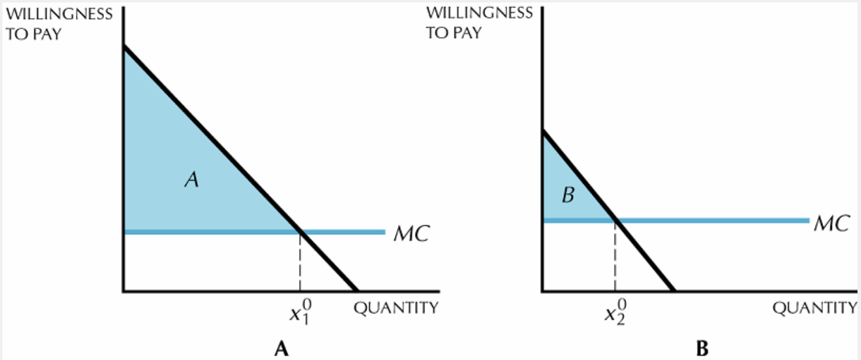
25.3 Third Degree Price Discrimination

What is First Degree? Perfect price discrimination is an idealized concept. Nevertheless interesting. Assume two consumers:



We consider a setting with intensive margin: Each consumer decides to consume more or less. The monopolist wants to sell to the left consumer x_1^0 and charges a markup A.

Is First Degree Price Discrimination Realistic?

Varian's examples:

- Prices are known because of earlier bargaining. Example: Sellers may learn the willingnesses to pay.

- Southwest Airlines: DING: You disclose your willingness to pay (as in an auction..) http://www.southwest.com/ding/

- So, if first-degree price-discrimination is an idealized concept, don't we have other forms of price discrimination that aim at reducing the information gap of sellers?

Third Degree Price Discrimination

Sometimes you know something about the behavior of buyers because they cannot wait, they live in a particular region, or they belong to a particular group.

The question "What discriminatory prices will the monopolist set, one for each group?" is really the question "How many units of product will the monopolist supply to each group?"

Intuition: All buyers in a given group pay the same price, but price may differ across buyer groups.

A monopolist manipulates market price by altering the quantity of product supplied to that market.

So the question "What discriminatory prices will the monopolist set, one for each group?" is really the question "How many units of product will the monopolist supply to each group?"

Third Degree Price Discrimination

Two markets, 1 and 2.

y_1 is the quantity supplied to market 1. Market 1's inverse demand function is $p_1(y_1)$.

y_2 is the quantity supplied to market 2. Market 2's inverse demand function is $p_2(y_2)$.

Third Degree Price Discrimination

For given supply levels y_1 and y_2 the firm's profit is

$$\Pi(y_1,y_2)=p_1(y_1)y_1+p_2(y_2)y_2-c(y_1+y_2).$$

What values of y_1 and y_2 maximize profit?

Third Degree Price Discrimination

$$\Pi(y_1,y_2)=p_1(y_1)y_1+p_2(y_2)y_2-c(y_1+y_2).$$

First-order conditions:

$$\frac{\partial \Pi}{\partial y_1}=\frac{\partial}{\partial y_1}\left(p_1(y_1)y_1\right)-\frac{\partial c(y_1+y_2)}{\partial (y_1+y_2)}\cdot\frac{\partial (y_1+y_2)}{\partial y_1}=0$$

$$\frac{\partial \Pi}{\partial y_2}=\frac{\partial}{\partial y_2}\left(p_2(y_2)y_2\right)-\frac{\partial c(y_1+y_2)}{\partial (y_1+y_2)}\cdot\frac{\partial (y_1+y_2)}{\partial y_2}=0$$

Third Degree Price Discrimination

Since: $\frac{\partial (y_1+y_2)}{\partial y_1}=1$ **and** $\frac{\partial (y_1+y_2)}{\partial y_2}=1,$ **this reduces to**

$$\frac{\partial}{\partial y_1}\left(p_1(y_1)y_1\right)=\frac{\partial c(y_1+y_2)}{\partial (y_1+y_2)},$$ **and**

$$\frac{\partial}{\partial y_2}\left(p_2(y_2)y_2\right)=\frac{\partial c(y_1+y_2)}{\partial (y_1+y_2)}.$$

Third Degree Price Discrimination

$$\underbrace{\frac{\partial}{\partial y_1}\left(p_1(y_1)y_1\right)=\frac{\partial}{\partial y_2}\left(p_2(y_2)y_2\right)}=\frac{\partial c(y_1+y_2)}{\partial (y_1+y_2)}.$$

MR1(y_1) = MR2(y_2) says that the allocation y_1, y_2 maximizes the revenue from selling y_1 + y_2 output units.

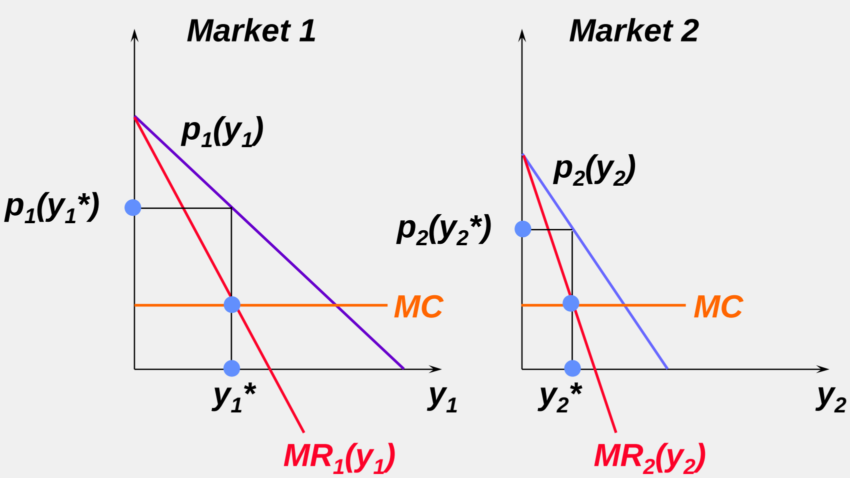
If MR1(y_1) > MR2(y_2) then an output unit should be moved from market 2 to market 1 to increase total revenue (!)

Third Degree Price Discrimination

$$\frac{\partial}{\partial y_1}\left(p_1(y_1)y_1\right) = \frac{\partial}{\partial y_2}\left(p_2(y_2)y_2\right) = \frac{\partial\, c(y_1+y_2)}{\partial\,(y_1+y_2)}.$$

The marginal revenue common to both markets equals the marginal production cost if profit is to be maximized.

Third Degree Price Discrimination



$MR_1(y_1^*) = MR_2(y_2^*) = MC$ and $p1(y1^*) \neq p2(y2^*)$.

Third Degree Price Discrimination

In which market will the monopolist cause the higher price?

Recall that:

$$MR_1(y_1) = p_1(y_1)\left[1 + \frac{1}{\varepsilon_1}\right].$$

But,

$$MR_2(y_2) = p_2(y_2)\left[1 + \frac{1}{\varepsilon_2}\right],$$

and $MR_1(y_1^*) = MR_2(y_2^*) = MC(y_1^* + y_2^*).$

Third Degree Price Discrimination

So $p_1(y_1^*)\left[1 + \frac{1}{\varepsilon_1}\right] = p_2(y_2^*)\left[1 + \frac{1}{\varepsilon_2}\right].$

Therefore, $p_1(y_1^*) > p_2(y_2^*)$, **only if**

$$1 + \frac{1}{\varepsilon_1} < 1 + \frac{1}{\varepsilon_2} \quad \Rightarrow \quad \varepsilon_1 > \varepsilon_2.$$

The market with the higher price must have the lower elasticity of demand.

An elastic demand is price-sensitive.

25.3 Second Degree Price Discrimination

Recall: "information gap" of sellers

We can use the information we have about consumers and "design packages" such that we discriminate. Why? Changing the two possible bundles will harm one consumer more than the other when picking the bundle he should not take.

Intuition: Sellers offer particular editions (books, DVDs, CDs) for particular groups of buyers. These editions may be relatively cheap to produce, but can be sold at a high price to the "high-type" buyer.

If you like a particular TV series, you want to have all episodes instead of just the 12 "most seen" ones, since you as a real connoisseur don't like them as much as others.. (your taste is different).

Coffee Shop Example

Coffee Shop example (Nicholson and Snyder, to appear)

Dirt Cowboy offers two cup sizes:

- **small, directed at the typical coffee drinker**
- **directed at the true coffee hound.**

As a thought experiment, suppose the shop can identify which consumers are typical and which are coffee hounds and can force each type to buy the cup meant for it (e.g. anyone identified as a coffee hound would be forbidden to buy one or more small cups of coffee).

The profit-maximizing menu in this thought experiment might involve selling a 12-ounce cup for $1.50 to typical coffee drinkers and a 24-ounce cup for $5.00 to coffee hounds, extracting all the surplus from both.

Second step: Asymmetric information

Now leave this thought experiment aside and suppose, more realistically, that there is asymmetric information about types

The shop would not know which consumers are coffee hounds and so could not prevent them from buying the small cup.

Coffee hounds indeed would buy the small cup unless the price of the large cup were reduced, say to $2.00.

The coffee shop could do even better by reducing the size of the small cup, say to 8 ounces, and sell it for a lower price, say $1.25.

Second step: Asymmetric information

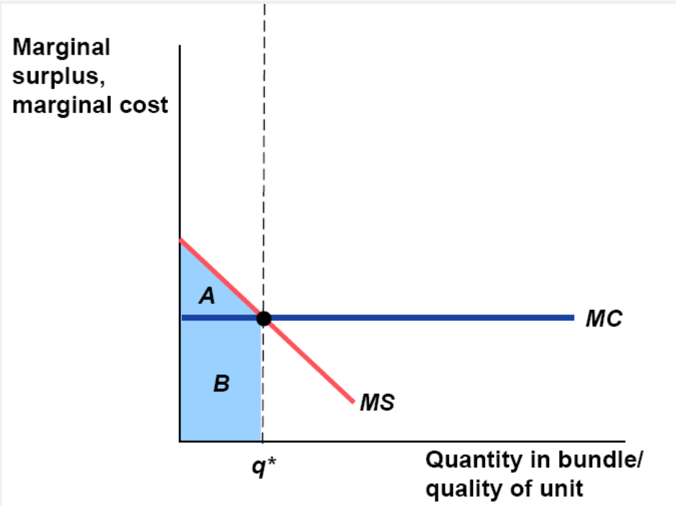
This would make the small cup less attractive to coffee hounds and allow the shop to increase the price for the large cup, say to $2.50.

Notice that the coffee shop is not squeezing all of the profit out of the typical coffee drinker that it could. The typical coffee drinker may be willing to pay the extra 25 cents for 4 more ounces of coffee, and the marginal cost of these additional 4 ounces may be just a few pennies. But if a 12 ounce cup were available, coffee hounds may not be willing to pay as much as $2.50 for the 24 ounce cup.

Thus, Dirt Cowboy reduces the size of the small cup, not to harm the typical coffee drinker, but to squeeze more revenue out of the coffee hounds.

French Example: Third-Class railway traveling introduced to make sure everybody is happy traveling 2nd class

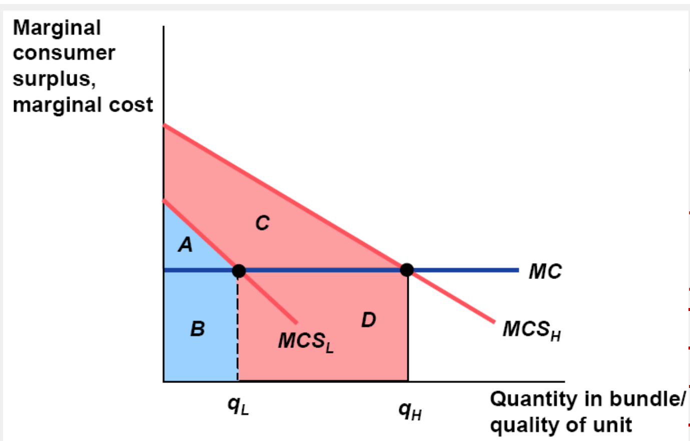
Graphing the issue



Source: Nicholson/Snyder

The same can be expressed in this graph: **This is reached in the intersection of the marginal surplus and marginal cost curves.** The monopolist charges a bundle price equal to the shaded area (A and B) and earns profit equal to the area of A.

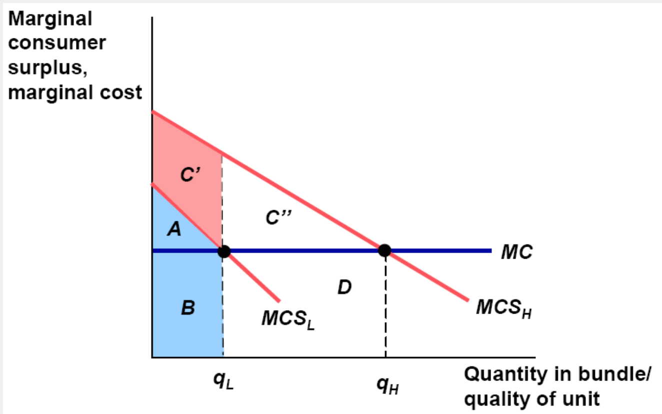
Now introduce two types



Source: Nicholson/Snyder

Facing a high-value and low-value consumer, the monopolist chooses bundles **given by the intersection between each type's marginal consumer surplus and marginal cost**. The high type receives a larger bundle, q_H, than the low type, q_L.

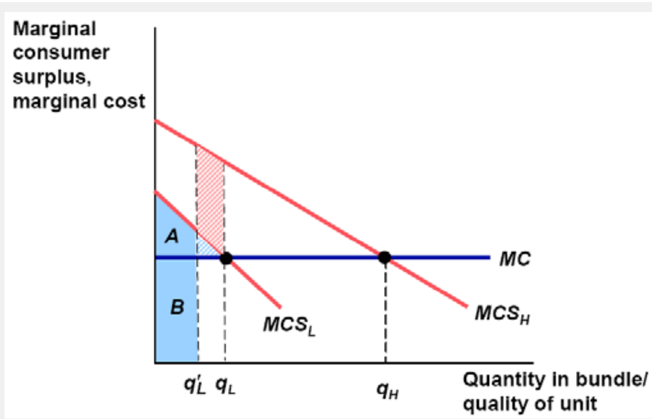
If the types are not known, it doesn't work



Source: Nicholson/Snyder

This is because of asymmetric information: the buyer knows her type, but the seller does not. The high-value consumer would gain surplus equal to the area of region C' by purchasing the q_L-unit bundle meant for low-value consumers rather than the q_H-unit bundle.

How to solve the problem



Source: Nicholson/Snyder

The monopolist reduces the size of the smaller bundle. This leads to reduced profits profit from sales to low types by the area of the blue hatched triangle.

This loss is however more than offset by the fact that the low-type's bundle is less attractive to high types, and so the price charged to high types for the q_H-unit bundle can be increased (by the area of the red hatched region).

A more formal approach (See problem #1)

The story: ***2 players:*** **Buyer and Seller.**
Good sold: wine at different quality q. Seller can virtually produce any quality.
Seller's profit function:`

$$\pi = T - cq$$

Buyer's utility function:

$$u(q,T) = \theta U - T$$

$$\theta \quad type\ of\ buyer, \Theta \in \{\theta_1, \theta_2\}$$

$$\left.\begin{array}{ll} q_i & quality \\ t_i & transfer \end{array}\right\} \text{ in state } \theta_i \in \{\theta_1, \ldots, \theta_n\} \}$$

The wine example

Benchmark 1: Full information (type of buyer is known)

Seller maximizes:

$$\max_{T(\cdot),q(\cdot)} p[T(\theta_1) - cq(\theta_1)] + (1-p)[T(\theta_2) - cq(\theta_2)]$$
$$s.t.\ \theta_2 U(q_2) - T_2 = 0$$
$$\theta_1 U(q_1) - T_1 = 0$$

Participation constraints are binding. $T(\theta_i) = \theta_i U(q(\theta_i))$

This leads to the following non-constrained problem:

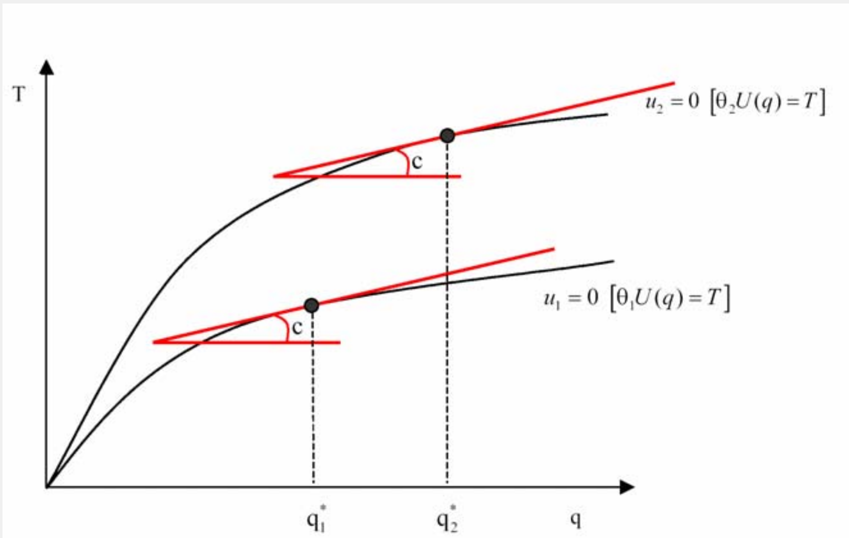
$$\max p[\theta_1 U(q(\theta_1)) - cq(\theta_1)] + (1-p)[\theta_2 U(q(\theta_2)) - cq_2]$$

First-order conditions: deriving w.r to q_1 and q_2:

$$\theta_1 U'(q_1) = c$$

$$\theta_2 U'(q_2) = c$$

Graph: symmetric information…



…and asymmetric information