Pricing to Mass Markets

Simple Monopoly Pricing, Price Discrimination and the Losses from Monopoly
Many Buyers

- Costly to set individual prices to each consumer to extract their individual willingness-to-pay.
- If set different prices, some consumers might re-sell to others. Your buyers might be potential competitors.
- Using a discounting strategy may cause some consumers to wait for better deals.
Information Problems

- Sellers do not know buyers’ willingnesses-to-pay
- Buyers do not know sellers’ costs
- May have a good statistical idea of distribution of types in the population.
Some Questions

• Why do unions sometimes strike?
  • Why do unions ever strike in practice?
  • When would you expect that strikes are most likely?

• Why do disputes ever go to court?
  • Why do disputes ever reach the courtroom in practice?
  • When would you expect that court trials are most likely?
  • Are most disputes settled out of court?
## Car Selling

- **Seller has many cars for sale. Each is worth $1,000**

- **There are two kinds of buyers**

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Proportion of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>$1,100</td>
<td>?</td>
</tr>
<tr>
<td>Low</td>
<td>$1,040</td>
<td>?</td>
</tr>
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</table>
One-sided Private Information

- Seller does not know each individual buyer’s type but knows the proportion of each type
- Buyer’s know their own type
Bargaining

- Seller makes take-it-or-leave-it offer to any potential buyer

- Must offer the same price to all:
  - Charge $1,040 and get expected profit of $40
  - Charge $1,100 and get expected profit of $50

- These are the only two price candidates

- Seller takes a 50% chance of not realising gains from trade
## No Breakdown

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<td>$1,100</td>
<td>?</td>
</tr>
<tr>
<td>Low</td>
<td>$1,060</td>
<td>?</td>
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</table>
Bargaining Experiment

- Pair-off
- Decide who is the seller and buyer
- If seller’s last name is from A-M, they value the good at $1. Otherwise, they value it at $5
- The buyer values the good by $2 more than the seller’s value.
- You have 5 minutes, tell me as soon as you have an agreement
Experiment #2

- Switch pairs and choose roles
- If seller’s birthday is an odd numbered year (say 1967), their value is $1. Otherwise it is $5. DO NOT REVEAL THIS TO THE BUYER (YET)
- The buyer values the good $2 more than the seller
- Same deal on reporting.
Screening

- When it does not have information, the seller may miss out on valuable trades
- What actions can the uninformed seller take to improve this?
- Can the seller use screening? That is, structure negotiations to reveal information.
Example again ...

- Suppose agreement may be reached immediately or one week later.
- Buyer dislikes waiting and will evaluate costs and benefits at 80% of this week’s value.
- Seller has no delay costs.
- The seller can commit to a price schedule: a price for this week and a price for next week.
- Buyer valuations as in second case (low = $1,060).
Price Schedule

■ What price schedule does the seller choose?
■ Choose prices to get sorting
  ■ Have high value buyer not delay
  ■ Have low value buyers delay
■ If second week price is $1,060: what should immediate price \( (p) \) be?
  ■ Make high value buyer indifferent between taking that price and waiting
  ■ \$1,100 - p > 0.8 (\$1,100 - \$1,060) = \$32
  ■ So long as \( p \) is less than \$1,068, will get screening.
Profits from Screening

- Now get $1,060 from low value buyers and $1,068 from high value buyers.
- Thus, on average price will be $1,064.
- Before screening, average price was $1,060.
- But does such haggling always work? What if the low buyer’s valuation is $1,040?
Age-Wage Profiles

• Pay increases with age -- this occurs even when controlling for higher human capital, responsibility and experience. Why?

• Could be a screening device. Turnover is costly to firms. Want to identify people who are less likely to move jobs.

• A positive age-pay profile, attracts workers who intend to stay with the firm and, thus, accept low wages initially.
Looking forward ...

- Concept of mass market demand
- Relationship between revenue and demand
- Concept of elasticity
- Profit maximising price levels
- Durable goods monopoly
- Price discrimination
Posted prices versus negotiation

- In mass markets, it is more convenient to simply post a price.
- Consumers whose willingness-to-pay is above that price will purchase from you.
- Consumers will lower their own demand and just purchase units for which their WTP for that unit exceeds price.
Mass Market Demand

- The monopolist faces a demand schedule or curve.
- This describes the number of units the monopolist will sell for any given price.
- The market demand curve is found by summing up the willingness-to-pay curves of all potential consumers.
Numerical Example

- Monopoly seller with marginal cost of $200 per unit. Can supply entire market.
- 1,000 potential buyers (only interested in a single unit each). Have different WTP ranging from $0 to $1,000.
What is the maximum value created in this market?

Simple rule: a unit should be sold if the WTP on that unit exceeds MC.
Therefore, produce 800 units at $200 each.
This yields total value of $(1000 - 200) \times 800/2$ or $320,000.
This is the maximum consumer surplus.
How does price influence revenue?

- As monopolist raises price:
  - they reduce the number of units sold (buyers are excluded)
  - they increase the mark-up on each unit they do sell.

- This is the price setter’s dilemma. By raising price the monopolist can capture more value but at the cost of excluding buyers.
## Price and Revenue

<table>
<thead>
<tr>
<th>Price</th>
<th>$1000</th>
<th>$900</th>
<th>$800</th>
<th>$700</th>
<th>$600</th>
<th>$500</th>
<th>$400</th>
<th>$300</th>
<th>$200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$0</td>
<td>$90t</td>
<td>$160t</td>
<td>$210t</td>
<td>$240t</td>
<td>$250t</td>
<td>$240t</td>
<td>$210t</td>
<td>$160t</td>
</tr>
</tbody>
</table>
Revenue and Elasticity

- Notice that as price rises, revenue increases initially and then falls.
- In determining price it is important to know how sensitive demand is to price changes.
  - If it is relatively insensitive, then by raising price the monopolist does not exclude many buyers.
  - If it is relatively sensitive, raising price can exclude many buyers.
- Sensitivity is related to the mathematical
Perfectly Elastic Demand

Price

Demand

Quantity
Perfectly Inelastic Demand

Price | Demand | Quantity
Algebraic Analysis

- In mathematical terms, sensitivity of a demand or supply function is captured by the term elasticity.

- For example, price elasticity of demand is the percentage change in quantity demanded divided by the percentage change in price.

\[
E_D = \frac{\% \text{ change in } Q_D}{\% \text{ change in } P} = \frac{\Delta Q_D / Q_D}{\Delta P / P}
\]
### Some Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Value of Price Elasticity of Demand $(E_D)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfectly inelastic</td>
<td>0 (vertical demand)</td>
</tr>
<tr>
<td>Inelastic</td>
<td>Less than 1</td>
</tr>
<tr>
<td>Unit elastic</td>
<td>1</td>
</tr>
<tr>
<td>Elastic</td>
<td>Greater than 1</td>
</tr>
<tr>
<td>Perfectly elastic</td>
<td>Infinity (horizontal)</td>
</tr>
<tr>
<td>Good A is relatively elastic</td>
<td>Good A has a higher elasticity than good B</td>
</tr>
</tbody>
</table>

Good A is relatively elastic compared with good B.
Some Properties of Elasticity

- Minus sign is implicit: e.g., a 10% increase in the price of oil decreases quantity demanded by 20%. Therefore, $E_D = -2$.

- Unit-Free Measure: can compare elasticities among different goods. Is oil more price sensitive than butter?

- Elasticity vs. Slope: these are not the same thing. Slope is $\Delta P / \Delta Q$.

- Point Elasticity: $E_D = -\frac{fQ}{fP} \frac{P}{Q}$
## Estimated Price Elasticities

<table>
<thead>
<tr>
<th>Type of Good or Service</th>
<th>Price Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs</td>
<td>0.1</td>
</tr>
<tr>
<td>Petrol</td>
<td>0.2</td>
</tr>
<tr>
<td>Shoes</td>
<td>0.9</td>
</tr>
<tr>
<td>Foreign Travel</td>
<td>1.2</td>
</tr>
<tr>
<td>Alcoholic Beverages</td>
<td>1.5</td>
</tr>
<tr>
<td>Jewelry</td>
<td>2.6</td>
</tr>
</tbody>
</table>
Accounting for Differences

- Degree of Substitutability
- Temporary vs. Permanent Price Changes
- Long-run vs. Short-run run elasticity
The Price Setter’s Dilemma

- To increase price, the monopolist must restrict its supply.
- To sell more output, the monopolist must lower its price.
- Which action will increase its total revenue?
- Price elasticity of demand gives the answer as it gives a relationship between percentage changes in
Unit Elasticity, Total Revenue, and Expenditure

- If demand is unit elastic, an increase in price results in an equal percentage decrease in the quantity demanded and total revenue and total expenditure remain constant.
Elastic Demand, Revenue and Expenditure

If demand is elastic, a decrease in price results in a larger percentage increase in the quantity demanded and total revenue and total expenditure increase.

\[ E_n > 1 \text{ then } P \downarrow \quad Q \uparrow \quad \text{and} \quad TR \uparrow \]
Inelastic Demand, Revenue and Expenditure

If demand is inelastic, an increase in price results in a smaller percentage decrease in the quantity demanded and total revenue and total expenditure increase.

\[ E_d < 1 \] then

\[ P \uparrow \quad Q \downarrow \quad \text{and} \quad TR \uparrow \]
Total Revenue Test

The total revenue test is a method of estimating the price elasticity of demand by observing the change in total revenue that results from a price change (all other things remaining the same).
Maximising Revenue

- A monopolist who wishes to maximise revenue will set price equal to $500 and only sell 500 units.
- But a monopolist is interested in maximising its payoff, that is, revenue minus costs or profit.
Maximising Profit

When should the monopolist supply an additional unit?
- Whenever the additional revenue earned by supplying that unit exceeds the marginal cost of producing that unit.
- In our example, whenever marginal revenue exceeds $200.

By producing up to the point where marginal revenue equals marginal cost, the monopolist maximises
### Marginal Revenue

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<th>Price</th>
<th>$1000</th>
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<td>$250t</td>
<td>$240t</td>
<td>$210t</td>
<td>$160t</td>
</tr>
<tr>
<td>Marginal Revenue</td>
<td>$90t</td>
<td>$70t</td>
<td>$40t</td>
<td>$30t</td>
<td>$10t</td>
<td>-$10t</td>
<td>$-30t</td>
<td>$-40t</td>
<td></td>
</tr>
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</table>

Marginal revenue from $100 price movements
Marginal cost of 100 unit movements equals $20t
# A Snapshot

<table>
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<tr>
<th>Price</th>
<th>$602</th>
<th>$601</th>
<th>$600</th>
<th>$599</th>
<th>$598</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$239,596</td>
<td>$239,799</td>
<td>$240,000</td>
<td>$240,199</td>
<td>$240,396</td>
</tr>
<tr>
<td>Marginal Revenue</td>
<td>$205</td>
<td>$203</td>
<td>$201</td>
<td>$199</td>
<td>$197</td>
</tr>
<tr>
<td>Profits</td>
<td>$159,996</td>
<td>$159,999</td>
<td>$160,000</td>
<td>$159,999</td>
<td>$159,996</td>
</tr>
</tbody>
</table>
Graphically

- WTP
- MR
- MC

Profit
Total Cost

Quantity

$1200
$1000
$800
$600
$400
$200
$0

$-400
$-200

200
400
600
800
1000

0

Graphically
Mathematically

- **Demand:**
  - Demand function: \( Q_D = 1000 - P \)
  - Total Revenue: \( P \times Q = 1000Q - Q^2 \)
  - Marginal Revenue: \( \frac{dTR}{dQ} = 1000 - 2Q \)

- **Costs:**
  - Total Cost function: \( C(Q) = \text{Fixed} + 200Q \)
  - Marginal Cost: \( \frac{dC(Q)}{dQ} = 200 \)
Marginal Condition

- Set Marginal Revenue equal to Marginal Cost:

\[ 1000 - 2Q = 200 \]

or

\[ Q = 400 \]

- Find price by substituting this into the inverse demand function \( P = 1000 - Q = \$600 \).
Monopoly Price and Elasticity

- How does monopoly price relate to elasticity?
- Suppose market demand is \( Q = D(P) \). The monopolist maximises \( D(P)(P - c) \).
- Differentiate profits with respect to \( P \): 
  \[
  \frac{fQ}{fP} (P - c) + Q = 0 \quad ? \quad P = \frac{1}{1 - \frac{1}{ED}} c
  \]
Elasticity as a Measure of Monopoly Power

- Recall that demand will be more elastic if close substitutes for a product exist.
- Therefore, elasticity can be a measure of monopoly power.
- In particular, economists look to cross elasticities of demand and supply to define markets.
Social Losses

- By setting price equal to $600, the monopolist earns $160,000. Consumer surplus is $80,000.
- The cost of this is that those buyers with valuations between $200 and $600 do not purchase the good, even though WTP exceeds marginal cost.
- The loss in potential value is $80,000 or 25% of potential value. This is termed a ‘deadweight loss.’
**Modified Example**

- Suppose that the seller has two products that are similar. One is the ‘deluxe’ version and the other is a ‘budget’ version.
- The budget version is missing some features that 20% of customers find essential. Their WTP for the budget version is zero. They also happen to be the consumers with the highest WTP for the product.
- 80% have no use for the deluxe features and value the two products the same.
- Both products cost the same to produce.
Graphical Depiction

Deluxe Market

$WTP - 1$
$MC$

Quantity
Graphical Depiction

Budget Market

$\text{WTP - 2}$

$\text{MC}$

Quantity
Price Discrimination

- Having two products allows the monopolist to discriminate among customers. It charges different prices for the two products.

  - Budget product pricing:
    - \( MR = 800 - 2Q = 200 \) or \( Q = 300 \), \( P_B = $500 \)

  - Deluxe product pricing:
    - If price is below $800 you are simply losing revenue without gaining customers.
Enhanced Value

- Monopolist now sells 500 units.
- Its revenue is $310,000 and profit is $210,000. A gain of $50,000.

What happens to consumer surplus?
- $20,000 + $45,000 = $65,000
- A reduction from the single product case

What happens to value created?
- Deadweight loss of $45,000
Damaged Goods

Some firms engage in ‘crimping the product.’ That is, they engage in costly adjustments to differentiate products.

Examples: Cannon printers
Student versions of software

Previous example indicates value to the monopolist from doing this. This can also improve social welfare.
Price Discrimination in General

- The example indicates that by charging different prices a monopolist can create more value.
- To achieve this, the monopolist must be able to segment the market.
  - Otherwise arbitrage will be possible
  - Change product
  - Identify different customer types.
Types of Price Discrimination

- First degree (perfect) price discrimination:
  - charge a different price for every consumer and every unit sold.

- Second degree price discrimination
  - volume discounts, multi-part tariffs and non-linear prices

- Third degree price discrimination
  - segment the market; charge a uniform price within each market segment
First degree price discrimination

- Charge a different price for each unit purchased
- Like bargaining over each unit individually.
- Then monopolist has no incentive to exclude any buyer or unit and restrict supply. Maximum value creation.
- Why might this be difficult?
  - Arbitrage
Second degree price discrimination

“Block” Electricity Pricing:
- suppose there are large and small customers.
- Charge a certain price up to X MWh
- Then have a discount.
- Small buyer demand unchanged
- Larger buyers purchase more
Two part tariff

- Telephone pricing
  - set marginal or per unit price at marginal cost
  - capture surplus through rental or continuing charges

- Water pricing
Third degree price discrimination

- Segment market
- Charge higher price to market with relatively inelastic demand
- This is what occurred in the product crimping story
- Other examples ...
Example 1: Railroads

- Railroads set different prices for coal and grain
  - coal traffic: relatively inelastic
  - grain traffic: elastic (intermodal competition)
- Coal 2 or 3 times higher than grain
- How are markets segmented?
  - Railroads know who buys coal (electricity generators). They do not buy wheat.
Example 2: Airline Tickets

Why is there a discount for a Saturday night stay?

- Way of segmenting market. Business travellers less likely to stay over weekend.

- Different elasticities:
  - price elasticity (discount): -1.83
  - price elasticity (full economy): -1.3

- Also make it hard to change discount
Example 3: Stamps

- In Sri Lanka postage of a plain postcard cost 1 rupee (2 cents). Postage of a pictured postcard cost 14 rupees.
- Exploit relatively inelastic demand of tourists.
Example 4: Intertemporal effects

- Product life cycle discrimination
- Early buyers often have much more inelastic demand
  - first run movies
  - computer software
  - computer hardware
  - CDs
  - new sports equipment
Application

Pricing and the Internet
Difficulties in Pricing Information

- Characteristics of information
  - High sunk costs of production
  - Low (or zero) marginal costs of replication
- If no property rights, why produce information?
  - Example: CD phone directories
Forms of Differential Pricing

- Personalised pricing
  - Sell to each user at a different price
- Versioning
  - Offer a product line and let users choose
- Group pricing
  - Based on group membership/identity
Personalised Pricing

- Catalog inserts
  - Market research
  - Differentiation
- Easy on the Internet
Traditional Industries

- Airlines
- Direct mail
- Lexis/Nexis
- Supermarket scanners
  - Profit margin more than doubled 1993-1996
  - More effective than other forms of advertising
Internet

- Virtual Vineyards
- Auctions
- Closeouts, promotions
Personalise Your Product

- Personalise product, personalise price
  - PointCast
  - Personalised ads
- Hot words (in cents/view) bulk & target
  - Deja News: 2.0 4.0
  - Excite: 2.4 4.0
  - Infoseek: 1.3 5.0
  - Yahoo: 2.0 3.0
Versioning

Need to add value to the initial version of a product

- Delay
- User Interface
- Convenience
- Image Resolution
- Speed of Operation
- Flexibility of Use
- Capability
- Features & Functions
- Comprehensiveness
- Annoyance
- Support
Example

- 40 type As: $100 for speed, $40 for slow
- 60 type Bs: $50 for speed, $30 for slow
- Identity-based pricing: $7000 revenues
- Offer only speedy: $50 is best price, revenues = $5,000
- Offer only slow: not as profitable
Versioning Solution

- Try speedy for $100, slow for $30
  - Will this work? Compare benefits and costs
  - $100 - 100 = 0, but $40 - 30 = 10 > 0
  - Discount the fast version: $100 - p = $40 - 30
  - So, $p = 90
  - Revenues = $5,400 = 90x40 + 30x60
Making Self-Selection Work

- May need to cut price of high end
- May need to cut quality at low end
- Value-subtracted versions
  - May cost more to produce the low-quality version.
- In design, make sure you can turn features off!
Pitfalls

- Resentment
  - Victoria’s secret
- Arbitrage
  - Windows NT workstation/server
Online and Offline Versions

- The Whole Internet
- Netscape Navigator
- Dyson Dictum: think of content as free
  - Focus on adding value to online version
- National Academy of Science Press
  - Format for browsing, not printing
Group Pricing

- Price sensitivity
- Network effects, standardisation
- Lock-In
- Sharing
Price Sensitivity

- International pricing
  - US edition textbook: $70
  - Indian edition textbook: $5

- Problems raised by Internet
  - Localization as solution
Network Effects

- Compatibility
  - Site licenses
  - Variety of schemes: per client, per user, per server, etc.

- Lock-In

- Microsoft Office
  - Per seat, concurrent
Sharing

- Transactions cost of sharing
- Videos
- Desire for repeat play
Electric Library

- Who to sell to?
- Households
- Schools/libraries