BAYLOR UNIVERSITY
HANKAMER SCHOOL OF BUSINESS
DEPARTMENT OF ECONOMICS

ECO 5315 Chapter 5 and Chapter 6 Problem Set Solutions
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Solutions for assigned problems from Chapter 5, problems 2, 4, 6, 10, 12 on pp. 153-156 and Chapter 6, problems 2, 4, 6 on pp. 196-197.

Chapter 5 Problems

2. Haverford Company is considering three types of plants to make a particular electronic device. Plant A is much more highly automated than plant B, which in turn is more highly automated than plant C. For each type of plant, average variable cost is constant so long as output is less than capacity, which is the maximum output of the plant. The cost structure for each type of plant is as follows:

Average Variable Costs	**Plant A**	**Plant B**	**Plant C**
Labor	\$1.10	\$2.40	\$3.70
Materials	0.9	1.2	1.8
Other	0.5	2.4	2
Total	\$2.50	\$6.00	\$7.50
Total fi xed costs	\$300,000	\$75,000	\$25,000
Annual capacity	200,000	100,000	\$50,000

a. Derive the average costs of producing 100,000, 200,000, 300,000, and 400,000 devices per year with plant A. (For output exceeding the capacity of a single plant, assume that more than one plant of this type is built.)
b. Derive the average costs of producing 100,000, 200,000, 300,000, and 400,000 devices per year with plant B.
c. Derive the average costs of producing 100,000, 200,000, 300,000, and 400,000 devices per year with plant C.
d. Using the results of parts (a) through (c), plot the points on the long-run average cost curve for the production of these electronic devices for outputs of 100,000, 200,000, 300,000 and 400,000 devices per year.

<u>Solution:</u>

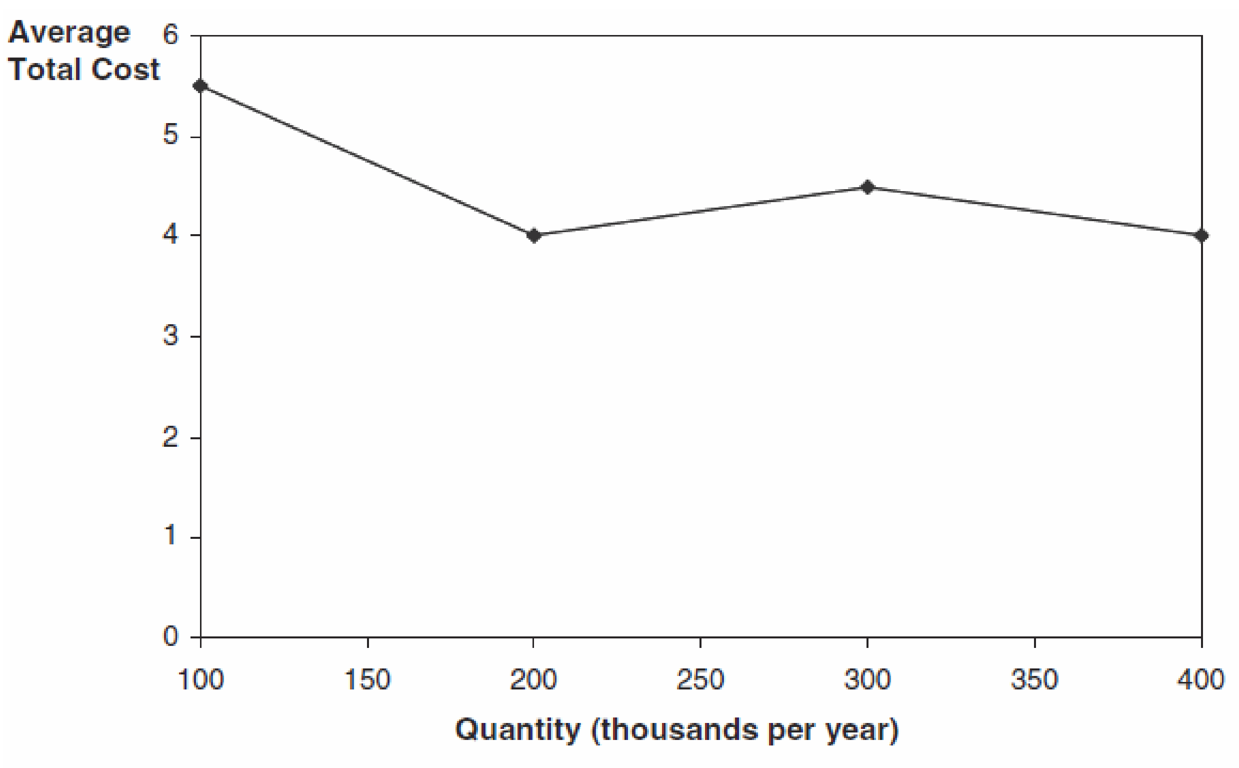
a. At Q = 100: $AC_A = AFC_A + AVC_A = \$300,000/100,000 + \$2.50 = \$5.50$
At Q = 200: $AC_A = AFC_A + AVC_A = \$300,000/200,000 + \$2.50 = \$4.00$
At Q = 300: $AC_A = AFC_A + AVC_A = \$600,000/300,000 + \$2.50 = \$4.50$

At Q = 400: $AC_A = AFC_A + AVC_A$ = \$600,000/400,000 + \$2.50 = \$4.00

b. At Q = 100: $AC_B = AFC_B + AVC_B$ = \$75,000/100,000 + \$6.00 = \$6.75
At Q = 200: $AC_B = AFC_B + AVC_B$ = \$150,000/200,000 + \$6.00 = \$6.75
At Q = 300: $AC_B = AFC_B + AVC_B$ = \$225,000/300,000 + \$6.00 = \$6.75
At Q = 400: $AC_B = AFC_B + AVC_B$ = \$300,000/400,000 + \$6.00 = \$6.75

c. At Q = 100: $AC_C = AFC_C + AVC_C$ = \$50,000/100,000 + \$7.50 = \$8.00
At Q = 200: $AC_C = AFC_C + AVC_C$ = \$100,000/200,000 + \$7.50 = \$8.00
At Q = 300: $AC_C = AFC_C + AVC_C$ = \$150,000/300,000 + \$7.50 = \$8.00
At Q = 400: $AC_C = AFC_C + AVC_C$ = \$200,000/400,000 + \$7.50 = \$8.00

d. See the diagram below:



4. According to a statistical study, the following relationship exists between an electric power plant's fuel costs (C) and its eight-hour output as a percentage of capacity (Q):

$$C = 16.68 + 0.125Q + 0.00439Q^2$$

a. When Q increases from 50 to 51, what is the increase in the cost of fuel for this electric plant?
b. Of what use might the result in part (a) be to the plant's managers?
c. Derive the marginal (fuel) cost curve for this plant, and indicate how it might be used by the plant's managers.

Solution:

a. TC(Q = 51) - TC(Q = 50) = \$34.47339 - \$33.905 = \$0.56839.

b. Marginal cost is useful for determining the profit-maximizing level of output. This information will be useful if the manager finds that it is possible to expand sales at the current price and this price exceeds \$0.57.

c. $MC = 0.125 + 0.00878Q \Rightarrow MC(Q = 50) = \$0.564$, $MC(Q = 51) = \$0.57278$. Notice that $DTC = TC(Q = 51) - TC(Q = 50)$ is the average of the marginal cost evaluated at $Q = 50$ and $Q = 51$. Marginal fuel cost might be used to choose among alternative techniques or among alternative output levels.

6. The Deering Manufacturing Company's short- run average cost function in 2008 was

$$AC = 3 + 4Q$$

where AC is the firm's average cost (in dollars per pound of the product), and Q is its output rate.

a. Obtain an equation for the firm's short-run total cost function.
b. Does the firm have any fixed costs? Explain.
c. If the price of the Deering Manufacturing Company's product (per pound) is \$3, is the firm making profit or loss? Explain.
d. Derive an equation for the firm's marginal cost function.

Solution:

a. $TC = AC \times Q = 3Q + 4Q^2$.
b. No, the firm's total costs are equal to zero when $Q = 0$.
c. At every $Q > 0$, $AC > 3$, so the firm cannot be making positive profits. The best it can do is produce nothing if $P = \$3$.
d. $MC = dTC/dQ = 3 + 8Q$.

10. The Berwyn Company is considering the addition of a new product to its product line. The firm has plenty of excess manufacturing capacity to produce the new product, and its total fixed costs would be unaffected if the new product were added to its line. Nonetheless, the firm's accountants decide that a reasonable share of the firm's present fixed costs should be allocated to the new product. Specifically, they decide that a \$300,000 fixed charge will be absorbed by the new product. The variable cost per unit of making and selling the new product is \$14, which is composed of the following:

Direct labor	\$18.20
Direct materials	11.9
Other	13.9
Total	\$14.00

a. Should the Berwyn Company add the new product to its line if it can sell about 10,000 units of this product at a price of $25?
b. Should it add the new product if it can sell about 10,000 units at a price of $20?
c. Should it add the new product if it can sell about 10,000 units at a price of $15?
d. What is the minimum price for the new product that will make it worthwhile for Berwyn to add the new product to its line?

Solution:

a. If the AVC = $14. $AFC(Q$ = 10,000) = $30. $ATC(Q$ = 10,000) = $44
If the accountants prevail, the product will not be introduced at a price of $25, because this will not cover the ATC at the level of sales achievable at this price. Nonetheless, the price of $25 exceeds the average variable cost of $14, so the product should be introduced.
b. As in part a, the price does not cover the average total cost but does cover the average variable cost, so the product should be introduced.
c. As in part a, the price does not cover the average total cost but does cover the average variable cost, so the product should be introduced.
d. $14.

12. The Smith Company made and sold 10,000 metal tables last year. When output was between 5,000 and 10,000 tables, its average variable cost was $24. In this output range, each table contributed 60 percent of its revenue to fixed costs and profit.

a. What was the price per table?
b. If the Smith Company increases its price by 10 percent, how many tables will it have to sell next year to obtain the same profit as last year?
c. If the Smith Company increases its price by 10 percent, and if its average variable cost increases by 8 percent as a result of wage increases, how many tables will it have to sell next year to obtain the same profit as last year?

Solution:

$$AVC = \$24 \text{ for } 5{,}000 < Q < 10{,}000$$

a. Variable costs = $0.4PQ$

$$AVC = 0.4P \rightarrow P = \$60$$

b. Fixed costs + profits = 0.6[$60(10,000)] = $360,000

At P = $66, $P - AVC$ = $42. $360,000/$42 = 8,571.43

c. AVC = 1.08($24) = $25.92

At P = $66, $P - AVC$ = $40.08. $360,000/$40.08 = 8,982.036

Chapter 6 Problems

2. In 2008, the box industry was perfectly competitive. The lowest point on the long-run average cost curve of each of the identical box producers was $4, and this minimum point occurred at an output of 1,000 boxes per month. The market demand curve for boxes was

$$Q_D = 140{,}000 - 10{,}000P$$

where P was the price of a box (in dollars per box) and Q_D was the quantity of boxes demanded per month. The market supply curve for boxes was

$$Q_S = 80{,}000 + 5{,}000P$$

where Q_S was the quantity of boxes supplied per month.

a. What was the equilibrium price of a box? Is this the long-run equilibrium price?
b. How many firms are in this industry when it is in long-run equilibrium?

SOLUTION:

a. The long-run equilibrium price must be $4 since this is the minimum long-run average total cost of all the firms. Also, we can note that the intersection of the demand and supply curves given occurs at a quantity of 100,000 and a price of $4. Thus the short-run equilibrium price is equal to the long-run equilibrium price.
b. Since each firm's average cost is minimized at $Q = 1{,}000$, and the total industry supplies 100,000 units, there must be 100 firms.

4. The supply and demand curves for pears are

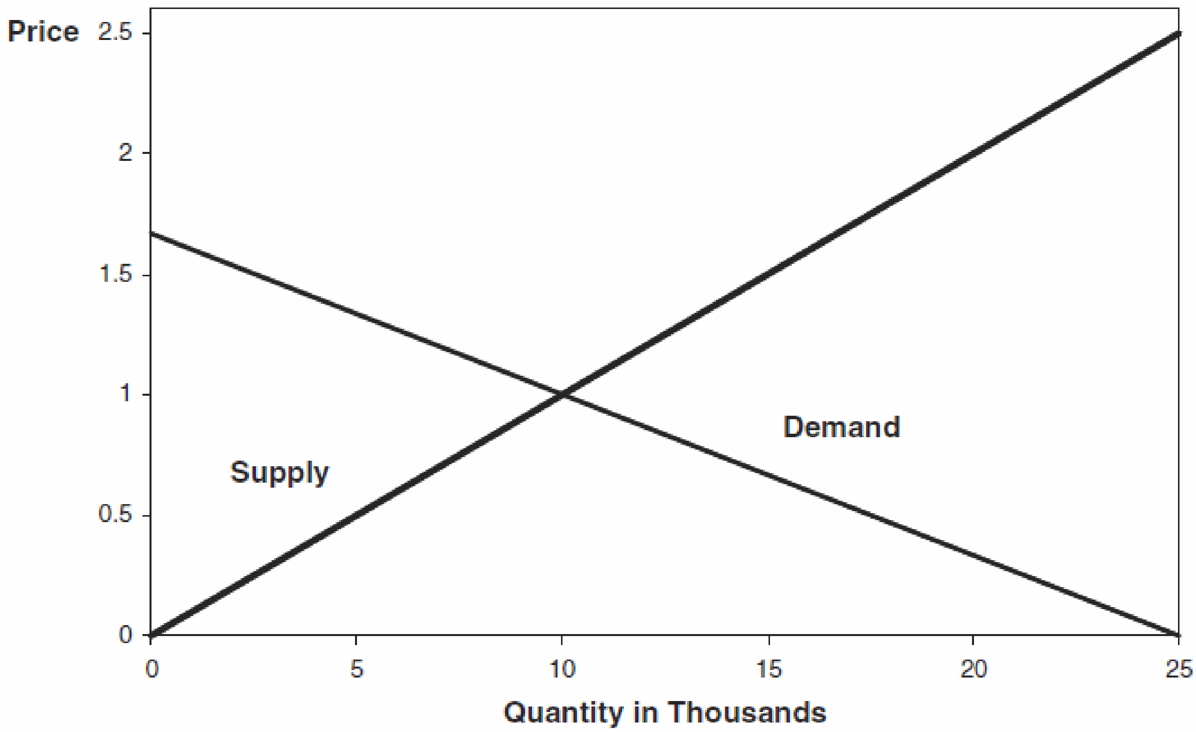
$$Q_S = 10{,}000P$$
$$Q_D = 25{,}000 - 15{,}000P$$

where Q_S is the quantity (tons) supplied, Q_D is the quantity (tons) demanded, and P is the price per pear (in hundreds of dollars per ton).

a. Plot the supply and demand curves.
b. What is the equilibrium price?
c. What is the equilibrium quantity?

SOLUTION:

a.



b. Setting $Q_S = Q_D$, we get $25{,}000 - 15{,}000P = 10{,}000 \rightarrow P = 1$.

c. $Q = 10{,}000$.

6. The long-run supply curve for a particular type of kitchen knife is a horizontal line at a price of \$3 per knife. The demand curve for such a kitchen knife is

$$Q_D = 50 - 2P$$

where Q_D is the quantity of knives demanded (in millions per year) and P is the price per knife (in dollars).

a. What is the equilibrium output of such knives?

b. If a tax of \$1 is imposed on each knife, what is the equilibrium output of such knives? (Assume the tax is collected by the government from the suppliers of knives.)

c. After the tax is imposed, you buy such a knife for \$3.75. Is this the long-run equilibrium price?

SOLUTION:

a. The demand curve can be rewritten as $P_D = 25 - 0.5Q_D$, and the supply curve is given as $P_S = 3$. Setting $P_D = P_S$ and solving for Q_D, we get $Q = 44$.
b. The price will now have to cover the \$1 tax. Setting $P_D = P_S + 1$ and solving for Q_D, we get $Q = 42$.
c. No, the long-run equilibrium price must be \$4. If the price initially is \$3.75, the existing firms are only receiving \$2.75 per knife after they pay the \$1 tax and so must be losing money. Exit from the industry will occur until the net price received by the firms increases back to \$3.