Mirror Images: Marginal Product and Marginal Cost

Most of the activities in this unit concern costs. You will be concerned with *fixed costs, variable costs, total costs, average costs* and, most importantly, *marginal costs.* These economic costs are the *costs of production.* In the final analysis, these costs are opportunity costs and involve forgoing the opportunity to produce alternative goods and services. These costs depend on how efficient the production process is. The efficiency of the production process is affected by the *law of diminishing marginal returns.* This activity shows how the law of diminishing marginal returns affects production and how changes in productive efficiency affect costs.

Part A

The Law of Diminishing Marginal Returns

Use the data from Figure 25.1 to plot total product at various quantities of labor on Figure 25.2. Then use the data from Figure 25.1 to plot marginal product and average product at various quantities of labor on Figure 25.3 (plot the marginal between the points). The first two points are plotted for you. Now answer questions 1 through 9.

Figure 25.1
The Law of Diminishing Marginal Returns

(1) Inputs of the Variable Resource (labor)	(2) Total Product	(3) Marginal Product Δ2 / Δ1	(4) Average Product (2) / (1)
0	0		
1	10	10	10
2	25	15	$12^{1}/_{2}$
3	37	12	$12^{1}/_{3}$
4	47	10	$11^{3}/_{4}$
5	55	8	11
6	60	5	10
7	63	3	9
8	63	0	$7^{7}/_{8}$
9	62	−1	$6^{8}/_{9}$

Source: Campbell McConnell and Stanley Brue, *Economics,* 13th ed., 1996.

Activity written by John Morton, National Council on Economic Education, New York, N.Y.

Mirror Images: Marginal Product and Marginal Cost

Part A
The Law of Diminishing Marginal Returns

Figure 25.2
The Law of Diminishing Marginal Returns

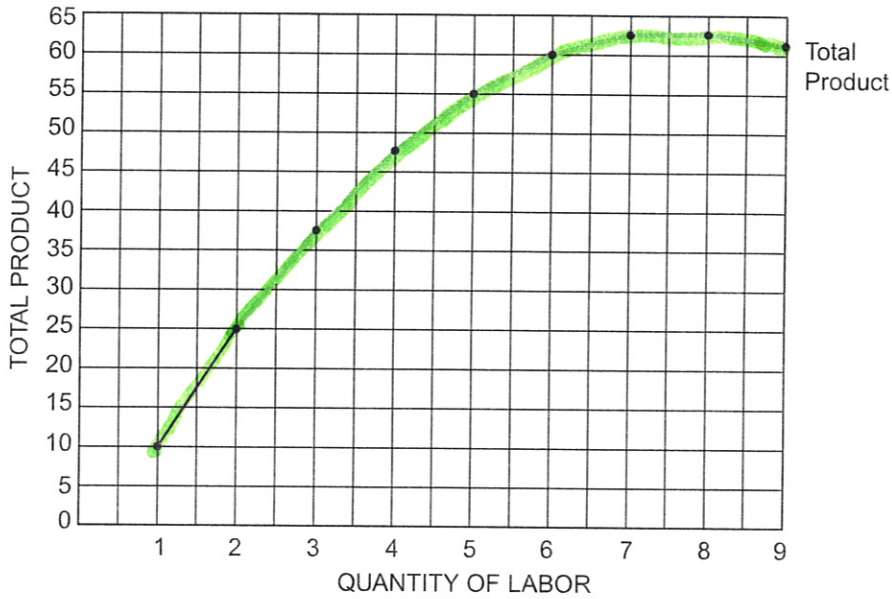
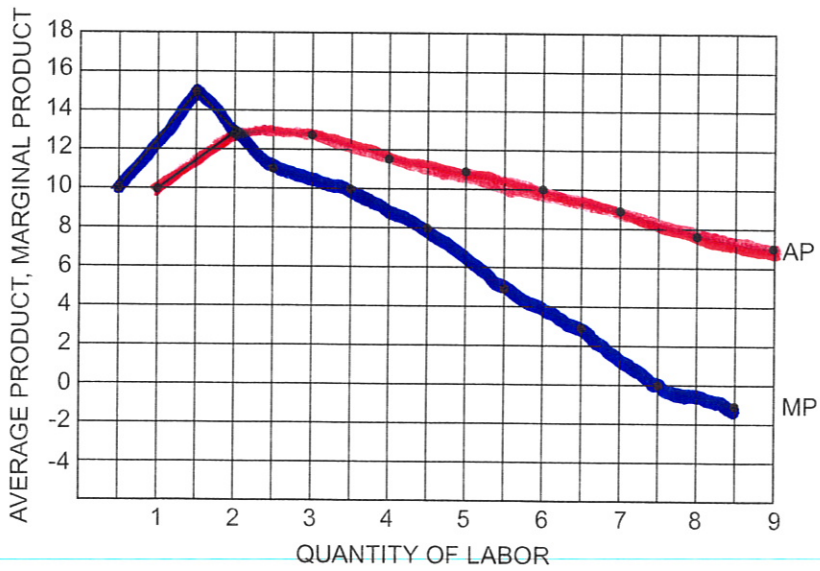


Figure 25.3
Marginal and Average Product



1. What happens to the total product curve as output (production) increases?

2. What happens to the marginal product curve as output increases?

3. What happens to the average product curve as output increases?

4. Where does the marginal product curve cross the average product curve?

5. Why do these curves look the way they do?

6. What is the law of diminishing marginal returns?

7. Why is this concept important?

8. What is the relationship between marginal product and total product?

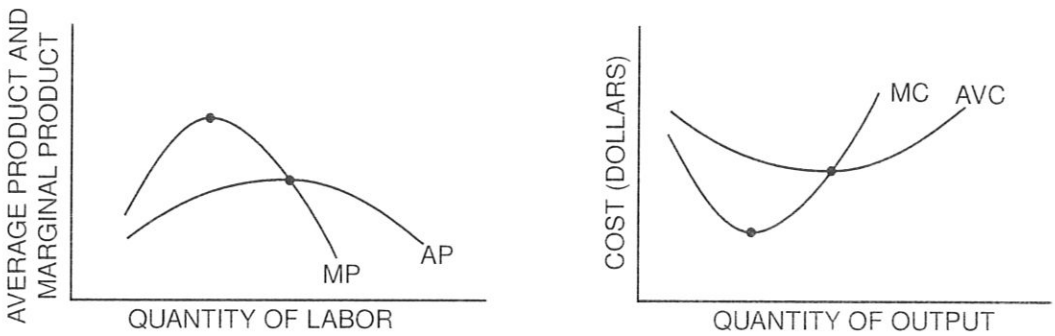
9. What is the relationship between marginal product and average product?

Part B

Products and Costs: A Mirror View

Now look at Figure 25.4, which relates marginal and average product to marginal and average variable costs. Then answer the questions that follow the graph. (*Variable costs* are costs that change with the level of output. *Average variable costs* are total variable costs divided by output.)

Figure 25.4
Marginal Product and Marginal Cost



10. Where does marginal product cross average product?

11. Where does marginal cost cross average variable cost?

12. Will this always be true? Why or why not?

13. How does the law of diminishing marginal returns affect output (product) and costs?

Costs of the Individual Firm

Part A

Fill in the blanks and answer the questions.

1. M.I. Fortunate was employed as plant manager for a corporation at a salary of $50,000 a year, and she had savings of $100,000 invested in securities that yielded an 8 percent annual income. She went into business for herself, investing all her savings in the enterprise. At the end of the first year, her accounts showed a net income of $55,000 after all expenses of operation. One accountant said this accounting profit represented a 55 percent return on her $100,000 investment. Another accountant, who had taken introductory microeconomics, said, "No, you should pay yourself the $50,000 salary you would have earned anyway, and your accounting profit of $5,000 represents a return of 5 percent on your investment of $100,000." A serious student of introductory microeconomics, however, should say, "No, your true economic profit from going into business for yourself is _____, and this is a return of _____ percent." Was M.I. Fortunate fortunate? Why or why not?

2. Figure 26.1 (on the next page) shows a comprehensive set of cost data for a firm with a given plant at various levels of output. Study this table to understand how it is set up.

   Marginal cost is the *additional* cost of producing an *additional* unit of output ($\Delta TC / \Delta Q$). If producing an additional 100 units of output adds $700 to total cost, the marginal cost per unit is $700 / 100 = $7.00, etc. Note that in the table, the "marginal" changes are located between output levels.

   After you have filled in the blanks in Figure 26.1, finish plotting the aggregate cost data for fixed cost, variable cost and total cost (*not* change in total cost) on Figure 26.2. Also, finish plotting the unit cost data for FC / Q, VC / Q, TC / Q and $\Delta TC / \Delta Q$ on Figure 26.3. Note that marginal cost ($\Delta TC / \Delta Q$) is plotted at the midpoint (between output levels).

3. After you have finished plotting, answer the eight questions in Part B.

Figure 26.1
Aggregate and Unit Cost Structure

	Aggregate Cost Data				Unit Cost Data		
Output	Total Fixed Cost	Total Variable Cost	Total Cost	Marginal Cost (ΔTC / ΔQ)	Average Fixed Cost	Average Variable Cost	Average Total Cost
0	$500	$0	$500				
100	500	700	1,200	$7.00	$5.00	$7.00	$12.00
200	500	1,300	*1,800*	6.00	2.50	6.50	9.00
300	*500*	*1,800*	2,300	5.00	1.67	6.00	*7.67*
400	*500*	2,400	*2,900*	6.00	1.25	6.00	7.25
500	500	3,100	3,600	7.00	1.00	6.20	*7.20*
600	500	*3,820*	4,320	7.20	0.83	6.37	7.20
700	500	4,700	5,200	8.80	0.71	6.71	7.42

Figure 26.2
Graph of Aggregate Cost Data

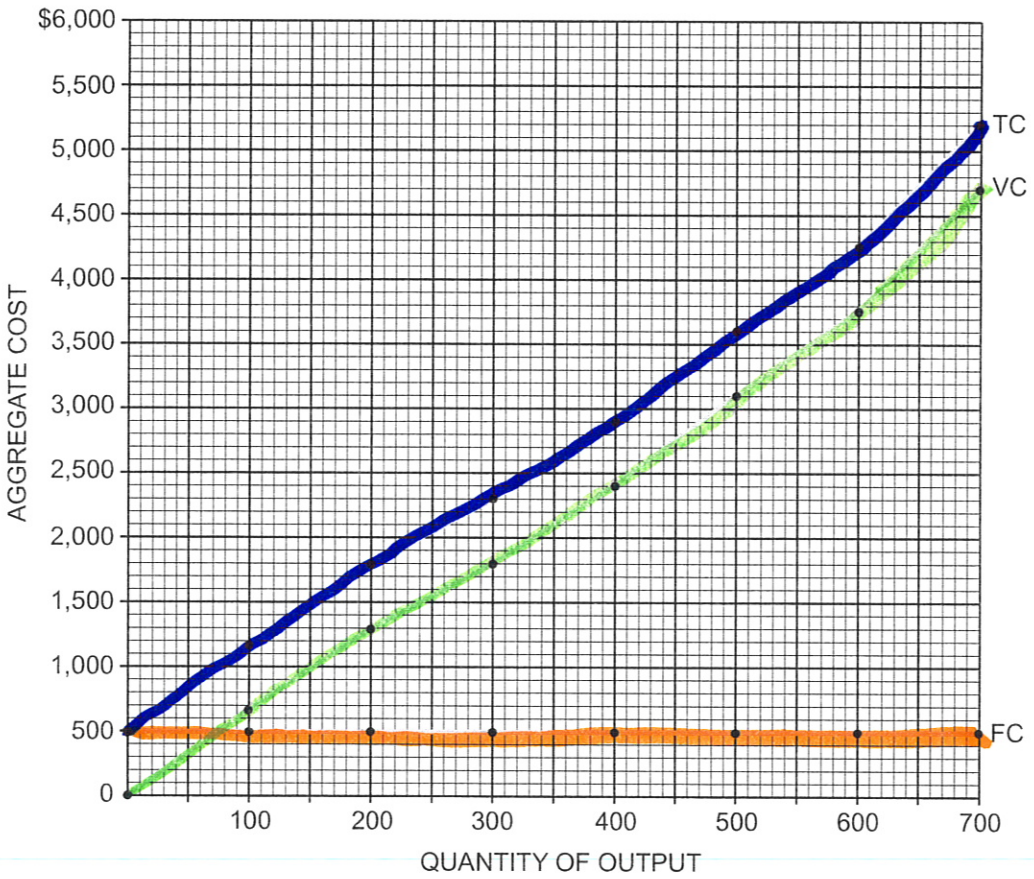
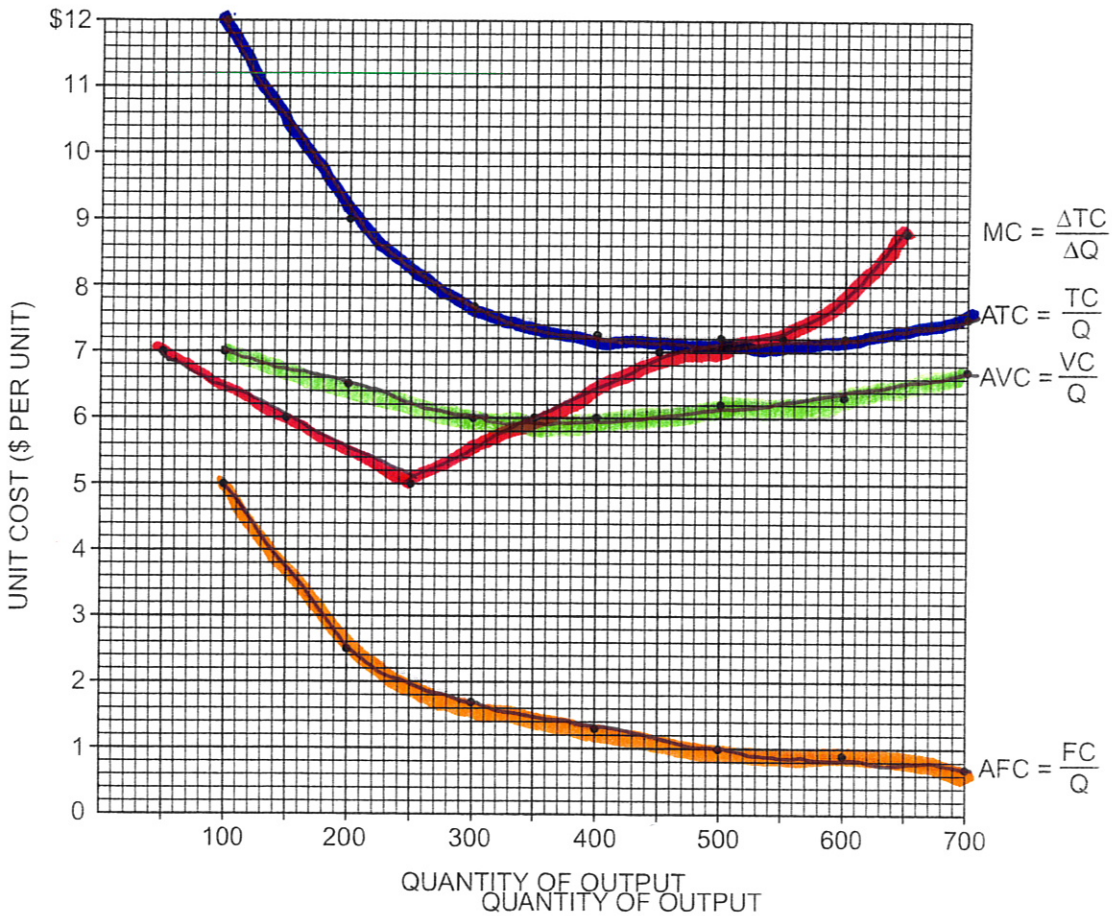


Figure 26.3

Graph of Unit Cost Data

Note: Marginal cost (ΔTC / ΔQ) is plotted between the output levels shown in Figure 26.1.



Part B

4. How is marginal cost (ΔTC / ΔQ) represented in Figure 26.2?

5. On Figure 26.3, total cost per unit (TC / Q or average total cost) is at a minimum at an output level of _____ units.

6. On Figure 26.3, variable cost per unit (VC / Q or average variable cost) is at a minimum at an output level of _____ units.

7. On Figure 26.3, what is the relation between marginal cost (ΔTC / ΔQ) and average total cost (TC / Q) when average total cost is at its minimum?

8. On Figure 26.3, what is the relation between marginal cost ($\Delta TC / \Delta Q$) and average variable cost (VC / Q) when average variable cost is at its minimum?

9. Explain why marginal cost on a unit-cost graph always intersects average total cost and average variable cost at their minimum points.

10. On Figure 26.3, what does the vertical distance between the TC / Q curve and VC / Q curve represent?

11. Explain why fixed cost has no influence on marginal cost.