Price discrimination

- Up to now, consider situations where each firm sets one uniform price
- Consider cases where firm engages in non-uniform pricing:
  1. Charging customers different prices for the same product (airline tickets)
  2. Charging customers different prices depending on time of purchase (concerts, airlines again)
  3. Charging customers a price depending on the quantity purchased (electricity, telephone service)
3 types of price discrimination

1. Perfect price discrimination: charging each consumer a different price. Often infeasible.

2. Third-degree price discrimination: charging different prices to different *groups* of customers
   - Senior or student discounts

3. Second-degree price discrimination: each customer pays her own price, depending on characteristics of purchase
   - Ex: nonlinear pricing, bundling
Perfect price discrimination (PPD)

- Graph.
- Monopolist sells product with downward-sloping demand curve.
- Each consumer demands one unit: demand curve graphs number of consumers against their willingness-to-pay for the product.
- Perfect price discrimination: charge each consumer her WTP.
- Perfectly discriminating monopolist produces more than “regular” monopolist: both produce at \( q \) where \( MC(q) = MR(q) \), but for PD monopolist \( MR(q) = p(q) \). PD monopolist produces at perfectly competitive outcome where \( p(q) = MC(q) \).
- Perfectly discriminating monopolist makes much higher profits (takes away all of the consumer surplus).
- Lower consumer welfare (no consumer surplus under PPD) but high output.
Perfect price discrimination (PPD) 2

- Clearly, there is profit motive for price discrimination.
- In order for PPD to work, assume consumers can’t trade with each other:
  - Requires *no resale*. With resale, marginal customer buys for whole market.
  - Equivalent to assuming that monopolist knows the WTP of each consumer: if consumers could lie, same effect as resale (everybody underreports their WTP).
  - Purchase constraints also prevent resale and support price discrimination: *limit two per customer sales?*
- Typically, information requirement of PPD too severe.
- Next: focus on settings where monopolist doesn’t know the WTP of each consumer.
3rd-degree price discrimination (3PD) 1

- Monopolist only knows demand functions for different groups of consumers (graph): groups differ in their price responsiveness
- Cannot distinguish between consumers in each group (i.e., resale possible within groups, not across groups)
  - Student vs. Adult tickets
  - Journal subscriptions: personal vs. institutional
  - Gasoline prices: urgent vs. non-urgent
- Main ideas: under optimal 3PD—
  1. Charge different price to different group, according to inverse-elasticity rule. Group with more elastic demand gets lower price.
  2. Can increase consumer welfare: group with more elastic demand gets lower price under 3PD.
3rd-degree price discrimination (3PD) 2

- Consider two groups of customers, with demand functions
  
  \[ q_1 = 5 - p \]
  
  \[ q_2 = 5 - 2 \times p \]
  
  (graph)

- Assume: monopolist produces at zero costs
If monopolist price-discriminates:

- $\max_{p_1, p_2} p_1 * (5 - p_1) + p_2 * (5 - 2 * p_2)$. Given independent demands, solves the two problems separately.

- $p_{1,PD}^* = \frac{5}{2}$  
  $p_{2,PD}^* = \frac{5}{4}$

- $q_{1,PD}^* = \frac{5}{2}$  
  $q_{2,PD}^* = \frac{5}{2}$

- $CS_{1,PD}^* = \frac{25}{8}$  
  $CS_{2,PD}^* = \frac{25}{16}$

- $\pi_{1,PD}^* = \frac{25}{4}$  
  $\pi_{2,PD}^* = \frac{25}{8}$
3DPD: Inverse elasticity redux

Price-discriminating monopolist follows inverse elasticity rule with respect to each group:

\[
\frac{(p_i - MC(q_i))}{p_i} = -\frac{1}{\epsilon_i}
\]

or (assuming constant marginal costs)

\[
\frac{p_i}{p_j} = \frac{1 + \frac{1}{\epsilon_j}}{1 + \frac{1}{\epsilon_i}}
\]

Consumers with less-elastic demands should be charged higher price:

- Senior discounts
- Food at airports, ballparks, concerts
- Caveat (as before): this condition satisfied only at optimal prices (and elasticity is usually a function of price)
Third-degree price discrimination: “pricing-to-market”

3DPD vs. uniform pricing

If monopolist doesn’t price-discriminate (uniform pricing):

\[ \max_p \pi^m = p \ast (5 + 5 - (1 + 2) \ast p) = p \ast (10 - 3p) \]

- \[ p_1^M = \frac{5}{3} \quad p_2^M = \frac{5}{3} \]
- \[ q_1^M = \frac{10}{3} \quad q_2^M = \frac{5}{3} \]
- \[ CS_1^M = \frac{50}{9} \quad CS_2^M = \frac{25}{36} \]
- \[ \pi_1^M = \frac{50}{9} \quad \pi_2^M = \frac{25}{9} \]
Welfare effects of 3DPD

- 3PD affects *distribution of income*: higher price (lower demand) for group 1, lower price (higher demand) for group 2, relative to uniform price scheme.
- Total production is same (5) under both scenarios (specific to this case). In general, if total output higher under 3PD, increases welfare in economy.
- Higher profits for monopolist under 3PD (always true: if he can 3PD, he can make *at least* as much as when he cannot).
Welfare effects cont’d

- Compare per-unit consumer welfare \((CS/q)\) for each group under two scenarios:

  \[
  (CS/q)_1^M = \frac{5}{3} = 1.67 \quad (CS/q)_2^M = \frac{5}{12} = 0.42
  \]
  \[
  (CS/q)^{PD}_1 = \frac{5}{4} = 1.25 \quad (CS/q)^{PD}_2 = \frac{5}{8} = 0.625
  \]

  Group 2 gains; group 1 loses

- Compare weighted average of \((CS/q)\) under two regimes: \(\frac{CS_1 + CS_2}{q_1 + q_2}\)

  1. without PD: 1.25
  2. with PD: 1.5625

- So average consumer welfare higher under 3PD:
  - specific to this model
2nd-degree price discrimination

- Second degree price discrimination is a general rubric for many types of firm pricing and product design policies.
- Main jist: Firm charges different price depending on characteristics of the purchase.
- These characteristics include:
  - Amount purchased (nonlinear pricing). Examples: sizes of grocery products
  - Quality of product purchased: high-end, low-end (Banana Republic vs. Gap vs. Old Navy)
  - Bundle of products purchased (bundling, tie-ins). Examples: fast-food “combos”, cable TV
Compared to 3DPD, here we assume that monopolist has even less information.

- It cannot classify consumers into groups, i.e., it knows there are two groups of consumers, but doesn’t know who belongs in what group.
- It cannot ask consumers to announce their group truthfully...
- Firm designs specific product for each type of consumer, and prices them so that consumers “self-select” into different products and hence pay different prices.
- *Indirect* price discrimination
Ex: airline pricing

- Firm cannot distinguish between business travellers and tourists
  - But knows that the former value higher quality seats more. Hence:
  - Hence: firm set prices for 1st-class ($p_F$) and coach seats ($p_C$) so that consumers “self-select”.
- This is called *market segmentation*

This involves two types of constraints:

1. **Self-selection constraints** ensure that each type of traveller chooses the appropriate seat:

   - $u_B(\text{first class}) - p_F > u_B(\text{coach}) - p_C$ (1)
   - $u_T(\text{coach}) - p_C > u_T(\text{first class}) - p_F$ (2)

2. **Participation constraints** ensure that each type of traveller purchases a plane ticket:

   - $u_B(\text{first class}) - p_F > 0$ (3)
   - $u_T(\text{coach}) - p_C > 0$ (4)

(Prevents airline from setting exorbitant prices)
Airline pricing: add some numbers

- Suppose
  
  \[ u_B(F) = 1000 \quad u_B(C) = 400 \]
  
  \[ u_T(F) = 500 \quad u_T(C) = 300 \]

- Under perfect information, airline should charge
  
  \[ p_C = 300; \quad p_F = 1000. \]

- But under these prices, B would buy coach seat instead!

- Under imperfect information, airline prices must obey constraints:

  \[ 1000 - p_F \geq 400 - p_C \quad \text{Type B buys first class} \]
  
  \[ 300 - p_C \geq 500 - p_F \quad \text{Type T buys coach} \]
  
  \[ 1000 - p_F \geq 0 \quad \text{Type B decides to travel} \]
  
  \[ 300 - p_C \geq 0 \quad \text{Type T decides to travel} \]
Airline pricing: solution

1000 \(- p_F \geq 400 - p_C \) Type B buys first class \hspace{1cm} (5)
300 \(- p_C \geq 500 - p_F \) Type T buys coach \hspace{1cm} (6)
1000 \(- p_F \geq 0 \) Type B decides to travel \hspace{1cm} (7)
300 \(- p_C \geq 0 \) Type T decides to travel \hspace{1cm} (8)

- What are airline’s optimal prices?
- Charge \( p_C = 300 \). Any higher would violate (8), and any lower would not be profit-maximizing.
- If charge \( p_F = 1000 \), type B prefers coach seat: violate constraint (5). Hence, upper bound on \( p_F \) is 900, which leaves him just indifferent b/t coach and 1-class.
- To maximize profits, charge \( p_C = 300 \) and \( p_F = 900 \).
Features of optimal solution

In general:

- \( p_C = u_B(C) \): Charge “low demand” types their valuation (leaving them with zero net utility)

- \( p_F = u_F(F) - (u_F(C) - p_C) \): Charge “high demand” types just enough to make them indifferent with the two options, given that “low demand” receive zero net utility.

- At optimal prices, only constraints 1 and 4 are binding: participation constraint for low type, and self-selection constraint for the high type \( \implies \) make low type indifferent between buying or not, and make high type indifferent between the “high” and “low” products

- General principle which holds when more than 2 types

- See this in next lecture.
Another 2DPD example: Bundling

- 2DPD is pervasive, and many market institutions can be interpreted in this light.
- Stigler: *Block booking* of movies
- Pervasive practice:
  - Movie companies force theaters to show all their movies
  - Cereals: forcing supermarkets to carry entire product line
  - Cable TV: Tribune company
  - Academic journals: Elsevier
Block booking

- Film distributor offers: *Gone with the Wind* and *Getting Gertie’s Garter*.
- There are movie theaters with “high” and “low” WTP for each movie:

<table>
<thead>
<tr>
<th>Theater</th>
<th>WTP for GWW</th>
<th>WTP for GGG</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>8000</td>
<td>2500</td>
</tr>
<tr>
<td>B</td>
<td>7000</td>
<td>3000</td>
</tr>
</tbody>
</table>

- Specific assumption about preferences:
  - Theater A is “high” for GWW, and “low” for GGG.
  - Theater B is “low” for GWW and “high” for GGG → preferences for the two products are *negatively related*

- Monopolist would like to charge each theater a different price for GWW (same with GGG), but that is unlawful.

- Question: does bundling the movies together allow you to price discriminate?
Without bundling, monopolist charges $7000 = \min(8000, 7000)$ for GWW and $2500 = \min(2500, 3000)$ for GGG.

- Total profits: $2 \times (7000 + 2500) = 19500$.

With bundling, monopolist charges $10000 = \min(8000 + 2500, 7000 + 3000)$ for the bundle.

- Profits $= 2 \times 10000$ (higher)

Akin to price discrimination: charging $(7000, 3000)$ to theater B, and $(8000, 2000)$ to theater A
Bundling 3

The optimality of bundling is delicate:

1. This will not work if preferences are not negatively correlated:

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<td>1500</td>
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Here a-la carte and bundle prices coincide (7000, 1500)

2. Also will not work if “extremely” negatively correlated:

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<td>A</td>
<td>8000</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>4000</td>
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Firm optimizes by prices (8000, 4000), and just selling GWW to A, and GGG to B
Other examples

- Consider a simple durable goods market: cars live two periods (new/used)

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- 1 Hi consumer, and 1 Low consumer

- Without secondary markets, consumers can only buy new cars, and hold onto them for two periods.

- Pricing without secondary markets?
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Pricing with secondary markets?
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- 1 Hi consumer, and 1 Low consumer
- Without secondary markets, consumers can only buy new cars, and hold onto them for two periods.
- Pricing without secondary markets?
  - charge $4000, sell 2 cars every two years (profits = $4000 per annum)
- Pricing with secondary markets?
  - charge $7000, sell 1 car every year!
After drug patent expires:

- Figure 1: Measures the time, in years, since the initial entry into the market by generics. Note that the data suggest an upward drift in real brand-name prices. These data are consistent with the observations made by Grabowski and Vernon (1992). The figure shows a 50% rise in brand-name price five years after generic entry. The trend runs counter to the notion that brand-name producers engage in vigorous price competition with generic entrants.

- Figure 2: Offers an analogous view of the behavior of generic prices during the period following initial market penetration. Note that three years after generic entry, generic prices are less than 50% of the brand-name price. These data are supportive of the view that the generic market represents a highly competitive fringe to the brand-name drug market.

- Figure 3: Presents information on the behavior of generic prices relative to brand-name prices as the number of firms selling a compound increases. The graph in Figure 3 suggests that expanded entry is consistent with a downward drift in the ratio of generic to brand-name price. The relationship is not monotonic as the time path of prices indicates. This indicates that the timing of entry by generics does not occur continuously over time.

- Figure 4: Shows the number of generic entrants in relation to the years since patent protection was lost. The graph reflects the fact that on average about five generic producers enter a market during the first postpatent year of the brand-name product.
After drug patent expires:

FIGURE 2.

FIGURE 3.

What is going on?
Conclusions

- Perfect PD: monopolist gets higher profits, consumers pay more
- 3rd-degree PD: monopolist gets high profits, but possible that consumers are better off.
- 2nd-degree PD: used when monopolist cannot distinguish between different types of consumers.
- Indirect price discrimination