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 a price depending on the quantity purchased (electricity, telephone service)
- Consider three 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
  3. Second-degree price discrimination: each customer pays her own price, depending on characteristics of purchase (bundling)
- Throughout, consider just monopoly firm.

Perfect price discrimination (PPD) 1

- 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 $p(q) = MC(q)$!
- Perfectlly discriminating monopolist makes much higher profits (takes away all of the consumer surplus)

Perfect price discrimination (PPD) 2

This simple example illustrates:

- Profit motive for price discrimination
- In order for PPD to work, assume consumers can't trade with each other: *no resale condition*. 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: public goods problem).
  - Purchase constraints also prevent resale and support price discrimination: *limit two per customer* sales?
- Lower consumer welfare (no consumer surplus under PPD) but high output.
- When consumers demand more than one unit, but have varying WTP for each unit, firm may offer *price schedules* or *quantity discounts* (example: electricity, telephone pricing, TTC tokens)
- Next: focus on models 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

$$\text{group 1: } q_1 = 5 - p$$

$$\text{group 2: } q_2 = 5 - 2 * p$$

  (graph)

- Assume: monopolist produces at zero costs

3rd-degree price discrimination (3PD) 3

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.
- graph
-

$$
\begin{aligned}
p_1^{PD} &= \frac{5}{2} & p_2^{PD} &= \frac{5}{4} \\
q_1^{PD} &= \frac{5}{2} & q_2^{PD} &= \frac{5}{2} \\
CS_1^{PD} &= \frac{25}{8} & CS_2^{PD} &= \frac{25}{16} \\
\pi_1^{PD} &= \frac{25}{4} & \pi_2^{PD} &= \frac{25}{8}
\end{aligned}
$$

Compare with outcome when monopolist cannot price-discriminate.

3rd-degree price discrimination (3PD) 3

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

- $\max_p \pi^m = p * (5 + 5 - (1 + 2) * p) = p * (10 - 3p)$
- $$p_1^M = \frac{5}{3} \qquad p_2^M = \frac{5}{3}$$
  $$q_1^M = \frac{10}{3} \qquad q_2^M = \frac{5}{3}$$
  $$CS_1^M = \frac{50}{9} \qquad CS_2^M = \frac{25}{36}$$
  $$\pi_1^M = \frac{50}{9} \qquad \pi_2^M = \frac{25}{9}$$

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Effects of 3PD:

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

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

  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

  Average consumer welfare higher under 3PD: specific to this model

3rd-degree price discrimination (3PD) 5

In general, 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)

$$\frac{p_i}{p_j} = \frac{1 + \frac{1}{\epsilon_j}}{1 + \frac{1}{\epsilon_i}}$$

This is the "Ramsey pricing rule": (roughtly speaking) consumers with less-elastic demands should be charged higher price

- Senior discounts
- Food at airports, ballparks, concerts
- Optimal taxation
- Caveat: this condition is satisfies only at optimal prices (and elasticity is usually a function of price)

2nd-degree price discrimination 1

Firm charges different price depending on characteristics of the purchase. These characteristics include:

- Amount purchased (nonlinear pricing). Examples: sizes of grocery products
- Bundle of products purchased (bundling, tie-ins). Examples: fast-food "combos", cable TV

Difference with 3rd-degree PD: here, assume that monopolist *cannot classify consumers into groups*, i.e., it knows there are two groups of consumers, but doesn't know who belongs in what group. Set up a pricing scheme so that each type of consumer buys the amount that it should: rely on consumer "self-selection"

Groups, or "types", of consumers are distinguished by their willingness-to-pay for the firm's product. Characteristic of purchase is a signal of a consumer's type. So signal-contingent prices proxy for type-contingent prices.

Example: airline ticket pricing

2nd-degree price discrimination 2

Example: airline pricing

Assume firm cannot distinguish between business travellers and tourists, but knows that the former are willing to pay much more for 1st-class seats.

Formally: firm wants to price according to **type** (business or tourist) but cannot; therefore it does next best thing: set prices for 1st-class and coach seats so that consumers "self-select".

Airline chooses prices of first-class (p_F) vs. coach fares (p_C). such that business travellers choose first-class seats and tourists choose coach seats. This entails:

1. Ensuring that each type of traveller prefers his "allocated" seat (**self-selection constraints**):

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

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

2. Ensuring that $u_B(\text{first class}) - p_F > 0$, and $u_T(\text{coach}) - p_C > 0$, so that both types of travellers prefer travelling to not: **participation constraints**

2nd-degree price discrimination 3

Airline pricing example: add some numbers

2 travellers, one is business (B), and one is tourist (T), but monopolist doesn't know which.

Plane has one first-class seat, and one coach seat. $u_B(\text{F}) = 1000$
$u_B(\text{C}) = 400$
$u_T(\text{F}) = 500$
$u_T(\text{C}) = 300$

If firm knew each traveller's type, charge $p_C = 300$, and $p_F = 1000$.

But doesn't know type, so set p_C, p_F, subject to:

$$1000 - p_F \geq 400 - p_C \text{ Type B buys first class} \tag{3}$$

$$300 - p_C \geq 500 - p_F \text{ Type T buys coach} \tag{4}$$

$$1000 - p_F \geq 0 \text{ Type B decides to travel} \tag{5}$$

$$300 - p_C \geq 0 \text{ Type T decides to travel} \tag{6}$$

$$\tag{7}$$

2nd-degree price discrimination 4

Solution to airline pricing example

- Charge $p_C = 300$. Any higher would violate (6), and any lower would not be profit-maximizing.
- If charge $p_F = 1000$, type B prefers coach seat: violate constraint (3). By constraint (3), type B must receive net utility from first-class of at least 100, which he would get from purchasing coach at price of 300. Thus upper bound on p_F is 900, which leaves him with net utility=100.
- Lower bound on p_F is 500, to prevent type T from prefering first-class.
- To maximize profits, charge the upper bound $p_F = 900$.

2nd-degree price discrimination 5

In general:

- $p_C = u_B(\mathrm{C})$: Charge "low demand" types their valuation (leaving them with zero net utility)
- $p_F = u_F(\mathrm{F}) - (u_F(\mathrm{C}) - p_C)$: 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 $\Longrightarrow$ 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

Tie-ins 1

- Nonlinear pricing: price-discriminate by offering consumers different-sized bundles (example in practice problems)
- Tie-in sales: offer consumers bundles of products. Focus on this.

Tie-ins 2

Example (Stigler): Block booking

Monopoly offers two movies: *Gone with the Wind* and *Getting Gertie's Garter*. There are movie theaters with "high" and "low" WTP for each movie:

Theater	WTP for GWW	WTP for GGG
A	8000	2500
B	7000	3000

Specific assumption about preferences: Theater A is "high" for GWW, and "low" for GGG. Theater B is "low" for GWW and "high" for GGG $\longrightarrow$ preferences for the two products are *negatively correlated*

Monopolist would like to charge each theater a different price for GWW (same with GGG), but that is against the law. Question: does bundling the movies together allow you to price discriminate?

Tie-ins 3

- Without bundling, monopolist charges $7000 = \min(8000, 7000)$ for GWW and $2500 = \min(2500, 3000)$ for GGG. Total profits: $2 * (7000 + 2500) = 19500$.
- With bundling, monopolist charges $10000 = \min(8000 + 2500, 7000 + 3000)$ for the bundle: profits = 2*10000 (higher)
- What about price discrimination? Akin to charging theater B 7000 and 3000 for GWW and GGG, and theater A 8000 and 2000.
- This will not work if preferences are not negatively correlated:

Theater	WTP for GWW	Wtp for GGG
A	8000	2500
B	7000	1500

With or without bundling, preferences of theater B (low type) dictate market prices.

- Also will not work if "extremely" negatively correlated:

Theater	WTP for GWW	Wtp for GGG
A	8000	10
B	20	4000

  Here, monopolist maximizes profits by just selling GWW to A, and GGG to B: need one product to be "better" than other (cable TV bundling?)

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.
- Bundling can be used to price discriminate.