Chapter 2:
DEMAND, SUPPLY, AND MARKET EQUILIBRIUM

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 (Á), (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:

$$Q_d = f(P, M, P_R, Á, P_E, N)$$

   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 DQ_d/DP 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 DQ_d/DM 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 DQ_d/DP_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 DQ_d/DP_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, DQ_d/DP_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 Á, will increase (decrease) demand for a good. Thus $DQ_d/D\Im$ is positive.

   (6) An increase (decrease) in the number of consumers in a market will increase (decrease) the demand for a good. Thus DQ_d/DN is positive.

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

$$Q_d = a + bP + cM + dP_R + eÁ + fP_E + gN$$

   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, Á, P_E, or N) while holding the other five variables constant. For example, b ($= DQ_d/DP$) measures the change in Q_d per unit change in P holding M, P_R, Á, 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
Á	Direct	$e = \Delta Q_d / \Delta$ Á 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 $(M, P_R, Á, P_E, N)$. The direct demand equation expresses quantity demanded as a function of product price only:

$$Q_d = f(P)$$

The variables M, P_R, Á, 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 $(M, P_R, \text{Á}, P_E, N)$ 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 leftward. 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

$$Q_s = f(P)$$

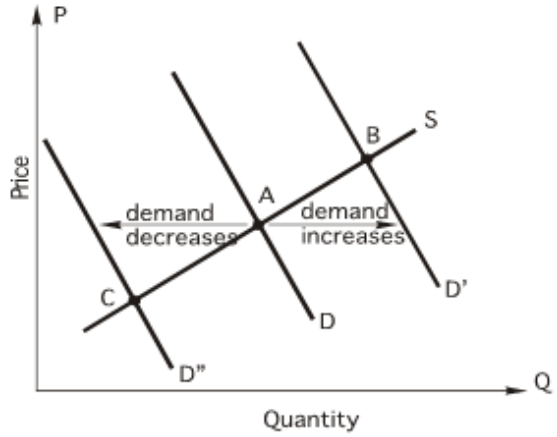
where P_I, P_r, T, P_e, and F are assumed to be constant and therefore do not appear as variables in the supply function. An increase (decrease) in price causes an increase in quantity supplied, which is represented by an upward (downward) movement along a given supply curve.

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.

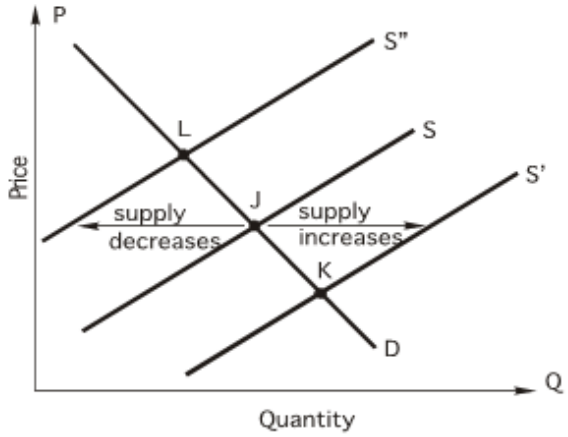
15. When any of the five determinants of supply (P_I, P_r, T, P_e, F) change, "supply" (not "quantity supplied") changes. A change in supply results in a shift of the supply curve. Only when the price of a good changes does the quantity supplied change.

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 constant)

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 2.10 of the textbook.

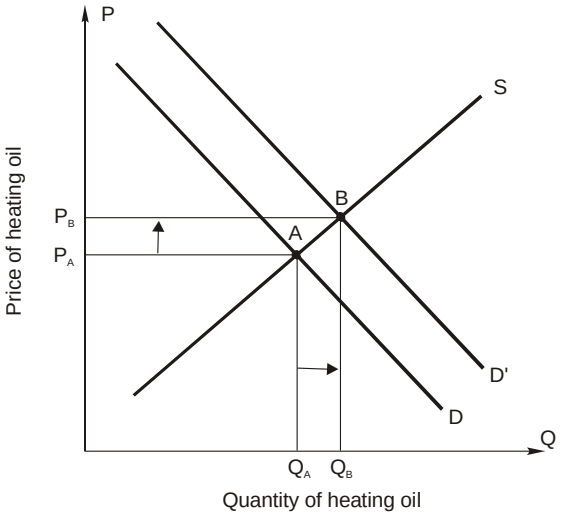
19. When government sets a ceiling price below the equilibrium price, a shortage results because consumers wish to buy more of the good than producers are willing to sell at the ceiling price. If government sets a floor price above the equilibrium price, a surplus results because producers offer for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

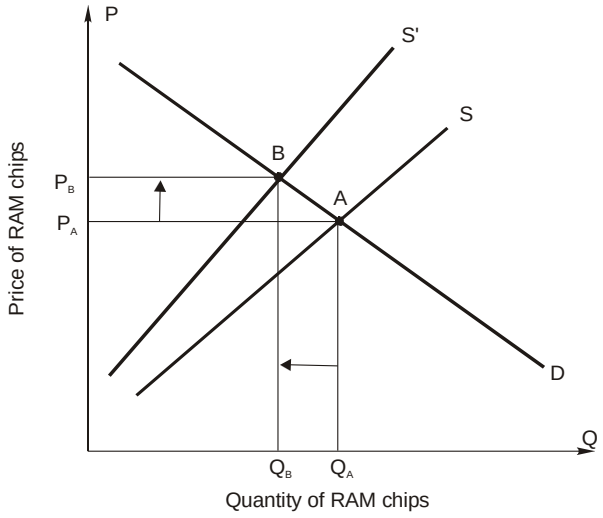
Answers to Applied Problems

1. a. Demand will decrease, so price will decrease.
   b. Supply will increase, so price will decrease.
   c. Demand will increase, so price will increase.
   d. Demand will decrease, so price will decrease.
   e. Supply will decrease, so price will increase.
   f. Supply will increase, so price will decrease.
   g. Supply will increase (when the price of a complement in production increases), so price will decrease.
   h. Demand will decrease, so price will decrease.

2. a. Supply will decrease, so price will increase and output will decrease.
   b. Supply will increase, so price will decrease and output will increase.
   c. Demand will increase, so price will increase and output will increase.
   d. This one is challenging. An increase in the price of Florida grapefruit could be interpreted as either a demand shifter (change in the price of a substitute in consumption) or a supply shifter (change in the price of a substitute in production) or BOTH simultaneously. If only demand decreases (supply constant), then price will decrease and output will decrease. If only supply increases (demand constant), then price will decrease and output will increase. If both happen simultaneously, then price will decrease but the change in output will be indeterminate.

3. a. An increase in demand for home heating oil causes demand for heating oil to shift rightward. In the absence of price controls, no shortage occurs because market price is bid up to P_B. An increase in demand causes equilibrium price and quantity to rise.
   b. A decrease in supply of RAM chips does not cause a shortage in the absence of a price ceiling. A supply decrease shifts supply leftward, causing the equilibrium price of RAM chips to rise and equilibrium quantity to fall.





4. a. No effect on demand (no shift)—just a movement up the demand.
   b. Decrease demand for hotels.
   c. Demand for rental cars decreases.
   d. Supply of overnight mail decreases.

5. Construct a demand and supply diagram like Panel *A* of Figure 2.12.

   a. Imposing rent controls creates a shortage of low-income housing, which decreases the quantity supplied at the lower rent imposed by the controls compared to the amount of housing supplied at the market-clearing (higher) rent level.

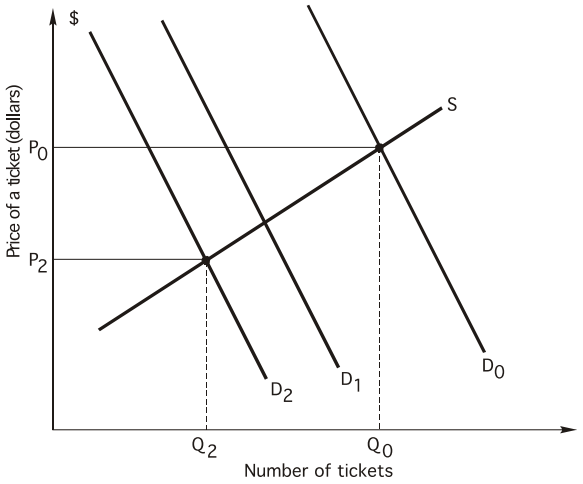
   b. No, the shortage created by rent controls means that more low-income families are willing and able to pay for rent-controlled housing than the amount of rent controlled housing that is available. Compare this to the situation before rent controls in which markets clear at higher rent levels.

c. In the short run, families who are able to get housing at the lower rent levels may be better off. In many cases, however, families must pay large bribes "under the table" to get into the rent-controlled homes. And, as time passes, landlords have little or no incentive to make repairs to the rent-controlled units. Politicians may also gain from rent controls because it appears to be a compassionate policy to help the poor. The losers are the families who cannot get the rent-controlled housing even though they are willing and able to pay the higher market-clearing rent.

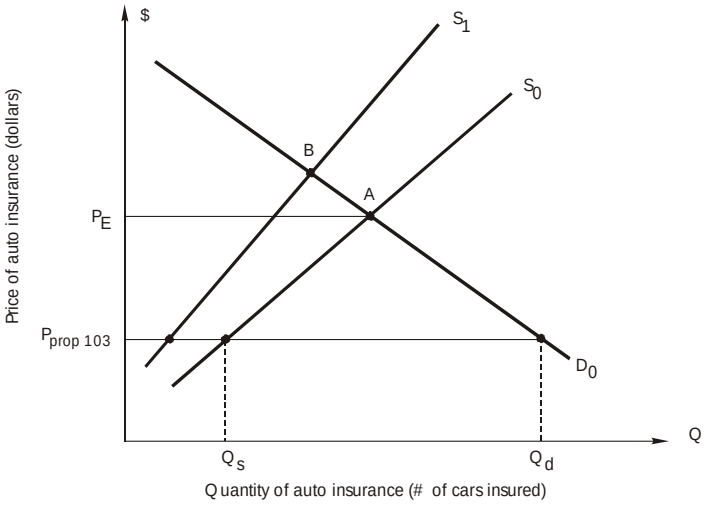
d. History has shown that rent-controlled districts over time fall into a state of decay and ruin. Rent-controlled properties undermine the incentive for landlords to maintain the housing. With a shortage of low-income housing, low rent housing will be fully rented no matter what condition the roof or plumbing might be in. Furthermore, if landlords let the property decay sufficiently, renters will leave, and the property can be converted to some other use (commercial or industrial use) not subject to rent controls.

e. Taxpayers, genuinely compassionate about providing more housing for low-income families, could offer builders subsidies to build low-income housing. In the absence of rent controls, this would shift supply rightward and equilibrium rents would fall. Also, there would be no shortage of low-income housing. Owners would have incentives to properly maintain roofs and plumbing. Of course building subsidies would cost real money; but everyone knows that there's no such thing as a free lunch (well, maybe not everyone knows this).

6. In the graph, let D_0 be the initial demand for tickets to Disneyland and S_0 be the supply of tickets to Disneyland. Slowing tourism causes demand to decrease, as represented by the demand curve D_1. The new rides at Six Flags further reduce demand to D_2. These events all result in lower ticket prices at Disneyland as well as reduced attendance. This is not a violation of the law of demand since price is falling due to a decrease (shift) in demand, not a movement along a given demand curve.



7. In the graph, S_0 and D_0 are the supply and demand curves for auto insurance *before* Proposition 103 is passed. P_E is the price of auto insurance. After Proposition 103 passes, $P_{prop103}$ is the ceiling price established by passage of Proposition 103. The result is a shortage of auto insurance in California. This shortage gets worse over time as the costs of providing insurance rise because supply shifts leftward (S_1) increasing the gap



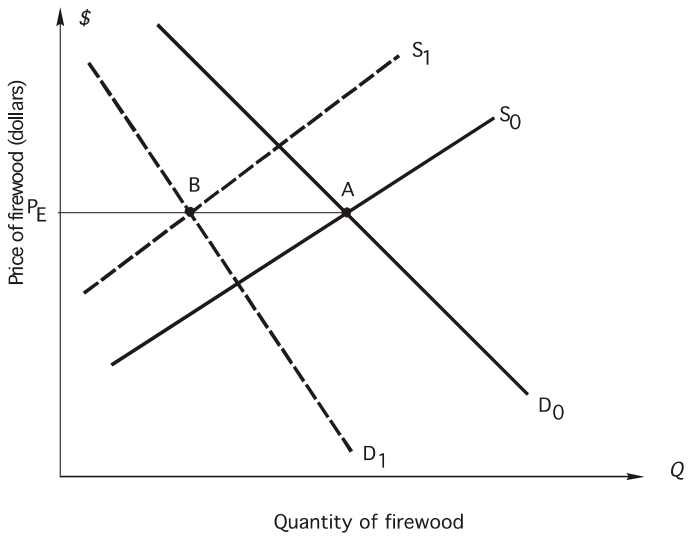
between Q_d and Q_s (at $P = P_{\text{prop 103}}$). If Proposition 103 is defeated, no price ceiling will be forthcoming and no shortage will occur. The increasing costs of providing insurance will cause insurance rates to rise (from *A* to *B*).

8. a. Increase in the price of a complement goods causes demand to shift leftward. Movie ticket prices fall and ticket sales fall.
   b. Decrease in the price of a substitute good causes demand to shift leftward. Movie ticket prices fall and ticket sales fall.
   c. Presumably, pay-per-view movies on cable are more convenient to some consumers than going to the movie theater, thereby changing some consumers' tastes away from theater movies toward pay-per-view movies. Demand shifts leftward due to the change in tastes, and movie theater ticket prices fall and ticket sales fall.
   d. The end of the strike increases the number of movie scripts available, lowering the price producers must pay to get a movie script. The decrease in price of an input (movie scripts) increases the supply of movies out of Hollywood. Supply shifts rightward. Movie ticket prices fall and ticket sales rise.
   e. As in part *d*, a decrease in the price of an input causes supply to shift rightward. Movie ticket prices fall and ticket sales rise.

9. a. The new process causes an increase in supply, shown as a rightward shift in the supply of crude oil curve. The rightward shift in supply of crude oil does NOT cause a surplus because the equilibrium price of crude oil falls until quantity demanded equals quantity supplied. The market clears at the now lower price of crude oil. No surplus arises because the lower crude price results in an increase in quantity demanded of crude oil, which works to eliminate any surplus. The end result of the new process is to decrease the equilibrium price of crude oil and increase the quantity of crude oil consumed and produced in equilibrium.
   b. Even in the unlikely event that no new oil deposits are ever discovered, growing worldwide demand for crude oil would still be met. Rightward shifts in demand, supply constant, would simply drive up the equilibrium price of crude oil. No shortage would occur unless governments impose price ceilings on crude oil preventing its price from rising to market clearing levels.

10. In the figure, the environmental curbs on burning wood causes supply to shift leftward from S_0 to S_1. The substitution from burning wood to gas hearths is represented by the leftward shift in demand from D_0 to D_1. Comparing initial equilibrium point *A* to *B*, the price of firewood has remained unchanged while the quantity of firewood burned decreases.

11. Demand and supply both increase simultaneously. An increase in customers (*N*) causes demand to shift rightward. An increase in the number of businesses in a market (*F*) causes supply to shift rightward. Equilibrium output definitely increases, but the effect of the Internet on equilibrium price is indeterminate.



12. a. At \$3,600 per metric ton, quantity demanded is 34 metric tons per year (= 124 – 0.025 × 3,600) and quantity supplied is 40 metric tones per year (= –50 + 0.025 × 3,600). So, the annual rate of inventory growth is 6 tons per year (= 40 – 34), which corresponds 0.5 ton per month.

b. The global market-clearing price of primary aluminum is \$3,480:

$$Q_d = Q_s$$
$$124 - 0.025P = -50 + 0.025P$$
$$174 = 0.05P$$
$$3480 = \overline{P}$$