

ECO101A: Introduction to economics

Tutorial 3

1. The production function for a product is given by $q = 100KL$. If the price of capital is \$120 per day and the price of labor \$30 per day, what is the minimum cost of producing 1000 units of output?
2. Suppose a production function is given by $F(K, L) = KL^2$, the price of capital is \$10, and the price of labor \$15. What combination of labor and capital minimizes the cost of producing any given output?
3. Suppose the process of producing light-weight parkas by Polly's Parkas is described by the function:

$$q = 10K^{0.8}(L - 40)^{0.2}$$

where q is the number of parkas produced, K the number of computerized stitching machine hours, and L the number of person-hours of labor. In addition to capital and labor, \$10 worth of raw materials are used in the production of each parka.

- a. By minimizing cost subject to the production function, derive the cost-minimizing demands for K and L as a function of output (q), wage rates (w), and rental rates on machines (r). Use these results to derive the total cost function, that is costs as a function of q , r , w , and the constant \$10 per unit materials cost.
 - b. This process requires skilled workers, who earn \$32 per hour. The rental rate on the machines used in the process is \$64 per hour. At these factor prices, what are total costs as a function of q ? Does this technology exhibit decreasing, constant, or increasing returns to scale?
 - c. Polly's Parkas plans to produce 2000 parkas per week. At the factor prices given above, how many workers should the firm hire (at 40 hours per week) and how many machines should it rent (at 40 machines-hours per week)? What are the marginal and average costs at this level of production?
4. Suppose that a firm's production function is $q = 10L^{\frac{1}{2}}K^{\frac{1}{2}}$. The cost of a unit of labor is \$20 and the cost of a unit of capital is \$80.
 - a. The firm is currently producing 100 units of output, and has determined that the cost-minimizing quantities of labor and capital are 20 and 5 respectively. Graphically illustrate this situation on a graph using isoquants and isocost lines.
 - b. The firm now wants to increase output to 140 units. If capital is fixed in the short run, how much labor will the firm require? Illustrate this point on your graph and find the new cost.
 - c. Graphically identify the cost-minimizing level of capital and labor in the long run if the firm wants to produce 140 units.
 - d. If the marginal rate of technical substitution is K/L , find the optimal level of capital and labor required to produce the 140 units of output.
 5. A computer company's cost function, which relates its average cost of production AC to its cumulative output in thousands of computers Q and its plant size in terms of thousands of computers produced per year q , within the production range of 10,000 to 50,000 computers is given by

$$AC = 10 - 0.1Q + 0.3q.$$
 - a. Is there a learning curve effect?
 - b. Are there economies or diseconomies of scale?

- c. During its existence, the firm has produced a total of 40,000 computers and is producing 10,000 computers this year. Next year it plans to increase its production to 12,000 computers. Will its average cost of production increase or decrease? Explain.
6. Suppose the long-run total cost function for an industry is given by the cubic equation $TC = a + bQ + cQ^2 + dQ^3$. Show (using calculus) that this total cost function is consistent with a U-shaped average cost curve for at least some values of a, b, c, d .
7. Why would a firm that incurs losses choose to produce rather than shut down?
8. Explain why the industry supply curve is not the long-run industry marginal cost curve.
9. In long-run equilibrium, all firms in the industry earn zero economic profit. Why is this true?
10. Why do firms enter an industry when they know that in the long run economic profit will be zero?
11. Suppose a competitive industry faces an increase in demand (i.e., the demand curve shifts upward). What are the steps by which a competitive market insures increased output? Will your answer change if the government imposes a price ceiling?
12. Suppose you are the manager of a watchmaking firm operating in a competitive market. Your cost of production is given by $C = 200 + 2q^2$, where q is the level of output and C is total cost. (The marginal cost of production is $4q$. The fixed cost of production is \$200.)
- If the price of watches is \$100, how many watches should you produce to maximize profit?
 - What will the profit level be?
 - At what minimum price will the firm produce a positive output?
13. A firm produces a product in a competitive industry and has a total cost function $TC = 50 + 4q + 2q^2$ and a marginal cost function $MC = 4 + 4q$. At the given market price of \$20, the firm is producing 5 units of output. Is the firm maximizing profit? What quantity of output should the firm produce in the long run?
14. Suppose the cost function is $C(q) = 4q^2 + 16$.
- Find variable cost, fixed cost, average cost, average variable cost, and average fixed cost.
 - Show the average cost, marginal cost, and average variable cost curves on a graph.
 - Find the output that minimizes average cost.
 - At what range of prices will the firm produce a positive output?
 - At what range of prices will the firm earn a negative profit?
 - At what range of prices will the firm earn a positive profit?
15. Suppose you are given the following information about a particular industry:

$$Q^D = 6500 - 100P \quad \text{Market demand}$$

$$Q^S = 1200P \quad \text{Market supply}$$

$$C(q) = 722 + q^2/200 \quad \text{Firm total cost function}$$

Assume that all firms are identical, and that the market is characterized by pure competition.

- a. Find the equilibrium price, the equilibrium quantity, the output supplied by the firm, and the profit of the firm.
 - b. Would you expect to see entry into or exit from the industry in the long-run? Explain. What effect will entry or exit have on market equilibrium?
 - c. What is the lowest price at which each firm would sell its output in the long run? Is profit positive, negative, or zero at this price? Explain.
 - d. What is the lowest price at which each firm would sell its output in the short run? Is profit positive, negative, or zero at this price? Explain.
16. Suppose that a competitive firm has a total cost function $C(q) = 450 + 15q + 2q^2$ and a marginal cost function $MC(q) = 15 + 4q$. If the market price is $P = \$115$ per unit, find the level of output produced by the firm. Find the level of profit and the level of producer surplus.