REVIEW TERMS AND CONCEPTS

average product, 138
capital-intensive technology, 136
firm, 130
homogeneous products, 131
labor-intensive technology, 136
law of diminishing returns, 138
long run, 135
marginal product, 138
normal rate of return, 133
optimal method of production, 136
perfect competition, 130
production, 129
production function or total product function, 136
production technology, 136
profit (economic profit), 132
short run, 135
total cost (total economic cost), 132
total revenue, 132

1. Profit = total revenue − total cost
2. $\text{Average product of labor} = \frac{\text{total product}}{\text{total units of labor}}$

PROBLEM SET

1. Consider a firm that uses capital and labor as inputs and sells 5,000 units of output per year at the going market price of $10. Also assume that total labor costs to the firm are $45,000 annually. Assume further that the total capital stock of the firm is currently worth $100,000, that the return available to investors with comparable risks is 10% annually, and that there was no depreciation. Is this a profitable firm? Explain your answer.
2. Two former Berkeley students worked in an investment bank at a salary of $60,000 each for 2 years after they graduated. Together they saved $50,000. After 2 years, they decided to quit their jobs and start a business designing Web sites. They used the $50,000 to buy computer equipment, desks, and chairs. For the next 2 years they took in $40,000 in revenue each year, paid themselves $10,000 annually each, and rented an office for $18,000 per year. Prior to the investment, their $50,000 was in bonds earning interest at a rate of 10 percent. Are they now earning economic profits? Explain your answer.
3. Suppose that in 2001 you became president of a small nonprofit theater company. Your playhouse has 120 seats and a small stage. The actors have national reputations, and demand for tickets is enormous relative to the number of seats available; every performance is sold out months in advance. You are elected because you have demonstrated an ability to raise funds successfully. Describe some of the decisions that you must make in the short run. What might you consider to be your "fixed factor"? What alternative decisions might you be able to make in the long run? Explain.
4. The following table gives total output or total product as a function of labor units used:

LABOR	TOTAL OUTPUT
0	0
1	5
2	9
3	12
4	14
5	15

   a. Define diminishing returns.
   b. Does the table indicate a situation of diminishing returns? Explain your answer.
5. Suppose that wimps can be produced using two different production techniques, *A* and *B*. The following table provides the total input requirements for each of five different total output levels:

	Q = 1		Q = 2		Q = 3		Q = 4		Q = 5	
TECH.	K	L	K	L	K	L	K	L	K	L
A	2	5	3	10	5	14	6	18	8	20
B	5	2	8	3	11	4	14	5	16	6

   a. Assuming that the price of labor (P_L) is $1 and the price of capital (P_K) is $2, calculate the total cost of production for each of the five levels of output using the optimal (least-cost) technology at each level.
   b. How many labor hours (units of labor) would be employed at each level of output? How many machine hours (units of capital)?
   c. Graph total cost of production as a function of output. (Put cost on the *Y*-axis and output, *q*, on the *X*-axis.) Again, assume that the optimal technology is used.
   d. Repeat a. through c. under the assumption that the price of labor (P_L) rises from $1 to $3 while the price of capital (P_K) remains at $2.
6. A female student who lives on the fourth floor of Bates Hall is assigned to a new room on the seventh floor during her junior year. She has 11 heavy boxes of books and "stuff" to move. Discuss the alternative combinations of capital and labor that might be used to make the move. How would your answer differ if the move were to a new dorm 3 miles across campus, and to a new college 400 miles away?

PROBLEM SET

1. Consider the following costs of owning and operating a car. A $15,000 Ford Taurus financed over 5 years at 10 percent interest means a monthly payment of $318.71. Insurance costs $100 a month regardless of how much you drive. The car gets 20 miles per gallon and uses unleaded regular that costs $1.50 per gallon. Finally suppose that wear and tear on the car costs about 15 cents a mile. Which costs are fixed and which are variable? What is the marginal cost of a mile driven? In deciding whether to drive from New York to Pittsburgh (about 1,000 miles round-trip) to visit a friend, which costs would you consider? Why?

2. July 18, 2005 LONDON (Reuters)—The sixth volume of the Harry Potter saga sold more than 8.9 million copies in the first 24 hours it went on sale in the United States and Britain to become the fastest-selling book in history, publishers said. In book publishing fixed costs are very high and marginal costs are very low and fairly constant. Suppose that the fixed cost of producing the new Harry Potter volume is $30 million. What is the *average fixed cost* if the publisher produces 5 million copies? 10 million copies? 20 million copies?

   Now suppose that the marginal cost of a Harry Potter book is $1.50 per book and is the same for each book up to 40 million copies. Assume this includes all variable costs. Explain why in this case marginal cost is a horizontal line, as is average variable cost. What is the *average total cost* of the book if the publisher produces 5 million copies? 10 million copies? 20 million copies?

   Sketch the average fixed cost curve and the average total cost curve facing the publisher.

3. Do you agree or disagree with this statement? Firms minimize costs; thus, a firm earning short-run economic profits will choose to produce at the minimum point on its average total cost function.

4. The following table gives capital and labor requirements for 10 different levels of production:

q	K	L
0	0	0
1	2	5
2	4	9
3	6	12
4	8	15
5	10	19
6	12	24
7	14	30
8	16	37
9	18	45
10	20	54

   a. Assuming that the price of labor (P_L) is $5 per unit and the price of capital (P_K) is $10 per unit, compute and graph the total variable cost curve, the marginal cost curve, and the average variable cost curve for the firm.
   b. Do the curves have the shapes that you might expect? Explain.
   c. Using the numbers here, explain the relationship between marginal cost and average variable cost.
   d. Using the numbers here, explain the meaning of "marginal cost" in terms of additional inputs needed to produce a marginal unit of output.
   e. If the output price was $57, how many units of output would the firm produce? Explain.

5. Do you agree or disagree with each of the following statements? Explain your reasons.
   a. For a competitive firm facing a market price above average total cost, the existence of economic profits means the firm should increase output in the short run even if price is below marginal cost.
   b. If marginal cost is rising with increasing output, average cost must also be rising.
   c. Fixed cost is constant at every level of output except zero. When a firm produces no output, fixed costs are zero in the short run.

6. A firm's cost curves are given by the following table:

Q	TC	TFC	TVC	AVC	ATC	MC
0	$100	$100	—	—	—	—
1	130	100	—	—	—	—
2	150	100	—	—	—	—
3	160	100	—	—	—	—
4	172	100	—	—	—	—
5	185	100	—	—	—	—
6	210	100	—	—	—	—
7	240	100	—	—	—	—
8	280	100	—	—	—	—
9	330	100	—	—	—	—
10	390	100	—	—	—	—

   a. Complete the table.
   b. Graph *AVC*, *ATC*, and *MC* on the same graph. What is the relationship between the *MC* curve and the *ATC*, and between *MC* and *AVC*?
   c. Suppose that market price is $30. How much will the firm produce in the short run? How much are total profits?
   d. Suppose that market price is $50. How much will the firm produce in the short run? What are total profits?
   e. Suppose that market price is $10. How much would the firm produce in the short run? What are total profits?

7. A 2006 Georgia Tech graduate inherited her mother's printing company. The capital stock of the firm consists of three machines of various vintages, all in excellent condition. All machines can be running at the same time:

	COST OF PRINTING AND BINDING PER BOOK	MAXIMUM TOTAL CAPACITY (BOOKS) PER MONTH
Machine 1	$1.00	100
Machine 2	2.00	200
Machine 3	3.00	500

   a. Assume that "cost of printing and binding per book" includes *all* labor and materials, including the owner's own wages. Assume further that Mom signed a long-term contract (50 years) with a service company to keep the machines in good repair for a fixed fee of $100 per month.
      (1) Derive the firm's marginal cost curve.
      (2) Derive the firm's total cost curve.
   b. At a price of $2.50, how many books would the company produce? What would total revenues, total costs, and total profits be?

and total cost is $50,050. Mega Farm produces 100,000 chickens per month at a total cost of $91,000. These data suggest that there are significant economies of scale in chicken production. Do you agree or disagree with this statement? Explain your answer.

8. Indicate whether you agree or disagree with each of the following statements. Briefly explain your answers.
   a. Firms that exhibit constant returns to scale have U-shaped long-run average cost curves.
   b. The supply curve of a competitive firm in the short run is its marginal cost curve above average total cost.
   c. A firm suffering losses in the short run will continue to operate as long as total revenue will at least cover fixed cost.

9. You are given the following cost data:

q	*TFC*	*TVC*
0	12	0
1	12	5
2	12	9
3	12	14
4	12	20
5	12	28
6	12	38

If the price of output is $7, how many units of output will this firm produce? What is the total revenue? What is the total cost? Will the firm operate or shut down in the short run, and in the long run? Briefly explain your answers.

10. In the box on page 198, data were presented showing a substantial decline in the number of banks in the United States between 1985 and 2004. Go to the Web site of the Federal Deposit Insurance Corporation (www.fdic.gov) and click on "Industry Analysis." Explore the data presented there to determine if the trend toward mergers and larger banks has continued since 2004. If you have a bank account, is it at a large national bank with many branches or is it at a small bank? As a customer of a bank, what advantages or disadvantages do you find associated with its size? Do you think that economies of scale exist in banking?

11. The following problem traces the relationship between firm decisions, market supply, and market equilibrium in a perfectly competitive market.
   a. Complete the following table for a single firm in the short run:

OUTPUT	*TFC*	*TVC*	*TC*	*AVC*	*ATC*	*MC*
0	$300	$ 0	—	—	—	—
1	—	100	—	—	—	—
2	—	150	—	—	—	—
3	—	210	—	—	—	—
4	—	290	—	—	—	—
5	—	400	—	—	—	—
6	—	540	—	—	—	—
7	—	720	—	—	—	—
8	—	950	—	—	—	—
9	—	1,240	—	—	—	—
10	—	1,600	—	—	—	—

   b. Using the information in the table, fill in the following supply schedule for this individual firm under perfect competition, and indicate profit (positive or negative) at each output level. (*Hint:* At each hypothetical price, what is the *MR* of producing one more unit of output? Combine this with the *MC* of another unit to figure out the quantity supplied.)

PRICE	QUANTITY SUPPLIED	PROFIT
$50	—	—
70	—	—
100	—	—
130	—	—
170	—	—
220	—	—
280	—	—
350	—	—

   c. Now suppose there are 100 firms in this industry, all with identical cost schedules. Fill in the market quantity supplied at each price in this market:

PRICE	MARKET QUANTITY SUPPLIED	MARKET QUANTITY DEMANDED
$50	—	1,000
70	—	900
100	—	800
130	—	700
170	—	600
220	—	500
280	—	400
350	—	300

   d. Fill in the blanks: From the market supply and demand schedules in c., the equilibrium market price for this good is ____ and the equilibrium market quantity is ____. Each firm will produce a quantity of ____ and earn a ____ (profit/loss) equal to ____.
   e. In d., your answers characterize the short-run equilibrium in this market. Do they characterize the long-run equilibrium as well? If yes, explain why. If no, explain why not (that is, what would happen in the long run to change the equilibrium, and why?).

*12. Assume that you are hired as an analyst at a major New York consulting firm. Your first assignment is to do an industry analysis of the tribble industry. After extensive research and two all-nighters, you have obtained the following information.
   - *Long-run costs:*
     Capital costs: $5 per unit of output
     Labor costs: $2 per unit of output
   - No economies or diseconomies of scale
   - Industry currently earning a normal return to capital (profit of zero)
   - Industry perfectly competitive, with each of 100 firms producing the same amount of output
   - *Total industry output:* 1.2 million tribbles

   Demand for tribbles is expected to grow rapidly over the next few years to a level twice as high as it is now, but (due to short-run diminishing returns) each of the 100 existing firms is likely to be producing only 50 percent more.
   a. Sketch the long-run cost curve of a representative firm.
   b. Show the current conditions by drawing two diagrams, one showing the industry and one showing a representative firm.
   c. Sketch the increase in demand and show how the industry is likely to respond in the short run and in the long run.

*Note: Problems marked with an asterisk are more challenging.

LABOR	Q	TVC	TFC	AVC	AFC	ATC	MC
0	0	0	100				
1	10	50	100				
2	22	100	100				
3	36	150	100				
4	52	200	100				
5	70	250	100				
6	86	300	100				
7	100	350	100				
8	112	400	100				
9	122	450	100				
10	130	500	100				
11	137	550	100				
12	143	600	100				
13	148	650	100				
14	152	700	100				
15	155	750	100				
16	157	800	100				
17	158	850	100				
18	158	900	100				
19	157	950	100				

Q	TFC	TVC	TC	AFC	AVC	ATC	MC
0	$ 10.00		$ 10.00				
1			$ 15.00				
2						$ 9.00	
3					$ 3.33		
4			$ 21.00				
5							$ 2.00
6		$ 16.00					
7							$ 4.00
8					$ 3.13		
9			$ 41.00				
10							$ 7.00
11			$ 56.00				

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