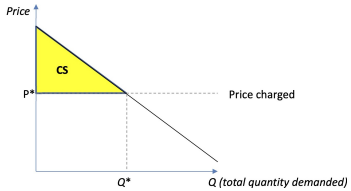
Consumer Demand

Willingness To Pay (WTP): The most a consumer will pay for a good.

Consumer Demand: For each price P what quantity is demanded? $Q = Q_D(P)$. **Inverse demand**: the price at which quantity Q could be sold. $P = P_D(Q)$

Consumer Surpluse: Area below demand curve and above price paid.



Elasticity: measure of price sensitivity

Own-price elasticity of demand $\frac{\%\Delta Q_1^D}{\%\Delta P_1}$: the % change in quantity demanded for a 1% change in its price. Always negative by Law of Demand. $|E| \begin{cases} <1 & \text{Inelastic} \\ >1 & \text{Elastic} \end{cases}$

Cross-price elasticity of demand $\frac{\%\Delta Q_1^D}{\%\Delta P_2}$: the % change in quantity demanded for a 1% change in another good's price.

$\begin{cases} >0 & \text{SUBSTITUTES (wine \& beer)} \\ <0 & \text{COMPLEMENTS (popcorn \& beer)} \end{cases}$

Demand Estimation

Demand Shifts: Any change in the envrionment that changes demand other than price. E.g. before and after advertising.

Estimation Techniques:

1. Randomized Control Trials: A/B tests. Considered the gold standard for demand estimation because of their ability to establish causality. In a randomized experiment, subjects are randomly allocated to different prices and this allows us to attribute the change in demand to price changes rather than to some other confounding variable.
2. "Nautral" or "Quasi-" experiments: when price variation is "as good as random" (e.g. demand just above or below price-surge threshold).

Equity Tradeoffs: different equity objectives may exist in different applications. Continuous algorithmic testing, penalties for disparities, affirmative information potential solutions.

Costs

Sunk Cost: costs that are unavoidable and cannot be recovered. Whether a cost is sunk or not depends on the timing of the business decision.

Opportunity Cost: the highest valued alternative use of an input; an example is "no such thing as a free lunch": you could do something else with your time. Example of Capital: Rate of return on the next best alternative use of funds (relative to the current business decision).

Fixed Cost: costs that don't vary with the level of output (Q).

Variable Cost: costs that vary with the level of output (Q).

The fixed vs variable cost distinction depends on the business question and on the time horizon. E.g., all inputs (including capacity) are variable in the "Long Run"

Economies of Scale: average cost ($\frac{TC}{Q}$) falls with higher Q. Why a firm might have EoS:

- fixed cost is spread out over more units
- different technology / specialization is used at larger scale
- greater bargaining power lowering input prices
- Learning curve could be sped up as well (although this would shift the AC curve) whereas EoS is about moving along an AC curve.

Net Present Value (NPV): multiply all future cash flows by $\frac{1}{(1+r)^t}$ and add them up, where r = annual interest rate (opportunity cost of capital) and t = number of years in the future. E.g.:

- If the opportunity cost of capital is 10% per annum, a startup cost of 280 and annual flow expenditures of 100 for 3 years (beginning next year): $NPV = -\frac{280}{1.1} - \frac{100}{1.1} - \frac{100}{1.21} - \frac{100}{1.331} = -503$
- If the opportunity cost of capital is 10% per annum, an annual flow expenditures of 200 for 3 years (beginning next year): $NPV = -\frac{200}{1.1} - \frac{200}{1.21} - \frac{200}{1.331} = -497$

Sources of Market Power

Barriers to entry: e.g. large fixed costs

Network Externality: The product is more valuable to you if it is used by others. To maintain n.e., (1) establish switching costs (2) interoperability (weakens direct n.e.)

- Direct n.e.: Emails – requires other users
- Indirect n.e.: Windows – requires complements like software developed for Win.

Positive N.E.: the value of a product increases with the # of users (higher WTP). Network goods. Makes demand *more elastic* so an aggressive pricing strategy becomes more profitable. **Negative N.E.**: e.g. luxury goods.

Learning Curve: Average costs falls with experience. Commonly discussed as: AC falls $X\%$ with a doubling of output (e.g., manufacturing processes have strong learning effects.) Google Search has strong learning effects: more experience → more data → better machine learning for search algorithm and targeted advertising.

Monopoly Pricing

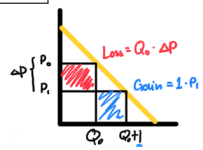
Monopoly: a single firm is in the market.

Marginal Cost (MC): How cost changes as output Q changes: for 1 unit, $Cost(Q) - Cost(Q-1)$; for more units, $\frac{\Delta Cost}{\Delta Q}$; and for small changes, $\frac{dCost}{dQ}$. Fixed costs don't enter MC.

Marginal Revenue (MR): in order to sell more units, the price must be lowered for all units.

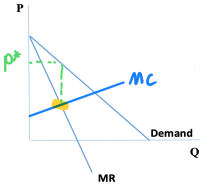
$$MR = \frac{\Delta Rev(Q)}{\Delta Q} = P(Q) + Q\frac{\Delta P(Q)}{\Delta Q}$$

Decrease price results in: **gain** in Rev from Q increases + **loss** in Revenue from P reduction for all units. If demand curve linear, MR has same intercept and twice the slope. $P(Q) = 100 - Q \rightarrow MR = 100 - 2Q$



Profix Maximization: optimal Q^* when $MC(Q^*) = MR(Q^*)$. Then solve for optimal price $P^* = P(Q^*)$

Mark-up Formula: resulting from profit-max, P^* satisfies: $\frac{P-MC}{P} = -\frac{1}{\epsilon}$ (ϵ is the demand elasticity). Relatively more elastic markets (markets with more price-sensitive consumers) will face smaller markups (i.e., lower prices if costs are the same across markets).



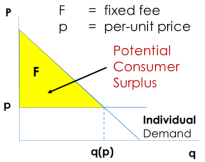
Consumer Self-Selection and Two-Part Tariffs

Price Discrimination: requires

- Market power (competition undermines price discrimination)
- Knowledge about the customer: seller needs *data*
- No re-sale (to prevent arbitrage)

Two-Part Tariff: Charge 2 prices: access fee (F) and per-unit price (p)

Two-Part Tariff with One Type of Customer: If $MC = 0$, optimal: $p^* = 0$ and F^* = total WTP. If $MC > 0$, optimal: $p^* = MC$ and F^* = CS when p=MC.



Two-Part Tariff with Multiple Types of Customers: F affects all buyers the same, but p extracts more out of high WTP buyers since they buy more.

A consumer pays a two-part tariff if their Total WTP at that price $\geq F + P \cdot Q$, where Q is the quantity they would consume at price P (can get Q from their demand curve).

Product Portfolios

Consumers maximize surplus so they pick a choice with higher CS out of multiple (products/two-part tarrifs). By reducing the quality of its low-end goods, a firm can often make these goods much less attractive for high WTP buyers, while having a comparatively smaller effect on the value to low WTP buyers. For any given portfolio of products:

1. For **each consumer type** (e.g. H and L) and for **each choice** (e.g. S and I), compute CS and they will buy the choice with highest CS.
2. Estimate profits from **each consumer type** from buying their preferred choice. Multiply profit per consumer from that type with the # of such type to get total profit from this consumer type.
3. Add up profits across all consumer types.
4. **Check**: are consumers buying the product you are targeting with?
   - No: adjust product portfolio and/or price; then re-estimate above.
   - Yes: try adjusting prices such that the **Check** still holds *AND* profits increase.

Consumer WTP	Superior Prod	Inferior Prod
Type H	5000	2000
Type L	3000	1000

To max value extraction serving both markets:

1. Set $P_I = WTP_{L,I}$ = \$1000
2. Set $P_S = WTP_{H,S} - CS_{H,I}$ = \$5000 – (\$2000 – \$1000) = \$4000

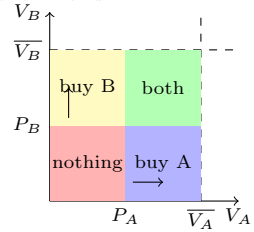
Strategic Pricing & Bundling

Bundling: practice of selling different goods in a package.

Bundled discount: a price reduction (relative to single-product prices) for a customer who buys a specified combination of products.

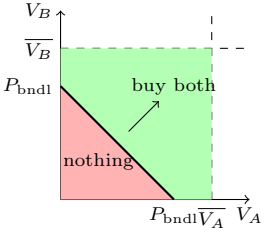
In graphes: each point's coordinates are one consumer's WTP on A and B. $\overline{V_A}$ and $\overline{V_B}$: highest WTPs any customers have for A and B.

Individual pricing: separate decisions for each product.

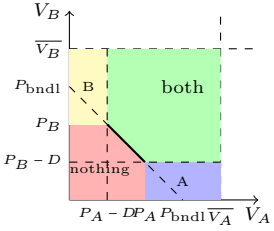


- buy A if $V_A \geq p_A$
- buy B if $V_B \geq p_B$

Pure bundling: only the total value of the bundle matters. Buy bundle if $V_A + V_B \geq P_{\text{bundle}}$



Mixed bundling: choose the option that gives you the highest CS. $P_{\text{bndl}} = P_A + P_B - D$. Choose max out of:



- 0 nothing
- $V_A - P_A$ A only
- $V_B - P_B$ B only
- $V_A + V_B - P_{\text{bndl}}$ bundle

Adverse Selection

Arises when the buyers who are costlier to serve are also the ones who are most inclined to purchase, and firms **cannot tell which consumers are higher** vs. lower cost to serve. Affects markets across sectors and product type e.g. insurance, cars, restaurants, as long as lack of information on "good" vs. "bad" risks. In extreme cases, adverse selection can make it impossible for a firm to sell a product profitably. If higher WTP customers are also higher cost to serve while we need to price above the AC, it's impossible to find such price.

Firm-level solutions: (i) Add information (screening & signaling) about which consumers are high vs. low cost to serve; (ii) Warrenties, reputation, advertising; (iii) Strategic pricing: Premium, deductible and co-pay.

Policy-level solutions: (i) Lemons Laws; (ii) BBB (firm reputation); (iii) Risk Pooling e.g. health insurance prices set at the community level, insurance mandates.