A Heterogeneous Market

- If consumers are homogeneous, and only a single price can be charged, then finding the best price that maximizes the seller's profit is the best the firm can do.

- If consumers differ in their willingness to pay, then the profit-maximizing firm can increase its profits by charging a variety of prices, that is, by price discriminating.

Example

Suppose there are four equal-size segments of customers in the market for a textbook, each willing to pay a different price for it. Segment A is willing to pay up to $40, segment B up to $30, segment C up to $20, and segment D up to $10. Assume that no customer will buy more than one book and will buy only if his or her customer surplus (that is, reservation price minus the price asked) is nonnegative. Suppose the firm's variable cost per book is $5, and there are no fixed costs.
**The Best Single Price to Charge**

No point in charging a price less than $10-everyone is willing to pay at least $10, and there is no point in charging a price in between the various reservation prices.

<table>
<thead>
<tr>
<th>Price ($)</th>
<th>Profits ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4N(10-5)=20N</td>
</tr>
<tr>
<td>20</td>
<td>3N(20-5)=45N</td>
</tr>
<tr>
<td>30</td>
<td>2N(30-5)=50N</td>
</tr>
<tr>
<td>40</td>
<td>N(40-5)=35N</td>
</tr>
</tbody>
</table>

N - is the number of consumers in each segment

**Charging a Variety of Prices**

◊ Suppose that a monopolistic firm can charge four different prices to the four segments.
◊ Firm's profits:

\[ \$N[(40-5)+(30-5)+(20-5)+(10-5)]=\$80N. \]

This kind of price discrimination is known as direct price discrimination
Single Price vs. Price Discrimination

Optimal profit under price discrimination

\[= (30-5)x2 + 10 + (20-5) + (10-5) = 80\]

Market Served and Customer Surplus: Single Price vs. Price Discrimination

Under price discrimination:

- The firm extracts every customer’s complete surplus.
- The firm serves every customer who is willing to pay at least as much as the firm’s cost (inclusion).
Suppose the firm’s variable cost per book is $15

Customer 4 is excluded: The firm does not serve any customer whose willingness-to-pay is less than the firm’s costs.

Features of Direct Price-Discrimination

1. The firm extracts every customer’s complete surplus. (*Extraction:* No money is left on the table.)
2. The firm serves every customer who is willing to pay at least as much as the firm’s cost (in the case $5: *inclusion*).
3. The firm does not serve any customer whose willingness-to-pay is less than the firm’s costs (exclusion: in the case $15).
4. Direct price discrimination is efficient. That is, no other pricing scheme can be found that will simultaneously improve the welfare of customers and increase the profits of the seller.
Direct price discrimination, seems like an excellent idea for the firm, but implementing it in practice involves several difficulties.

**Difficulties Involved in Practicing Price Discrimination**

1. Identifying customers’ reservation prices is difficult.
2. Targeting a particular price to a particular segment is difficult.
3. It is difficult to prevent arbitrage: consumers with low reservation prices may buy up a lot of the product and supply it to high-reservation-price consumers at a price lower than their reservation price.
4. Charging different prices to different segments may be illegal.
5. Customers may view price discrimination as unfair.
Despite the Difficulties DPD Does Exists

◊ Examples of direct price discriminations:
  ◆ local telephone companies discriminate between residential and business users in their prices
  ◆ senior citizen and student discounts are forms of this type of price discrimination.

In all these cases the points 1-5 (identification, targeting, arbitrage prevention, legality requirements) are satisfied.

Price Discrimination (Indirect)
Indirect Price Discrimination

To identify:

- The reservation prices of different segments
- Their preferences for some attributes of the product

The firm can tie its different prices to different levels of the attributes and allow *customers to freely choose* the level of the attribute they want to buy.

Example of Indirect PD

*Airline industry pricing*: offer a variety of fares with various restrictions (and some with no restrictions).

- The higher fares are associated with no advance purchase requirements, no cancellation penalties, and so on.
- The lower fares have many of these restrictions.

The intention is to create a product line differentiated on the *restrictions attribute* with different products to different segments.

- The business traveler finds the restrictions costly and finds the higher unrestricted fares appealing.
- The vacation traveler finds the lower fares appealing and does not mind the restrictions.
Temporal Price Discrimination

The idea:

- to introduce a new product at a high price initially, intending to sell it to high-reservation-price consumers

- then lower it gradually to lower and lower reservation-price consumers.

For example, books are introduced in hardcover at a high price and after about a year or so the paperback version is introduced at a lower price.

One condition necessary for such skimming strategies to work is that the product be a durable good; otherwise, the early purchasers will return to the market when the price is lowered.

Temporal Price Discrimination cont d

Many researchers have analyzed temporal PD possibilities when consumers expect the price to decline in the future.

If the price were to come down too fast, then some of the more patient customers may choose to wait for the lower price. Thus, temporal price discrimination possibilities may be substantially reduced when consumers anticipate the seller’s future pricing strategy.

From the seller’s point of view, given consumers’ expectations, it might be better to commit to a pricing strategy for now and for future-rather than price each period.
Example:

Consider the four segments A, B, C, D, each of size N with reservation prices $40, $30, $20, and $10, respectively. Suppose each segment discounts next period consumer surplus at the rate $\delta$; and the seller also discounts next period profits at the rate of $\delta$. The seller's marginal cost is $5/unit.

Assume the seller's price flexibility is limited to two periods; that is, he can charge a price $p_1$ in the first period, a (possible) different price $p_2$ in the second, but then he has to keep his price constant at $p_2$.

What is the seller's optimal strategy?

The Seller's Optimal Strategy

If consumers were myopic:

$$p_1 = 30, \quad p_2 = 20.$$  

The firm's present value of profits will be:  

$$N(50+15\delta).$$  

In this case, it is better not to commit.

If consumers had foresight: The best pricing, if the seller doesn't make any commitments is:

$$p_1 = 30 - 10\delta, \quad p_2 = 20$$  

yielding:  

$$N[2(30-10\delta-5)+(20-5)\delta] = N(50-5\delta)$$  

in profits. Otherwise, the profit will be only:  

$$3(20-5)\delta = 45\delta.$$  

However, committing to a price of $30 for both periods yields: $50N$ profits.
Non-Linear Pricing or Quantity Discounts

Two-part tariff
Block tariff

Two-Part Tariff

- A fixed up-front payment $F$ and then a per-unit charge $p$.
  - membership clubs
    - membership fee and offer discounted merchandise
    - video clubs (membership fee+per movie)
  - a durable good + supplies
    - instant camera+ film
    - fixed fee + per-unit charge of using the durable good
    - razor + blades
    - copying machines+copier paper
Two-Part Tariff (TPT) & Linear Pricing (LP)

- A TPT is similar to a simple LP in that the marginal price charged is constant in quantity.
- A TPT is a quantity discount scheme only because the average price paid is:
  \[(F/Q) + p\] for quantity \(Q\).
- In a LP scheme both marginal and average prices are constant for any quantity purchased.
- The presence of a fixed fee in a TPT allows the seller to extract more consumer surplus than a simple LP scheme.

TPT Extracts Consumer Surplus

- \(p^*\) = optimal LP
- \(Q^*\) = Demand at \(p^*\)
- \(F^c\) = Area ABF = Fixed fee under optimal two-part tariff (unit price = \(C\))
- \(F'\) = Area Ap'E = Fixed fee under non-optimal two-part tariff (unit price = \(p^*\))
**Optimal TPT of a Homogeneous Market: A Mathematical Proof**

\[ (F^1, p^1) = \text{optimal TPT} \]

\[ F^1 = \text{Area } Ap = (a-bp^1)(a/b - p^1)/2 = (a-bp^1)^2/2b \]

\[ \max_{p^1} \Pi = F^1 + Q(p^1)(p^1-C) = (a-bp^1)^2/2b + (a-bp^1)(p^1-C) \]

First Order Cond.: \( d\pi/dp^1 = 0, -2b(a-bp^1)/2b + (a-bp^1) - b(p^1-C) = 0 \)

\[ p^1 = C \]

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**Optimal TPT: Two Segments**

1. The seller offers the product only to segment B. \( F^c = \text{area ABO} \) and has a profit equal to \( \Pi_c = F^c \).

2. The seller offers the product to segments A and B. \( F_1 = \text{area RST} \) and will have a profit: \( \Pi_1 = 2F_1 + (q_A + q_B)(p - C) \), where \( p_1 \) maximizes \( \Pi_1 \).

The optimal TPT is either \( (F^1, p^1) \) or \( (F^c-C) \)
Illustrative Example

1. If the seller offers the product only to segment B.
   \[ F^0 = \text{area ABO} = (6-1)(6-1)/2 = 12.5 \] and has a profit equal to \( \Pi_1 = F^0 = 12.5 \).

2. If the seller offers the product to segments A and B.
   \[ F^1 = \text{area RST} = (5-p_1)(5-p_1)/2 \] and will have a profit:
   \[ \Pi_2 = 2F^1 + (q_A + q_B)(p_1-C) = (5-p_1)(5-p_1) + (11-2p_1)(p_1-1), \]
   where \( p_1 \) maximizes \( \Pi_2 \).

   \[ \frac{d \Pi_2}{dp_1} = 0; \] \( p_1 = 1.5, F^1 = 6.125 \) \( \Pi_2 = 16.25. \)

The optimal TPT is \( (F^1, p_1) = (6.125, 1.5) \).

A Two-Part Tariff Can Also be Used to Price Discriminate

- Through the fixed fee; it can be set so high that some, but not all, consumers don’t purchase the product.
  - The consumers with demand curve A would not purchase the product at all if the fixed fee is set equal to the consumer surplus with demand curve B.

- By charging different average prices to different customers.
**TPT to Price Discriminate**

The optimal TPT is either $(F_1, p_1)$ or $(F=C)$; $F_1 =$ Area RST, $F=C =$ Area ABO

1. If $(F_1, p_1)$ is the optimal TPT, then the price discrimination is through average price. Each customer pays a different average price: $\frac{F_1}{q_A} + p_1 > \frac{F_1}{q_B} + p_1$.

2. If $(F=C)$ is optimal then the price discrimination is through the fixed fee since customer A would not buy at a fixed fee which is greater than its surplus for this price.

**Block Tariff**

Are the most widely used form of quantity discount.

It has at least two marginal prices; it may or may not have a fixed fee.

Local telephone company tariffs typically have a fixed subscription fee as well as several price breaks built into the schedule.
Three-Block Tariff with no Fixed Fee

Total amount paid = \( p_1 Q_1 + p_2 (Q_2 - Q_1) + p_3 (Q_3 - Q_2) \)

Block Pricing Can Improve Two-Part Tariff

\( F^1 = \text{Area RST}, \quad F^2 = \text{Area ABO} \)

The optimal TPT is either \((F^1, p')\) or \((F^2, C)\). If \((F^1, p')\) is the optimal TPT, then the two-block scheme \((p_1, Q, p_2)\) with fixed-payment \(F^1\) yields even greater profits.

profit by TPT = \( 2F^1 + (p_1 - C)(Q - Q_b) \)

profit by TB = \( 2F^1 + (p_1 - C)(Q_a + Q_b) + (p_2 - C)(Q_b - Q_a) \)
Optimal Block Pricing

Max $\Pi = 2F^1 + (p_1 - C)(Q_a + Q_b) + (p_2 - C)(Q_b - Q_a)$

$= (5-p_1)^2 + (p_1 - 1)(11 - 2p_1) + (p_2 - 1)(6 - p_2 - 6 + p_1)$

$Q_a = 5-p, Q_b = 6-p, C = 1$

$2F^1 = (5-p_1)^2$

$d\Pi/dp_1 = 0 
\Rightarrow p_1^* = \frac{5}{3} = 1.66$

$d\Pi/dp_2 = 0 
\Rightarrow p_2^* = \frac{4}{3} = 1.33$

$\Pi^* = \frac{49}{3} = 16.333 > 16.25$

Other Forms of Price Discrimination

- Price promotions (impose some inconvenience cost on the consumer)
  - Sales (limited-time reductions in price)
  - Coupons
  - Rebates
- Customer characteristics
  - Age
  - Income/education
  - Membership
- The distribution outlet
  - Specialty stores charge higher prices than supermarkets
- Brand differentiation
  - Selling generics at a lower (unbranded) price than their brand counterparts