2 Demand, Supply, and Market Equilibrium

Learning Objectives

After reading Chapter 2 and working the problems for Chapter 2 in the textbook and in this Workbook, you should be able to:

➢ Work with three different types of demand relations: general, direct, and inverse demand functions.

➢ List six principal variables that determine the quantity demanded of a good.

➢ Derive a direct demand function from a general demand function.

➢ Give two interpretations of a point on a demand curve.

➢ Find inverse demand functions.

➢ Distinguish between changes in "quantity demanded" (i.e., a *movement* along demand) and changes in "demand" (i.e., a *shift* in the demand curve)

➢ Work with three different types of supply relations: general, direct, and inverse supply functions.

➢ List six principal variables that determine the quantity supplied of a good.

➢ Distinguish between changes in "quantity supplied" (i.e., a *movement* along supply) and changes in "supply" (i.e., a *shift* in the supply curve)

➢ Explain why market equilibrium occurs at the price for which quantity demanded equals quantity supplied (i.e., neither excess demand nor excess supply exist).

➢ Employ the concepts of consumer surplus, producer surplus, and social surplus to measure the gains to society from market exchange between buyers and sellers.

➢ Explain why the demand price for any particular unit demanded can be interpreted as the economic value of that unit (i.e., the maximum amount anyone would pay for that unit of the good).

➢ Analyze the impact on equilibrium price and quantity of a shift in either the demand curve or the supply curve, while the other curve remains constant.

➢ Analyze simultaneous shifts in both demand and supply curves.

➢ Explain the impact of government imposed price ceilings and price floors.

Essential Concepts

1. The amount of a good or service that consumers are willing and able to purchase during a given period of time is called *quantity demanded* (Q_d). Six principal variables influence quantity demanded: (1) the price of the good or service (P), (2) the incomes of consumers (M), (3) the prices of related goods and services (P_R), (4) the taste patterns of consumers ($\Im$), (5) the expected price of the product in some future period (P_e), and (6) the number of consumers in the market (N). The relation between quantity demanded and the six factors that influence the quantity demanded of a good is called the *general demand function* and is expressed as follows:

$$Q_d = f(P, M, P_R, \Im, P_e, N)$$

The general demand function shows how all six variables *jointly* determine the quantity demanded.

2. The impact on Q_d of changing one of the six factors *while the other five remain constant* is summarized below.

    (1) The quantity demanded of a good is inversely related to its own price by the *law of demand*. Thus $\Delta Q_d / \Delta P$ is negative.

    (2) A good is said to be *normal* (*inferior*) when the amount consumers demand of a good varies directly (inversely) with income. Thus $\Delta Q_d / \Delta M$ is positive (negative) for normal (inferior) goods.

    (3) Commodities that are related in consumption are said to be *substitutes* if the demand for one good varies directly with the price of another good so that $\Delta Q_d / \Delta P_R$ is positive. Alternatively, two goods are said to be *complements* if the demand for one good varies inversely with the price of another good so that $\Delta Q_d / \Delta P_R$ is negative.

    (4) When buyers expect the price of a good or service to rise (fall), demand in the current period of time increases (decreases). Thus, $\Delta Q_d / \Delta P_e$ is positive.

    (5) A movement in consumer tastes toward (away from) a good, as reflected by an increase (decrease) in the consumer taste index $\Im$, will increase (decrease) demand for a good. Thus $\Delta Q_d / \Delta \Im$ is positive.

    (6) An increase (decrease) in the number of consumers in a market will increase (decrease) the demand for a good. Thus $\Delta Q_d / \Delta N$ is positive.

3. The general demand function can be expressed in linear functional form as

$$Q_d = a + bP + cM + dP_R + e\Im + fP_e + gN$$

where the slope parameters *b, c, d, e, f,* and *g* measure the effect on Q_d of changing one of the six variables (P, M, P_R, $\Im$, P_e, or N) while holding the other five variables constant. For example, *b* ($= \Delta Q_d / \Delta P$) measures the change in Q_d per unit change in P holding M, P_R, $\Im$, P_e, and N constant. When the slope parameter of a particular variable is positive (negative), Q_d is directly (inversely) related to that variable. The following table summarizes the interpretation of the parameters in the general linear demand function.

Variable	Relation to Quantity Demanded	Sign of Slope Parameter
P	Inverse	$b = \Delta Q_d / \Delta P$ is negative
M	Direct for normal goods Inverse for inferior goods	$c = \Delta Q_d / \Delta M$ is positive $c = \Delta Q_d / \Delta M$ is negative
P_R	Direct for substitute goods Inverse for complement goods	$d = \Delta Q_d / \Delta P_R$ is positive $d = \Delta Q_d / \Delta P_R$ is negative
$\Im$	Direct	$e = \Delta Q_d / \Delta \Im$ is positive
P_e	Direct	$f = \Delta Q_d / \Delta P_e$ is positive
N	Direct	$g = \Delta Q_d / \Delta N$ is positive

4. The *direct demand function* (or simply *demand*) shows the relation between price and quantity demanded when all other factors that affect consumer demand are held constant. The "other things" held constant are the five variables other than price that can affect demand $(M, P_R, \Im, P_e, N)$. The direct demand equation expresses quantity demanded as a function of product price only:

$$Q_d = f(P)$$

The variables M, P_R, $\Im$, P_e, and N are assumed to be constant and therefore do *not* appear as variables in direct demand functions.

5. When graphing demand curves, economists traditionally plot the independent variable price (P) on the vertical axis and Q_d, the dependent variable, on the horizontal axis. The equation so plotted is actually the *inverse* demand function $P = f(Q_d)$.

6. A point on a demand curve shows either: (1) the maximum amount of a good that will be purchased if a given price is charged; or (2) the maximum price consumers will pay for a specific amount of the good. This maximum price is sometimes referred to as the *demand* price for that amount of the good.

7. The *law of demand* states that quantity demanded increases when price falls and quantity demanded decreases when price rises, other things held constant. The law of demand implies $\Delta Q_d / \Delta P$ must be negative; Q_d and P are inversely related.

8. When the price of a good changes, the "quantity demanded" changes. A change in a good or service's own price causes a change in quantity demanded, and this change in quantity demanded is represented by a movement along the demand curve.

9. The five variables held constant in deriving demand $(M, P_R, \Im, P_e, N)$ are called the *determinants of demand* because they determine where the demand curve is located. When there is a change in any of the five determinants of demand, a "change in demand" is said to occur, and the demand curve shifts either rightward or left-

ward. An increase (decrease) in demand occurs when demand shifts rightward (leftward). The determinants of demand are also called the "demand-shifting variables."

10. The quantity supplied (Q_s) of a good depends most importantly upon six factors: (1) the price of the good itself (P), (2) the price of inputs used in production (P_I), (3) the prices of goods related in production (P_r), (4) the level of available technology (T), (5) the expectations of producers concerning the future price of the good (P_e), and (6) the number of firms producing the good or the amount of productive capacity in the industry (F). The *general supply function* shows how all six of these variables *jointly* determine the quantity supplied

$$Q_s = g(P, P_I, P_r, T, P_e, F)$$

11. The impact on Q_s of changing one of the six factors *while the other five remain constant* is summarized below.

   (1) The quantity supplied of a good is directly related to the price of the good. Thus $\Delta Q_s / \Delta P$ is positive.

   (2) As input prices increase (decrease), production costs rise (fall), and producers will want to supply a smaller (larger) quantity at each price. Thus $\Delta Q_s / \Delta P_I$ is negative.

   (3) Goods that are related in production are said to be *substitutes in production* if an increase in the price of good X relative to good Y causes producers to increase production of good X and decrease production of good Y. Thus $\Delta Q_s / \Delta P_r$ is negative for substitutes in production. Goods X and Y are said to be *complements in production* if an increase in the price of good X relative to good Y causes producers to increase production of both goods. Thus $\Delta Q_s / \Delta P_r$ is positive for complements in production.

   (4) Advances in technology (reflected by increases in T) reduce production costs and increase the supply of the good. Thus $\Delta Q_s / \Delta T$ is positive.

   (5) If firms expect the price of a good they produce to rise in the future, they may withhold some of the good, thereby reducing supply of the good in the current period. Thus, $\Delta Q_s / \Delta P_e$ is negative.

   (6) If the number of firms producing the product increases (decreases) or the amount of productive capacity in the industry increases (decreases), then more (less) of the good will be supplied at each price. Thus $\Delta Q_s / \Delta F$ is positive.

12. The general supply function can be expressed in linear functional form as

$$Q_s = h + kP + lP_I + mP_r + nT + rP_e + sF$$

where the slope parameters are interpreted as summarized in the following table:

Variable	Relation to Quantity Supplied	Sign of Slope Parameter
P	Direct	$k = \Delta Q_s / \Delta P$ is positive
P_I	Inverse	$l = \Delta Q_s / \Delta P_I$ is negative
P_r	Inverse for substitutes in production (wheat and corn)	$m = \Delta Q_s / \Delta P_r$ is negative
	Direct for complements in production (oil and gas)	$m = \Delta Q_s / \Delta P_r$ is positive
T	Direct	$n = \Delta Q_s / \Delta T$ is positive
P_e	Inverse	$r = \Delta Q_s / \Delta P_e$ is negative
F	Direct	$s = \Delta Q_s / \Delta F$ is positive

13. The *direct supply function* (or simply *supply*) gives the quantity supplied at various prices and may be expressed mathematically as

$$Q_s = f(P)$$

where P_I, P_r, T, P_e, and F are assumed to be constant and therefore do not appear as variables in the supply function. An increase (decrease) in price causes an increase in quantity supplied, which is represented by an upward (downward) movement along a given supply curve.

14. A point on the direct supply curve indicates either (1) the maximum amount of a good or service that will be offered for sale at a given price, or (2) the minimum price necessary to induce producers voluntarily to offer a particular quantity for sale. This minimum price is sometimes referred to as the *supply price* for that level of output.

15. When any of the five determinants of supply (P_I, P_r, T, P_e, F) change, "supply" (not "quantity supplied") changes. A change in supply results in a shift of the supply curve. Only when the price of a good changes does the quantity supplied change.

16. The equilibrium price and quantity in a market are determined by the intersection of demand and supply curves. At the point of intersection, quantity demanded equals quantity supplied, and the market clears. Buyers can purchase all they want and sellers can sell all they want at the "market-clearing" (equilibrium) price.

17. Since the location of the demand and supply curves is determined by the five determinants of demand and the five determinants of supply, a change in any one of these ten variables will result in a new equilibrium point. The following figure summarizes the results when either demand or supply shifts while the other curve remains constant.
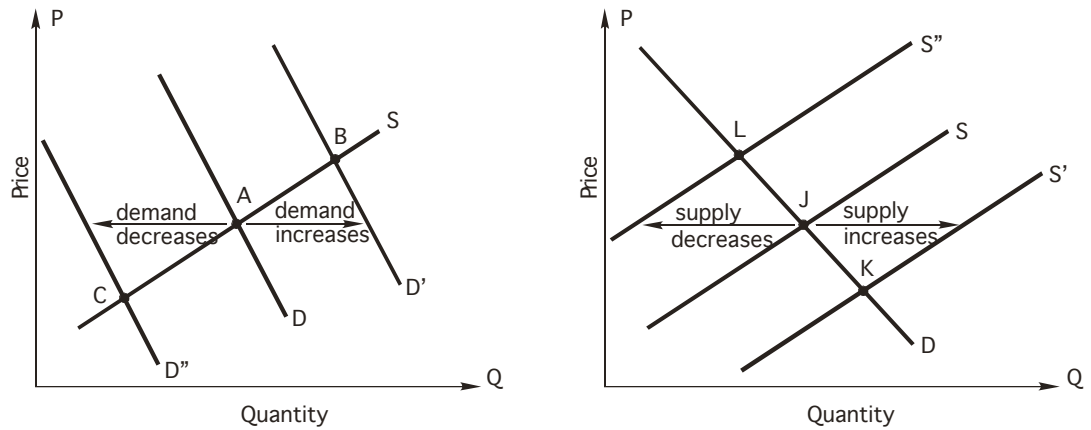
Panel A: Shifts in demand (supply constant) **Panel B:** Shifts in supply (demand con

When demand increases and supply remains constant, price and quantity sold both rise, as shown by the movement from point *A* to *B* in Panel *A* above. A decrease in demand, supply constant, causes both price and quantity sold to fall, as shown by the movement from point *A* to *C*. When supply increases and demand remains constant, price falls and quantity sold rises, as shown by the movement from point *J* to *K* in Panel *B* above. A decrease in supply, demand constant causes price to rise and quantity to fall, as shown by the movement from *J* to *L*.

18. When both supply and demand shift simultaneously, it is possible to predict either the direction in which price changes or the direction in which quantity changes, but not both. The change in equilibrium quantity or price is said to be indeterminate when the direction of change depends upon the relative magnitudes by which demand and supply shift. The four possible cases for simultaneous shifts in demand and supply are summarized in Figure 2.9 of your textbook.

19. When government sets a ceiling price below the equilibrium price, a shortage results because consumers wish to buy more of the good than producers are willing to sell at the ceiling price. If government sets a floor price above the equilibrium price, a surplus results because producers offer for sale more of the good than buyers wish to consume at the floor price.

Matching Definitions

ceiling price
change in demand
change in quantity demanded
change in quantity supplied
complements
complements in production
consumer surplus
decrease in demand
decrease in supply
demand
demand price
determinants of demand
determinants of supply
economic value
equilibrium price

equilibrium quantity
excess demand (shortage)
excess supply (surplus)
floor price
general demand function
general supply function
increase in demand
increase in supply
indeterminate
inferior good
inverse demand function
inverse supply function
law of demand
market clearing price

market equilibrium
normal good
producer surplus
qualitative forecasts
quantitative forecasts
quantity demanded
quantity supplied
slope parameters
social surplus
substitutes
substitutes in production
supply
supply price
technology

1. _____ Amount of a good or service that consumers are willing and able to purchase during a given period of time.

2. _____ Relation between quantity demanded and the six principal variables affecting quantity demanded.

3. _____ A good for which demand decreases with decreases in income.

4. _____ A good for which demand increases with decreases in income.

5. _____ Two goods for which an increase in the price of one causes an increase in consumption of the other, all other things constant.

6. _____ Two goods for which a decrease in the price of one causes an increase in consumption of the other, all other things constant.

7. _____ Parameters in a linear function that measure the effect on the dependent variable of a one-unit change in the value of an independent variable, holding all others variables constant.

8. _____ The relation that shows how quantity demanded varies with price, holding all other factors constant.

9. _____ Price is expressed as a function of quantity demanded.

10. _____ The maximum price consumers will pay for a specific amount of a good.

11. _____ Quantity demanded increases when price falls and decreases when price rises, other things held constant.

12. _____ A movement along a given demand curve caused by a change in the good's own price.

13. _____ Quantity demanded increases at every price.

14. _____ Quantity demanded decreases at every price.

15. _____ The five principal variables that determine the location of the demand curve $(M, P_R, \Im, P_e, N)$. These are the demand shifting variables.

16. _____ A shift in demand that occurs when one of the demand shifting variables changes.

17. _____ The amount of a good or service offered for sale per time period.

18. _____ The relation between quantity supplied and the six principal factors affecting the quantity supplied.

19. _____ Two goods for which an increase in the price of one good causes a decrease in the production of the other good.

20. _____ Two goods for which an increase in the price of one good causes an increase in the production of the other good.

21. _____ The state of knowledge about how to combine resources to produce goods and services.

22. _____ The functional relation between price and quantity supplied, holding all other factors constant.

23. _____ The five principal variables that determine the location of the supply curve (P_I, P_r, T, P_e, F). These are the supply shifting variables.

24. _____ A movement along the supply curve caused by a change in the price of the good.

25. _____ Price is expressed as a function of quantity supplied.

26. _____ The minimum price necessary to induce producers voluntarily to offer a given quantity for sale.

27. _____ Rightward shift of a supply curve when quantity supplied increases at every price.

28. _____ Leftward shift of a supply curve when quantity supplied decreases at every price.

29. _____ Buyers can purchase all of a good they wish and producers can sell all they wish at the prevailing price.

30. _____ The price at which quantity demanded equals quantity supplied.

31. _____ The amount of a good or service that is demanded and sold in market equilibrium.

32. _____ When quantity supplied is greater than quantity demanded.

33. _____ When quantity demanded is greater than quantity supplied.

34. _____ Another name for equilibrium price.

35. _____ Maximum amount a buyer will pay for a unit of a good.

36. _____ Economic value minus market price paid for a good.

37. _____ Area below market price above supply.

38. _____ Area below demand and above supply over the range of output produced and consumed.

39. _____ Forecasts that predict only the direction in which economic variables will move.

40. _____ Forecasts that predict both the direction in which economic variables will move and the magnitudes of the changes.

41. _____ Term referring to the condition in which it is impossible to predict the direction of the change in either equilibrium quantity or equilibrium price.

42. _____ The maximum price government permits seller to charge for a good.

43. _____ The minimum price government permits seller to charge for a good.

Study Problems

1. What happens to the demand for Sony color television sets when each of the following changes occurs?

    _____ a. The price of Zenith color television sets rises.

    _____ b. The price of a Sony rises.

    _____ c. Personal income falls (color televisions are normal goods).

    _____ d. Technological advances result in dramatic price reductions for video tape recorders.

    _____ e. Congress is persuaded to impose tariffs on Japanese television sets starting next year.

2. What happens to the supply of random access memory (RAM) chips, a component in the manufacture of personal computers, when each of the following changes occurs?

     _____   a.   Two huge new manufacturing plants begin operation in South Korea.

     _____   b.   Scientists discover a new production technology that will lower the cost of making RAM chips.

     _____   c.   The price of silicon, a key ingredient in RAM chip production, rises sharply.

     _____   d.   The price of RAM chips increases.

     _____   e.   The market for personal computers turns sour and RAM chip makers now expect RAM chip prices to fall by 25 percent next quarter.

3. "The salaries of chief executive officers (CEOs) are unreasonably high." Critically evaluate this statement.

4. Suppose the quantity demanded of good (Q_d) depends only on the price of the good (P), monthly income (M), and the price of a related good R (P_R):

$$Q_d = 180 - 10P - 0.2M + 10P_R$$

a. On the axes below, construct the (direct) demand curve for the good when M = \$1,000 and P_R = \$5. The equation for demand is

      $Q_d =$ _____ .

b. Interpret the intercept and slope parameters for the demand equation in part *a*.

c. Let income decrease to \$950. Construct the new demand curve. This good is _____ (normal, inferior). Explain using your graph.

d. For the demand curve in part *c*, find the inverse demand function:

      $P =$ _____ .

e. Let the price of good R increase to \$6 (income remaining at \$950). Construct the new demand curve. Good R is a _____ (substitute, complement) good. Explain using your graph.

f. For the demand curve in part *e*, the demand price for 20 units is \$_____ . At a price of \$4, the maximum amount consumers are willing and able to purchase is _____ units.

g. For the demand curve in part *e*, find the equilibrium price and quantity when supply is $Q_s = -10 + 10P$.

      $P_E =$ _____   and $Q_E =$ _____

Construct the supply curve and verify your answer.

h. For the equilibrium in part *g*, the consumer surplus is $_____. Producer surplus is $_____. Social surplus is $_____. The net gain to society created by the market for this good is $_____.
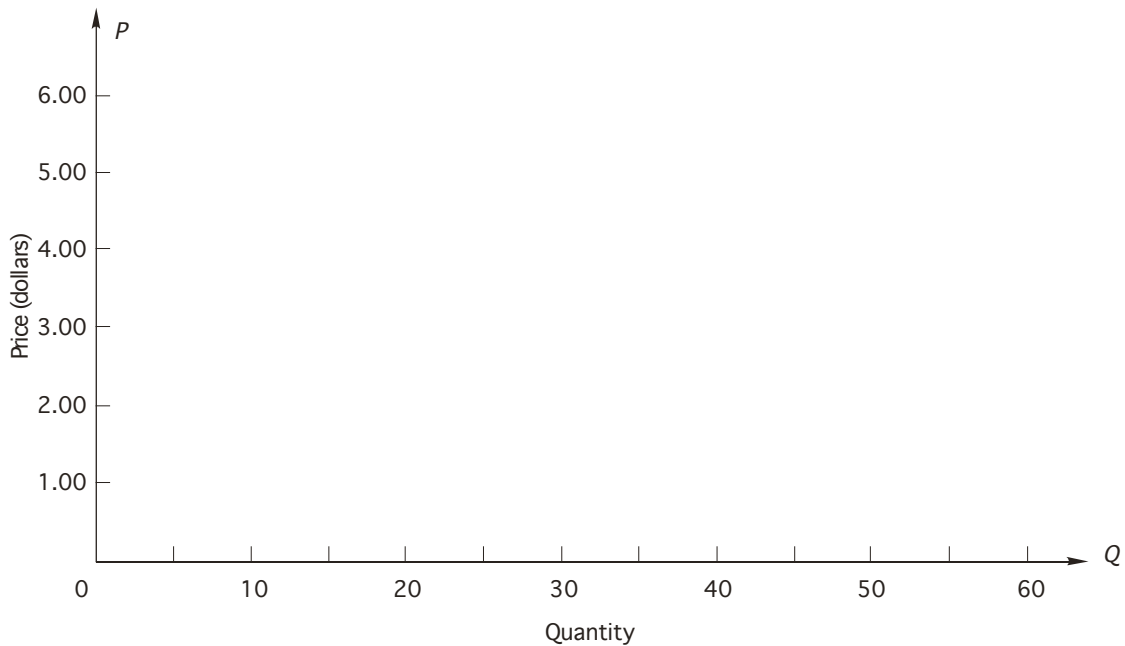

5. Consider the following demand and supply functions for tomatoes:

$$Q_d = 6,000 - 4,000P$$
$$Q_s = -1,000 + 10,000P$$

a. Plot the demand and supply functions on the axes below.

b. At a price of $1.00 per tomato, _____ tomatoes is the maximum amount that can be sold. A price of $_____ per tomato is the maximum price that consumers will pay for 2,000 tomatoes, which is the demand price for 2,000 tomatoes.

c. The maximum amount of tomatoes that producers will offer for sale if the price of tomatoes is $0.30 is _____. The minimum price necessary to induce producers to offer voluntarily 2,000 tomatoes for sale is $_____, which is called the supply price for 2,000 tomatoes.

d. In equilibrium, the price of tomatoes is $_____ and _____ tomatoes will be sold.

e. In equilibrium, the quantity of tomatoes produced is _____ tomatoes.

f. In equilibrium, the quantity of tomatoes consumed is _____ tomatoes.

g. Are your answers to parts *e* and *f* the same? Why or why not?

h. Congress imposes a $0.30 per tomato ceiling price on tomatoes. This results in a _____ (surplus, shortage) of _____ tomatoes.

Price per tomato (dollars)

Quantity of tomatoes
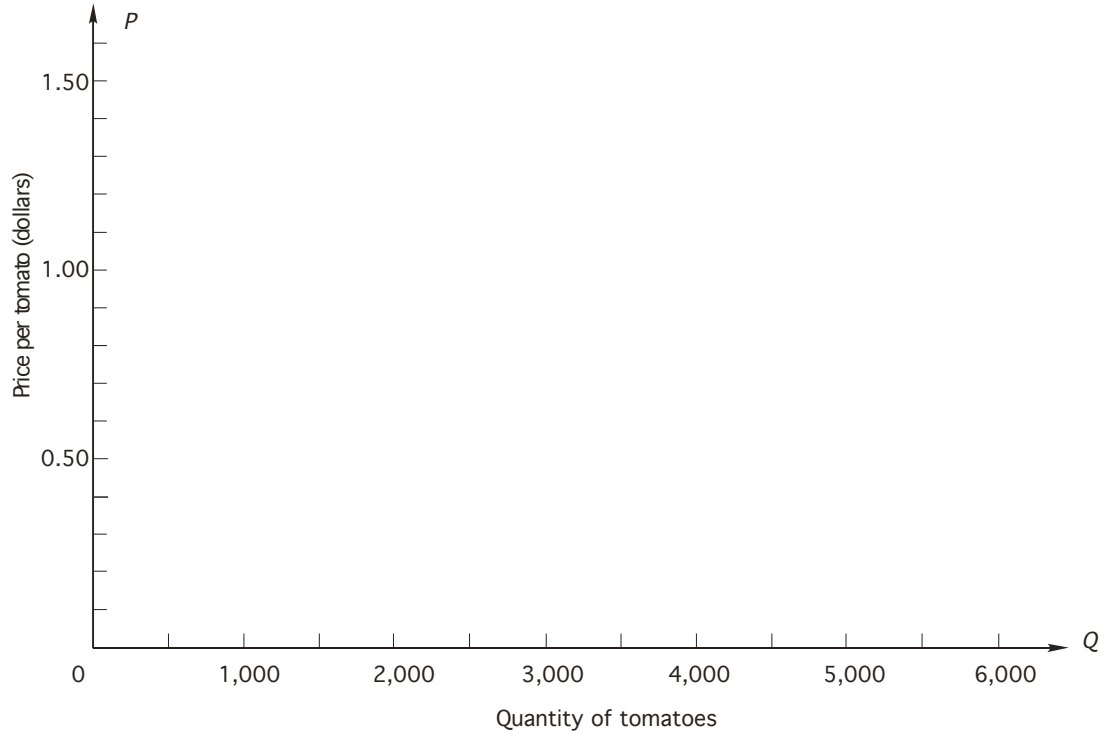
6. "A decrease in the supply of crude oil will cause a shortage of crude oil." Evaluate this statement with a concise narrative and graphical analysis.

7. "An increase in the demand for electricity will cause a shortage of electricity." Evaluate this statement with a concise narrative and graphical analysis.

8. Determine the effect on equilibrium price and quantity if the following changes occur in a particular market:

|	*Equilibrium price*	*Equilibrium quantity*	
a.	_____	_____	Consumers' income decreases and the good is inferior.
b.	_____	_____	The price of a substitute good (in consumption) decreases.
c.	_____	_____	The price of a substitute good in production decreases.
d.	_____	_____	The price of a complement good (in consumption) decreases.
e.	_____	_____	The price of inputs used to produce the good decrease.

9.	At the meat counter of a local supermarket, two shoppers were overheard complaining about the high price of hamburger. They concluded that government should not allow the price of beef to rise above $2.25 per pound. Do you think the shoppers would actually be better off if a price ceiling were imposed to lower hamburger prices? Why or why not?

10.	The following events occur simultaneously:

>	(i)	Scientists at Texas A&M University discover a way to triple the number of oranges produced by a single orange tree.

>	(ii)	The *New England Journal of Medicine* publishes research results that show "conclusively" that drinking orange juice reduces the risk of heart attack and stroke by 40 percent.

a.	Draw a demand-and-supply graph showing equilibrium in the market for orange juice before the two events described above. Label the axes and curves. Label the initial equilibrium—before events (i) and (ii)—as P_0 and Q_0 on your graph.

b.	Now show on your graph how event (i) affects the demand or supply curves for orange juice. Briefly explain which of the demand or supply variables caused the effect you are showing on your graph.

c.	Now show on your graph how event (ii) affects the demand or supply curves for orange juice. Briefly explain which of the demand or supply variables caused the effect you are showing on your graph.

d.	Based on your graphic analysis, what do you predict will happen to the equilibrium price of orange juice? The equilibrium quantity of orange juice?

Multiple Choice / True-False

1.	Which one of the following will NOT cause an increase in the demand for Whirlpool dishwashers?
	a.	A decline in home mortgage interest rates.
	b.	An increase in real disposable income.
	c.	General Electric raises the price of its dishwashers.
	d.	Introduction of new semiconductors reduces the per unit cost of producing dishwashers.

2.	The quantity supplied of coffee beans decreases when
	a.	average annual rainfall decreases due to a drought in Central and South America.
	b.	the price of coffee beans falls.
	c.	the price of tea rises.
	d.	a labor union for coffee bean pickers forms and wages rise.

3. Which of the following statements correctly describes market equilibrium?
   a. Consumers can buy all of the good they wish at the market price.
   b. Producers can sell all of the good they wish at the market price.
   c. Neither a surplus nor a shortage exists.
   d. All of the above.

Use the figure below to answer questions 4 and 5.
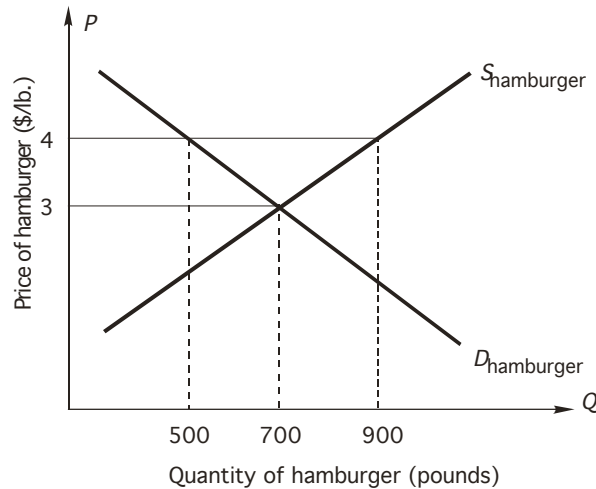
4. Suppose government sets a floor of $4 on the price of beef. This results in
   a. a surplus of 400 tons of hamburger.
   b. a surplus of 200 tons of hamburger.
   c. a shortage of hamburger.
   d. consumers purchasing 900 tons of hamburger at a price of $4.

5. Suppose government imposes a ceiling price of $4 on hamburger. This results in
   a. a surplus of 400 tons of hamburger.
   b. a surplus of 200 tons of hamburger.
   c. a shortage of hamburger.
   d. consumers purchasing 700 tons of hamburger at a price of $3.

6. When the Super Bowl was played in Tampa, some fans complained that there were not enough hotel rooms. We can conclude that
   a. the game should have been played in a bigger city.
   b. the market for hotel rooms was in equilibrium.
   c. the city council should have done a study so that the hotel industry would have constructed more hotel rooms.
   d. the price of hotel rooms was below the market-clearing price.

Use the following supply and demand functions to answer Questions 7 - 9:

$$Q_d = 100 - 2P$$

$$Q_s = -20 + P$$

7. What are equilibrium price and quantity?
   a. $P_E = \$20$ and $Q_E = 100$
   b. $P_E = \$40$ and $Q_E = 20$
   c. $P_E = \$60$ and $Q_E = 40$
   d. $P_E = \$30$ and $Q_E = 40$

8. At the equilibrium price and quantity found in question 7, which of the following statements is FALSE?
   a. Social surplus is $400.
   b. Consumer surplus for the last unit consumed is zero.
   c. Producer surplus is $200.
   d. Consumer surplus is $.5 \times 20 \times \$10$.
   e. The economic value of the 20th unit consumed is $40.

9. Suppose a price of $46 is imposed on the market. This results in a
   a. shortage of 10 units.
   b. shortage of 26 units.
   c. surplus of 10 units.
   d. surplus of 18 units.

10. Suppose a price of $30 is imposed on the market. This results in a
    a. shortage of 30 units.
    b. shortage of 10 units.
    c. surplus of 10 units.
    d. surplus of 30 units.

11. In which of the following cases will the effect on equilibrium output be indeterminate (i.e., depend on the magnitudes of the shifts in supply and demand)?
    a. Demand increases and supply increases.
    b. Demand decreases and supply decreases.
    c. Demand decreases and supply increases.
    d. Demand remains constant and supply increases.

The general linear demand function below is used to answer the next three questions:

$$Q_d = a + bP + cM + dP_R$$

where Q_d = quantity demanded, P = the price of the good, M = household income, P_R = the price of a good related in consumption.

12. The law of demand requires that
    a. $a < 0$.
    b. $b < 0$.
    c. $P < 0$.
    d. $a < 0$ and $b < 0$.
    e. $b < 0$ and $P < 0$.

13. If $c = 0.01$ and $d = -32$, the good is
   a. a normal good.
   b. an inferior good.
   c. a substitute for good R.
   d. a complement with good R.
   e. both a and d.

14. For the general linear demand function given above
   a. $\Delta Q_d / \Delta M = c$.
   b. d is the effect on the quantity demanded of the good of a one-dollar change in the price of the related good, all other things constant.
   c. b is the effect on the quantity demanded of the good of a one-dollar change in the price of the good, all other things constant.
   d. all of the above.

15. In which of the following case(s) must equilibrium quantity always fall?
   a. Demand increases and supply increases.
   b. Demand decreases and supply decreases.
   c. Supply decreases and demand remains constant.
   d. Demand decreases and supply increases.
   e. Both b and c.

16. T   F   A decrease in supply causes a shortage.

17. T   F   When demand decreases, supply constant, equilibrium output rises.

18. T   F   Predicting that price will rise by 10 percent as a result of an increase in the price of labor is a *qualitative* forecast.

19. T   F   A market is in equilibrium when supply equals demand.

20. T   F   A rise in the price of aluminum will cause an increase in the demand for steel and plastic.

21. T   F   Only a change in a good's own price will cause a change in the quantity demanded of the good.

22. T   F   The economic value of a kilowatt of electricity is the difference between the price paid for a kilowatt and the minimum price the electric company will accept to produce a kilowatt.

23. T   F   For the equilibrium quantity of a good, consumer surplus is positive for every unit consumed except for the last unit, which has zero consumer surplus.

Answers

1. quantity demanded
2. general demand function
3. normal good
4. inferior good
5. substitutes
6. complements
7. slope parameters
8. demand
9. inverse demand function
10. demand price
11. law of demand
12. change in quantity demanded
13. increase in demand
14. decrease in demand
15. determinants of demand
16. change in demand
17. quantity supplied
18. general supply function
19. substitutes in production
20. complements in production
21. technology
22. supply

23. determinants of supply
24. change in quantity supplied
25. inverse supply function
26. supply price
27. increase in supply
28. decrease in supply
29. market equilibrium
30. equilibrium price
31. equilibrium quantity
32. excess supply (surplus)
33. excess demand (shortage)
34. market clearing price
35. economic value
36. consumer surplus
37. producer surplus
38. social surplus
39. qualitative forecasts
40. quantitative forecasts
41. indeterminate
42. price ceiling
43. price floor

STUDY PROBLEMS

1.
   a. Demand increases (shifts rightward)
   b. Nothing happens to Sony demand; demand does not shift. Quantity demanded, however, decreases.
   c. Demand decreases (shifts leftward)
   d. Demand increases (shifts rightward)
   e. Demand in the current time period increases (shifts rightward) since consumers expect price to be higher next year.

2.
   a. Supply increases (shifts rightward)
   b. Supply increases (shifts rightward)
   c. Supply decreases (shifts leftward)
   d. Nothing happens to RAM chip supply; supply does not shift. Quantity supplied, however, increases.
   e. Supply in the current time period increases (shifts rightward) as producers increase production in the current time period to sell more chips at a price that is higher relative to the price they expect to receive in the next quarter.

3.
   The salaries of CEOs are determined by supply and demand. If supply were greater or demand smaller, then the salaries of CEOs would be lower.

4.   The three demand curves for parts *a*, *c*, and *e*, and the supply curve in part *g* are plotted below:
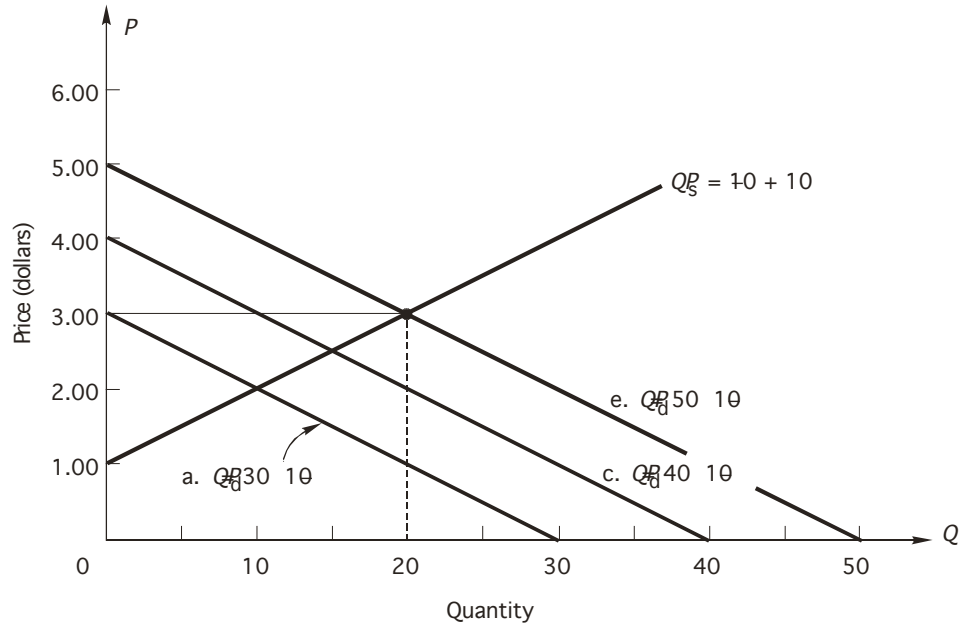
a. $Q_d = 30 - 10P$. The demand curve is shown in the figure above.

b.   Intercept parameter $a = 30$:   If price is zero, consumers will take only 30 units.

Slope parameter $b = -10$:   For each $1 increase in price, consumers buy 10 fewer units.

c.   The demand curve is shown in the figure above as $Q_d = 40 - 10P$. Inferior, since *de-creasing* income from $1,000 to $950 results in an increase in demand, which can only happen for inferior goods.

d. $P = 4 - 1/10 Q_d$

e.   The demand curve is shown in the figure above as $Q_d = 50 - 10P$. Substitutes, since increasing the price of *R* from $5 to $6 results in an increase in demand.

f. $3 (= 5 - (1/10) \times 20$, which is the inverse demand in part *e*); 10 ($= 50 - 10 \times 4$)

g.   Set $Q_d = Q_s$: $50 - 10P = -10 + 10P$. Solve to get $P_E = 3. Substituting $3 into either the demand equation or the supply equation:
$$50 - 10 \times 3 = -10 + 10 \times 3 = 20 = Q_E$$

h.   Consumer surplus at the equilibrium point in part g is $20 [= .5 × 20 × ($5 − $3)]. Producer surplus is $20 [= .5 × 20 × ($3 − $1)]. Social surplus is $40, the sum of consumer surplus and producer surplus. The net gain to society from this market is measured by social surplus, which is $40.

5. a. Your demand and supply curves should look like this:
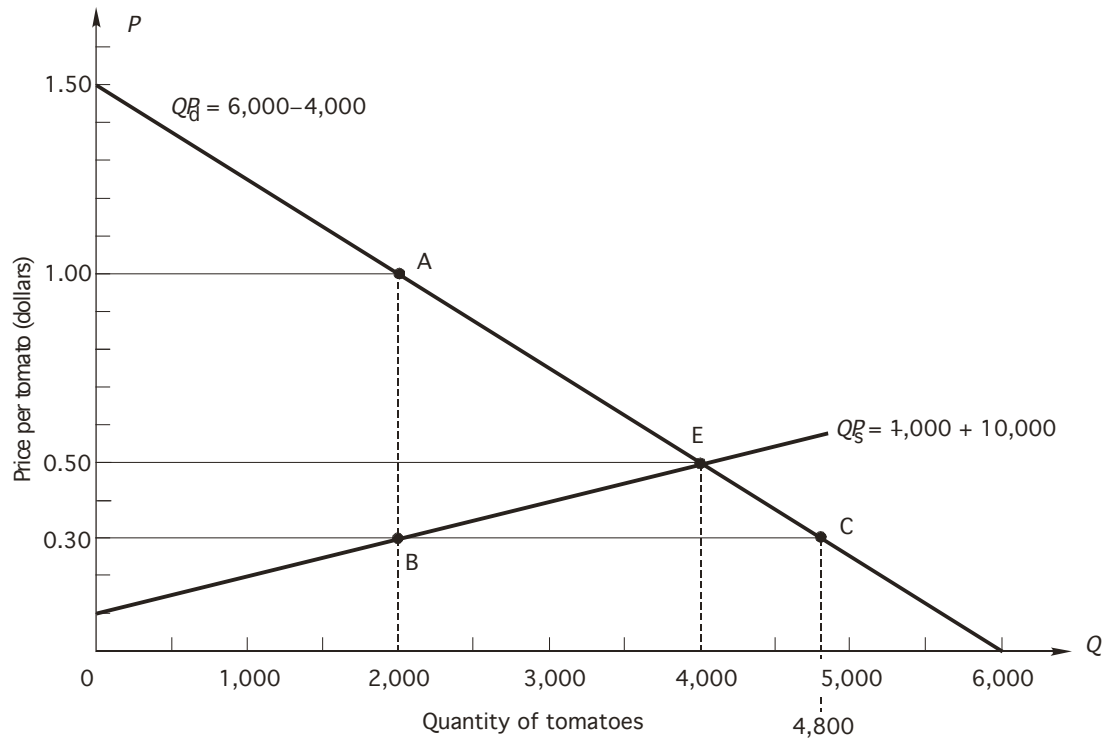
b. 2,000 $(= 6,000 - 4,000 \times 1.00)$ see point A; $1
c. 2,000 $(= -1,000 + 10,000 \times 0.30)$ see point B; $0.30
d. $0.50; 4,000 (see point E)
e. 4,000
f. 4,000
g. Yes, in equilibrium quantity consumed equals quantity produced $(Q_d = Q_s)$.
h. Shortage; 2,800. Notice that at $0.30, quantity demanded is 4,800
$(= 6,000 - 4,000 \times 0.30)$, and quantity supplied is 2,000 $(= -1,000 + 10,000 \times 0.30)$.
Thus, the shortage is 2,800 $(= 4,800 - 2,000)$.

6. A decrease in the supply of crude oil will not cause a shortage as long as the price of crude oil is allowed to rise to the market clearing level. After a decrease in supply, the crude oil market will continue to clear but at a higher price. At the higher equilibrium price of crude oil, consumers can buy all they want and producers can sell all they want. Only if government places a ceiling price below the market clearing price can there be a shortage of crude oil when supply decreases. Shortages are not caused by decreases in supply. The following graph shows a decrease in crude oil supply as a leftward shift in supply from S_A to S_B, which causes equilibrium in the crude oil market to move from point A to point B and the market clearing price of crude oil rises from P_A to P_B.

Quantity of crude oil
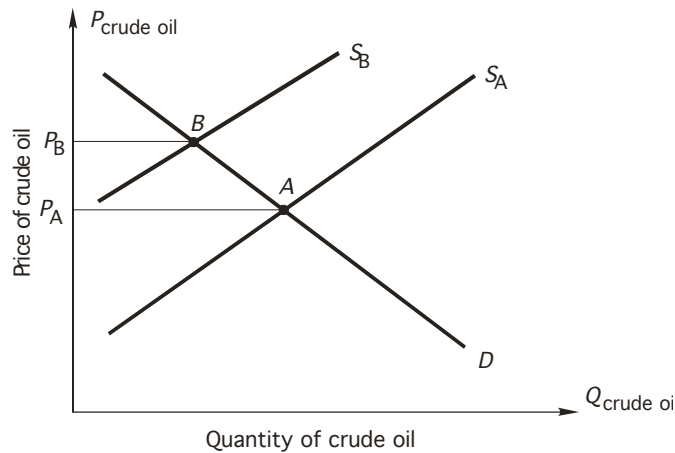
7.   An increase in the demand for electricity will not cause a shortage as long as the price of electricity is allowed to rise to the market clearing level. After an increase in demand, the electricity market will continue to clear but at a higher price. At the higher equilibrium price of electricity, consumers can buy all they want and producers can sell all they want. Only if government places a ceiling price below the market clearing price can there be a shortage of electricity when demand increases. Shortages are not caused by increases in demand. The graph below shows an increase in electricity demand as a rightward shift in demand from D_A to D_B, which causes equilibrium in the electricity market to move from point A to point B and the market clearing price of electricity rises from P_A to P_B.

Quantity of electricity
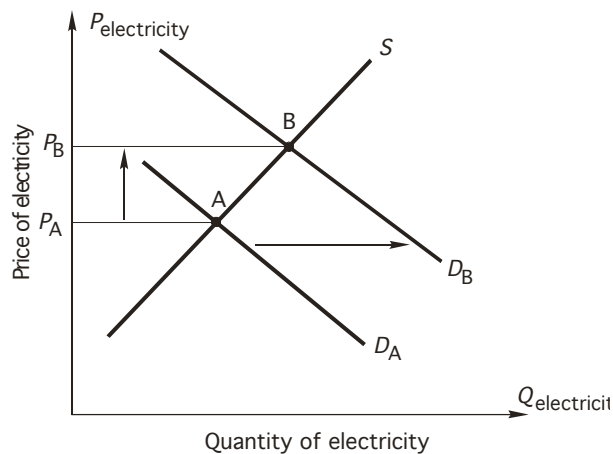
8.   a.   The increase in demand results in an increase in both P_E and Q_E.
        b.   The decrease in demand results in a decrease in both P_E and Q_E.
        c.   The increase in supply results in a decrease in P_E and increase in Q_E.
        d.   The increase in demand results in an increase in both P_E and Q_E.
        e.   The increase in supply results in a decrease in P_E and increase in Q_E.

9.   If the government imposed price ceiling is lower than the market clearing price, then a shortage will result; that is, quantity demanded of hamburger will exceed the quantity supplied. Consumers will not be able to purchase all the hamburger they desire at the artificially low price. Some form of hamburger rationing must be devised. Frequently used rationing devices include waiting lines, lotteries, black markets, and bureaucratic schedules based upon "need." Experience with price ceilings has consistently

demonstrated that most consumers prefer paying the market-clearing price rather than face the inefficiencies involved in rationing schemes.

10. Your graph should look like, for the most part, the following figure:
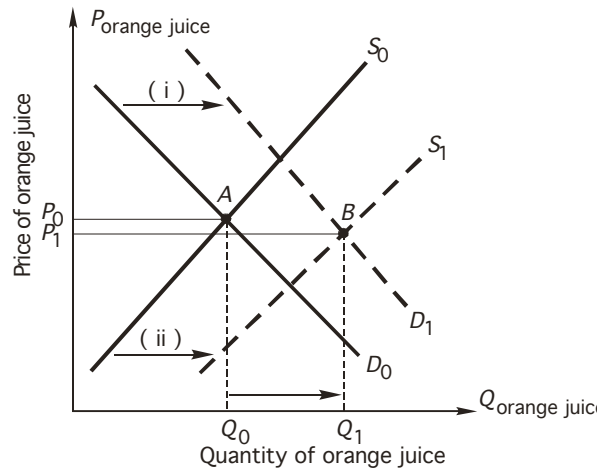
a. See the preceding graph.

b. You could explain event (i) as either an increase in productive capacity, F, (capacity has tripled for the same number of trees) or as an improvement in technology, T. Either way you explain it, event (i) causes an increase in supply of orange juice as shown by the rightward shift from S_0 to S_1.

c. You could explain event (ii) as either an increase in the number of buyers of orange juice, N, or as an increase in consumer tastes toward consuming more orange juice, $\mathfrak{I}$. Either way you explain it, event (ii) causes an increase in demand for orange juice as shown by the rightward shift from D_0 to D_1.

d. The simultaneous increase in demand and supply cause equilibrium quantity to increase, but equilibrium price of orange juice could rise, fall, or stay the same depending on the magnitudes of the shifts in demand and supply. Thus, the predicted change in the price of orange juice is indeterminate.

MULTIPLE CHOICE/TRUE-FALSE

1. d   New semiconductors that reduce production costs causes *supply* to increase.

2. b   Only a change in the price of coffee beans causes a change in the quantity supplied of coffee beans. Since P and Q_s are directly related, a decrease in the price of coffee beans causes a decrease in the quantity supplied of coffee beans.

3. d   All of these are true in equilibrium. (See the definition of market equilibrium.)

4. a   At a price of $4, $Q_s > Q_d$ (900 > 500), so there is a surplus of 400 tons of hamburger.

5. d   Since the ceiling price is set *higher* than the equilibrium price, it has no effect on the market. Equilibrium is reached at $3 and 700 tons of hamburger.

6. d   Since $Q_d > Q_s$, the price of hotel rooms must have been below equilibrium.

7. b $100 - 2P = -20 + P \Rightarrow 120 = 3P \Rightarrow P_E = \$40.$ $Q_E = 100 - 2(40) = 20$.

8. a   Social surplus is $300, which is the sum of consumer surplus ($100) and producer surplus ($200).

9. d $Q_d = 100 - 2(46) = 8$; $Q_s = -20 + 46 = 26 \Rightarrow$ surplus of $26\ \ 8 = 18$ units.

10. a $Q_d = 100 - 2(30) = 40$; $Q_s = -20 + 30 = 10 \Rightarrow$ shortage of $40\ -10 = 30$ units.

11. c Practice drawing the situation depicted in Panels *B* and *C* in Figure 2.9 of your textbook. You should try not to rely on memorization, but rather you should be able to derive these graphs on your own.

12. b Law of demand states that Q_d and *P* are inversely related, so *b* is negative.

13. e Since $c > 0$, the good is normal. Since $d < 0$, the related good *R* is a complement.

14. d All of the choices are true.

15. e See the movement from point *A* to *C* in Panel *B* of Figure 2.12 of your text and Panel *D* of Figure 2.9 of your text.

16. F Decreasing supply (demand constant) causes Q_E to decrease, but there is no shortage.

17. F Equilibrium output falls.

18. F This is a quantitative forecast since the magnitudes of change are forecast.

19. F Equilibrium occurs when quantity demanded equals quantity supplied.

20. T Steel and plastic are substitutes for aluminum.

21. T Q_d is inversely related to *P*. Changes in the variables held constant along a demand curve causes demand to shift.

22. F *Producer surplus* (not economic value) is the difference between the price paid for a kilowatt and the minimum price the electric company will accept to produce a kilowatt.

23. T For the last unit consumed in equilibrium, the economic value (i.e., demand price) exactly equals the market price, so consumer surplus is zero for this unit.

Homework Exercises

Consider the market for new, single-family homes in New Orleans. The general demand function for new housing in New Orleans is estimated to be

$$Q_d = 15 - 2P + 0.05M + 0.10R$$

where Q_d is the monthly quantity demanded, P is the price per square foot, M is average monthly income in New Orleans, and R is the average monthly rent for a three-bedroom apartment in New Orleans. Q_d is measured in units of 1,000 square feet per month.

1. New housing in New Orleans is a(n) _____ (normal, inferior) good. How can you tell from the general demand function?

2. New housing and three-bedroom apartments are _____ (substitutes, complements) in New Orleans. How can you tell from the general demand function?

3. If average monthly income is \$1,500 and the monthly rental rate for three-bedroom apartments is \$700, then the demand function for new housing in New Orleans is

    $Q_d =$ _____.

4. Graph the demand curve for new housing in New Orleans on the axes provided below. Label the demand curve D_0.

The general supply function for new housing in New Orleans is estimated to be

$$Q_s = 96 + 2P - 10P_L - 4P_K$$

where P is the price per square foot of new housing in New Orleans, P_L is the average hourly wage rate for construction workers, and P_K is the price of capital (as measured by the average rate of interest paid on loans to home builders). Q_s is measured in units of 1,000 square feet per month.

5. Does it make sense for P_L and P_K to have negative coefficients in the general supply function? Explain why or why not.

---

6.   If the average hourly wage rate for construction workers is $10 per hour and the average rate of interest on loans to builders is 9 percent (i.e., $P_K = 9$), then the supply function for new housing is

$$Q_s = \underline{\hspace{5cm}}.$$

7.   Graph the supply curve for new housing in the graph below. Label supply S_0.

8.   Solve mathematically for equilibrium price and quantity. Show your work:

$P_E = \$\underline{\hspace{2cm}}$ per square foot.

$Q_E = \underline{\hspace{2cm}}$ square feet per month (in 1,000s).

9.   Do your supply and demand curves intersect at P_E and Q_E found in question 8 above? Should they?

10.   At the equilibrium point in question 8, compute consumer, producer, and social surpluses:

$CS = \$\underline{\hspace{3cm}}$

$PS = \$\underline{\hspace{3cm}}$

$SS = \$\underline{\hspace{3cm}}$

11.   Suppose New Orleans suffers a serious recession that causes average monthly income to fall from $1,500 to $1,100 per month. If other things remain the same, the demand for new housing in New Orleans is now:

$$Q_d = \underline{\hspace{5cm}}.$$

Plot this new demand curve in the figure below. Label it D'.

12.   Suppose that because of the recession in New Orleans, the wage rate for construction workers falls to $8 per hour. If other things remain the same, the supply of new housing in New Orleans is now:

$$Q_s = \underline{\hspace{5cm}}.$$

Plot this new supply curve in the figure. Label the new supply curve S'.

13.   After income falls to $1,100 and wages fall to $8, new equilibrium price and quantity are

$P_E = \$\underline{\hspace{2cm}}$ per square foot

$Q_E = \underline{\hspace{2cm}}$ square feet per month (in 1,000s)

Housing Market in New Orleans

Price of new housing (dollars per square foot) — *P* axis: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

Quantity of new housing (thousands of square feet/month) — *Q* axis: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160