LM02 Introduction to the Firm and Market Organization

Version 1.0

1. Introduction & Analysis of Market Structures

This reading covers:

- Analysis of market structures: degree of competition, how the management determines pricing and output strategy.
- Characteristics, demand, supply, optimal price, and output for different types of market structures: perfect competition, and pure monopoly.

Analysis of Market Structures

The market is defined as a group of buyers and sellers that are aware of each other, and are able to agree on a price for the exchange of goods and services.

The market structure is classified into the following four categories:

- Perfect competition
- Monopolistic competition
- Oligopoly
- Monopoly

Perfect competition and monopoly are two extremes of the market structure in terms of number of firms and profits with the other types falling somewhere in between.

Factors that Determine Market Structure

The five factors that determine market structure are:

- The number and relative size of firms supplying the product. The higher the number of firms, the higher the degree of competition.
- The degree of product differentiation.
- Pricing power of the sellers. Are they price takers, or can they influence market prices?
- The relative strength of the barriers to market entry and exit.
- The degree of non-price competition.

The table below summarizes the basic characteristics of the four market structures:

	Perfect Competition	**Monopolistic Competition**	**Oligopoly**	**Monopoly**
Number of Sellers	Many firms	Many firms	Few firms	Single firm
Barriers to Entry and Exit	Very low	Low	High	Very high
Product Differentiation	Homogeneous	Substitutes but differentiated	Close substitutes or differentiated	Unique product

Non-price Competition	None	Advertising and product differentiation	Advertising and product differentiation	Advertising
Pricing Power	None. Price taker.	Some	Some to significant	Considerable
Example	Oranges; Milk; Wheat	Toothpaste	Prices of commercial airlines for a given route	Electricity provider/any utility company (water, cooking gas) as they are typically controlled by a government authority

The most preferred market structure by producers is monopoly/oligopoly because they offer the highest pricing power. The most preferred market structure by consumers is perfect competition as prices are lower.

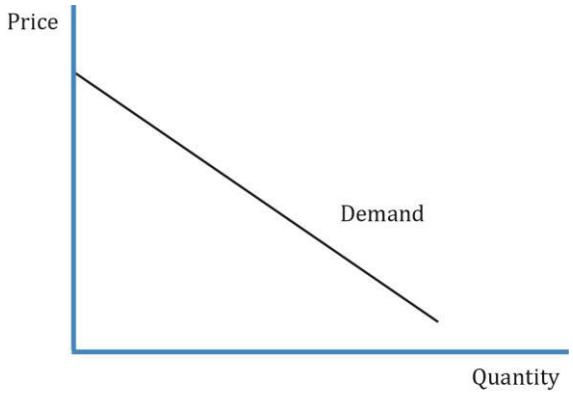
2. Perfect Competition

The characteristics of perfect competition are as follows:

- There are a large number of potential buyers and sellers.
- The products offered by the sellers are homogenous i.e. they are identical.
- There are few or easily surmountable barriers to entry and exit.
- Sellers have no market-pricing power. Each firm is so small relative to the market that it does not have any influence on market prices.
- Non-price competition is absent.

Demand Analysis in Perfectly Competitive Markets

The graph below shows the market demand curve for a perfectly competitive market. Here price is plotted on the y-axis and quantity on the x-axis and the market demand curve is downward sloping:



To understand this curve, let us assume that the market demand is given by the following equation:

Q = 50 – 2P where Q = quantity demanded and P = product's price.

Rearranging, we get P = 25 – 0.5Q

Total revenue: TR = P * Q = 25 Q – $0.5Q^2$

MR = $\frac{\Delta TR}{\Delta Q}$ = 25 – Q_P

(Using calculus, the first derivative of 0.5 * Q^2 is 2 * 0.5 * Q = Q)

We derived this based on two assumptions which are often not true in the real world:

- Only price determines quantity demanded.
- A linear relationship between price and quantity demanded.

Movement along the demand curve happens only if the price and quantity demanded of the product changes, all else constant. If any factor other than price/quantity demanded changes, then there is a shift in the demand curve. For instance, an increase in income will cause the demand curve to shift up.

Elasticity of Demand

Price elasticity of demand measures the sensitivity of quantity demanded to a change in price. It depends on the following three factors:

Factors affecting price elasticity of demand	
Substitutes	Elasticity is high if there are more close substitutes i.e. customers are more sensitive to price changes. If the price of a substitute goes down, the quantity demanded of the substitute goes up and the quantity demanded of the original product goes down.
The share of the consumer's budget spent on the item	The greater the share, the higher the price elasticity. Ex: Expensive goods such as cars are highly elastic. Grocery essentials such as cereals, sugar and salt are inelastic. A 10% increase in the price of cars and cereals will affect the demand for cars but not that of cereals.
Length of time within which demand schedule is being considered	The longer the period, the higher the elasticity. Ex: If the price of cooking gas increases, the demand will not change much in the short run; however, demand will decline in the long run as consumers switch to electric stoves.

Numerically, price elasticity of demand falls into three categories:

Price elasticity of demand	
Elastic demand	$\|\varepsilon\| > 1$; a 1% change in price will cause a more than 1% change in quantity demanded. Ex: furniture ($\varepsilon = 3.15$).
Unitary elastic demand	$\|\varepsilon\| = 1$
Inelastic demand	$\|\varepsilon\| < 1$; a 1% change in price will cause a less than 1% change in quantity demanded. Ex: coffee ($\varepsilon = 0.16$).
Special Cases	
Perfectly elastic or horizontal demand schedule	Horizontal demand curve. At a given price, quantity demanded is infinite. $\varepsilon = \infty$. Ex: corn.
Perfectly inelastic or vertical demand schedule	Vertical demand curve. Quantity demanded is fixed irrespective of price. $\varepsilon = 0$. Ex: insulin.

3. Other Factors Affecting Demand

Income elasticity of demand is the percentage change in the quantity demanded, divided by a percentage change in income, all else equal. It measures how sensitive the quantity demanded is to changes in income.

- For normal goods, income elasticity is positive.
- For inferior goods, income elasticity is negative.

Cross-price elasticity of demand measures how the quantity demanded of a good changes when there is a change in the price of another good.

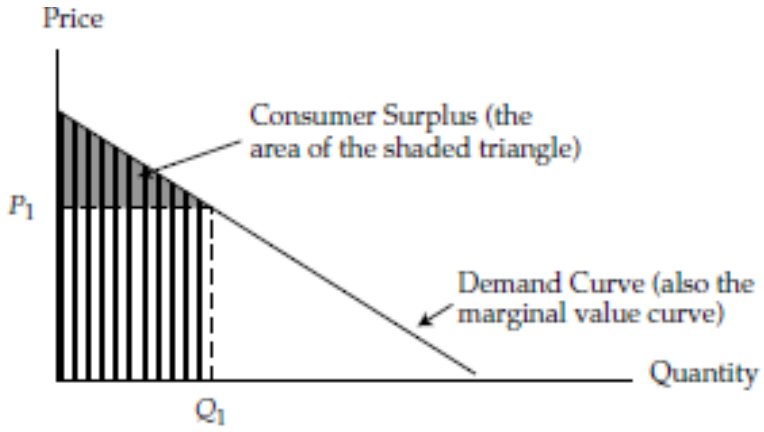
- If the cross-price elasticity is positive, then the two products are substitutes. Ex: cereals and oats.
- If the cross-price elasticity is negative, then the two products are complements. Ex: cereals and milk.

Instructor's Note: Changes in own price causes a movement along the demand curve, whereas, changes in income and price of substitutes cause a shift in the demand curve.

4. Consumer Surplus: Value Minus Expenditure

Consumer surplus is the difference between the price that consumers are willing to pay (value) and the price that they actually pay (expenditure).

On a supply and demand curve, it is the area beneath the demand curve and above the price paid.



The total consumer surplus received from buying Q_1 units at a level price of P_1 per unit is the difference between the area under the demand curve and the area of the rectangle $P_1 \times Q_1$. This is represented by the triangle.

Example:
(*This is based on Example 1 from the curriculum.*)

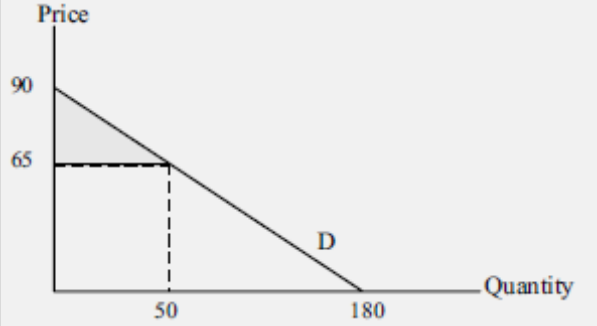
A market demand function is given by the equation $Q_D = 180 - 2P$. Find the value of consumer surplus if price is equal to 65.

Solution:

Quantity demanded at the price of 65 is: $Q_D = 180 - 2(65) = 50$

The inverted demand function is: $P = 90 - 0.5Q_D$

Using this information, we can draw the following demand curve.



Consumer surplus = area of the triangle in the upper section = ½ (Base)(Height) = ½ (50)(25) = 625

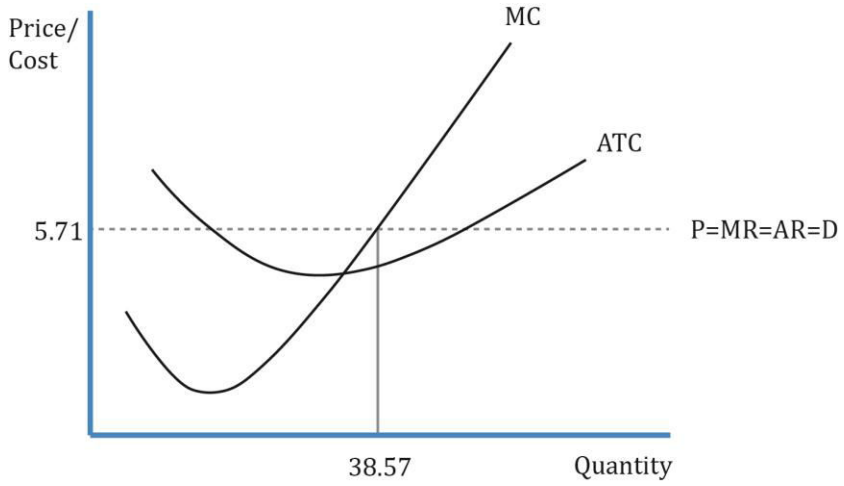
5. Supply Analysis & Optimal Price and Optimal Output in Perfectly Competitive Markets

When market prices increase, firms supply greater quantities. The market supply curve is the sum of the supply curves of the individual firms. Some key terms (covered earlier) are:

- Economic costs: These include all explicit costs and implicit opportunity costs that are required to acquire a resource or keep it in production.
- Opportunity cost: This is the value of the next best opportunity that is foregone when another alternative is chosen. For example, if a stay-at-home mom was employed, she would earn $90,000 a year. In this case, the mother staying home had given up the opportunity to work, and with it an income of $90,000.
- Economic profit = total revenue minus opportunity cost.

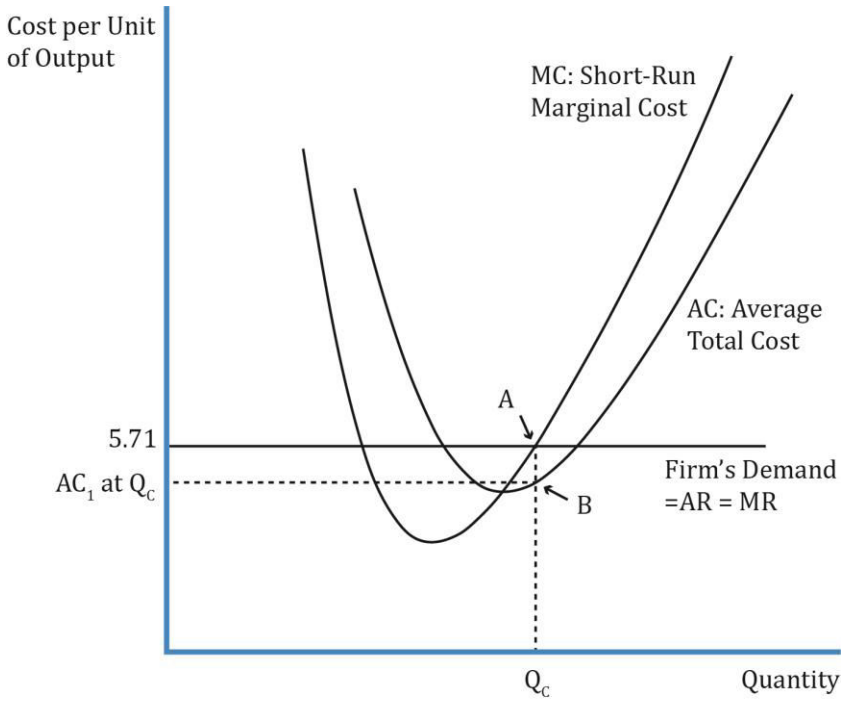
Optimal Price and Output in Perfectly Competitive Markets

To determine the equilibrium price and quantity, we must equate market supply and demand functions. Say for a given industry the demand function is: $P = 25 - 0.5Q_D$ and the supply function is $P = -2 + 0.2Q_S$. We would solve for the equilibrium quantity and price by using the equation: $P = 25 - 0.5Q_D = -2 + 0.2Q_S$. Solving for Q, we get 38.57. Similarly, P = 5.71.



The equilibrium (optimal) price and quantity are 5.71 and 38.57 respectively. Each firm is a price taker, which means each firm in the market must sell the product at 5.71. The equilibrium price is determined by the market and each firm is too small to influence the price. If a firm decides to sell the product at 6 instead of 5.71, then it will not find any consumers who are willing to buy at that price. The quantity produced by each firm is not determined by the market. A firm may produce 10 or 10,000 units of the product to sell at 5.71 each. The optimal quantity is determined by the firm's cost curves.

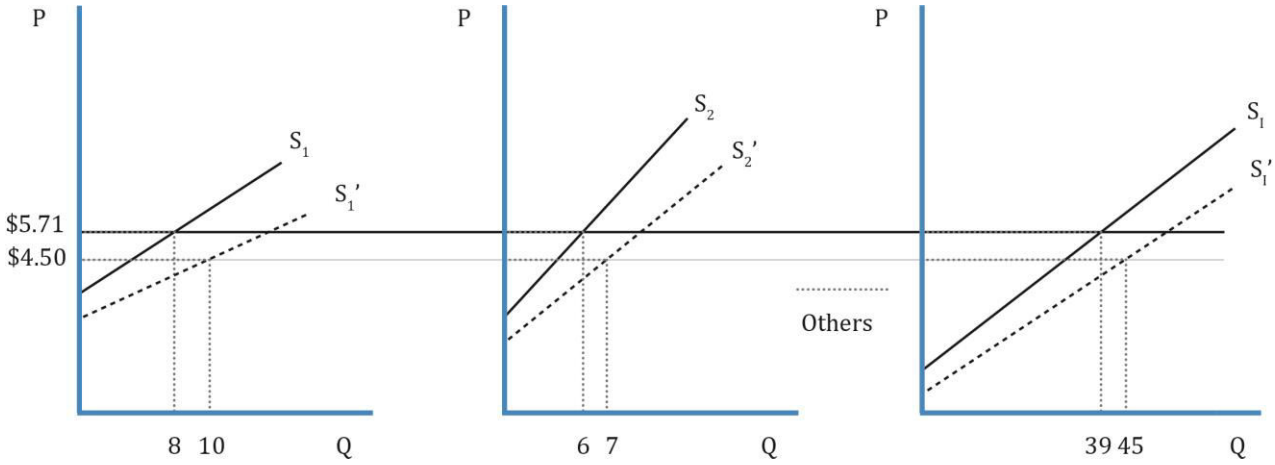
The graph below plots MC and ATC curves for an individual firm in a perfectly competitive market selling oranges at the market price of 5.71.



Interpretation of the graph**:**

- This graph plots cost per unit on the y-axis and output quantity on the x-axis.
- Generally, cost curves are U-shaped because of the law of diminishing returns. The cost of selling oranges comes down as the quantity increases until it reaches a minimum. Beyond that point (optimal quantity), increasing the output quantity increases the cost.
- MC curve intersects the ATC curve at its minimum point.
- The horizontal line shows the market price of 5.71. It is also the marginal revenue, average revenue and the demand curve (perfectly elastic). P = MR = AR = D.
- Profit-maximization condition: The firm's profit-maximizing condition is MR = MC. The corresponding quantity is Q_C.
- Link between a firm's supply and MC curve: A firm's supply curve is the portion of the firm's MC curve above the minimum point of its AVC curve. This is the upward-sloping portion of the MC curve.
  Assume the market price of oranges comes down to 4, the total fixed cost is 0, and the variable cost of producing each orange is 5; ATC is 5. So, will the firm sell oranges? No, as the cost is more than the market price. The supply will be zero. That explains why the firm's supply curve is an MC curve above the minimum point of ATC.
- Economic profit = TR – TC.

6. Long-Run Equilibrium in Perfectly Competitive Markets



- Let us continue our orange example. Other firms will be attracted to enter the market to sell oranges when they see this firm makes a positive economic profit. This means more output (supply of oranges), which shifts the supply curve to the right.
- For a given demand curve, the supply curve shifts to the right. Because of the increase in output quantity, the price comes down.
- In the long run, the firm will operate at a point where equilibrium price = MC = MR = minimum ATC. Economic profit will be zero because TR = TC. As economic profit is zero, no more firms will enter the perfectly competitive market.

7. Monopoly Markets: Demand/Supply and Optimal Price/Output

This is a market structure in which a single company makes up the entire market. It is on the opposite end of the spectrum as compared to perfect competition.

Characteristics**:**

- Single seller of a highly differentiated product.
- No close substitute.
- Significant barriers to entry.
- Considerable pricing power.
- Product is differentiated through non-price strategies such as advertising.

Ex: Government created monopolies such as electricity or water supply in a major city.

How monopolies are created**:**

- Patent or copyright.
- Control over critical resources – Ex: De Beers' control of mining resources in South Africa.
- Government authorization – Ex: utilities like electricity, water, etc.
- Strong brand loyalty which creates high barriers to entry (Rolex watches).
- Network effect (Microsoft).

A natural monopoly is one where cost decreases with quantity. The firm is able to meet most of the quantity demanded at a low cost, making it difficult for new firms to enter the market.

Demand Analysis in Monopoly Markets

The demand curve in a monopoly is downward sloping. Let us take the example of electricity. As a consumer, the quantity demanded is still dependent on the price. To sell an additional unit of the good, the producer must lower the price to increase quantity. This explains why the demand curve is downward sloping.

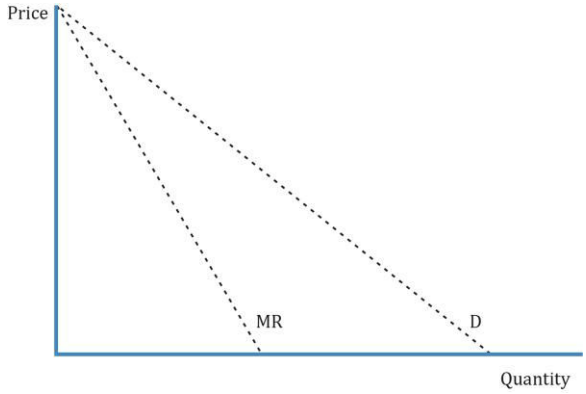
Let us say the quantity demanded is given by:

$Q = 400 - 0.5P$

Rewriting the demand function, we get $P = 800 - 2Q$

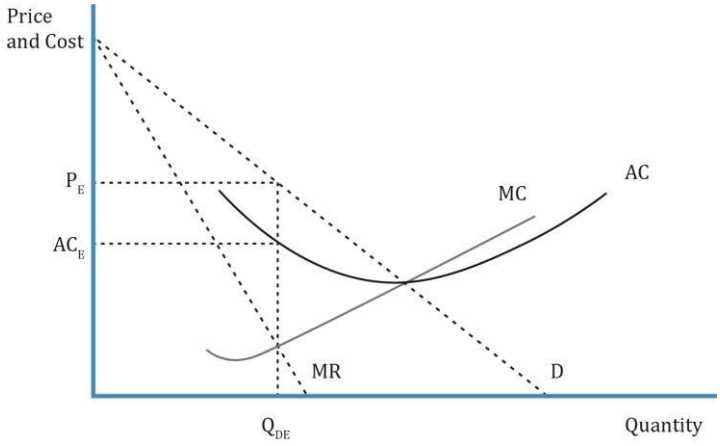
$TR = P * Q = 800Q - 2Q^2$
$MR = \Delta TR/\Delta Q = 800 - 4Q$
$AR = 800 - 2Q$

The average revenue for a demand curve is the same as the demand curve.



Supply Analysis in Monopoly Markets

The graph below shows the demand, MR, AC, and MC curves for a monopoly firm.



The profit-maximizing level of output, Q_E, is when MR = MC. The corresponding price, P_E, at this level of output is determined by the demand curve.

Profit is based on the demand curve = TR – TC. Let us say TC is given by:

$TC = 20000 + 50Q + 3Q^2$ (the TC equation will be given; you need not derive it)

From TC, we can derive $MC = \Delta TC/\Delta TQ = 50 + 6Q$.

Given the total cost function, you can derive the MC curve as shown above. Supply and demand can be equated to determine the profit-maximizing output.

$800 - 4Q = 50 + 6Q$

$Q = 750/10 = 75$

Optimal Price and Output in Monopoly Markets

In the previous section, we calculated the optimal output by equating MR = MC.

Another way of determining the profit-maximizing output is to equate $\frac{\Delta\pi}{\Delta Q} = 0$. At this point there is no change in profit when output changes.

The price at the profit-maximizing output level of 75 is:

$P = 800 - 2\ (75) = 650$

If $\pi = -20000 + 750Q - 5Q^2$, at what quantity is profit maximized?

$\frac{\Delta\pi}{\Delta Q} = 750 - 10\ Q.$

Equating it to 0, we get $750 - 10Q = 0 \rightarrow Q = 75$.

Relationship between MR and price elasticity is: $MR = P\left[1 - \frac{1}{E}\right]$

Profit maximization condition in monopoly: MR = MC

$MC = P\left[1 - \frac{1}{E}\right]$

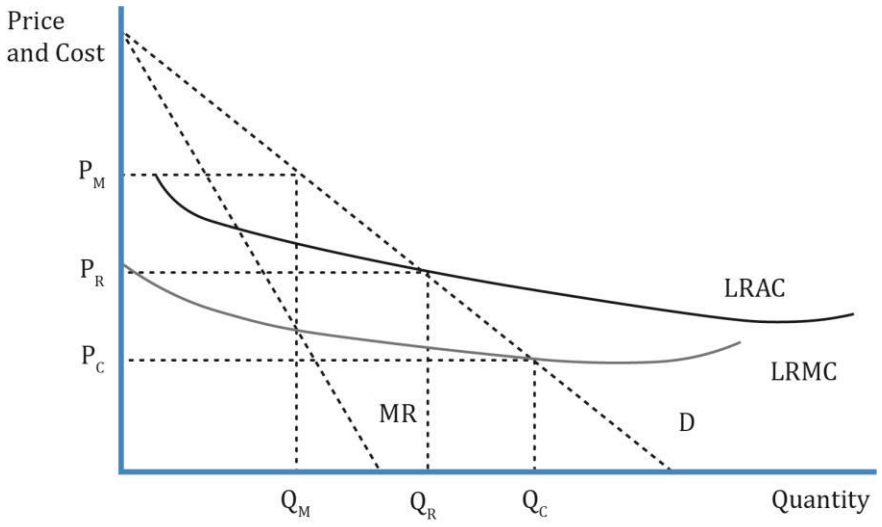
Profit-maximizing price = $\frac{MC}{\left[1 - \frac{1}{E}\right]}$

If MC = 75 and the own price elasticity of demand = 1.5, what is the profit-maximizing price?

Profit-maximizing price = $\frac{75}{\left[1 - \frac{1}{1.5}\right]} = 225.$

Natural Monopoly in Regulated Pricing Environment

A natural monopoly is a market where the average cost of production falls over the relevant range of consumer demand. There are three possible cases for output and pricing:



Natural Monopoly Under Different Environments				
Case	**Condition**	**Output**	**Price**	**Comments**
No regulation of monopoly.	LRMC = MR	Q_M	P_M (the corresponding price on the demand curve)	Profit is maximized by producing this output. Notice that the price is highest and quantity produced is lowest.
Perfect competition	P = MC	Q_C	P_C	Quantity produced is higher while the price is lower. Price does not cover the average cost of production, and there is an economic loss. So the government must subsidize the monopoly: LRAC- P_C
Regulated monopoly	Set price such that LRAC = AR	Q_R	P_R	The monopoly earns a normal profit, i.e. economic profit is zero at this output level.

- Left unregulated, monopoly will maximize profits by producing the quantity for which MR = MC
- Government regulation may attempt to improve resource allocation by requiring average cost pricing or marginal cost pricing.

8. Price Discrimination and Consumer Surplus

What a monopolist charges for their product and how much quantity is supplied lie on two extremes: On one end the price and quantity supplied may be equal to that of perfect competition where there is a uniform price, and on the other end is discriminating consumers on some grounds, which leads to different prices for the same product.

Ex: In restaurants, lunch is cheaper than dinner, or weekday prices are different from Friday-Sunday prices.

First-degree price discrimination:

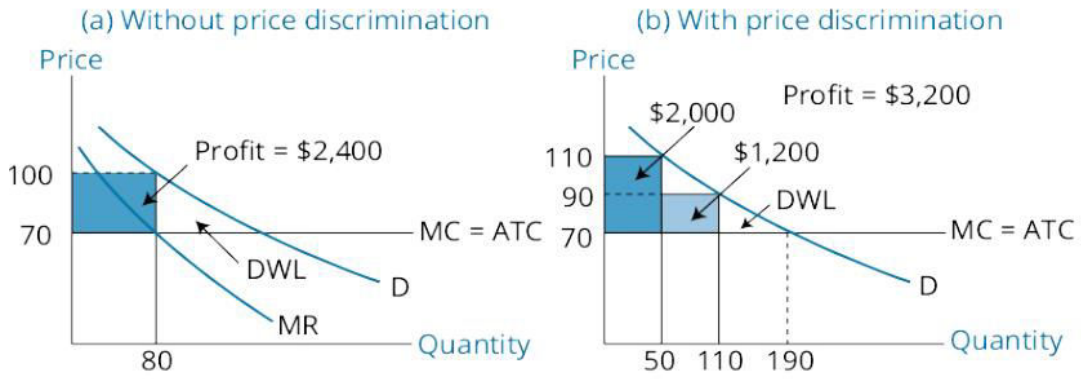
- Consumer is charged the maximum that he is willing to pay; sellers are able to capture all consumer surplus.
- Consumers are charged different prices for the same product (airline tickets).
- The monopolist is able to measure exactly how much each consumer is willing to pay and what their preferences are. Prices vary for each consumer and unit. In some cases, public price disclosure may not be permitted. So one customer is not aware of how much another customer is paying for the same product.

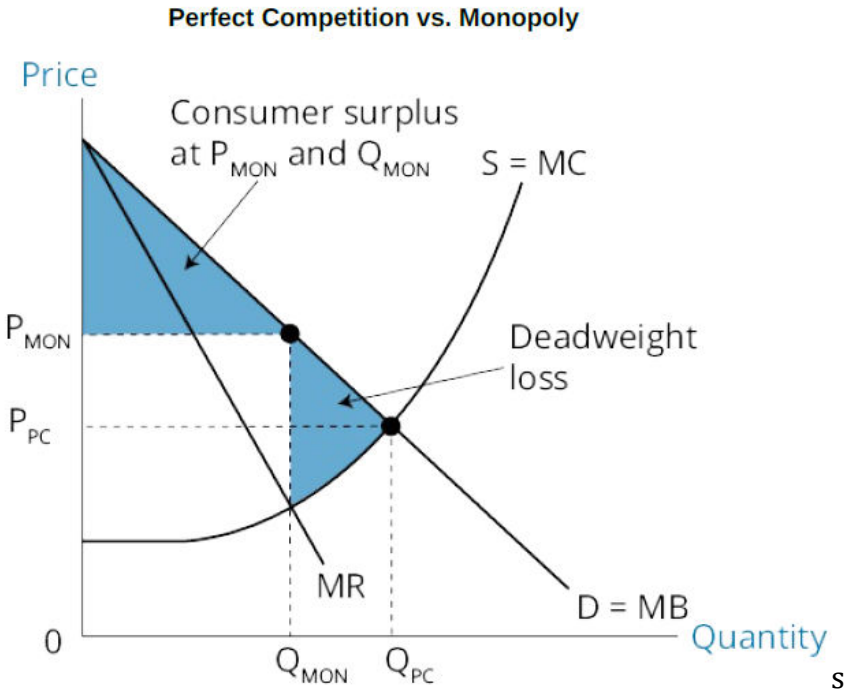
Second-degree price discrimination:

- Unlike first-degree, the monopolist is not able to measure the consumer's exact preferences, or his willingness to pay before pricing the product.
- Consumer charged differently based on how much he values the product. Ex: a TI BAII Plus Professional.
- Another instance is where consumers are charged differently based on the quantity sold. Ex: Quantity discounts (the price per unit decreases as the number of units sold to a consumer is higher) are often seen. Family-fare airline tickets (different fare if the number of passengers traveling is more than 2) is another example.
- Some amount of consumer surplus is captured in this form of discrimination.

Third-degree price discrimination:

- Consumers segregated based on demographic or other traits (gender, age).
- Example: One-day (business travelers) vs. round-trip airline tickets, milk prices within the state/outside state. Student vs. professional version of many software packages.





s

Example

My monthly demand for visits to the local gym is given by: Q = 25 - 5P where Q is the number of visits per month and P is the price per visit. The gym's marginal cost is 1 per visit.

1. What are the X-axis and Y-axis intercepts for the demand curve?
2. If the gym charged a price per visit equal to its marginal cost, how many visits would I make per month?
3. What is my surplus at this price?
4. How much could the club charge per month for a membership fee?

Solution:

1. $Q = 25 - 5P$, $P = 5 - \frac{1}{5} * Q$

X-axis intercept when P = 0 is Q = 25.

Y-axis intercept when Q = 0 is P = 5.

2. If P = 1, then $Q = 25 - 5 * 1 = 20$

I would make 20 visits per month.

3. Consumer surplus $= \frac{1}{2} * b * h = \frac{1}{2} * 20 * 4 = 40$.
4. The club could charge a membership fee of 40 to extract all the consumer surplus. In addition, it must charge 1 per visit. This pricing method is called a two-part tariff.

Example

Monopolists have considerable pricing power and may charge consumers in different ways. Exporters charging higher prices for denim jeans in the international market compared to local markets is an example of:

A. First-degree price discrimination.

B. Second-degree price discrimination.

C. Third-degree price discrimination.

Solution: C

Third-degree price discrimination occurs when customers are segregated by demographics. Dividing the customers into two groups, local and international; and charging two different prices is an example of third-degree price discrimination. The first degree of price discrimination allows a monopolist to charge the highest price each customer is willing to pay. The second degree of price discrimination is when the monopolist charges different people different prices using the quantity purchased as an indicator of how highly the customer values the product.

9. Monopoly Markets: Long-Run Equilibrium

Unregulated monopolies can earn economic profits in the long run as all factors of production are variable in the long run.

For regulated monopolies, there are several possible solutions in the long run:

- Price = marginal cost. But this will be less than long-run average cost. So there must be a government subsidy to compensate for the loss. Ex: Amtrak.
- National ownership. But the problem is consumers are not willing to accept price increases once the price is fixed even if the input price increases.
- Regulated, authorized monopoly. P = LRAC. Investors make a normal profit, but the challenge is to identify the monopolist's realistic LRAC.
- Franchise monopolistic firm through a bidding war to select a firm whose P = LRAC.

Summary

LO: Describe characteristics of perfect competition, monopolistic competition, oligopoly, and pure monopoly.

	Perfect Competition	Monopolistic Competition	Oligopoly	Monopoly
Number of Sellers	Many firms	Many firms	Few firms	Single firm
Barriers to Entry	Very low	Low	High	Very high
Nature of Substitute Products	Very close substitutes	Substitutes but differentiated	Very close substitutes or differentiated	No good substitutes
Nature of Competition	Price only	Price, marketing, & features	Price, marketing, & features	Advertising
Price Power	None	Some	Some to significant	Significant

LO: Explain relationships between price, marginal revenue, marginal cost, economic profit, and the elasticity of demand, under each market structure.

Perfect Competition:

- Price = marginal revenue = marginal cost (in equilibrium).
- Firm-demand curve is perfectly elastic.
- Zero economic profit in equilibrium.

Monopoly:

- Price > marginal revenue = marginal cost (in equilibrium).
- Downward sloping firm demand curve.
- May have positive economic profit in long-run equilibrium.
- Profits may be zero because of expenditures to preserve monopoly.

LO: Describe a firm's supply function under each market structure.

- Under perfect competition, a firm's short-run supply curve is the portion of the firm's short-run marginal cost curve above its average variable cost. Its long-run supply curve is the portion of the firm's long-run marginal cost curve above its average total cost.
- Under monopoly, supply function is not well-defined. Neither marginal-cost curves nor average-cost curves are supply curves.

LO: Describe and determine the optimal price and output for firms under each market structure.

In perfect competition and monopoly, profits are maximized by producing the quantity for which marginal revenue equals to marginal cost.

LO: Explain factors affecting long-run equilibrium under each market structure.

In the long run,

- the perfectly competitive firm cannot make economic profits.
- the unregulated monopoly firm can make economic profit.

LO: Describe pricing strategy under each market structure.

In equilibrium,

- Perfect Competition: Price = marginal revenue = marginal cost.
- Monopoly: Price > marginal revenue = marginal cost.

