Chapter Summary

This chapter covers five key principles of economics, the simple, self-evident truths that most people readily accept. If you understand these principles, you are ready to read the rest of the book, which will show you how to do your own economic analysis. The five key principles are:

- **Principle of Opportunity Cost**: The opportunity cost of something is what you sacrifice to get it.
- **The Marginal Principle**: Increase the level of an activity as long as its marginal benefit exceeds its marginal cost. Choose the level at which the marginal benefit equals the marginal cost.
- **Principle of Voluntary Exchange**: A voluntary exchange between two people makes both people better off.
- **Principle of Diminishing Returns**: Suppose that output is produced with two or more inputs, and we increase one input while holding the other inputs fixed. Beyond some point—called the point of diminishing marginal returns—output will increase at a decreasing rate.
- **The Real–Nominal Principle**: What matters to people is the real value of money or income—its purchasing power—not the face value of money or income.

Applying the Concepts

After reading this chapter, you should be able to answer these seven key questions:

1. What is the opportunity cost of running a business?
2. How do people think at the margin?
3. What is the rationale for specialization and exchange?
4. Do farmers experience diminishing returns?
5. How does inflation affect the real minimum wage?
6. How does inflation affect lenders and borrowers?

 관한 Study Tip

While the concepts introduced in this chapter may seem very elementary, they are quite important. In fact, the rest of the book is an application of the principles in this chapter. As you go through the text, you may wish to look back and see how different topics are examples of these five principles.
2.1 The Principle of Opportunity Cost

To make a good decision we must compare the benefits of the decision with the costs. The important cost concept for decision making is that of the **opportunity cost**, what you sacrifice to get something. It is important to recognize that opportunity costs often don’t involve spending money. Waiting in line is a cost: You sacrifice time you can’t get back. Would you wait in line for 15 minutes at a gas station to save $1 on a tank full of gas instead of paying $1 more at a gas station with no line? In this case you need to recognize that sacrificing your time is part of the cost of the gasoline. Only if you value 15 minutes of time at less than $1 would you want to wait in line.

An opportunity cost can involve both time and money. When evaluating the costs of college, some costs, such as tuition and books, are obvious because they involve spending money. Some costs are not obvious, because they don’t involve spending money. The income you give up by going to college instead of taking a full-time job is a cost. You sacrificed the income you could have earned to go to college. Some things we think of as costs are not relevant to the decision. For instance, whether you go to college or find a full-time job, you must have a place to live and food to eat. As a result, room and board aren’t relevant costs to the decision to go to college—you would have to pay these costs regardless of your choice.

Like you and other people, economies (countries) face opportunity costs. Economists use the **production possibilities curve** to represent these costs. The production possibilities curve shows the possible combinations of products that an economy can produce, given that its productive resources are fully employed and efficiently used. The production possibilities curve shows us the cost of one good in terms of the amount of the other good we must sacrifice. The bowed-out shape of the production possibilities curve reflects the fact that the opportunity cost of a good increases as we produce more of it. Look at Figure 2.1 in your text. The first few tons of wheat, moving from point \( a \) to point \( b \), require little sacrifice of steel. This makes sense as there are some resources (fertile land) that are very suited for wheat production, but not very well suited for steel production. As we produce more and more wheat, however, we must begin to use resources that are better suited for steel production and, thus, we give an increasing amount of steel for each additional unit of wheat. You can see this as we move from point \( c \) to point \( d \) in Figure 2.1.

**Study Tip**

The concept of opportunity cost is one of the most important concepts in microeconomics. Make sure that you can recognize all the costs of a particular decision, both the monetary costs and the opportunity costs. For an individual, the other uses of your time are an important source of opportunity cost. You also need to recognize when particular costs are not relevant to a decision.
Let’s review an Application that answers a key question we posed at the start of the chapter:

1. What is the opportunity cost of running a business?

APPLICATION 1: DON’T FORGET THE COSTS OF TIME AND INVESTED FUNDS

When you use your own time and money in a business, you sacrifice the opportunity to use those resources in other ways. You sacrifice the opportunity to trade your time for the money you could earn working for someone else, as well as the interest you could have earned investing the money you’ve used in your business. Even though you don’t write a check for these costs, they are important costs for decision making. As a result, Betty’s revenues must not only cover the explicit costs of doing business, they must also replace the implicit costs of her time and invested funds in order for her business to be profitable. If she is not able to cover these implicit costs, she will likely not start her own business.

2.2 The Marginal Principle

Economics is concerned with making choices. We will assume that the relevant choice is whether to change a current activity level by a little bit. That is, do we hire one more worker? Produce one more unit of output? Purchase one more slice of pizza? This is what is known as a marginal change. To make a good decision, we compare the marginal benefit, the additional benefit resulting from a small increase in some activity, with the marginal cost, the additional cost resulting from a small increase in some activity. If the marginal benefit is greater than the marginal cost, we want to increase the level of the activity. Doing so will increase our total well-being by the difference between the marginal benefit and the marginal cost. If the marginal benefit is less than the marginal cost, we want to reduce the level of the activity. If they are equal, we are at the optimal amount of the activity.

Your text provides three examples:
- How many movie sequels?
- What should it cost to rent college facilities?
- How strict should automobile emissions standards be?

☐ A marginal change refers to a small change in some activity. You can think of a marginal change as taking the next step in a logical sequence. You would never, for instance, compare the salary of someone with a Ph.D. against someone who didn’t finish high school. Why not? These aren’t two logical options. A person doesn’t decide to either earn a Ph.D. or drop out of high school. She decides whether to drop out of high school or get a high school diploma. She next decides whether to go to college or not. Upon graduating college she decides whether to take a job or go to graduate school. These are each sequential steps, and thus we can make relevant comparisons between them. A person will continue to go to school as long as the marginal benefit of the next level of schooling exceeds the marginal cost.

☐ A restaurant might use the marginal principle when deciding whether to open for breakfast in addition to lunch. Since many of the costs of the restaurant (rent, payments for equipment) are fixed, the only additional cost of opening for breakfast would be the food, labor, and utilities needed to open earlier. If the revenue from selling breakfast exceeds these costs, the restaurant should open for breakfast.
Let’s review an Application that answers a key question we posed at the start of the chapter:

2. How do people think at the margin?

APPLICATION 2: WHY NOT WALK UP AN ESCALATOR?

In this Application we see that people will tend to not walk up escalators because the marginal benefit of walking is reduced on an escalator relative to stairs. If you want to get to the second level of a building, and only stairs are available, the only way to the second level is to walk. If an escalator is available, you don’t have to climb stairs. You’ll reach the second level a little faster if you walk up the escalator, but because the marginal benefit of walking has been reduced, people are less likely to walk up the escalator.

🔗 Study Tip

Decision making based on the marginal principle is the basis for all decisions in this book. Be sure you understand the concepts of marginal benefit and marginal cost. Recognize that people should continue to take an action as long as the marginal benefit is greater than the marginal cost.

2.3 The Principle of Voluntary Exchange

The principle of voluntary exchange states that a voluntary exchange between two people makes both people better off. Think about the last time you purchased a movie ticket. Since you were willing to pay the price of a ticket, you must have valued seeing the movie more than the ticket cost. The theater manager knows that the ticket price was higher than the theater’s cost of letting you see a movie. Neither of you felt cheated in the transaction because you were both better off.

🔗 Most of us recognize this principle in practice. All of us realize that we are better off trading our time for money and then spending that money on other goods and services. Many people choose to eat dinner in a restaurant, even though they could make the same food at home. This principle works for trades between individuals and, as we will see later in the book, for trades between countries as well.

Let’s review an Application that answers a key question we posed at the start of the chapter:

3. What is the rationale for specialization and exchange?

APPLICATION 3: JASPER JOHNS AND HOUSEPAINTING

Why would a famous painter hire someone to paint his house? In the case of Jasper Johns it is better for him to specialize in painting artwork, even though he could probably do a better (and faster) job of painting his house than could someone else. Why? Opportunity cost. If Jasper Johns can hire someone to spend 10 days painting his house for $150 per day, or paint it himself in one day (by giving up the opportunity to earn $5,000 for his art) he is clearly better off spending $1,500 hiring someone. In fact, he is better off by $3,500, the $5,000 that he earned minus the $1,500 that he paid to have his house painted.
2.4 The Principle of Diminishing Returns

The principle of diminishing returns says that if we produce output using two or more inputs and change the amount of only one input, beyond some point output will increase at a decreasing rate.

Think of a local fast-food restaurant and imagine that they currently have only two workers on a shift. If the restaurant hired an additional person for that shift, would they be able to serve more food? Yes. That person could staff another register or cook more burgers, or take care of the drive-thru business. What if the restaurant kept hiring people? With a fixed number of registers, preparation areas or grill space, it would be harder for additional workers to add much to output because of the fixed amount of capital. In fact, at some point the workers would start to get into each other’s way and output might actually fall as we hire more workers.

Let’s review an Application that answers a key question we posed at the start of the chapter:

4. Do farmers experience diminishing returns?

APPLICATION 4: FERTILIZER AND CROP YIELDS
Adding fertilizer increases crop yields, but after adding the first bag, each additional bag adds less to our output than the previous bag. So, as you can see in Table 2.1 in the text, adding the first bag of fertilizer increases output by 35 bushels per acre. The second bag increases output by only 15 bushels, and each additional bag of fertilizer adds a smaller amount to output. This is the principle of diminishing returns. More fertilizer increases output, but each additional bag adds a smaller and smaller amount to total output.

2.5 The Real–Nominal Principle

This principle states that what matters to people is the purchasing power of money, not its face value. Suppose that you earn $500 per month, and you spend $250 on rent, $150 on food, and $100 on entertainment. If your money income increases to $1,000, are you better off? If prices stay the same you are because you’ll be able to buy more things. If, however, your rent increases to $500, food to $300, and the cost of entertainment to $200, you are no better off earning $1,000 than you were earning $500. Why? What you can purchase with your money income is the same in both cases.
Remember

The important concern in economics is not how many dollars you have, but what you can purchase with those dollars. This is why we distinguish between real and nominal amounts.

Let’s review two Applications that answer key questions we posed at the start of the chapter:

5. How does inflation affect the real minimum wage?

APPLICATION 5: THE DECLINING REAL MINIMUM WAGE
Would you rather earn $2 per hour or $5.85 per hour? What about $2 or $7.25 an hour? The answer depends on what you can buy with that money. Even though at $5.85 per hour the dollar amount of the minimum wage is higher in 2007 than it was in 1974, the purchasing power of the 1974 minimum wage of $2 per hour was much greater. That is, even though you earned a smaller number of dollars (the nominal value, or the face value of an amount of money) those fewer dollars were able to purchase more stuff (the real value, or the value of money in terms of the quantity of goods it can buy). Even at the current minimum wage of $7.25 per hour, the dollars buy less than $2 per hour bought in 1974.

6. How does inflation affect lenders and borrowers?

APPLICATION 6: REPAYING STUDENT LOANS
Inflation reduces the purchasing power of a given sum of money. Borrowers like inflation (as they give up fewer goods in repaying their loans) while lenders do not like inflation (the nominal dollars they receive in repayment can’t buy as much as the dollars they loaned). When the nominal amount of the loan is fixed, inflation allows the loan to be repaid in less time. Deflation increases the amount of time that it takes to repay the loan.

Activity

Suppose that you earn $12 per hour. (That’s the same as 20 cents per minute.) Think about the following situations and consider the opportunity cost involved.

a. At the grocery store you have the choice to spend $1.50 for a package of unsliced mushrooms or to spend $1.90 for a package of pre-sliced mushrooms. How long would you have to spend slicing mushrooms to be better off buying the pre-sliced mushrooms?

b. There are two gas stations on opposite corners of the street. One sells gasoline for $2.35 per gallon, the other for $2.32 per gallon. Your gas tank holds 10 gallons of gas. There is a line at the gas station with the lower price, and you anticipate that you will spend five minutes waiting in that line. You could buy gas now at the gas station with the higher prices. What should you do?
Answers

a. Since you can earn 20 cents per minute, if you would spend more than 2 minutes slicing mushrooms you should buy the pre-sliced mushrooms.

b. You will save 30 cents buying gasoline at the lower priced station since you save 3 cents per gallon on each of the 10 gallons that you purchase. In terms of time, 30 cents is only one and a half minutes. You are better off buying the higher priced gasoline.

Key Terms

**Marginal benefit**: The extra benefit resulting from a small increase in some activity.

**Marginal cost**: The additional cost resulting from a small increase in some activity.

**Nominal value**: The face value of an amount of money.

**Opportunity cost**: What you sacrifice to get something.

**Production possibilities curve**: A curve that shows the possible combinations of products that an economy can produce, given that its productive resources are fully employed and efficiently used.

**Real value**: The value of an amount of money in terms of what it can buy.

Practice Quiz

(Answers are provided at the end of the Practice Quiz.)

1. The principle of opportunity cost evolves from the concept of
   a. consumer spending.
   b. wealth.
   c. poverty.
   d. scarcity.

2. A friend offers you a Coke, a Pepsi, or a Diet Coke. You don’t like Diet Coke, so after some thought, you take the Pepsi. What is the opportunity cost of your choice?
   a. the Pepsi
   b. the Coke
   c. the Coke plus the Diet Coke
   d. the Coke plus the Diet Coke plus the Pepsi

3. Which of the following is NOT an opportunity cost of attending college?
   a. the wages that you could have earned while going to class
   b. tuition
   c. the cost of books
   d. the cost of housing
4. This question tests your understanding of Application 1 in this chapter. From the choices A, B, and C below, choose the ones that you would include in your estimate of the opportunity cost of doing business.

A: the expenses for bottle caps and paint
B: the interest that the funds Betty invested in the business could have earned at the bank or elsewhere
C: the value of Betty’s time when used in the best alternative activity

a. A and B
b. B and C
c. A and C
d. A, B, and C

5. The table below shows the production possibilities for an economy that produces two goods: lobsters and boats. What is the opportunity cost of moving from point C to point D?

<table>
<thead>
<tr>
<th></th>
<th>Lobsters</th>
<th>Boats</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>9</td>
</tr>
<tr>
<td>C</td>
<td>200</td>
<td>7</td>
</tr>
<tr>
<td>D</td>
<td>300</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>400</td>
<td>0</td>
</tr>
</tbody>
</table>

a. 3 boats
b. 100 lobsters
c. 100 lobsters and 3 boats
d. 4 boats

6. Refer to the graph below. Which move best describes an increase in efficiency in the use of existing resources?

a. a move from i to d
b. a move from c to d
c. a move from d to g
d. None of the above. Higher efficiency in the use of resources is not represented by a move but by a shift of the production possibilities curve.
7. Refer to the graph below. At which point, or points, are resources fully and efficiently employed?

![Graph showing production possibilities frontier]

a. at points c and d only  
b. at point g only  
c. at points c, d, and g  
d. at point i only

8. Refer to the graph below. Which of the following factors can cause a move from point d to points g or h?

![Graph showing production possibilities frontier with additional curves]

a. The economy’s resources increase.  
b. The opportunity cost of producing farm goods or factory goods changes.  
c. The economy utilizes its resources fully.  
d. Resources that used to be more suitable for producing farm goods are now perfectly adaptable to the production of either farm goods or factory goods.
9. Refer to the graph below. According to this graph, the opportunity cost of producing an additional 20 tons of wheat, from 140 to 160 tons, is

- higher with normal precipitation than during a drought.
- higher during a drought than with normal precipitation.
- the same with normal precipitation or during a drought.
- zero during a drought.

10. Refer to the graph below. What can we conclude about opportunity cost based on the shape of this production possibilities curve?

- The curve shows that as more of a good is produced, the higher the opportunity cost of producing that good.
- Resources appear to be perfectly substitutable, or equally adaptable to the production of either bullet trains or space missions.
- We can conclude that as you move downward along the curve, the opportunity cost of producing bullet trains decreases.
- The economy’s resources are abundant.
11. Refer to the table below. What is the marginal benefit of the fourth slice of pizza?

<table>
<thead>
<tr>
<th>Slices of Pizza</th>
<th>Total Cost</th>
<th>Total Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1.50</td>
<td>$4.00</td>
</tr>
<tr>
<td>2</td>
<td>$3.00</td>
<td>$7.00</td>
</tr>
<tr>
<td>3</td>
<td>$4.50</td>
<td>$9.00</td>
</tr>
<tr>
<td>4</td>
<td>$6.00</td>
<td>$10.50</td>
</tr>
<tr>
<td>5</td>
<td>$7.50</td>
<td>$10.75</td>
</tr>
</tbody>
</table>

a. $6.00  
b. $1.50  
c. $10.50  
d. $4.50

12. The table below shows the marginal benefit that Ted earns from keeping his store open one more hour. Ted has a marginal cost of $90 per hour. How many hours should Ted stay open?

<table>
<thead>
<tr>
<th>Hours</th>
<th>Marginal Benefit Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>200</td>
</tr>
<tr>
<td>21</td>
<td>140</td>
</tr>
<tr>
<td>22</td>
<td>110</td>
</tr>
<tr>
<td>23</td>
<td>70</td>
</tr>
<tr>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>26</td>
<td>0</td>
</tr>
</tbody>
</table>

a. 21  
b. 22  
c. 23  
d. 24

13. The optimal amount of an activity is determined at the point where the activity yields

a. maximum marginal benefit.  
b. minimum marginal cost.  
c. equal value of marginal benefit and marginal cost.  
d. zero marginal cost.
14. Refer to the graph below. The price line indicates the additional revenue (or additional benefit) obtained from selling an additional unit of output. The marginal cost curve shows the cost of producing an additional unit. What is the optimal level of output?

![Graph showing marginal cost and price curves]

- a. 55 units, where price is greater than marginal cost
- b. 85 units, where price equals marginal cost
- c. 100 units, where price is below marginal cost
- d. either 55 units or 100 units, or as long as price differs from marginal cost

15. This question tests your understanding of Application 4 in this chapter: Fertilizer and crop yields. Do farmers experience diminishing returns? The table below shows the relationship between the amount of fertilizer and the corn output, all else the same.

<table>
<thead>
<tr>
<th>Table 2.1</th>
<th>FERTILIZER AND CORN YIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bags of Fertilizer</td>
<td>Bushels of Corn Per Acre</td>
</tr>
<tr>
<td>0</td>
<td>85</td>
</tr>
<tr>
<td>1</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>135</td>
</tr>
<tr>
<td>3</td>
<td>144</td>
</tr>
<tr>
<td>4</td>
<td>147</td>
</tr>
</tbody>
</table>

What causes a farmer to experience diminishing returns?
- a. The fact that he doubles up all of his inputs at once in order to increase his crop yield.
- b. The fact that he changes just one of the inputs, fertilizer, in order to increase crop yield.
- c. The ability of the farmer to increase his crop yield faster than the rate of increase in fertilizer.
- d. The farmer experiences diminishing returns anytime this year’s crop is less than last year’s crop.

16. Which of the following key principles of economics is the principle of voluntary exchange?
- a. If participation in a market is voluntary, both the buyer and the seller must be better off as a result of a transaction.
- b. What matters to people is the real value of money or income—its purchasing power—not the face value of money or income.
- c. What matters in decision making is what happens at the margin.
- d. The opportunity cost of something is what you sacrifice to get it.
17. From the principle of voluntary exchange, we conclude that
a. often buyers are made better off and sellers are worse off when an exchange is made.
b. often sellers are made better off and buyers are worse off when an exchange is made.
c. both the buyer and the seller must be better off as a result of a transaction.
d. both the buyer and the seller might be worse off as a result of a transaction.

18. According to the real-nominal principle, what matters to workers is the real wage rate (or purchasing power of wages). The real wage rate
a. always increases when the nominal wage rate increases.
b. always increases when the nominal wage rate decreases.
c. may increase or decrease when nominal wages change.
d. will not change with a change in the nominal wage rate.

19. Which of the following is NOT an example of nominal value?
   a. a price shown on a clothing tag in a retail store
   b. the value you could sell your house for at an auction today
   c. tuition costs that are adjusted for inflation
   d. the amount of money you receive from the bank as interest on a deposit

20. James has enough money to buy a car at the market price from fifteen years ago, but that amount of money is only half of what he would need to buy it today. Which principle does this problem represent?
   a. the principle of opportunity cost
   b. the principle of voluntary exchange
   c. the principle of diminishing returns
   d. the real-nominal principle

21. During your next job interview, you will use the marginal principle to explain why you should be hired. What will you say?

22. Think about opportunity cost. What is the opportunity cost of you attending college? Write a short essay describing what it really costs you to attend.

23. Which economic principles are involved in the analysis of scarcity using a production possibilities curve?

24. Among the reasons for the use of marginal analysis in economics is that there are natural and technical constraints that prevent us from achieving unlimited results. Provide five examples of situations in which additional effort yields diminishing returns.

25. Think about the discussion of speed and safety in the text. Drivers have to decide whether or not to speed as they drive down the interstate. Explain how each of the following factors affects the decision to speed:
   i. a smaller likelihood of getting caught speeding.
   ii. better safety equipment in cars.
   iii. increased fines for speeding.
Answers to the Practice Quiz

1. d. The concept of opportunity cost is based on the principle of scarcity. Because resources are scarce, there exists a tradeoff for every choice you make.

2. b. Opportunity cost is the value of your next best choice, which in this case, is the Coke.

3. d. Housing is not an opportunity cost because you have to live somewhere anyway. However, you are implicitly giving up the wages that you could have earned.

4. b. Opportunity costs are costs stated in terms of the alternative use, such as how the funds could have been used, or the value of your time when used in the best alternative activity.

5. a. Three boats must be sacrificed (7 – 4) in order to increase the production of lobsters by 100.

6. a. When the economy moves from a point inside to a point on the production possibilities curve, resources become fully and efficiently employed.

7. a. As long as a point lies on the curve, resources are fully and efficiently employed at that point.

8. a. An increase in the amount of resources available to the economy shifts the production possibilities curve outward.

9. c. In both instances, the economy must give up to 40 metric tons of aluminum in order to increase wheat production from 140 to 160 tons.

10. b. Since the production possibilities curve is a straight line, the opportunity cost remains constant as you move downward along the line. A linear production possibilities curve reflects perfect substitutability of resources in production.

11. b. The marginal benefit is the extra benefit provided by the 4th slice of pizza: $10.50 – $9.00 = $1.50.

12. 2. The marginal benefit of the 23rd hour is only $70, and so Ted would not want to pay costs of $90 to stay open for an hour if the benefit is only $70.

13. c. According to the marginal principle, we should increase the level of an activity if its marginal benefit exceeds its marginal cost; reduce the level of an activity if its marginal cost exceeds its marginal benefit. If possible, pick the level at which the activity’s marginal benefit equals its marginal cost. Maximum, minimum, or zero are not the measures of optimality.

14. b. Stop the level of an activity where marginal benefit (or price in this case) equals marginal cost.

15. b. The notion of diminishing returns applies to all inputs to the production process. Because the farmer is changing just one of the inputs, fertilizer, the output will increase, but at a decreasing rate. Eventually, additional fertilizer will actually decrease output as the other nutrients in the soil are overwhelmed by the fertilizer.

16. a. According to the principle of voluntary exchange, a voluntary exchange between two people makes both people better off.
17. c. According to the principle of voluntary exchange, if participation in a market is voluntary, both the buyer and the seller must be better off as a result of a transaction.

18. c. Changes in the real wage rate depend not only on the nominal wage rate but also on the price level.

19. c. When costs are adjusted for inflation, they represent real values. An increase in prices due to inflation does not represent an actual increase in the amount of the good or service provided.

20. d. The real value of a good is a sum of money in terms of the quantity of good it can buy. The real value of this car has not changed—only its nominal value, the face value of a sum of money, has changed.

21. In accordance with the marginal principle, you should be hired because the additional cost to the company (your salary and benefits) will outweigh the contributions you will make to the firm, or the additional revenue the firm will obtain from your productive activity.

22. What is the opportunity cost of a college degree? Consider a student who spends a total of $40,000 for tuition and books. Instead of going to college, the student could have spent this money on a wide variety of goods, including housing, stereo equipment, and world travel. Part of the opportunity cost of college is the $40,000 worth of other goods the student sacrifices to pay for tuition and books. Also, instead of going to college, the student could have worked as a bank clerk for $20,000 per year and earned $80,000 over four years. That makes the total opportunity cost of this student’s college degree $120,000.

23. The production possibilities curve involves two of the fundamental principles: the principle of opportunity cost, and the principle of diminishing returns. The principle of opportunity cost is described by a move from one point to another along the curve. The curve shows combinations of two goods, or sets of goods, that can be produced when resources are fully and efficiently employed.

As we increase the production of one good, we must sacrifice some of the other good. The principle of diminishing returns explains the shape of the curve. The curve is bowed out because resources are not perfectly substitutable in production. For this reason, it takes an ever greater amount of resources to produce additional units of a good, particularly when the production of that good is already high.

24. a. Additional water into a flowerpot does not cause a flower to grow proportionally to the amount of water added.
   b. As speed rises, it becomes harder and harder to gain an extra mile of speed.
   c. As consumption rises, an extra bite does not yield as much satisfaction as the previous one.
   d. The knowledge gained from an extra hour of study is less than the knowledge gained from the previous hour, particularly when you have been studying for a long time already.
   e. In an eight-hour workday, the productivity of the last hour is smaller than the productivity of the first hour.

25. A lower likelihood of getting caught speeding would lower the marginal cost of speeding. For instance, if there is a 10% chance of getting a ticket, and a ticket costs $100, the expected cost of getting caught is .1(100) = $10. If there is only a 5% chance of getting caught, the marginal cost of speeding drops to $5 and more people will speed. As cars become safer the risk of injury in an accident decrease, as does the expected injury if one occurs. This also lowers the marginal cost of speeding and should lead to more speeding. Increased fines make speeding more expensive raising the marginal cost and discouraging people from speeding.