXERCISE 12.5

Third-Degree Price Discrimination for Airline Tickets

According to Table 2.2, the estimated price elasticity of demand for coach class airline tickets for business travelers is $\epsilon_{Q_B, P_B} = -1.15$, while for vacation (leisure) travelers it is $\epsilon_{Q_V, P_V} = -1.52$.[15] Suppose an airline facing these demand elasticities wants to use third-degree price discrimination to maximize profit, by setting the price of a business travel ticket to P_B and the price of a vacation travel ticket to P_V. Also suppose that the airline faces the same marginal cost MC for both types of travelers.

Problem Use the inverse elasticity pricing rule [IEPR; see equation (11.4)] to determine the ratio P_B/P_V.

3rd Degree Price Discrimination

For the monopolist to implement the **3rd Degree PD**, it has to be able to "**screen**" consumers.

Screening is a process for sorting consumers based on their characteristics.

These characteristics can be

- Observable, e.g. sex and age.
- Unobservable but inferable, e.g. PED and willingness to pay.

3rd Degree Price Discrimination

Two Interesting Screening Mechanisms

Coupons and Rebates (a partial refund)

- For example, you buy a printer ink cartridge for $20, when it is empty, you can send it to the seller and get a rebate of $2.
- Consumer who take time to process rebates shows that they are price-sensitive.
- Sellers will offer lower prices for these consumers.

3rd Degree Price Discrimination

Two Interesting Screening Mechanisms

Time

- Intertemporal Pricing
  - PED becomes more elastic over time.
  - Short Run: Inelastic >> High Price
  - Long Run: Elastic >> Low Price
- Peak-Load Pricing
  - Demand may be high or low at a particular time.
  - On-Peak: High Demand >> High Price
  - Off-Peak: Low Demand >> Low Price

3rd Degree Price Discrimination

Intertemporal Pricing

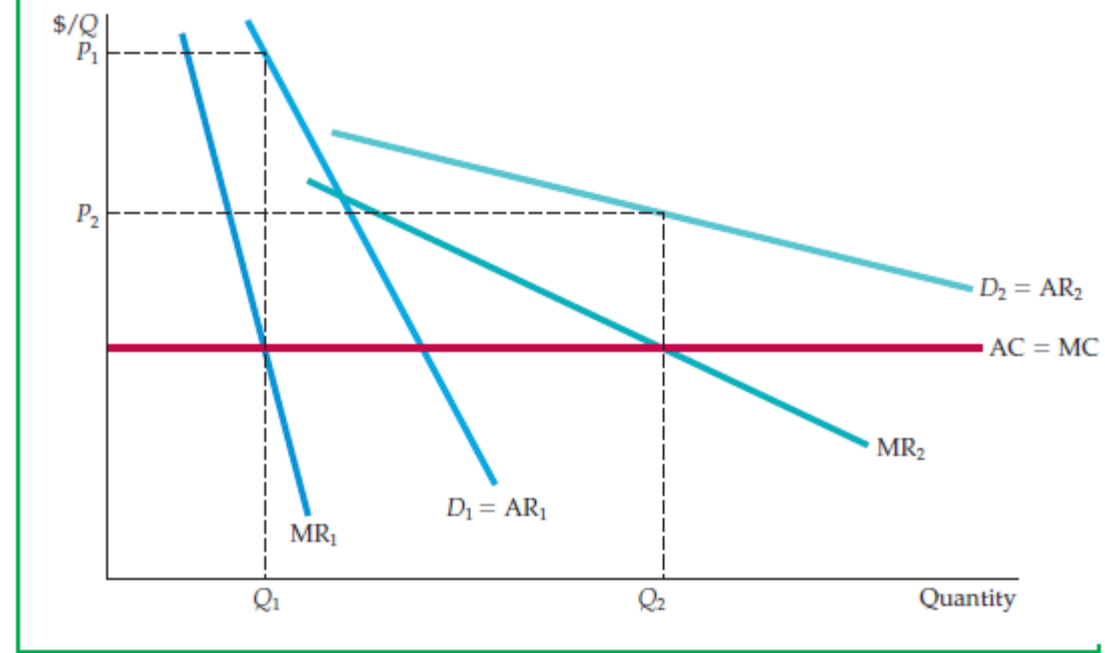


FIGURE 11.7
INTERTEMPORAL PRICE DISCRIMINATION

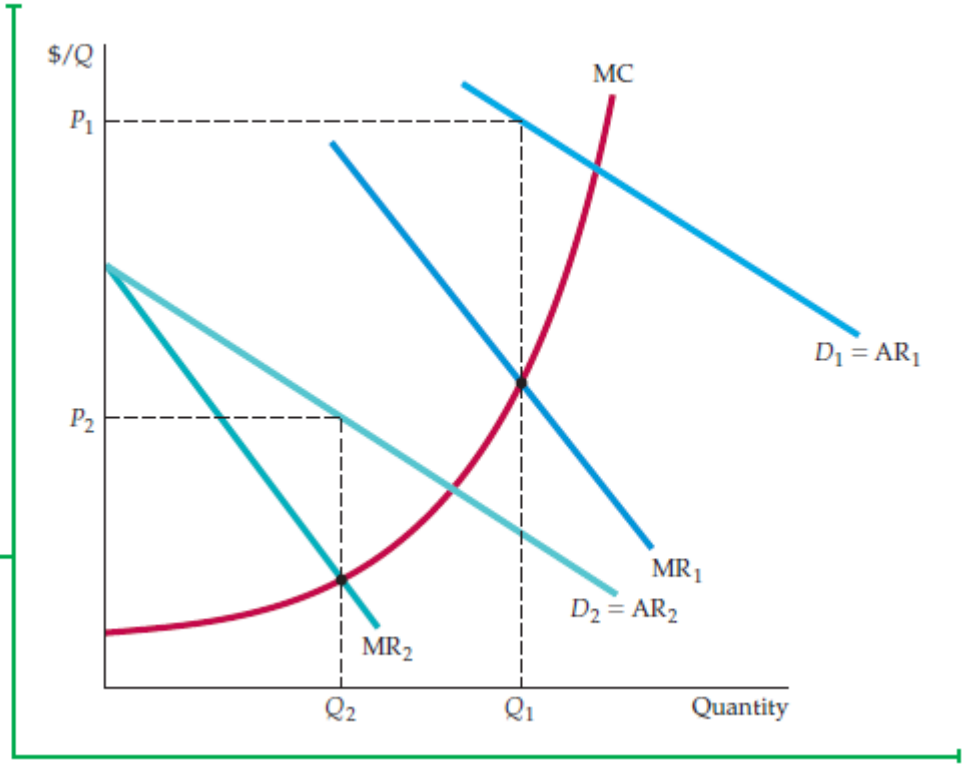
Consumers are divided into groups by changing the price over time. Initially, the price is high. The firm captures surplus from consumers who have a high demand for the good and who are unwilling to wait to buy it. Later the price is reduced to appeal to the mass market.

3rd Degree Price Discrimination

Peak-Load Pricing

FIGURE 11.8
PEAK-LOAD PRICING

Demands for some goods and services increase sharply during particular times of the day or year. Charging a higher price P_1 during the peak periods is more profitable for the firm than charging a single price at all times. It is also more efficient because marginal cost is higher during peak periods.



3rd Degree Price Discrimination

Implementing the 3rd Degree Price Discrimination

Suppose the monopolist cannot "screen" consumers.

How can it ensure that the consumers targeted to pay the high price ACTUALLY pay the high price?

Versioning refers to a strategy of selling two or more versions of a product with different quality levels at different prices.

Versioning takes advantage of the trait that the least price-sensitive buyers tend to be the most quality-sensitive.

3rd Degree Price Discrimination

Implementing the 3rd Degree Price Discrimination

Damaged Goods Strategy refers to a versioning strategy in which the firm creates a low-end version of its full-price good by deliberately damaging the product.

For example, one version of a 1990 IBM laser printer was "added" chips to slow down printing speed.

Other examples include goods in shopping outlets.

3rd Degree Price Discrimination

3rd Degree Price Discrimination with Capacity Constraints

Capacity Constraints: Production or supply of goods is limited, e.g. seats of airlines, cars of car rentals, etc.

Suppose that the monopolist can produce up to Q' units.

It is to supply Q' units of output in two market segments.

How should it allocate Q' between these two segments?

3rd Degree Price Discrimination

3rd Degree Price Discrimination with Capacity Constraints

Let Q1 be quantity supplied to Segment 1
Q2 be quantity supplied to Segment 2

It should allocate Q' = Q1 + Q2
such that MR(Q1) = MR(Q2).

If MR(Q1) > MR(Q2), it can increase revenue and hence profit by supplying more quantity in Segment 1.

3rd Degree Price Discrimination

LEARNING-BY-DOING EXERCISE 12.6

Price Discrimination Subject to Capacity Constraints

This exercise shows you how to determine the profit-maximizing prices and quantities for a firm that wants to engage in third-degree price discrimination but operates with a capacity constraint.

Suppose that the demand curve in market segment 1 is $Q_1 = 200 - 2P_1$ and the demand curve in market segment 2 is $Q_2 = 250 - P_2$. The marginal cost of selling in each market segment is \$10 per unit. The firm's overall capacity is 150 units.

Problem What are the profit-maximizing quantities and prices in each market segment?

Price Discrimination Summary

1st Degree

The monopolist charges each consumer the maximum price he/she is willing to pay.

2nd Degree

Price varies according to quantity demanded, i.e. quantity discount.

3rd Degree

The monopolist charges different prices for different "separable" consumer groups.

Tie-in Sales

Apart from Price Discrimination, ANY FIRMS with market power have another technique that can be used to "capture" surplus from consumers.

Definition: A **tie-in sale** occurs if customer can buy one product ONLY IF they agree to purchase another product as well. Examples include printers and ink cartridges, photocopiers and papers, computers and monitors, etc.

The firm can extend its market power from one product to the other.

Tie-in Sales – Bundling

Package tie-in sales *(or **bundling**)* occur when goods are combined so that customers cannot buy either good separately.

For example, one Disney Land ticket includes “admission fee” and “roller coaster fee”.

Bundling may be used in place of price discrimination to increase producer surplus when consumers have different willingness to pay for the goods sold in the bundle.

Bundling MAY NOT increase profit.

Tie-in Sales – Bundling

TABLE 12.2 Bundling Can Increase Profit When Customer Preferences Are Negatively Correlated

	Reservation Price (maximum willingness to pay)	
	Computer	**Monitor**
Customer 1	$1,200	$600
Customer 2	$1,500	$400
Marginal cost	$1,000	$300

WITHOUT Bundling

Max. profit from computer = 500, i.e. sold to Customer 2.
Max. profit from monitor = 300, i.e. sold to Customer 1.
Max. total profit = 500 + 300 = 800.

Tie-in Sales – Bundling

TABLE 12.2 Bundling Can Increase Profit When Customer Preferences Are Negatively Correlated

	Reservation Price (maximum willingness to pay)	
	Computer	**Monitor**
Customer 1	$1,200	$600
Customer 2	$1,500	$400
Marginal cost	$1,000	$300

WITH Bundling (MC = 1300)

At P* = 1800, BOTH customers buy the bundle.
Total Profit = 500 x 2 = 1000.
At P = 1900, ONLY Customer 2 buys the bundle.
Total Profit = 600.

Tie-in Sales – Bundling

TABLE 12.3 Bundling Does Not Increase Profit When Customer Preferences Are Positively Correlated

	Reservation Price (maximum willingness to pay)	
	Computer	**Monitor**
Customer 1	$1,200	$400
Customer 2	$1,500	$600
Marginal cost	$1,000	$300

WITHOUT Bundling

Max. profit from computer = 500, i.e. sold to Customer 2.
Max. profit from monitor = 300, i.e. sold to Customer 2.
Max. total profit = 500 + 300 = 800.

Tie-in Sales – Bundling

TABLE 12.3 Bundling Does Not Increase Profit When Customer Preferences Are Positively Correlated

	Reservation Price (maximum willingness to pay)	
	Computer	Monitor
Customer 1	$1,200	$400
Customer 2	$1,500	$600
Marginal cost	$1,000	$300

WITH Bundling (MC = 1300)

At P = 1600, BOTH customers buy the bundle.
Total Profit = 300 x 2 = 600.
At P* = 2100, ONLY Customer 2 buys the bundle.
Total Profit w/ Bundling = 800 = Total Profit w/o Bundling

Tie-in Sales – MIXED Bundling

Mixed Bundling is when firms allow customers to purchase components individually as well as in bundles.

- The firm should sell only computer to Customer 4.
- It should sell only monitor to Customer 1.
- For Customers 2 and 3, it can offer bundles.

TABLE 12.4 Mixed Bundling Can Increase Profit

	Reservation Price (maximum willingness to pay)	
	Computer	**Monitor**
Customer 1	$ 900	$800
Customer 2	$ 1,100	$600
Customer 3	$1,300	$400
Customer 4	$1,500	$200
Marginal cost	$1,000	$300

Advertising

The firm can capture surplus using ***non-price strategies*** such as advertising. Advertising increases demand and fixed cost, so D and AC curves shift up.