

### EE211 Section 1 Homework 3 Answers

1. Draw a production function that exhibits diminishing marginal product of labor. Draw the associated total cost curve (in both cases, be sure to label the axes.) Explain the shapes of the two curves you have drawn. (Answers from eBook Chapter 14)
2. Define total cost, average total cost, and marginal cost. How are they related? (Answers from eBook Chapter 14)
3. How and why does a firm's average-total-cost curve in the short run differ from its average-total-cost curve in the long run? (Answers from eBook Chapter 14)
4. Define economies of scale and explain why they might arise? (Answers from eBook Chapter 14)
5. Define diseconomies of scale and explain why they might arise? (Answers from eBook Chapter 14)
6. Nimbus, Inc. makes brooms and sells them door-to-door. Here is the relationship between the number of workers and Nimbus's output during a given day.

Workers	Output	Marginal Product	Total Cost	Average Total Cost	Marginal Cost
0	0	---	\$200	---	---
1	20	20	300	\$15.00	\$5.00
2	50	30	400	8.00	3.33
3	90	40	500	5.56	2.50
4	120	30	600	5.00	3.33
5	140	20	700	5.00	5.00
6	150	10	800	5.33	10.00
7	155	5	900	5.81	20.00

- a. Fill in the column of marginal products. What pattern do you see? How might you explain it? **Marginal product rises at first, then declines because of diminishing marginal product.**
- b. A worker costs \$100 a day, and the firm has fixed costs of \$200. Use this information to fill in the column for total cost.
- c. Fill in the column for average total cost. What pattern do you see? **Average total cost is U-shaped. When quantity is low, average total cost declines as quantity rises; when quantity is high, average total cost rises as quantity rises.**
- d. Now fill in the column for marginal cost. What pattern do you see? **Marginal cost is also U-shaped, but rises steeply as output increases. This is due to diminishing marginal product.**
- e. Compare the column for marginal product with the column for marginal cost. Explain the relationship. **When marginal product is rising, marginal cost is falling, and vice versa.**
- f. Compare the column for average total cost with the column for marginal cost. Explain the relationship. **When marginal cost is less than average total cost,**

average total cost is falling; the cost of the last unit produced pulls the average down. When marginal cost is greater than average total cost, average total cost is rising; the cost of the last unit produced pushes the average up.

7. Consider the following cost information for a pizzeria:

Quantity	Total Cost	Variable Cost
0 dozen pizzas	\$300	\$0
1	350	50
2	390	90
3	420	120
4	450	150
5	490	190
6	540	240

- What is the pizzeria's fixed cost?  
The fixed cost is \$300, because fixed cost equals total cost minus variable cost. At an output of zero, the only costs are fixed cost.
- Construct a table in which you calculate the marginal cost per dozen pizzas using the information on total cost. Also calculate the marginal cost per dozen pizzas using the information on variable cost. What is the relationship between these sets of numbers? Explain.

Quantity	Total Cost	Variable Cost	Marginal Cost (using total cost)	Marginal Cost (using variable cost)
0	\$300	\$0	---	---
1	350	50	\$50	\$50
2	390	90	40	40
3	420	120	30	30
4	450	150	30	30
5	490	190	40	40
6	540	240	50	50

Marginal cost equals the change in total cost for each additional unit of output. It is also equal to the change in variable cost for each additional unit of output. This relationship occurs because total cost equals the sum of variable cost and fixed cost and fixed cost does not change as the quantity changes. Thus, as quantity increases, the increase in total cost equals the increase in variable cost.

8. Consider the following table of long-run total costs for three different firms:

Quantity	1	2	3	4	5	6	7
<b>Firm A</b>	\$60	\$70	\$80	\$90	\$100	\$110	\$120
<b>Firm B</b>	11	24	39	56	75	96	119
<b>Firm C</b>	21	34	49	66	85	106	129

Does each of these firms experience economies of scale or diseconomies of scale? Explain.

The following table shows quantity (Q), total cost (TC), and average total cost (ATC) for the three firms:

Quantity	Firm A		Firm B		Firm C	
	<i>TC</i>	<i>ATC</i>	<i>TC</i>	<i>ATC</i>	<i>TC</i>	<i>ATC</i>
1	\$60.00	\$60.00	\$11.00	\$11.00	\$21.00	\$21.00
2	70.00	35.00	24.00	12.00	34.00	17.00
3	80.00	26.67	39.00	13.00	49.00	16.33
4	90.00	22.50	56.00	14.00	66.00	16.50
5	100.00	20.00	75.00	15.00	85.00	17.00
6	110.00	18.33	96.00	16.00	106.00	17.67
7	120.00	17.14	119.00	17.00	129.00	18.43

Firm A has economies of scale because average total cost declines as output increases. Firm B has diseconomies of scale because average total cost rises as output rises. Firm C has economies of scale from one to three units of output and diseconomies of scale for levels of output beyond three units.