

## CHAPTER 8

# PRODUCTION DECISIONS

*Microeconomics in Context* (Goodwin, et al.), 1<sup>st</sup> Edition (Study Guide 2008)

### Chapter Summary

In this chapter continues the discussion of production with a focus on decision-making. Much of the chapter focuses in on the question of how profit-maximizing firms would choose their level of production, under conditions in which “marginal thinking” applies.

But this chapter also looks at some of the factors that are overlooked in many discussions of this model, including the role played by externalities. Due to externalities, private net benefits from production and social net benefits may not be equivalent. Nor is “marginal thinking” appropriate for all cases. By the time you have finished this chapter, you will understand concepts including nonconvexity, multiple equilibria, path dependence, and network externalities. These concepts are often omitted from introductory textbooks, but are relevant to many real-world situations.

### Objectives

After reading and reviewing this chapter, you should be able to:

1. Discuss the role of externalities in decision-making.
2. Understand marginal thinking and how and when it can be used to determine the optimal level of production.
3. Understand discrete thinking, and how and when it is required in decision-making.
4. Discuss why sunk costs are irrelevant for determining the level of production (assuming some production takes place).
5. Define and discuss path dependence.
6. Describe how network externalities can determine production decisions.
7. Understand the importance of financial capital for production decisions.

### Key Terms

internal benefits  
net benefits  
revenue  
marginal benefit  
marginal revenue  
discrete decisions  
static analysis  
sunk cost  
switching costs  
perfect capital market

external benefits  
cost/benefit analysis  
economic profit  
marginal thinking  
convexity  
nonconvexity  
dynamic analysis  
path dependence  
network externality  
capital constraint

## Active Review Questions

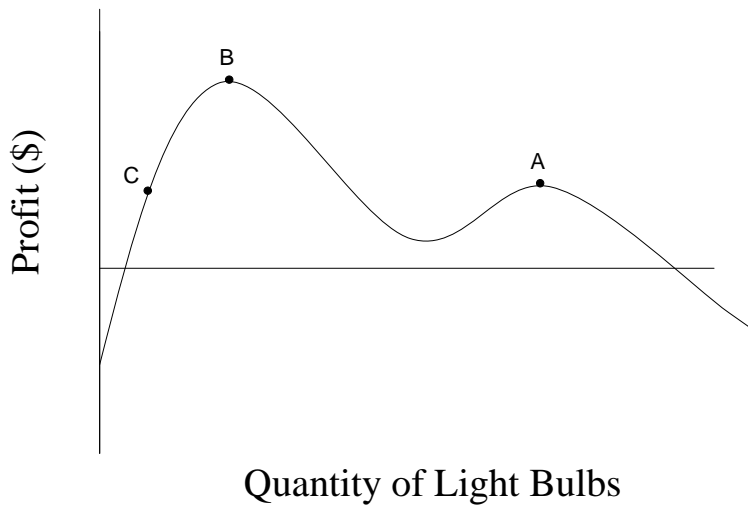
### *Fill in the Blank*

1. Full social efficiency and economic efficiency are achieved when production processes are chosen to maximize \_\_\_\_\_ benefits.
2. A group of ten people want to start a laundry business together, but due to racial discrimination they cannot obtain adequate financing. These people face a \_\_\_\_\_ constraint.
3. The benefit that accrues from producing the last unit of output is the \_\_\_\_\_ benefit.
4. Bob's Barber Shop produces one good: haircuts. Suppose there are no externalities associated with production of haircuts. Bob can maximize net benefits by producing a number of haircuts such that marginal benefit is equal to \_\_\_\_\_.
5. Cans of sardines sell at a constant rate of \$2.09 each. Thus, we can say that the \_\_\_\_\_ to a sardine seller is constant at \$2.09.
6. In a perfectly competitive market with no externalities, profits are maximized when \_\_\_\_\_ is set equal to price.
7. The profit curve for production of travel guides to Denmark has only one peak. Therefore this profit curve can be described as \_\_\_\_\_.
8. Discrete decision making is necessary when an economic problem is characterized by \_\_\_\_\_.

### *True/False*

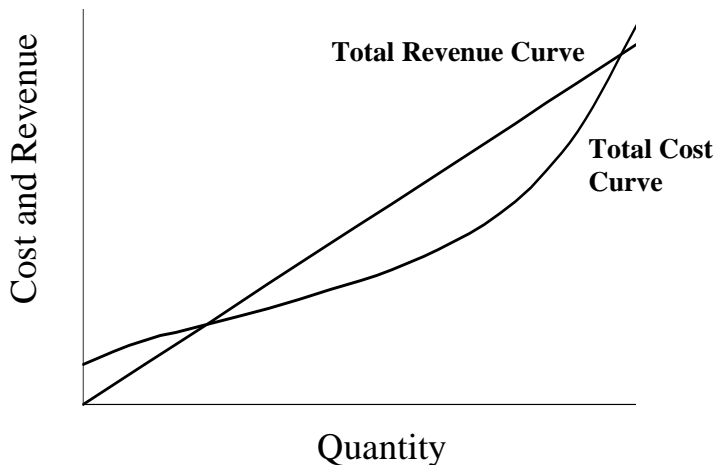
9. Economic profit is equal to the difference between revenues and economic costs.
10. Sometimes, a project with high social benefits may not be undertaken due to capital constraints.
11. When an economic problem displays the characteristic of nonconvexity, marginal thinking is sufficient to maximize net benefits.

Questions #12, #13, and #14 refer to the graph below.



12. The profit function for light bulb production has multiple equilibria.
13. The profit function for light bulb production is convex.
14. Marginal thinking will lead a light bulb producer to move from point A to point B on this profit curve.

Questions #15 and #16 refer to the graph shown below.



15. In the graph shown above, profits are maximized at the point where the total cost curve and the total revenue curve intersect.
16. In the graph shown above, the vertical distance between the two curves at any given point represents the profits earned at that level of production.
17. A shoe factory has fixed costs of \$1,500 per month. If revenues are insufficient to cover these fixed costs in full next month, the factory should shut down.

*Short Answer*

18. Describe the concept of “lumpiness” in relation to an industry that produces large, expensive goods, such as airplanes.

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19. Describe one drawback of cost-benefit analysis as a tool for decision-making by governments.

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20. A trolley must have 30 passengers paying \$1 each in order to meet the full cost of a trip across town. Right now, only 10 passengers are willing to pay the \$1 fare to get on the trolley, but the trolley must stick to its schedule, so it sets off on its route even though it is not full. Just as the trolley is starting to move, a group of 10 schoolchildren rush over and ask if they can get on at half-price. Assuming that the driver is in control and wants to maximize profits, should the driver let them on at half-price? Explain why or why not, using the vocabulary of marginal analysis.

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21. Describe an example of a network externality. (The textbook describes several examples; try to think of a different one from those presented in the book.)

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## Problems

1. Suppose that manufacturers of laptop computers are price takers operating in a perfectly competitive market. Each laptop can be sold for \$2,000.
  - a. Sketch the total revenue curve for laptop computers, and explain why it looks the way it does.

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- b. Sketch the marginal revenue curve for laptop computers, and explain why it looks the way it does.

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2. Suppose that the cost of production of laptop computers shows initially a brief span of decreasing marginal costs, followed by increasing marginal costs.

- a. On the same graph as the total revenue curve you drew for problem #1a, draw a possible total cost curve for laptop computer production. For a given quantity  $Q_1$  (placed at any location you choose on the horizontal axis), show the corresponding profit.

- b. On the same graph as the marginal revenue curve you drew for problem #1b, draw a possible marginal cost curve for laptop computer production. Indicate the profit maximizing output level.

3. A flashlight manufacturing company has the following cost structure (some columns are intentionally left blank):

| Quantity | Marginal Cost (\$) |  |  |  |
|----------|--------------------|--|--|--|
| 0        |                    |  |  |  |
| 1        | 12                 |  |  |  |
| 2        | 8                  |  |  |  |
| 3        | 10                 |  |  |  |
| 4        | 13                 |  |  |  |
| 5        | 17                 |  |  |  |

a. Supposing that the firm is a price taker and can sell each flashlight it makes for \$13, graph the Marginal Cost and Marginal Revenue curves for this flashlight manufacturer.

b. If you assume that “marginal thinking” applies, what does the figure you drew in part (a) imply is the profit-maximizing output level for the firm?

c. Assume that the firm has fixed costs of \$10. Calculate Total Cost, Total Revenue and Total Profit for the firm at the various production levels, using the blank columns in the table above.

d. With lamps selling for \$13, what is maximum profit the firm can make? What should it do? Explain.

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4. A farm can produce either chickens or horses, or both. The chickens eat corn, while the horses eat oats and hay. Both chicken and horse production is characterized by diminishing returns.

a. Draw a production possibilities frontier (PPF) for this farm.

b. Another farm can produce either chickens or turkeys, or both. The chickens and turkeys both require the same food. Furthermore, they fight with each other when they are kept in the same space. Thus, producing a combination of chickens and turkeys is less efficient than producing only chickens or only turkeys. Draw a PPF for this farm.

c. Which of the PPFs you have just drawn has a "corner solution"? Explain what this means.

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5. Snuffy's Dog Wash faces both fixed and variable costs as it provides the service of washing and grooming pet dogs.

a. The chart below shows the total costs at Snuffy's Dog Wash at various levels of of production. Based on the information shown here, fill in the marginal cost of a dog wash at each level of production.

| Number of dogs washed per day | Marginal cost per dog wash (\$) | Total cost (\$) |
|-------------------------------|---------------------------------|-----------------|
| 0                             |                                 | 10              |
| 1                             |                                 | 15              |
| 2                             |                                 | 19              |
| 3                             |                                 | 22              |
| 4                             |                                 | 27              |
| 5                             |                                 | 37              |
| 6                             |                                 | 48              |
| 7                             |                                 | 60              |

b. Suppose the going rate for a dog wash is \$11. Snuffy's Dog Wash has no control over the price of dog washes, but the manager knows she can always sell as many dog washes as she chooses to produce. To maximize profits, how many dogs will Snuffy's Dog Wash wash per day?

c. Calculate the profit at Snuffy's Dog Wash at the level of production identified in part (b).

**Self Test**

1. Economic profit is a narrower concept than net benefits because

- a. It includes only accounting profit.
- b. It includes only opportunity costs.
- c. It does not include benefits or costs that are external to the firm.
- d. It does not include marginal benefits or costs.
- e. It does not take long-term average costs into account.

2. Assuming that a problem is “convex,” net benefits are maximized when

- a. Producers select a level of production where internal benefits equal external costs.
- b. Producers select a level of production at which costs equal benefits.
- c. Producers engage in an activity up to the point where marginal benefit exceeds marginal cost.
- d. Producers engage in an activity up to the point where marginal benefit equals marginal cost.
- e. Producers engage in an activity up to the point where total average revenue exceeds total average cost.

Questions 3, 4, and 5 refer to the following scenario.

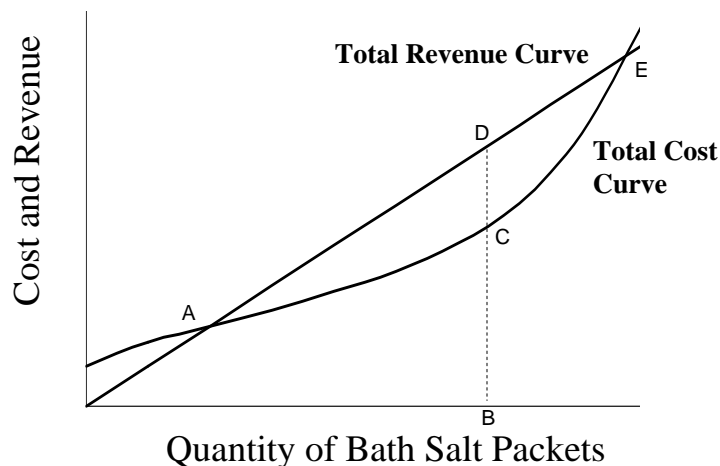
Handy Hardware Factory produces desk lamps, according to the following cost structure. They are a price taker, and can sell any number of lamps for \$8 each.

| Quantity of Lamps | Marginal Cost (\$) | Total Cost (\$) | Marginal Revenue (= Price) (\$) | Total Revenue (\$) | Total Profit (\$) |
|-------------------|--------------------|-----------------|---------------------------------|--------------------|-------------------|
| 0                 | --                 | 50              | --                              |                    |                   |
| 1                 | 15                 |                 | 8                               |                    |                   |
| 2                 | 5                  |                 | 8                               |                    |                   |
| 3                 | 6                  |                 | 8                               |                    |                   |
| 4                 | 8                  |                 | 8                               |                    |                   |
| 5                 | 12                 |                 | 8                               |                    |                   |

3. What is the total cost of producing 3 lamps?
  - a. \$ 6
  - b. \$ 8
  - c. \$ 50
  - d. \$ 76
  - e. None of the above.
  
4. What level of total profit will Handy Hardware make, if it produces 3 lamps?
  - a. less than \$ 0 (that is, a loss)
  - b. between \$ 0 and \$20
  - c. between \$20 and \$50
  - d. more than \$50
  - e. Cannot be determined from the information given.
  
5. What is the profit-maximizing level of output for Handy Hardware?
  - a. 0 lamps
  - b. 1 lamp
  - c. 3 lamps
  - d. 4 lamps
  - e. None of the above.

Questions 6, 7 and 8 refer to the following scenario.

Bertha's Bath Supplies produces packets of bath salts, which are sold for \$5 each. Bertha's Bath Supplies is a price-taking firm. Total revenue and total cost curves for the firm are shown in the graph below.

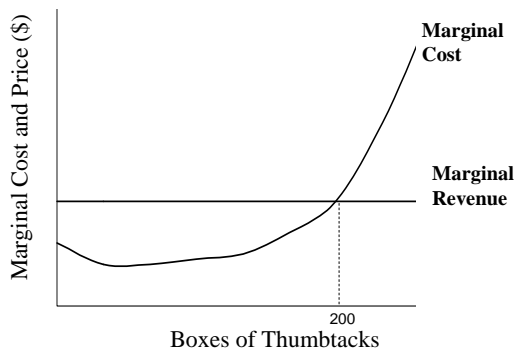


6. Which of the following statements is true regarding the graph shown above?
  - a. Profits are maximized at point E.
  - b. The distance from B to C represents profit earned.
  - c. The distance from B to D represents profit earned.

- d. The distance from C to D represents profit earned.
  - e. At point B, marginal revenue is designated by point D.
7. How would you determine whether point B is the profit-maximizing level of production for Bertha's Bath Supplies?
- a. Compare the slopes of the cost and revenue curves at points C and D.
  - b. Compare the distance from A to C with the distance from A to B.
  - c. Compare the slope of the cost curve at point C with the slope of the marginal cost curve.
  - d. Compare the distance from B to C with the distance from B to D.
  - e. None of the above.
8. Which of the following statements about Bertha's Bath Supplies do you know to be true, based on the information provided above?
- a. Profits are maximized when production reaches 100 packets.
  - b. Profits are maximized at point E.
  - c. Profits are maximized when marginal costs equal \$5 per packet.
  - d. Point B represents a production level yielding zero profit.
  - e. Point E represents a production level yielding positive profit.

Questions 9 and 10 refer to the scenario below.

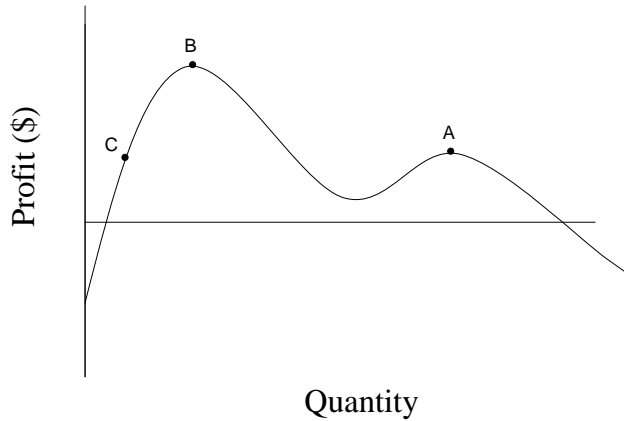
Tillie's Tack Place manufactures thumb tacks and sells them for \$2.00 per box of tacks. The graph below shows marginal cost and marginal revenue for Tillie's Tack Place.



9. When Tillie's Tack Place is producing 200 boxes of thumbtacks, which of the following statements must be true?
- a. Tillie's Tack Place is not yet making a profit.
  - b. Producing more tacks would reduce total profits.
  - c. Producing more tacks would increase total profits.
  - d. Total costs exceed total revenues at this point.
  - e. Producing one more box of tacks would mean that total costs would exceed total revenues.

10. When Tillie's Tack Place is producing 200 boxes of thumbtacks, the marginal cost per box is equal to
- \$50
  - \$25
  - \$5
  - \$2
  - The marginal cost cannot be determined from the information given here.
11. Which of the following is an example of an external benefit?
- Joan enjoys cooking, so she makes herself a three course dinner every night.
  - Marcia volunteers at a local shelter for the homeless.
  - James makes a profit selling apples from his orchard.
  - Susan gives a present to her boss so that her boss will be nicer to her.
  - Sam plants a rose bush outside his home and his neighbors enjoy the sweet smell.
12. George has watched half a movie. He is not enjoying the movie very much, and it occurs to him he could be spending this time visiting with a friend who is only in town for the weekend. George considers staying for the end of the movie since he paid \$8 for the movie ticket, but in the end he decides not to waste any more time watching the movie, and to go see his friend instead. George's decision is an example of
- marginal thinking
  - full cost accounting
  - increasing returns to scale
  - decreasing returns to scale
  - lumpiness
13. The price of lemon candy rises from \$1 per bag to \$1.20 per bag. In response to this price change, candy manufacturers increase production of lemon candy. Assuming candy manufacturers are price-taking, profit maximizing firms, we can conclude that:
- Candy makers have increased production to the point where average costs equal \$1.20.
  - Candy makers have increased production to the point where marginal costs equal \$1.20.
  - Candy makers have colluded to raise prices together.
  - Candy makers were making losses before the price change.
  - Candy makers were not maximizing profits at the lower price.

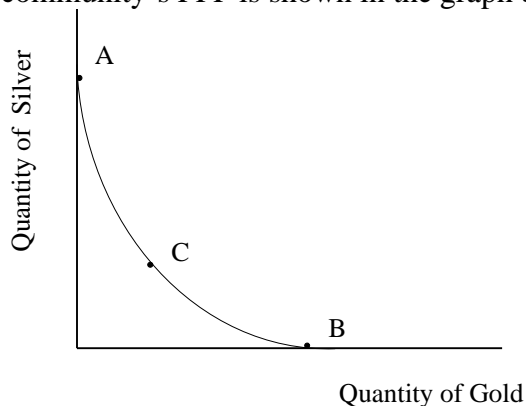
For Question #14 refer to the following graph:



14. Which of the following statements is true about the graph shown above?
- Profit maximization for this firm requires only marginal decision making.
  - Marginal decision making will move the firm gradually from Point A to Point B.
  - Starting from Point C, marginal decision making is sufficient to maximize profits.
  - Starting from Point C, discrete decision making is necessary for profit maximization.
  - The profit function for this firm is convex.
15. A ship builder can build two, three, or four ships, but can't build two and a half ships, even if the profits would theoretically be maximized at that level of production. This inconvenient fact is known as:
- Path dependence
  - Sunk cost
  - Static Analysis
  - Lumpiness
  - Convexity

Questions #16 and #17 refer to the following scenario:

A community has the option to mine for silver, to mine for gold, or to do both. The community's PPF is shown in the graph below.



16. Which of the following outcomes would be preferable for the community?
- Specialize in gold mining.
  - Specialize in silver mining.
  - Mine some of each.
  - Specializing in either gold or silver mining is preferable to doing some of each.
  - Can't tell from the information provided.
17. Which of the following statements about this graph is false?
- It has a corner solution.
  - Both silver and gold mining have increasing returns.
  - Silver and gold mining require similar resource inputs.
  - Point C represents the optimal level of gold and silver production.
  - Production efficiency increases with increasing levels of specialization.

For Question #18 and Question #19 refer to the following scenario:

Fuzzy Wuzzy Caterpillar Farm has a profit function with two equilibria. At one equilibrium point, the farm produces 50,000 caterpillars per season and enjoys total profits of \$10,000. At the other equilibrium point, the farm produces only 25,000 caterpillars and makes a profit of \$20,000. The farm started out producing 45,000 caterpillars because that sounded like a good number to the manager, and through marginal decision making has reached the equilibrium point of 50,000 caterpillars.

18. The situation described above is characterized by:
- path dependence
  - convexity
  - corner solution
  - sunk costs
  - both a and b are correct.
19. The farm conducts an analysis that indicates producing only 25,000 caterpillars would be better than what it is doing right now. But moving to a level of only 25,000 caterpillars requires a variety of adjustments, including laying off several workers and buying smaller caterpillar boxes for shipping smaller caterpillar orders to customers. These costs are known as:
- corner costs
  - network externalities
  - switching costs
  - negative costs
  - internal costs

20. You like to write papers on your manual typewriter. But when your typewriter runs out of ribbon, you have trouble buying a replacement ribbon. At your local office supplies store, the cashier explains they have stopped carrying typewriter ribbon because most people use computers now. Eventually you switch to using a computer for writing your papers because getting replacement ribbon for your typewriter is too complicated. You have experienced an example of:
- a concave production curve
  - a sunk cost
  - a switching cost externality
  - a path externality
  - a network externality

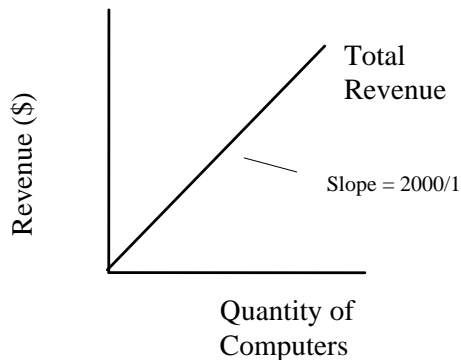
### Answers to Active Review Questions

- net
- capital
- marginal
- marginal cost
- marginal revenue
- marginal cost
- convex
- nonconvexity
- True.
- True.
- False.
- True.
- False.
- False.
- False.
- True.
- False.
- Lumpiness refers to the fact that some inputs can be obtained, or outputs produced, only in discrete quantities. On a profit curve for airplane production, it may look as though we have the option to produce a partial airplane because the line we draw is continuous. For example, a profit curve might show that producing 8.5 airplanes will maximize profits. In the real world, because of lumpiness, we have to choose between making 8 airplanes and making 9.
- Some costs and benefits are easier to measure than others. For example, it can be hard -- or impossible -- to quantify the value of preserving an endangered species or maintaining a pristine waterfront. Cost-benefit analyses can be misleading because of the difficulty of coming up with reasonable monetary figures to represent social costs or benefits. Because it is hard to quantify some social costs and benefits, policy analysts sometimes just leave them out, producing a misleading final analysis.

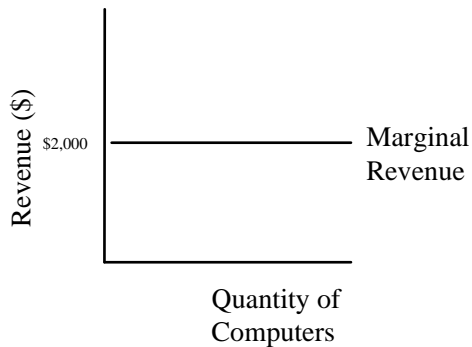
20. Yes, the driver should let the schoolchildren on the trolley, even though they are only paying half-price. The marginal benefit of taking on new passengers, in this case, is \$.50 each. The marginal cost of taking on new passengers, given that the trolley is already set to travel, is either zero or very low (perhaps it will take a little more fuel to move the trolley with the extra weight of the 10 children). Thus, the marginal benefit of taking the children on board exceeds the marginal cost, so it is worthwhile to take them, even though they are not paying enough to cover the average cost per passenger.
21. One example could be the difficulties you might face if you tried to maintain an old model of car that few other people were using. Over time, you would probably find it difficult to get the parts you needed, or even to find a mechanic who understood how to maintain this kind of car. Another example would be trying to get around with a horse and buggy. You would probably find that because cities are set up for traveling by cars and other automated forms of transport, you would have trouble navigating modern city streets with your horse and buggy.

### Answers to Problems

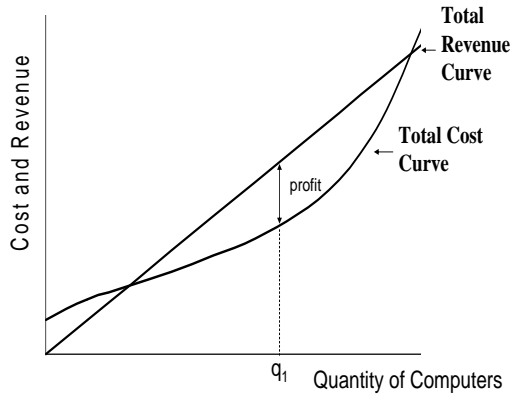
1.a. The total revenue curve for laptop computers is a straight upward-sloping line because in a perfectly competitive market, every laptop will sell for the same price. The slope of the line is +2000.



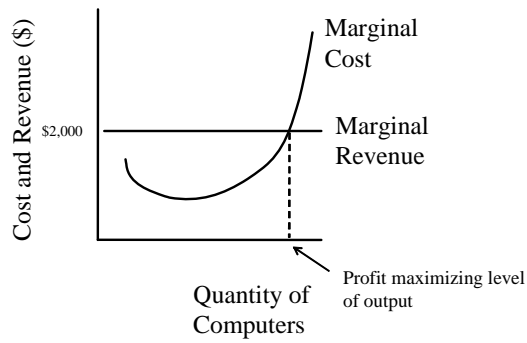
1.b. The marginal revenue curve is a straight line, horizontal at the market price (\$2,000). Each additional laptop sold brings in the same amount.



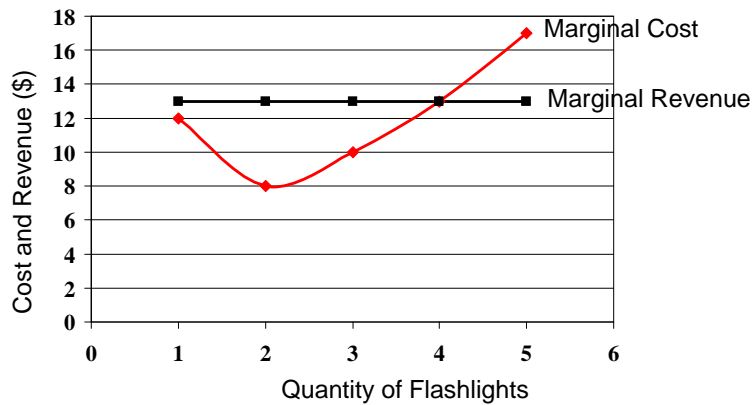
2. a.



2.b.



3. a.



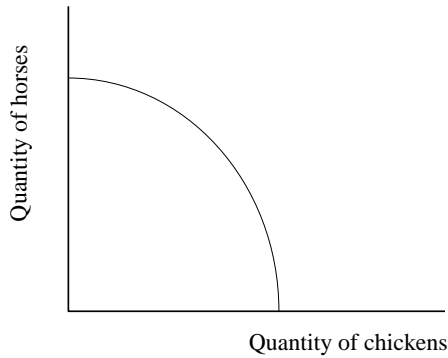
3. b. 4 flashlights (where marginal cost = marginal revenue)

3. c.

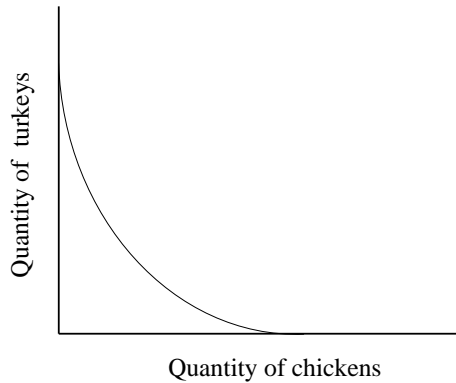
| Quantity | Marginal Cost (\$) | Total Cost (\$) | Total Revenue (Price = \$13) | Total Profit |
|----------|--------------------|-----------------|------------------------------|--------------|
| 0        |                    | 10              | 0                            | -10          |
| 1        | 12                 | 22              | 13                           | -9           |
| 2        | 8                  | 30              | 26                           | -4           |
| 3        | 10                 | 40              | 39                           | -1           |
| 4        | 13                 | 53              | 52                           | -1           |
| 5        | 17                 | 70              | 65                           | -5           |

3. d. At a price of lamps of \$13, the firm's maximum profit is a *loss* of \$1 (achievable at a production level of 3 or 4 lamps). The firm should continue to produce (in the short run), since losing \$1 is better than losing \$10, which is what it would lose if it shuts down.

4.a. (Note that the axes may also be reversed, with "chickens" on the vertical.)



4. b.



4. c. The PPF for part (b) has a corner solution, meaning that the preferred point is at an extreme corner of the graph. The farm can maximize total output by choosing one of the two "corners" -- i.e. by producing only chickens or only turkeys.

5. a.

| Number of dogs washed per day | Marginal cost per dog wash (\$) | Total cost (\$) |
|-------------------------------|---------------------------------|-----------------|
| 0                             | n/a                             | 10              |
| 1                             | 5                               | 15              |
| 2                             | 4                               | 19              |
| 3                             | 3                               | 22              |
| 4                             | 5                               | 27              |
| 5                             | 10                              | 37              |
| 6                             | 11                              | 48              |
| 7                             | 12                              | 60              |

5.b. To maximize profits, Snuffy's will produce six dog washes per day (where marginal revenue = marginal cost).

5.c. Revenue =  $\$11 \times 6$  washes =  $\$66$ , so Profit = Revenue - Cost =  $\$66 - \$48 = \underline{\$18}$ .

### Answers to Self Test Questions

1. c
2. d
3. d

For questions 3-5, note that the complete cost structure for Handy Hardware is as follows. Marginal Cost = Marginal Revenue at a production level of 4, but the firm makes higher profits (that is, lower losses) by making the “discrete decision” to not produce at all.

| Quantity of Lamps | Marginal Cost (\$) | Total Cost (\$) | Marginal Revenue (= Price) (\$) | Total Revenue (\$) | Total Profit (\$) |
|-------------------|--------------------|-----------------|---------------------------------|--------------------|-------------------|
| 0                 | --                 | 50              | --                              | 0                  | <b>-50</b>        |
| 1                 | 15                 | 65              | 8                               | 8                  | -57               |
| 2                 | 5                  | 70              | 8                               | 16                 | -54               |
| 3                 | 6                  | <b>76</b>       | 8                               | 24                 | <b>-52</b>        |
| 4                 | 8                  | 84              | 8                               | 32                 | -52               |
| 5                 | 12                 | 96              | 8                               | 40                 | -56               |

4. a
5. a
6. d
7. a
8. c
9. b
10. d
11. e
12. a
13. b
14. c
15. d
16. d
17. d
18. a
19. c
20. e