

Assignment 1

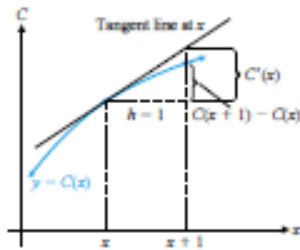
Course name: Managerial Economics (MSC506)

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1. In economics, the word marginal refers to a rate of change, or a derivative or a differential that we denote as d/dx .

Thus, if $C(x)$ is the total cost of producing x items, that is cost is a function of output x , here output is denoted by x , then the marginal cost represents the instantaneous rate of change of total cost C with respect to the number of items produced x e.g. dC/dx . That is, if x is increased by a very small amount h and h tends to zero or h is infinitesimally small, by how much does C increase or decrease. This is the marginal change. This is also captured through the slope of the tangent at the initial point of change.



Similarly, the marginal revenue is the derivative of the total revenue function and the marginal profit is the derivative of the total profit function.

$C(x)$ represents the total cost of producing x items, not the cost of producing a single item.

To find the cost of producing a single item, we use the difference of two successive values of $C(x)$:

Total cost of producing $x + 1$ items $= C(x + 1)$

Total cost of producing x items $= C(x)$

Exact cost of producing the $(x + 1)$ st item $= C(x + 1) - C(x)$

This is a more crude measure of marginal change (discrete case).

Now, imagine a company manufactures fuel tanks for automobiles.

The total weekly cost (in Rupees) of producing x fuel tanks is given by the cost function

$$C(x) = 10,000 + 90x - 0.05x^2$$

(A) Find the marginal cost (MC) function in both the continuous case (instantaneous change e.g. derivative or differential) and the discrete case (e.g. change in x is 1 unit).

(B) Find MC at a production level of 500 tanks per week and interpret the results.

(C) Find the exact cost of producing the 501st item.

2. A firm knows from production data that the total benefit function is $B(Q) = 100 + 36Q - 3Q^2$ and total cost function is $C(Q) = 80 + 12Q$ where Q is the output of a firm:

(A) Write the net benefit (NB) function of the firm in terms of Q ?

(B) Please write a schedule of different NB values for $Q = 0, 1, 2, \dots, 10$. Please plot these against Q .

(C) From the schedule, please denote at what level of output, Q^* , the net benefit function is maximised?

(D) Show that at the maximum of NB e.g. at Q^* , the rate of change of the NB function or in other words its differential (dNB/dQ) is equal to zero. Please point out this maximum on the plotted graph.

[Hint: Differentiate the NB function and substitute Q^* value in the differential]

(E) Find the second derivative of the NB function. What does its value imply?

[Hint: Differentiate the dNB/dQ function]

(F) Find the MB and MC function. Is MB greater than, equal to or less than MC at $Q = 2$. What is the intuitive implication of your finding?

3. The market research department of a company recommends that the company manufacture and market a new transistor radio. After suitable test marketing, the research department presents the following price–demand equation where x is demand and P_x is own price:

$$x = 10,000 - 1,000P_x \quad (1)$$

The financial department provides the following cost function:

$$C(x) = 7,000 + 2x \quad (2)$$

where Rs 7,000 is the estimate of fixed costs (tooling and overhead) and Rs 2 is the estimate of variable costs per radio (materials, labor, marketing, transportation, storage, etc.).

(A) Find the inverse demand function e.g. take P_x as the independent variable and bring it to left hand side LHS. Plot the inverse demand function on the x - P_x plane.

(B) We know the prices cannot be negative, e.g. $P > 0$. Find the domain of the function defined by the price–demand equation (1), e.g. the range of values of x for $P > 0$.

(C) Find the marginal cost function and interpret.

(D) We also know that the revenue is the amount of money, R , received by the company for manufacturing and selling x radios at Rs P_x per radio.

$$R \text{ (in Rs)} = x \text{ (in units)} * P_x \text{ (in Rs/unit)}$$

Find the revenue function as a function of x . (Hint: use inverse demand function)

(E) Find the marginal revenue at 3000, 5,000, and 7,000. Interpret these results. [Hint: MR is the first derivative of R function]

(F) If Marginal Revenue is the marginal benefits you have already studied, then what is the optimal manufacture of the new transistor radio?

4. Suppose $B(Q) = 10Q - 2Q^2$ and $C(Q) = 2 + Q^2$

What value of the managerial control variable, Q , maximizes net benefits?

5. Suppose the total benefit derived from a given decision, Q , is

$$B(Q) = 25Q - Q^2 \text{ and the corresponding total cost is } C(Q) = 5 + 2Q^2.$$

- What is total benefit when $Q = 2$? $Q = 10$?
- What is marginal benefit when $Q = 2$? $Q = 10$?
- What is marginal cost when $Q = 2$? $Q = 10$?
- What level of Q minimizes total cost?
- What level of Q maximizes net benefits?

5. Interest Rate is 10 per cent or $i = 0.1$. A financial asset promises to make pay-outs of Rs 20,000 per year for 5 years. Please schedule them. What is the maximum value you would be willing to pay for the asset if someone comes to sell it to you today?

6. Rs 200,000 is your yearly earnings from stock market investment, while you spend Rs 75,000 to buy stocks and bonds. Recently you received two job offers—one paying Rs 100,000 per year and travelling expenses Rs 10000, and the other paying Rs 80,000 and travelling expenses of Rs 5000.

- a. What is your accounting profit?
 - b. What is your economic profits?
 - c. Do you think you should take up the job offers? If so, which one?
7. You are in the market for a new refrigerator for your company's lounge, and you have narrowed the search down to two models. The energy efficient model sells for Rs 500 and will save you Rs 25 at the end of each of the next five years in electricity costs. The standard model has features similar to the energy efficient model but provides no future saving in electricity costs. It is priced at only Rs 400. Assuming your opportunity cost of funds is 5 percent, which refrigerator should you purchase?
8. A firm's current profits are Rs 550,000. These profits are expected to grow indefinitely at a constant annual rate of 5 percent. If the firm's opportunity cost of funds is 7 percent, determine the value of the firm:
- a. The instant before it pays out current profits as dividends.
 - b. The instant after it pays out current profits as dividends.
9. Suppose market dd curve is $Q_d = 10 - 2P$ and market ss curve is $Q_s = 2 + 2P$ for a market of wheat flour (P in Rs, Q in units).
- (A) What is the equilibrium price-output combination? Please plot a graph of the dd-ss curves showing the equilibrium.
 - (B) What is the quantity demanded and quantity supplied at a price level of Rs 1.50? Is there shortage or excess supply in the market? Please plot this on your graph.
 - (C) What is the quantity demanded and quantity supplied at a price level of Rs 2.25? Is there shortage or excess supply in the market? Please plot this on your graph.
 - (D) Calculate the supply elasticity w.r.t. own price at a price of Rs 1.50, Rs 2.00 and Rs 2.25. Can you reason why the supply elasticity is changing along the supply curve.
 - (E) Now, suppose, market supply has increased and supply curve S_0 has shifted to newer S_1 $Q_s = 4 + 2.5 P$. What is the new equilibrium price-quantity combination? Show this movement on the P-Q plane.