

List of Frequently Used Formulas in Managerial Economics

Consumer Behaviour Analysis:

1. Optimum allocation:

$$MU_X / P_X = MU_Y / P_Y$$

2. Budget = $Q_X \times P_X + Q_Y \times P_Y$

3. $MRS_{XY} = \Delta Y / \Delta X$

Demand & Supply and Analysis:

1. $e_p = (\Delta Q / \Delta P) \times (P / Q)$

Where, P = initial price, Q = initial quantity

(This formula is used when we know the initial and latest prices and quantities.)

$$\text{Arc } e_p = (\Delta Q / \Delta P) \times \{(P_1 + P_2) / (Q_1 + Q_2)\}$$

$$\text{Point } e_p = (\partial Q / \partial P) \times (P / Q)$$

(This formula is used when single price is given.)

Production Analysis:

1. Optimum Allocation:

$$MP_L / w = MP_K / r$$

2. Optimum Labour unit = $MP_L \times \text{Price of the good}$

3. $MP_L = \Delta TP / \Delta L$, $AP_L = TP / L$

4. Max AP: When $AP = MP$ or $\partial AP / \partial L = 0$

5. Max MP: $\partial MP / \partial L = 0$

Analysis of Costs:

1. $TC = TFC + TVC$
2. $MC = \Delta TC / \Delta Q = \Delta TVC / \Delta Q$
3. Min AC: When $AC = MC$ or $\partial AC / \partial Q = 0$
Min MC: When $\partial MC / \partial Q = 0$
4. $AC = AFC + AVC$

Market Structure: Perfect Competition

1. Profit Maximizing output: $P = MC$
2. Long run profit maximizing output: $P = \text{Min AC}$
3. Shut down point: $P = \text{Min AVC}$

Monopoly, Monopolistic Competition & Oligopoly

1. Profit Maximization: $MR = MC$
2. Long run profit maximization condition (monopolistic competition):

$$P = AC$$

3. $Q_n = Q_p (n / n+1)$

Where, Q_n = output in the market,
 Q_p = output in perfect competition
 n = number of firms

4. $MR = P \{1 - 1 / |e_p|\}$

Problems on Managerial Economics

Consumer Behaviour Analysis:

1. The marginal utility of a banana and an apple are 30 and 45 respectively. If the price of an apple is Rs 6 and the consumer is at equilibrium, what would be the price of a banana?

2. Norton consumes two commodities X and Y at an equilibrium level. If the marginal utility of commodity X is 175, price of the commodity X is Rs 25 and the price of a commodity Y is Rs 40, what is the marginal utility of Y?

3. Marginal utilities of goods A and B are 600 and 900, and the price of good B is Rs 120. If the consumer is in equilibrium, what is the price of good A?

4. Assume that utility can be measured in Rs. From the utility schedule given below, find how many Cokes the consumer would consume at the price of Rs. 9 per coke.

Cokes	Total Utility (Rs)
1	30
2	45
3	54
4	59
5	59

5. A consumer has an income of Rs 19 for a week. He would like to spend all the Rs 19 on three goods 'X, Y and Z'. Prices of X, Y and Z are Rs 5, Rs 3 and Rs 1 per unit respectively. The Marginal Utility (MU) schedule is given below for various levels of consumptions.

Units	Marginal Utilities		
	X	Y	Z
1	30	18	8
2	25	15	7
3	20	9	5
4	15	6	4
5	5	4	3

How the consumer will allocate his income on the three goods?

6. A family has a monthly budget of Rs 340 for Cheese, Fish and Meat. Prevailing prices are Rs 20/kg Cheese, Rs 40/kg Fish and Rs 50/kg Meat. The total utility schedule is given below:

Consumption (kg)	Cheese	Fish	Meat
1	70	80	160
2	130	160	290
3	170	210	410

4	205	250	510
5	230	285	590
6	250	315	650
7	260	335	680

What is the maximum total utility that can be achieved by the consumer?

7. A consumer has a monthly budget of Rs 4000 he spends all his income on two goods A and B. The prices of goods A and B are Rs 2 and Rs 4 respectively. His marginal utility functions are given by

$$MU_A = 3/A$$

$$MU_B = 9/B$$

What is the optimum amount to be spent on good A?

8. The consumer is indifferent between the combinations A and B.

Combination	Good X	Good Y
A	10	14
B	12	13

What is the absolute value of Marginal Rate of Substitution (MRS_{XY}) for the consumer?

Demand Theory and Analysis:

1. From the following table calculate the price elasticity and income elasticity of demand.

Price (Rs)	Quantity sold (units)	Income (Rs)
20	1,000	30,000
18	1,200	24,000
16	1,450	26,000
12	1,600	30,000
20	1,200	31,000

2. It is known that quantity demanded decreases by two units for each Rs 1 increase in price. At a price of Rs 5, quantity demanded is ten units.

- What will be the quantity demanded if price is zero?
- Write an equation for quantity demanded as a function of price.
- Write an equation that expresses price as a function of quantity.
- Write an equation for total revenue.

3. A market consists of three people, A, B, and C, whose individual demand equations are as follows:

$$A: P = 35 - 0.5 Q_A$$

$$B: P = 50 - 0.25 Q_B$$

$$C: P = 40 - 2.00 Q_C$$

The industry supply equation is given by $Q_S = 40 + 3.5 P$.

- Determine the equilibrium price and quantity.
- Determine the amount that will be purchased by each individual.

4. A market consists of two individuals. Their demand equations are $Q_1 = 16 - 4P$ and $Q_2 = 20 - 2P$, respectively.

- What is the market demand equation?
- At a price of Rs 2, what is the point price elasticity for each person and for the market?

5. The demand equation faced by DuMont Electronics for its personal computers is given by $P = 10,000 - 4 Q$.

- Write the marginal revenue equation.
- At what price and quantity will marginal revenue be zero?
- At what price and quantity will total revenue be maximized?
- If price is increased from Rs 6,000 to Rs 7,000, what will be the effect on total revenue? What does this imply about price elasticity?

6. The demand for shirts produced by a Canadian manufacturer has been estimated to be $P = 30 - Q/200$.

- Compute the point elasticity at $P = \text{Rs } 10$; at $P = \text{Rs } 15$.

b. How does the point elasticity vary with the price?

7. A manager believes that the demand for her product is given by the equation $P = 50 - Q/100$.

a. What is the arc elasticity of demand as price decreases from Rs 12 to Rs 10?

b. What is the arc elasticity of demand as price increases from Rs 10 to Rs 12?

8. For each of the following equations, determine whether demand is elastic, inelastic, or unitary elastic at the given price.

a. $Q = 100 - 4P$ and $P = \text{Rs } 20$.

b. $Q = 1500 - 20P$ and $P = \text{Rs } 5$.

c. $P = 50 - 0.1Q$ and $P = \text{Rs } 20$.

9. Sailright Inc. manufactures and sells sailboards. Management believes that the price elasticity of demand is -3.0 . Currently, boards are priced at Rs 500 and the quantity demanded is 10,000 per year.

a. If the price is increased to Rs 600, how many sailboards will the company be able to sell each year?

b. How much will total revenue change as a result of the price increase?

10. Demand for a managerial economics text is given by $Q = 20,000 - 300P$. The book is initially priced at Rs 30.

a. Compute the point price elasticity of demand at $P = \text{Rs } 30$.

b. If the objective is to increase total revenue, should the price be increased or decreased? Explain.

c. Compute the arc price elasticity for a price decrease from Rs 30 to Rs 20.

d. Compute the arc price elasticity for a price decrease from Rs 20 to Rs 15.

11. A consultant estimates the price-quantity relationship for New World Pizza to be $P = 50 - 5Q$.

a. At what output rate is demand unitary elastic?

b. Over what range of output is demand elastic?

c. At the current price, eight units are demanded each period. If the objective is to increase total revenue, should the price be increased or decreased? Explain.

12. The price elasticity for rice is estimated to be -0.4 and the income elasticity is 0.8 . At a price of Rs 40 per kg and a per capita income of Rs 20,000, the demand for rice is 50 million tons per year.

a. Is price an inferior good, a necessity, or a luxury? Explain.

b. If per capita income increases to Rs 20,500, what will be the quantity demanded of rice?

c. If the price of rice increases to Rs 41 per kg and income per capita remains at Rs 20,000, what will be the quantity demanded?

13. The R. J. Smith Corporation is a publisher of novels. The corporation hires an economist to determine the demand for its product. After months of hard work and submission of an exorbitant bill, the analyst tells the company, that demand for the firm's novels (Q_x) is given by the following equation:

$$Q_x = 12,000 - 5,000 P_x + 5 I + 500 P_c$$

Where P_x is the price charged for the R. J. Smith novels, I is income per capita, and P_c is the price of books from competing publishers.

Using this information, the company's managers want to;

- Determine what effect a price increase would have on total revenues.
- Evaluate how sale of the novels would change during a period of rising incomes.
- Assess the probable impact if competing publishers raise their prices.

Assume that the initial values of P_x , I and P_c are Rs 5, Rs 10,000 and Rs 6, respectively.

14. The McNight company is a major producer of steel. Management estimates that the demand for the company's steel is given by the equation

$$Q_s = 5,000 - 1,000 P_s + 0.1 I + 100 P_a$$

Where Q_s is steel demand in thousands of tons per year, P_s is the price of steel in Rs per pound, I is income per capita, and P_a is the price of aluminum in Rs per pound. Initially, the price of steel is Rs 20 per pound, income per capita is Rs 20,000 and the price of aluminum is Rs 18 per pound.

- How much steel will be demanded at the initial prices and income?
- What is the point income elasticity at the initial values?
- What is the point cross elasticity between steel and aluminum? Are steel and aluminum substitutes or complements?
- If the objective is to maintain the quantity of steel demanded as computed in part (a), what reduction in steel prices will be necessary to compensate for a Rs 2 reduction in the price of aluminum?

Production & Cost Analysis

1. International publishing has kept the following data on labour input and production of text books for each of eight production periods.

Production period:	1	2	3	4	5	6	7	8
Labour Input:	4	3	6	8	2	7	5	1
Output of Books (Total Product):	260	190	310	240	110	290	300	50

- a. Use the data on labour input and total product to compute the average and marginal product for labour input rates from one to eight. (Assume that a zero labour input would result in zero output.)
- b. Plot the total product function in the upper graph and average and marginal product functions in the lower graph. On the graph identify the rate of labour input: 1) where total output is at a maximum and the corresponding point where marginal product is zero; 2) where there is an inflection point on the total product function and the corresponding point where the marginal product function is at a maximum; and 3) where the slope of a line drawn through the origin to a point on the total product function would have maximum slope and the corresponding point where the average product curve is at a maximum.

2. Shoe & Co. manufactures shoes for export. The production function is $TP = 15L^2 - L^3$.

- a. If Shoe & Co., would like to achieve the highest possible AP_L (average productivity of labour), what is the labour to be employed?
- b. What can be the average productivity of labour (AP_L) when labour employed is 7.5?
- c. What is the marginal productivity of labour (MP_L) when the average productivity of labour (AP_L) is maximum?

3. Suppose the production function relating to agricultural output to varying amounts of capital input is of the following form:

$$Q = -K^3/3 + 2K^2 + 12K$$

Beyond what point do diminishing returns exists?

4. The production function of a firm is estimated to be $Q = L^{0.5}K^{0.5}$. The cost of inputs Labour (L) and Capital (K) are Rs 2 and Rs 4 per unit respectively. If the firm producing Q has budget constraint of Rs 80.

- a. What is the maximum output?
- b. If the firm would like to produce 90.50 units of output, what is the minimum possible cost of production?

5. Pyxes Team Works has the following production function $Q = 4L^2 + 6K^2 - 2LK$, where $Q =$ Output, $L =$ input of labour, $K =$ input of capital.

Budget constraint of the firm is Rs 720, the market going wage rate, $w =$ Rs 10 and cost of capital, $r =$ Rs 10. If the firm is operating at optimum level, find the output produced.

6. The production function of Boomex, an auto spare parts manufacturer, is estimated to be $Q = 30L^{0.5}K^{0.5}$. If the prices of capital (r) and labour (w) are Rs 20 and Rs 30 per unit respectively, what is the minimum possible cost for producing 180 units?
7. Production function for a firm is $TP_L = 10L - L^2$. Find the number of labour after which marginal production becomes negative.
8. If the production function is $Q = 20K^{0.3}L^{0.3}$, what is the marginal rate of technical substitution of labour for capital?
9. If the Average Product of labour (AP_L) is $30L - L^2$, find the maximum possible Total Product (TP_L).
10. Production function for a firm is $Q = 100L - 0.02L^2$. If 10 units of labour are used, find the average productivity of labour.

Analysis of Costs

1. The Total Variable Cost function of Nazareth Bros. is estimated to be $TVC = 50Q - 10Q^2 + Q^3$.
 - a. What is the output level where the marginal cost is minimum?

b. What is the output level where the average cost is minimum?

2. For a firm the $LTC = Q^3 - 2Q^2 - 6Q$. What is the optimum level of output for the firm?

3. A firm sells its output for Rs 20 per unit. The cost function is $TC = 16 + 17Q - 9Q^2 + Q^3$. What is its profit function?

4. The total cost function and demand function of a good are estimated to be $TC = 100 - 5Q + 2Q^2$ and $Q = 100 - P$ respectively. If the current output is 2 units, find out the average profit.

5. If total cost function for a firm is $TC = 18Q - 0.30Q^2 + 0.010Q^3$, find the output at which average cost is minimum.

6. Amchi Bike Co. manufactures bicycles. The cost function of the firm is estimated to be $TC = 60000 - 400Q + Q^2$. The revenue function is given by $TR = 400Q - Q^2$. What is the firms' break even output level?

7. The short run costs for different levels of output is given as

Q	0	20	40	60	80	100	120	140	150	160	180
STC (Rs)	80	200	260	300	320	340	370	420	453	500	720

The total revenue function of the firm is $4Q$. At what level of output, the breakeven point occurs?

8. The cost function of a firm producing race bike is estimated to be $TC = 80,000 - 600Q + 2Q^2$. The demand function for race bike is given by $Q = 400 - P$. What is the breakeven level of output for the firm?

9. The following is the marginal cost schedule for a good:

Output	1	2	3	4	5
Marginal Cost	6	5	4	6	7

What is the average cost of production, if the firm produces four units of output?

10. For a firm, the Average Cost function is estimated as

$$AC = 100/Q + 20 + 4Q$$

What is Total Variable Cost for the firm at an output of 15 units?

11. The demand function for a firm is $P = 30 - 3Q$. If the Average Cost (AC) is Rs 6, what is the output at which the firm earns normal profits?

12. The long run cost function of a firm is $TC = Q^3 - 40 Q^2 - 480 Q$. Beyond what output do diseconomies of scale exist?

13. Cost function of a firm is $TC = 500 + 10 Q - 0.25 Q^2$. If the current output is 100 units, find the Average Fixed Cost?

14. The Cost and Profit functions of a firm are

$$TC = 200 + 10 Q$$

$$\text{Profit} = -10 Q^2 + 200 Q - 200$$

If the firm aims at maximizing Total Revenue, what output should it produce?

Market Structure

I – Perfect Competition

1. Vijaya Ltd., is operating in a perfectly competitive industry. The Total Cost function of the firm is given by $TC = 25000 + 150 Q + 3 Q^2$.

- a. If the industry is in long run equilibrium what is the price of the Vijaya Stores product?
 - b. What is the profit maximizing output for the firm if the price is Rs 900?
2. If the firm is a perfectly competitive firm and is selling its goods at Rs 24.
 - a. What is its optimal output level?
 - b. If the output produced and sold by the firm is 5 units, What is the profits earned by the firm?
3. R. K. Enterprises is a small firm in the steel office chairs industry, which is perfectly competitive. The market price of each chair is Rs 640. The cost function of the firm is $TC = 240 Q - 20 Q^2 + Q^3$.
 - a. What is the profit maximizing output?
 - b. What is the Average Cost when the level of output is 20 units?
 - c. What is the profit earned by the R. K. Enterprises if the output sold in the market is 20 units?
 - d. Suppose the local government imposes a specific tax of Rs 325 per chair on the R. K. Enterprises, what is the profit maximizing output?
4. Racing Cycles Ltd., faces a horizontal demand curve. The firms' Total cost, TC is given by the equation $TC = 200 + 150 Q - 20 Q^2 + Q^3$. What is the price below which the firm is forced to shutdown its operations?
5. In a perfectly competitive market,

Demand function : $Q_d = 20000 - 400 P$

Supply function : $Q_s = 14000 + 200 P$.

What is the price charged by the member firm having a cost function of $TC = 100 + 50 Q$?
6. Pens and Pens Co., sells ball point pens at Rs 10 per pen. The cost function is $TC = 1000 + 2 Q + 0.01 Q^2$. What is the profit maximizing output for Pens and Pens Co.?
7. A bicycle manufacturer sells bicycles in a perfectly competitive market. The cost function is $TC = 5000 + 150 Q - 20 Q^2 + Q^3$. What is the price below which the manufacturers shutdown operations?

II – Monopoly Competition

1. The Total Cost function for a monopolist is given by the equation $TC = 900 + 40 Q^2$. The demand function for the good produced by the monopolist is given by $2Q = 48 - 0.08 P$. What is the profit maximizing price for the monopolist?

2. Average Cost (AC) takes the following values for the corresponding levels of output

$$Q = 50; \text{ the } AC = 15$$

$$Q = 200; \text{ the } AC = 6.5$$

$$Q = 250; \text{ the } AC = 5.5$$

If the firm sells to the high income market 50 units of Q at a price $P_1 = 10$, and to the low income market 200 units at a price $P_2 = 5$, find the amount of profit made by the firm.

3. The cost and demand function of a monopolist is given by $TC = 125 + 5 Q^2$ and $P = 100 - 5Q$ respectively, what is the maximum profit that can be earned by the monopolist.

4. A monopolist practicing third degree price discrimination has segmented the total market for his product into three sub markets with the following price elasticities of demand.

Market	Price Elasticity
1	1.5
2	2.5
3	4.0

If the profit-maximizing price charged in market 2 is Rs 50, what are the profit maximizing prices for market 1 and market 3?

5. Indexpo Ltd., is an export oriented trading firm. Index exports handicrafts to Europe and North America. The total demand function faced by Indexpo is $P = 140 - Q/0.15$. Further the market research team at Indexpo estimated individual demand functions for north America and Europe to be

$$P_A = 100 - 10 Q_A$$

$$P_E = 220 - 20 Q_E, \text{ respectively.}$$

Indexpo is actively considering a proposal for discriminating so as to maximize its total profits. The cost function of Indexpo is $TC = 400 + 20 Q$.

a. If the objective of Indexpo is to maximize its profits, what is the profit earned by Indexpo if it does not exercise price discrimination?

b. If the objective of Indexpo is to maximize total revenue, how many units should it export without exercising price discrimination?

c. If Indexpo exercises price discrimination and aims to maximize profits, what is the total profit earned by Indexpo?

6. The demand equation for the monopolist is given by $P = 50 - 2Q$. Marginal cost for the monopolist is Rs 10. Compared to pricing under perfectly competitive market, what is the effect on income redistribution because of monopoly pricing?

III – Monopolistic Competition

1. A firm is operating in monopolistic competition with the following demand and cost functions.

$$P = 11,100 - 30 Q$$

$$TC = 400,000 + 300 Q - 30 Q^2 + Q^3$$

What is the short run equilibrium output and price for the firm?

2. Long run demand and cost functions of a firm are given by

$$P = 5 - 0.002 Q$$

$$AC = 6 - 0.004 Q + 0.000001 Q^2$$

a. What are the equilibrium output and price for the firm?

b. If the output produced by the firm is 1000 units, what is the economic profit earned by the firm.

3. A firm is operating in a monopolistically competitive market faces the following demand function.

$$P = 8,000 - 4 Q$$

Long run average cost function of the firm is

$$LAC = 8,000 - 7 Q + 0.002 Q^2$$

What is the profit at profit maximizing output?

4. A monopolistically competitive firm has the following Cost and Revenue functions:

$$TC = 3000 + 30 Q - 20 Q^2 + Q^3$$

$$TR = 30 Q - 2 Q^2$$

If the firm is maximizing profits at the current level of output, what would be the total cost of the firm?

5. The Total Revenue and Total Cost functions of Nike Shoe Company are

$$TR = 400 Q - Q^2/2, \quad TC = 600 + 70 Q + Q^2$$

What is the profit maximizing output for the firm?

6. A firm is operating in monopolistic competition has the following demand function:

$$P = 1000 - Q$$

If the Marginal Cost of the firm is constant at Rs 10, what is the equilibrium output in the long run?

7. Demand function faced by a monopolistically competitive firm is $Q = 1500 - 0.20 P$. Long run cost curve for the firm is $TC = 7500 - 3 Q^2 - 0.02 Q^3$. If the firm is in long run equilibrium, what is the output?

National Income Measurement

1. Suppose in an economy, autonomous investment (I) is Rs 600 crores and the following consumption function is given:

$$C = 200 + 0.8 Y$$

Given the above, find out the equilibrium level of income.

2. Suppose the consumption function of an economy is $C = 0.8 Y$. Planned investment by entrepreneurs for a year is Rs 500 crores. Find out what will be the equilibrium level of income.

3. Suppose the consumption of an economy is given by

$$C = 20 + 0.6 Y$$

The following investment function is given:

$$I = 10 + 0.2 Y$$

What will be the equilibrium level of national income?

4. The following consumption function of an economy is given:

$$C = 40 + 0.8 Y, \text{ where } Y \text{ is national income.}$$

If the planned level of investment in a year equals Rs 75 crores, what will be the equilibrium level of national income and consumption?

5. For an economy following consumption function is given:

$$C = 60 + 0.75 Y$$

- If investment in a year is Rs 35 crores what will be the equilibrium level of income or output?
- If full-employment level of income (i.e. level of potential output) is Rs 460 crores what investment is required to be undertaken to ensure equilibrium at full-employment.