R08 Topics in Demand and Supply Analysis

Version 1.0

1. Introduction

Economics is a discipline that deals with factors affecting the production, distribution, and consumption of goods and services. It is divided into two broad areas: microeconomics and macroeconomics.

Macroeconomics deals with the production and consumption of the overall economy. It focuses on aggregate economic quantities such as gross domestic product, gross national income, and national output.

Microeconomics deals with demand and supply of goods and services at a micro level, such as individual consumers and businesses. According to microeconomics, private economic units can be divided into two groups of study:

- *The theory of the consumer* that focuses on the consumption of goods and services.
- *The theory of the firm* that focuses on the supply of goods and services.

This reading focuses on microeconomics and covers the demand and supply side of the market.

2. Demand Concepts

Demand is the willingness and ability of consumers to purchase a given amount of good or service at a given price. **The law of demand** states that as the price of a good rises, consumers will want to buy less of it. Similarly, as price falls, the quantity demanded increases. Apart from the good's own price, other factors that impact consumer demand include prices of other substitute and complement goods, customers' incomes, and individual tastes and preferences.

The general form of a **demand function** is shown below:

Demand function for good A: $Q^D = f(P_A, I, P_B \ldots \ldots)$

where:
Q^D = quantity demanded of some good.
I = consumer's income.
P_A= price per unit of a related good A.
P_B = price per unit of a related good B.

Let us take a hypothetical example of a demand function for the quantity of chairs demanded in a small town. The demand function is given by:

$$Q_D = 10 - 0.5P + 0.06I - 0.01P_T$$

In the equation above, I is the consumers' income and P_T is the price of tables. Note the signs of the coefficients for income and price of tables. Chairs and tables are complementary products as they sell together. The quantity demanded for chairs, Q_D, and price of tables, P_T, are inversely related. If the price of a table increases, then the quantity demanded for chairs decreases. Similarly, income has a positive coefficient. If income increases, then the quantity

demanded for chairs increases.

Now, let us assume that the consumers' income and the price of the table are fixed at a particular point in time. If the values of I and P_T are 1633.33 and 800.00 respectively, then the quantity demanded can be rewritten as:

$$Q^D = 100 - 0.5P$$

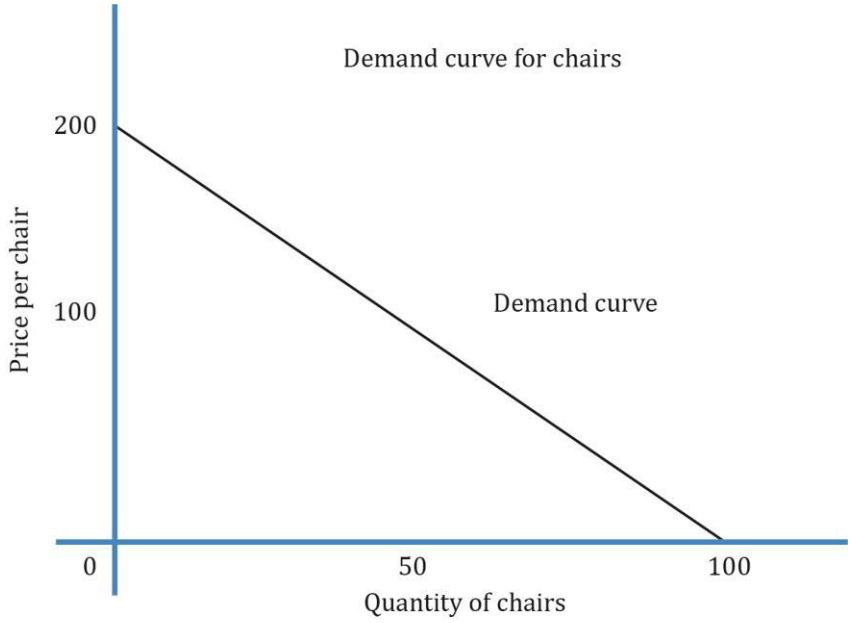
The **inverse demand function** expresses the simple demand function in terms of price. The above function can be rearranged and expressed in terms of P as:

$$P = 200 - 2Q$$

A **demand curve** is a graphical representation of the inverse demand function. The demand curve plots the price on the y-axis and the quantity on the x-axis. It shows the quantity of a good that consumers are willing to buy at any given price, all else equal.

Let us plot the demand curve given by the equation P = 200 - 2Q. Here, the intercept is 200 and the slope of the curve is -2. The slope of the demand curve is measured as the change in price divided by the change in quantity.

$$\text{Slope of the demand curve} = \frac{\Delta P}{\Delta Q}$$



Interpretation of the graph:

- The demand curve shows the highest quantity consumers are willing to purchase at each price. When P = 200, the highest quantity consumers are willing to purchase is 0.
- Similarly, the demand curve also shows the highest price consumers are willing to pay for each quantity. When Q = 50, the highest price consumers are willing to pay is 100.
- The slope of the demand curve is negative. This implies that as price decreases, the

quantity demanded increases.

- Movement along the demand curve: When a good's own price changes, the quantity demanded changes, all else equal. This change is called a movement along the demand curve. For instance, as price increases from 100 to 110, quantity decreases along the line (demand curve) from 50 to 45.
- Shift in the demand curve: A change in the value of any other variable will cause the demand curve to shift. This is called change in demand. For instance, shift in demand is caused by changes in consumers' incomes, price of substitutes, and price of complements.

3. Price Elasticity of Demand

Own-price elasticity of demand can be expressed as the percentage change in quantity divided by the percentage change in price.

$$E^{d}_{p_x} = \frac{\%\Delta Q^{d}_{x}}{\%\Delta P_x} = \frac{\frac{\Delta Q^{d}_{x}}{Q^{d}_{x}}}{\frac{\Delta P_x}{P_x}} = \left(\frac{\Delta Q^{d}_{x}}{\Delta P_x}\right) x \left(\frac{P_x}{Q^{d}_{x}}\right)$$

Before we go further, let us refresh a basic mathematical principle. Consider a simple equation:
A = 10 + 5B – 6C + 8D. Given this equation, ΔA/ΔB is equal to the coefficient of B which is 5. Similarly, ΔA/ΔC is equal to the coefficient of C which is -6.

Going back to our demand function, $Q^{D} = 100 - 0.5P$. Based on the mathematical principle we just discussed, ΔQ/ΔP = -0.5. Assume the price is $60; the quantity demanded at this price will be 70. The own-price elasticity of demand is: -0.5 x 60/70 = -0.4. This implies that when the price is $60, a 1% increase in price results in a 0.4% decrease in the quantity demanded for chairs.

Instructor's Note
Own-price elasticity of demand is usually negative because demand-curve is downward sloping, i.e. an increase in prices decreases quantity demanded.

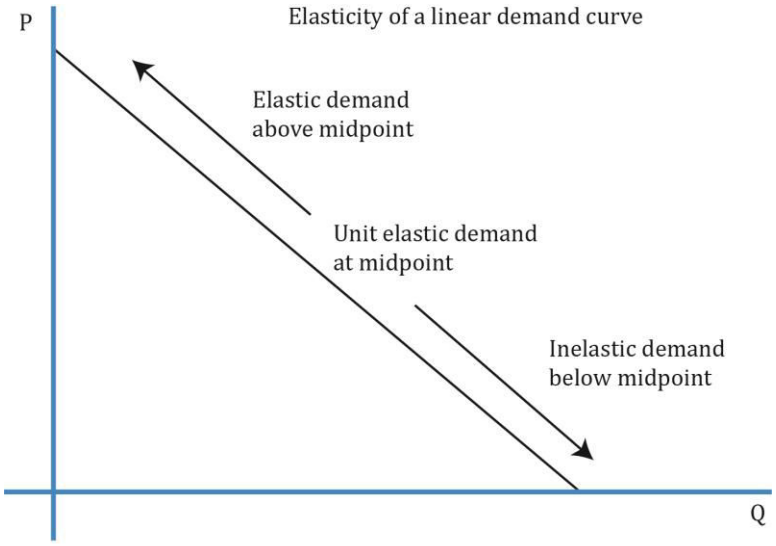
Elastic, Inelastic, and Unit Elastic

For all linear demand curves, elasticity varies depending on where it is calculated. Let us go back to the own-price elasticity of demand for chairs to see which parts of the demand curve are inelastic, elastic and unit elastic.

Elasticity = $-0.5 \text{ x } \frac{P}{Q}$

- Inelastic: When elasticity is less than one, demand is inelastic. At low prices, quantity demanded is high. This causes the P/Q ratio to be small which results in low elasticity.
- Unit elastic: An elasticity of 1 is said to be unit elastic.
- Elastic: When elasticity is greater than one, demand is elastic. At high prices, quantity

demanded is low. This causes the P/Q ratio to be high which results in high elasticity. These scenarios are shown in the figure below:



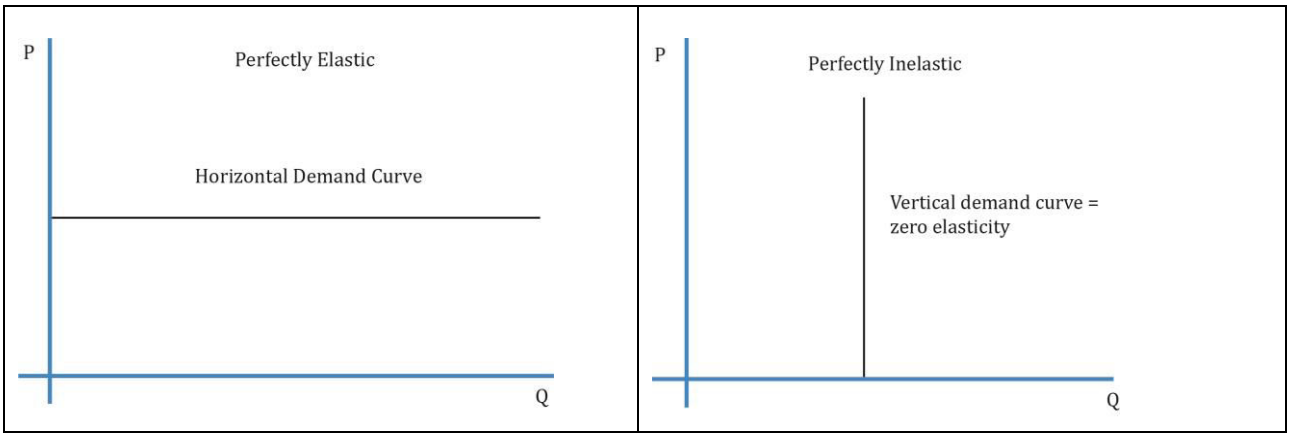
Inference:

- The top part of the demand curve is elastic.
- Somewhere in the middle, it is unit elastic.
- The bottom part of the demand curve is inelastic.
- If the demand curve is steeper, it will be relatively more inelastic.
- If the demand curve is flatter, it will be relatively more elastic.

Extremes of Price Elasticity

There are two special cases of linear demand curves in which the elasticity is the same at all points - perfectly elastic and perfectly inelastic - though it is difficult to find real life examples. Demand is perfectly inelastic (represented by a vertical demand curve) when the quantity demanded is the same over a price range. Demand is perfectly elastic for a given price (represented by a horizontal demand curve) when a change in price will cause the quantity demanded to reduce to zero.

Elasticity	
Perfectly Elastic	**Perfectly Inelastic**
Horizontal demand curve	Vertical demand curve.
Elasticity = ∞	Elasticity = 0
A small change in price can lead to infinitely large change in quantity. All producers must sell at the market price, or else consumers will shift to substitutes. Example: Gourmet food items.	A change in price has no change in quantity demanded. Example: generic food such as bread.



4. Predicting Demand Elasticity, Price Elasticity and Total Expenditure

Factors that affect Demand Elasticity

The factors that help in determining whether the demand for a product is highly elastic are as follows:

- Substitutes: If there are close substitutes for a good and the price of the good increases, then the quantity demanded for the good will decrease substantially implying the demand is highly elastic. If there are no close substitutes, the demand is less elastic.
- Portion of budget spent on a good: If people spend a large part of their income on a good, then the demand is likely to be elastic, e.g. cars. On the other hand, if people spend only a small portion of their income on a good, then the demand is likely to be inelastic, e.g. chocolates.
- Time horizon: Long-run demand is more elastic than the short-run demand for most products as people take time to adjust their consumption (quantity demanded) to the new prices. In the long run, consumers will find alternatives. For instance, if prices of cars increase, consumers will find alternative modes of transport in the long run.
- Discretionary vs. nondiscretionary: The demand for necessary goods is less elastic, e.g. bread. While the demand for discretionary goods is more elastic, e.g. vacations.

Elasticity and Total Expenditure

Total expenditure is the total amount consumers spend on a product. It is the price multiplied by the quantity.

Total expenditure = P x Q = Price per unit x quantity or number of units sold

Elastic demand: When demand is elastic, a 1% decrease in price causes a quantity demanded to increase by more than 1%. As a result, total expenditure increases.

Inelastic demand: When demand is inelastic, a 1% decrease in price causes quantity demanded to increase by less than 1%. As a result, total expenditure decreases.

Unit elastic: Total expenditure does not change at the point where demand is unit elastic.

The relationship between change in price and total expenditure is summarized in the table below:

Elasticity and Expenditure	
Own-price elasticity of demand = $\frac{\%\Delta Q}{\%\Delta P}$ Total expenditure = P x Q = Price per unit x quantity or number of units sold	
$E_d > 1$: elastic demand	Price and total expenditure move in opposite directions
$E_d = 1$: unitary elastic	Change in price has no effect on total expenditure
$E_d < 1$: inelastic demand	Price and total expenditure move in the same direction

5. Income Elasticity of Demand, Cross-Price Elasticity of Demand

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

$$\text{Income elasticity of demand} = \frac{\%\Delta Q}{\%\Delta I} = \frac{\Delta Q}{\Delta I} \text{ x } \frac{I}{Q}$$

If income elasticity of demand is 0.6, then it means that for every 1% increase in income, the quantity demanded will increase by 0.6%. While own-price elasticity is usually negative, income elasticity of demand can be positive, negative, or zero.

Positive income elasticity means that as income increases, quantity demanded also increases. Negative income elasticity means that as income increases, quantity demanded for these goods decreases.

Based on income elasticity, goods can be categorized as normal or inferior:

- **Normal good**: Income elasticity is positive. That is, as income rises, quantity demanded (consumption of the good) also rises.
- **Inferior good:** Income elasticity is negative. That is, as income rises, people buy less of these goods. For example, bicycles in South Asia and fast food in US.

As discussed earlier a change in any variable other than own price would cause the demand curve to shift. Therefore, a change in income will cause a shift in the demand curve.

Cross-Price Elasticity of Demand

Cross-price elasticity of demand measures how sensitive the quantity demanded of a good, X, is to changes in the price of another related good, Y, all else constant. The equation for the cross-price elasticity of demand is similar to the own-price elasticity of demand except that the denominator uses the price of another good, Y. It is expressed as:

$$\text{Cross-price elasticity of demand } E_d = \frac{\%\Delta Q_x}{\%\Delta P_y} = \frac{\Delta Q_x}{\Delta P_y} \text{ x } \frac{P_y}{Q_x}$$

Substitutes: Two goods are substitutes if one can be used instead of the other. The cross-

price elasticity of demand is positive for substitute goods. An increase in the price of a substitute good would increase the quantity demanded of the subject good.

Complements: Two goods are complements if they are used together. The cross-price elasticity of demand is negative for complement goods. An increase in the price of a complement good would decrease the quantity demanded of the subject good. Example: cereal and milk, and petrol and cars.

Example

A consumer's weekly demand for coffee is given by the following demand function:
$Q_A = 2 - 0.4P_A + 0.0005I + 0.10P_B - 0.15P_C$

Assume the price of coffee is $P_A = 10$, the price of tea is $P_B = 55$, the price of lemon water is $P_C = 10$, and income is I = 2,000. Given this data, calculate the following:

1. Own-price elasticity of demand for A.
2. Income elasticity of demand for A.
3. Cross-price elasticity of demand of A against price of B.
4. Are A and B substitutes or complements?
5. Cross-price elasticity of demand of A against price of C.
6. Are A and C substitutes or complements?

Solution:

1. First, calculate the value of Q by plugging in the values for $P_A = 10$, $P_B = 55$, $P_C = 10$, I = 2,000 in the demand function.

$Q_A = 2 - 0.4P_A + 0.0005I + 0.10P_B - 0.15P_C$
$= 2 - 0.4 \times 10 + 0.0005 \times 2000 + 0.1 \times 55 - 0.15 \times 10$
$= 2 - 4 + 1 + 5.5 - 1.5 = 3$

Own-price elasticity of demand for A = $\frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$

$\frac{\Delta Q}{\Delta P}$ is the own-price elasticity coefficient, which is -0.4 from the equation.

So, own-price elasticity of demand = $-0.4 \times \frac{10}{3} = -1.333$

2. Income elasticity of demand for A = $\frac{\Delta Q}{\Delta I} \times \frac{I}{Q} = 0.0005 \times \frac{2000}{3} = 0.33$

3. Cross-price elasticity of demand of A against price of B = $0.1 \times \frac{55}{3} = 1.8333$

4. A and B are substitutes because as the price of B goes up, the quantity demanded of A goes up. A positive relationship indicates the products are substitutes.

5. Cross-price elasticity of demand of A against price of C = $-0.15 \times \frac{10}{3} = -0.5$

6. A negative relationship between the price of C and the quantity demanded of A means the two products are complements.

6. Substitution and Income Effects; Normal Goods, Inferior Goods and Special Cases

The law of demand states that when a good's own-price falls, its quantity demanded increases, all else equal. Let us take an example of a hypothetical two-goods economy consisting of bread and milk to understand the two reasons why quantity demanded rises when price falls. Assume the price of bread decreases. Bread is now cheaper relative to milk, so consumers buy more bread. This is called the **substitution effect**. A lower price of bread means the consumer has greater buying power, which implies that the real income has increased. The change in income will impact how much bread consumers buy. This is called the **income effect**.

Normal and Inferior Goods

The table below summarizes the substitution and income effects of a **price decrease** for normal and inferior goods:

	Substitution Effect	**Income Effect**
Normal good	Buy more because when the good's price decreases, it is relatively cheaper than its substitutes.	Buy more because there is an increase in real income that increases the consumption.
Inferior good	Buy more because when the good's price decreases, it is relatively cheaper than its substitutes.	Buy less because the increase in real income causes the consumer to buy less of the inferior good.

Giffen goods:

A Giffen good is an extreme case of an inferior good where the income effect dominates the substitution effect. In this case, a decrease in price causes a decrease in quantity demanded which implies a positively sloped demand curve. *Hence Giffen goods are an exception to the law of demand*. The curriculum identifies rice in rural China as a possible Giffen good. When the price of rice decreased, consumers in rural China with very low incomes decreased their intake of rice and switched to alternatives such as meat that provided more calories.

Veblen goods

Like Giffen goods, Veblen goods also have an upward sloping demand curve and hence they also violate the law of demand. However, the similarity ends there. The characteristics of Veblen goods are described below:

- Veblen goods are status goods; an increase in price increases the value to some consumers and therefore their quantity demanded increases.
- Veblen goods are based on the concept of conspicuous consumption. This means that consumers derive utility from the fact that others regard them as someone who consumes an expensive good. As the price of such products increase, consumers will be inclined to purchase more to flaunt their affluence. For example, a Bugatti Veyron

car, a yacht, or a private island.

7. Supply Analysis: Cost, Marginal Return, and Productivity

Marginal Returns and Productivity

Factors of production are the inputs used by a firm to produce goods and services. These inputs include land, labor, capital, and raw materials. For simplicity, we will consider only two inputs:

- Labor (L): skilled, unskilled, management personnel, etc.
- Capital (K): physical capital such as machinery, equipment, and tools used by labor to produce output.

Before moving on, let us understand a few basic terms.

- Marginal product of labor**:** Increase in the quantity of output from an additional unit of labor.
- Marginal product of capital**:** Increase in the quantity of output from an additional unit of capital.
- Productivity**:** Average output per unit of input (such as labor or capital).
- Increasing marginal returns: Increase in productivity as the quantity of an input increases.
- Law of diminishing marginal returns: As more and more units of an input resource are added, productivity will eventually decrease.

Cost of production. The total cost of production is given by the equation below:

$$\text{Total cost TC} = \text{wL} + \text{rK}$$

where:
w is the wage rate per hour
L is the number of labor hours
r is the cost per hour of capital and
K is number of hours for which capital is used.

Two factors that lower the cost of producing at a given level of output are:

- Increase in input productivity.
- Decrease in input prices.

Total Product, Average Product, and Marginal Product

Total product is the total output from all inputs during a time-period. It is denoted by TP or Q. Total product gives information about the total production of a firm during a time-period, but reveals very little about how efficient the firm is.

Average product is the total product divided by the quantity of a given input. It measures the productivity of an input. The average product of labor is given by: $\frac{\text{TP}}{\text{L}}$ or $\frac{Q}{L}$.

Marginal product is the amount of additional output resulting from using one more unit of input, assuming other inputs are fixed. It is calculated by dividing the change in total product by the change in the quantity of input. Hence, the marginal product of labor is: $\frac{\Delta TP}{\Delta L}$ or $\frac{\Delta Q}{\Delta L}$.

Let us take an example of three companies X, Y and Z whose total product and average product of labor are given below:

Company	Output (TP)	Labor hours	AP = TP/L
Company X	250,000	250	1,000
Company Y	450,000	500	900
Company Z	500,000	625	800

It is not possible to identify the most efficient company by looking at just the TP values. AP is a better measure of efficiency. Company X has the highest AP and is therefore the most efficient.

The table below shows TP, AP and MP of labor for a firm across different levels of labor:

Units of Labor (L)	TP	AP	MP
1	100	100	100
2	210	105	110
3	300	100	90
4	360	90	60
5	400	80	40
6	420	70	20
7	350	50	-70

Interpretation:

- The total product (output) increases until the sixth unit of labor and declines when the seventh unit of labor is added. Hence the total product is maximum (420) with six units of labor.
- When we go from one unit of labor to two units of labor the marginal product (MP) increases. This implies increasing marginal returns. The marginal product for the second unit of labor is calculated as: $\frac{210 - 100}{2 - 1} = 110$.
- When a third unit of labor is added the MP decreases. This implies diminishing marginal returns.

8. Economic Profit Versus Accounting Profit

Economic profit is the difference between the total revenue and total economic costs. It is also known as abnormal profit. Another definition of profit is accounting profit. Accounting profit is the difference between the total revenue and total accounting costs.

Economic profit = Total revenue - Total economic costs
Economic profit = Accounting profit – Total implicit opportunity costs

Accounting profit = Total revenue – Total accounting costs

Economic cost considers opportunity costs, while accounting cost does not. Economic cost is the sum of accounting cost and opportunity cost. Let us take an example. Assume Megan starts a business with an equity capital of $100 million. The required return on the invested amount is 10%. Hence, the opportunity cost is 10% of $100 million = $10 million. If the accounting cost is $190 million, then the total economic cost is $200 million. Continuing with this example, if the revenue is $200 million, the economic profit is zero and the accounting profit is $10 million. In this case, it can be said that the business is earning a **normal profit** of $10 million.

Instructor's Note:

In this reading, 'cost' refers to economic cost and 'profit' refers to 'economic profit'.

If a firm's revenue is equal to the firm's total economic cost, the economic profit is zero and the firm is said to be earning a normal profit.

Accounting profit = economic profit + normal profit.

Normal profit = implicit costs or opportunity costs.

9. Marginal Revenue, Marginal Cost and Profit Maximization; Short-Run Cost Curves: Total, Variable, Fixed, And Marginal Costs

Marginal Revenue

Marginal revenue is defined as the change in total revenue divided by the change in quantity. It is the incremental revenue because of producing an additional unit per time-period. It is expressed as:

$$MR = \frac{\Delta TR}{\Delta TQ}$$

We will now analyze marginal revenue under two market conditions: perfect competition and imperfect competition.

Marginal revenue under perfect competition

In a perfectly competitive market:

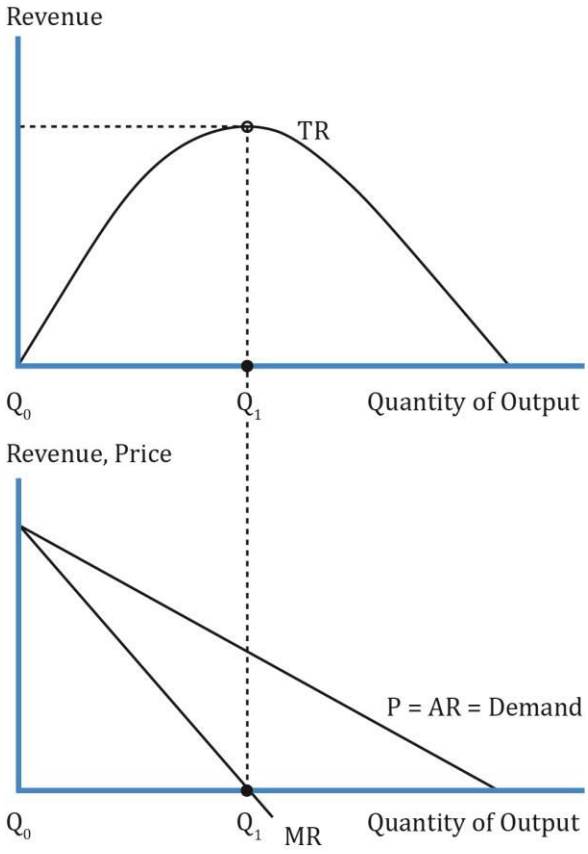
- There are many buyers and sellers and the interaction between them determines the equilibrium price.
- All the firms are relatively small and the products sold by the firms are identical, or homogeneous.
- All the firms are price takers. They have no pricing power – that is, the individual consumers and sellers cannot influence the market price of a good/service in any way.
- Any quantity of the product can be sold at the market price. But, a small increase in price would mean losing all sales. Example: wheat.

- The demand curve is horizontal or perfectly elastic.
- In a perfectly competitive market, MR = AR = P. Price is constant. This implies that total revenue increases by P if the quantity increases by one unit.

Marginal revenue under imperfect competition

In an imperfect competitive market:

- The firms sell differentiated products and have a large market share.
- There may not be any close substitutes.
- Marginal revenue intersects the x-axis at the point where total revenue is maximized.
- The marginal revenue and demand curve are downward sloping.



Marginal Cost

Marginal cost is the incremental cost of producing one more unit. It can be calculated by dividing the change in total cost by the change in quantity. It is expressed as:

$$\text{Marginal cost MC} = \frac{\Delta TC}{\Delta TQ}$$

Economists distinguish between short-run and long-run marginal cost. Short-run marginal cost is the cost of producing an additional unit assuming only labor costs vary and all other factors of production are constant. Short-run marginal cost is directly related to wage price

and inversely related to productivity. Short-run marginal cost, $\mathbf{SMC} = \frac{\mathbf{w}}{\mathbf{MP_L}}$. Long-run marginal cost is the cost of producing one more unit assuming all factors of production are variable.

Fixed and Variable Costs

Total cost can be broken down into fixed and variable costs. *Fixed costs* do not change with the quantity of output. *Variable costs* change with the quantity of output. Average variable cost is the ratio of total variable cost to quantity. It is expressed as:

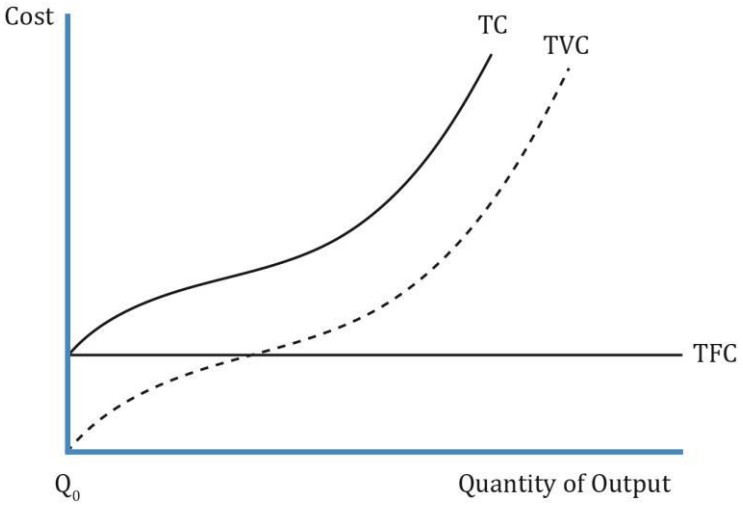
$$\text{Average variable cost} = \frac{\text{TVC}}{\text{Q}}$$

Profit Maximization

A firm's profit is maximized at a level of output where marginal revenue is equal to marginal cost (MR = MC). If marginal revenue exceeds marginal cost, a firm can increase profits by producing more. If marginal revenue is less than marginal cost, the firm should scale back. This discussion assumes that marginal cost is rising with increased output.

Understanding the Interaction between Total, Variable, Fixed, and Marginal Cost and Output

All the graphs we look at in this section are from a short-run perspective. In the short run, one or more factors of production are fixed. Usually capital is fixed in the short run while labor may change. The graph below shows the cost curves for a firm in the short run.

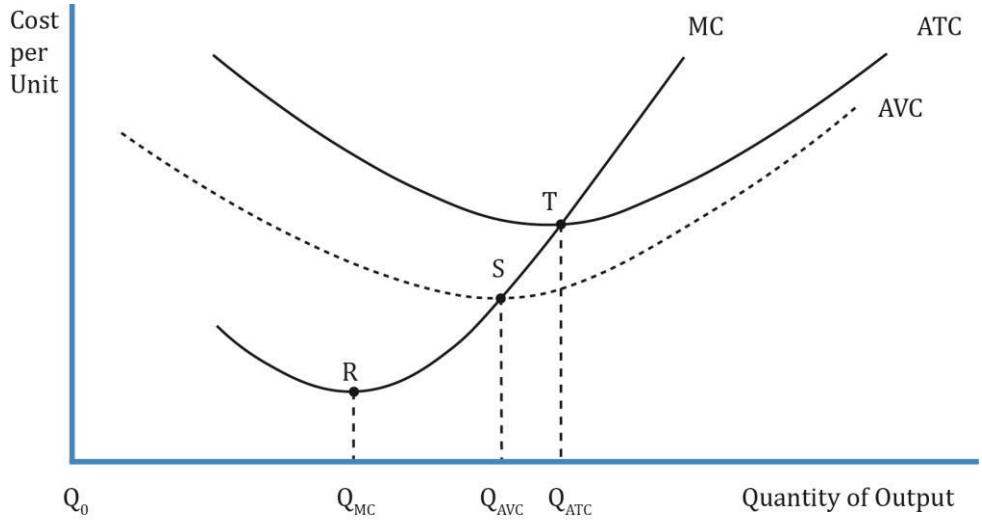


Interpretation of the graph:

- Total fixed cost is constant or flat for any given output level. It does not change as production varies.
- Total variable cost increases as the quantity of output increases. For simplicity, it is assumed to have a linear relationship with quantity. If there is no production, then TVC is zero.

- The total cost for any quantity of output is the sum of total fixed cost and total variable cost. It also increases as production increases and the quantity of output increases.

The graph below shows the MC, ATC and AVC curves for a firm in the short run.



Interpretation of the graph:

AVC Curve

- The AVC curve is U-shaped but this can vary from company to company, or industry to industry.
- As output increases, average variable cost falls to a minimum and then increases. It falls, because the total fixed cost is distributed over a large number of units.

ATC Curve

- Like the AVC curve, the ATC curve is also U-shaped but higher than the AVC curve because:
  - AFC is added to AVC for any given quantity of output.
  - AVC increases more quickly than AFC decreases.
- The distance between the ATC and AVC for any output quantity will be AFC.

Marginal cost curve

- MC intersects AVC at its lowest point, S. The corresponding quantity is Q_{AVC}. MC is greater than AVC beyond Q_{AVC}.
- If the marginal cost of producing one more unit is less than the average variable cost (to the left of the minimum point), then it will pull the AVC down.
- Similarly, if the marginal cost of producing one more unit is greater than the average variable cost (to the right of the minimum AVC point), then it will pull the AVC up.
- The lowest point for the ATC is T, where MC equals ATC. Beyond T, MC is greater than ATC.

AFC

- The difference between ATC and AVC for any quantity will be AFC. AFC is also the total fixed cost divided by the quantity.
- Average fixed cost falls as output increases because the numerator in the above formula is constant while the denominator increases. Put differently, the total fixed cost is spread over a larger output, so it slopes downward as output quantity increases.

10. Perfect and Imperfect Competition, Profit Maximization

Revenue under Conditions of Perfect and Imperfect Competition

Total revenue under perfect competition:

- Total revenue is the price multiplied by quantity (TR = P x Q).
- The firm has no pricing power, and price is decided by the market.
- The demand curve is horizontal and slope is zero.
- Market price is equal to marginal revenue, which is equal to average revenue. P = MR = AR.
- TR increases by the price for every incremental increase in output. The TR curve is linear and positively sloped.

Total revenue under imperfect competition

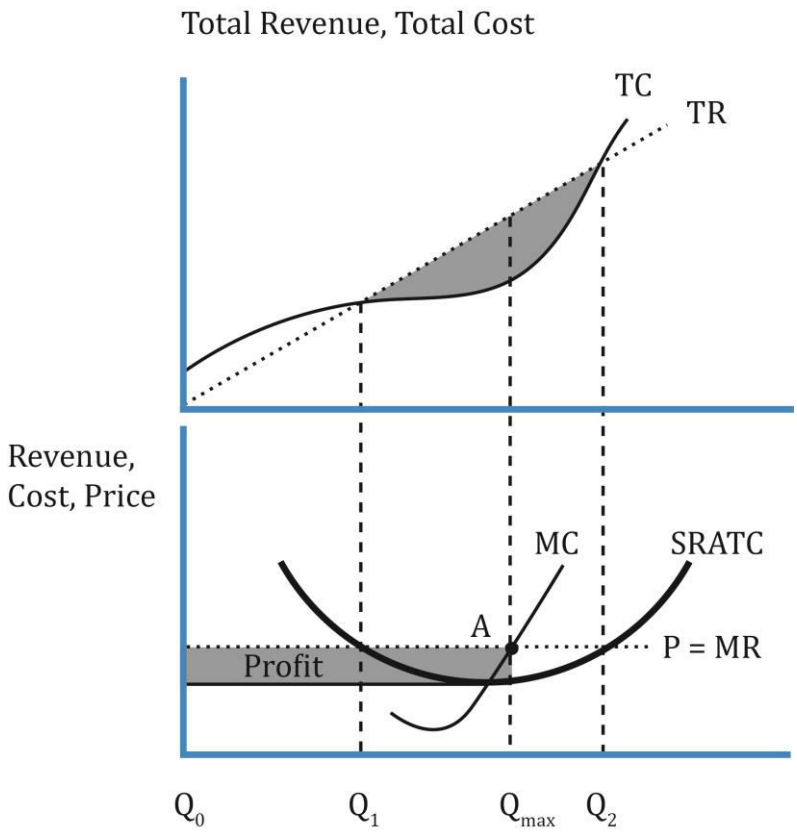
- The firm has a large market share.
- The demand curve is downward sloping. The firm must decrease the price in order to sell more.
- Total revenue increases with greater quantity. However, there is a quantity at which the profit is maximized. Beyond this, any price decrease will result in a decrease in total revenue as the effect of the decrease in price will be greater than the quantity sold.
- The TR curve for such a firm is initially zero, then it increases and subsequently decreases. It increases when MR is positive and demand is elastic. It falls when MR is negative and demand is inelastic. TR is maximum when MR is zero.

Profit Maximization, Breakeven, and Shutdown Points of Production

Profit is maximized when:

- Marginal revenue equals marginal cost. MR = MC.
- MC is rising.
- Alternatively, when the difference between total revenue and total cost is the greatest.

The graph below shows the TR, TC, demand curve, and profit maximization under perfect competition.



Q_{max} is the profit-maximizing quantity where MR = MC and MC is rising.

11. Break Even Analysis and Shutdown Decision

A firm is said to break even under the following conditions:

- total revenue equals total costs (TR = TC).
- price (average revenue) equals average total costs (AR = ATC).

When a firm is operating at its break-even point, the economic profit is zero. It might still be earning a positive accounting profit.

A perfectly competitive market with no barriers to entry will attract new entrants. The increased competition will lead to increased output and lower prices in the long run where no firm is able to earn an excess return or positive economic profit.

Instructor's Note

If economic profit is zero, accounting profit is called **normal profit.**

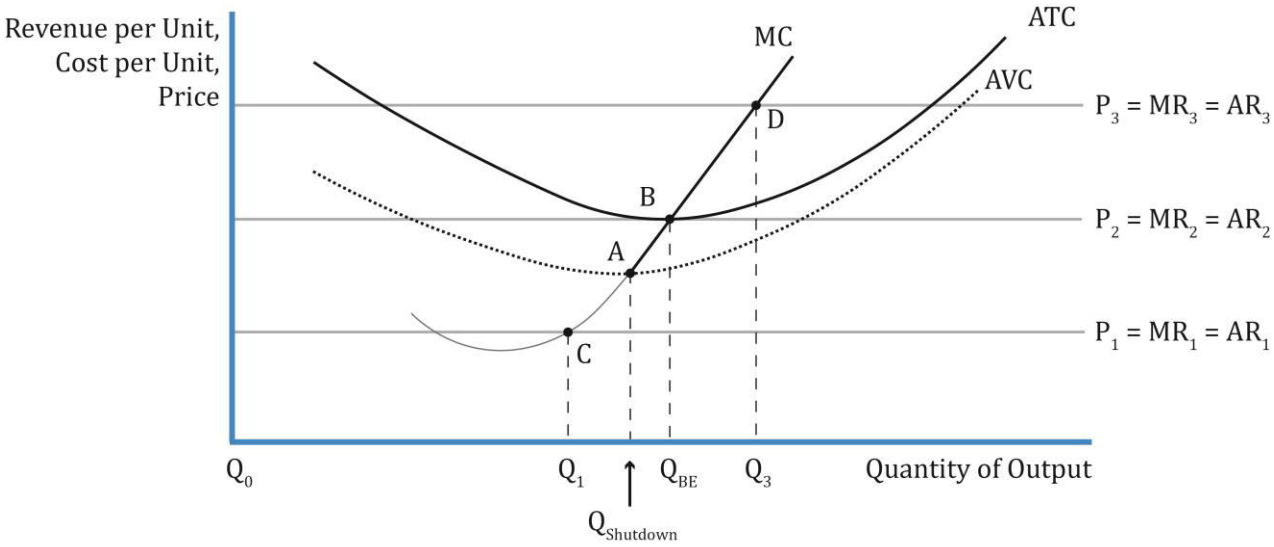
Under perfect competition, firms earn only normal profits in the long run.

The Shutdown Decision

The relationships that show when a firm must operate or shutdown are given in the table below:

Short-run effect of the relationship between price and ATC on a firm		
Situation	**Short run**	**Long run**
TR ≥ TC	Operate	Operate
TR ≥ TVC but TR < TC	Operate	Exit
TR < TVC	Shutdown	Exit

Let us understand a firm's breakeven and shutdown point using the graph below.



Interpretation of the graph:

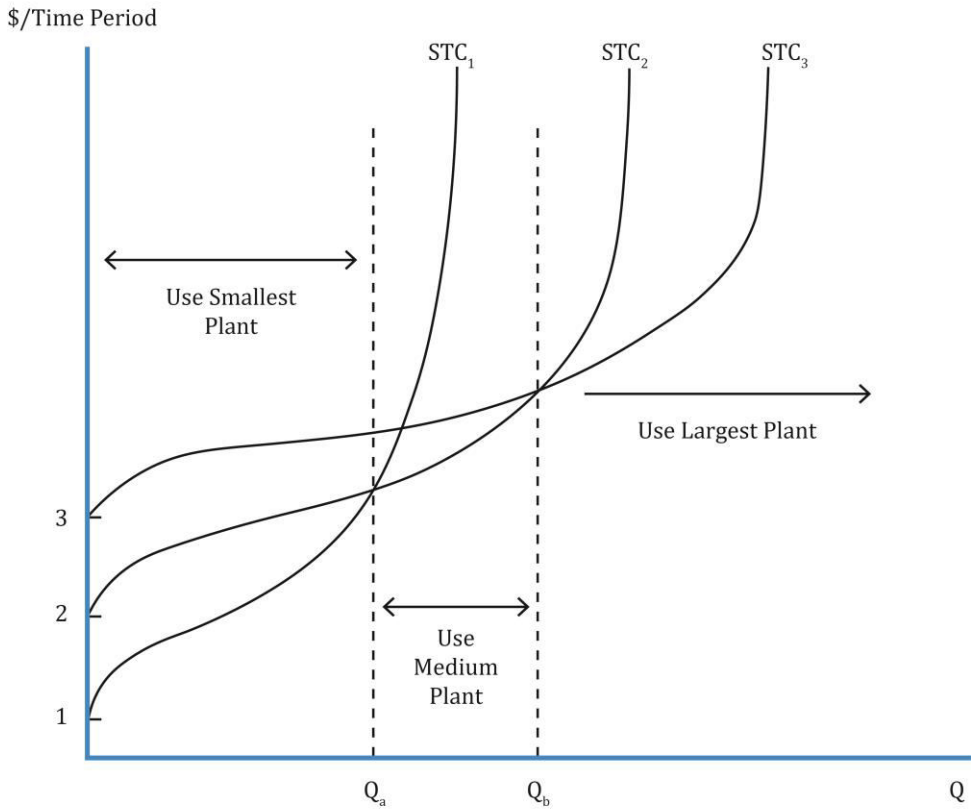
- Assume the price at P_3 is 150. If the competition is perfect, then P_3 is the demand curve and MR = AR.
- At any point on the MC between P_2 and P_3, the firm is profitable because the average revenue is greater than the average total cost.
- The breakeven point is the point where P = ATC = MC. Graphically, it is the point where MC intersects ATC. The corresponding quantity is the breakeven quantity, Q_{BE}. Suppose this price is 100.
- Between A and B, the price is greater than AVC. The firm will continue to operate in the short run even though it is not profitable.
- To the left of A, the price is less than AVC. The firm will shut down.

12. Economies and Diseconomies of Scale with Short-Run and Long-Run Cost Analysis

Economists use two time horizons based on how firms are able to vary the quantity of input: short run and long run. In the short run, at least one of the inputs or factors of production is constant. In the long run, all factors of production are variable.

Short- and Long-Run Cost Curves

The graph below shows a set of short-run total cost curves for each level of capital input.



In the short run**:**

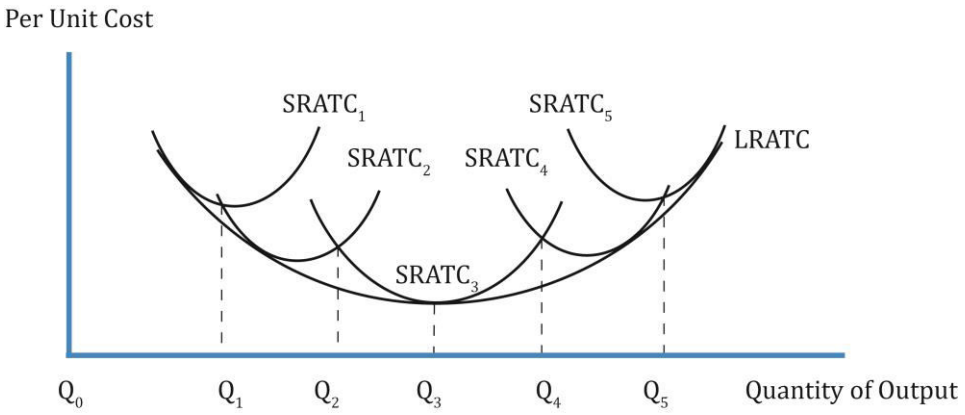
- Typically, where we are considering two factors of production, capital is fixed in the short run and the variable factor is labor. However, when capital changes, we get a new STC curve for each level of capital input.
- The fixed-input constraint along with other input prices determines a firm's short-run total cost curve (STC).

In the long run**:**

- All factors of production (both labor and capital) are variable.
- Think of the long-run total cost curve (LTC) as a combination of several STCs. By drawing a tangent to the minimum point of all the SRATC curves and connecting them, we get the LTC curve for the firm.
- The LTC is called the envelope curve. It envelops or encompasses all combinations of technology, plant size, and physical capital.

Defining Economies of Scale and Diseconomies of Scale

Each STC curve has a corresponding short-run average total cost curve (SRATC). The STCs for different plant sizes and the corresponding long-run average total cost curve (LRATC) is shown in the exhibit below.



Interpretation of the graph:

- The SRATC defines what the per-unit cost will be for any quantity in the short run.
- The SRATC shifts down and to the right. Note that as plant size increases, the per-unit cost decreases as can be seen in the case of $SRATC_3$.
- The LRATC is derived from connecting the lowest level of STC for each level of output.
- The shape of the long-run cost curve depends on whether the firm is facing economies of scale or diseconomies of scale.
- **Economies of scale** is the decrease in the long-run cost per unit as output increases. LRATC has a negative slope when there are economies of scale. The portion to the left of Q_3 represents economies of scale.
- Q_3 represents the **minimum efficient scale**. It is the output level at which the long-run average total cost is the lowest and the output is optimal. This portion exhibits constant returns to scale where long-run average total costs do not change as output quantity increases.
- Beyond Q_3, the LRATC goes up. This portion represents **diseconomies of scale**. Here there is an increase in long-run cost per unit as output increases. LRATC has a positive slope when there are diseconomies of scale. The right side of LRATC curve represents diseconomies of scale.

The factors contributing to economies of scale and a lower ATC are as follows:

- Increasing returns to scale: increase in output is relatively larger than the increase in input. The left side of Q_3 shows increasing returns to scale.
- Division of labor/management.
- Technologically/economically efficient equipment that results in increased productivity.
- Effective decision-making.
- Reduce waste and lowering costs through better quality control.
- Bulk purchases resulting in lower prices.

The factors contributing to diseconomies of scale are as follows:

- Decreasing returns to scale: Increase in output is relatively less than the increase in

input. The right side of Q_3 shows decreasing returns to scale.

- Higher resource costs due to supply bottlenecks.
- Improper management because of size.
- Duplication of product lines.
- Higher labor costs.

Summary

LO.a: Calculate and interpret price, income, and cross-price elasticities of demand, and describe factors that affect each measure.

Elasticity of demand is measured as a ratio of percentage change in quantity demanded to a percentage change in other variables.

Own-price elasticity

- Own price elasticity $= \frac{\%\text{ change in quanitity demanded}}{\%\text{ change in own price}}$
- Own-price elasticity of demand is usually negative.
- If |own-price elasticity| > 1, then demand is elastic.
- If |own-price elasticity| < 1, then demand is inelastic.

Income elasticity

- Income elasticity $= \frac{\%\text{ change in quanitity demanded}}{\%\text{ change in income}}$
- If income elasticity > 0, then the good is a normal good.
- If income elasticity < 0, then the good is an inferior good.

Cross price elasticity

- Cross price elasticity $= \frac{\%\text{ change in quanitity demanded}}{\%\text{ change in price of related good}}$
- If cross price elasticity > 0, then the related good is a substitute.
- If cross price elasticity < 0, then the related good is a complement.

LO.b: Compare substitution and income effects.

Substitution effect

- When a good's price falls, due to the substitution effect, consumers buy more of this good as compared to other goods for which the prices have remained the same.
- Substitution effect is always positive.

Income effect

- When a good's price falls, real income rises.
- If the good is a normal good, the income effect will be positive and more of this good will be purchased.
- If the good is an inferior good, the income effect will be negative and less of this good will be purchased.

LO.c: Contrast normal goods with inferior goods.

If income elasticity > 0, then the good is a normal good. If income increases, more of this good is demanded.

If income elasticity < 0, then the good is an inferior good. If income increases, less of this good is demanded.

Giffen goods

- Giffen goods are highly inferior, for which the negative income effect outweighs the positive substitution effect.
- Therefore, even though price falls, the quantity demanded still decreases.
- Giffen goods have positively sloped demand curves (which means that as price decreases the quantity demanded also decreases.)

Veblen goods

- Veblen goods are "high status" goods.
- If price increases, this makes the goods even more desirable and quantity demanded increases.
- Veblen goods also have a positively sloped demand curve.

LO.d: Describe the phenomenon of diminishing marginal returns

- Marginal returns refer to the additional output than can be obtained by adding one more unit of a productive input while keeping the quantities of other inputs constant.
- As the first few units of an input are added, marginal returns may increase. However, as we keep increasing the input quantity, we reach a point where marginal returns start to decrease.
- Inputs beyond this point produce diminishing marginal returns.

LO.e: Determine and interpret breakeven and shutdown points of production.

Situation	**Short Run**	**Long Run**
Price > ATC	Economic Profit - Operate	Economic Profit - Operate
Price = ATC	Breakeven - Operate	Breakeven - Operate
AVC < Price < ATC	Operate	Shutdown
Price < AVC	Shutdown	Shutdown

LO.f: Describe how economies of scale and diseconomies of scale affect costs.

Economies of scale: As output increases the long-run cost per unit decreases.
Diseconomies of scale: As output increases the long-run cost per unit increases.