Chapter 2
# Supply and Demand Analysis

Solutions to Review Questions

1.   Explain why a situation of excess demand will result in an increase in the market price. Why will a situation of excess supply result in a decrease in the market price?

Excess demand occurs when price falls below the equilibrium price. In this situation, consumers are demanding a higher quantity than is being made available by suppliers. This creates pressure for the price to increase – sellers can ask for higher prices and still find buyers, and buyers offer higher prices to secure the units they want. As the price increases, quantity demanded will fall as quantity supplied increases returning the market to equilibrium.

Excess supply occurs when price is above the equilibrium price. Suppliers have made available more units than consumers are willing to purchase at the high price. This creates pressure for the price to decrease – buyers can get away with paying less because sellers are happy to find a buyer at all, and sellers are willing to sell for less wanting to make sure they find a buyer. As the price decreases, the quantity demanded will go up while at the same time the quantity supplied will decrease, returning the market to equilibrium.

2.   Use supply and demand curves to illustrate the impact of the following events on the market for coffee:
**a) The price of tea goes up by 100 percent.**
b) A study is released that links consumption of caffeine to the incidence of cancer.
c) A frost kills half of the Colombian coffee bean crop.
d) The price of styrofoam coffee cups goes up by 300 percent.

a)   An increase in the price of a substitute, such as tea, will increase demand for coffee, raising the market equilibrium price and quantity. How much demand for coffee increases, depends on how sensitive coffee demand is to the price of tea (cross-price elasticity).
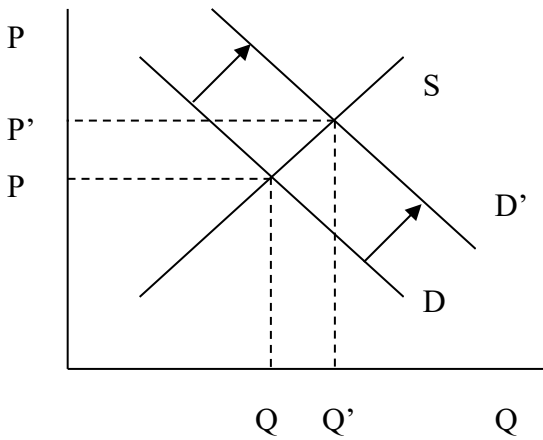
b)   This study will reduce demand for caffeine drinks as people drink less to reduce the risk of cancer, lowering the market equilibrium price and quantity.
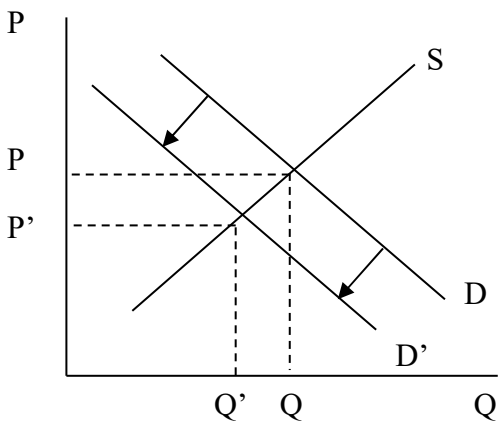

c)   The frost will reduce supply raising the equilibrium price while lowering the equilibrium quantity.
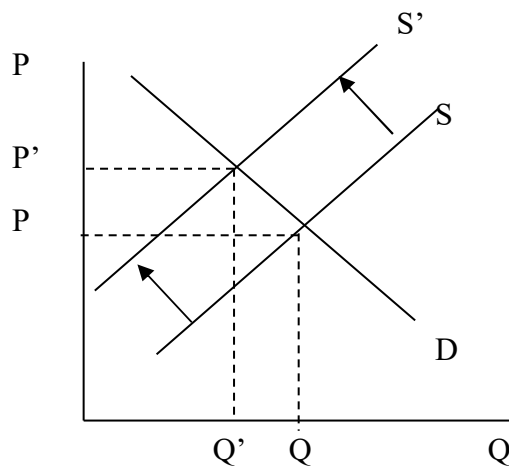
d)   Increasing the price of an input for a cup of coffee will reduce supply, increasing market price and reducing market quantity.   This will result in the same figure as that for part c).

3.   Suppose we observe that the price of soybeans goes up, while the quantity of soybeans sold goes up as well. Use supply and demand curves to illustrate two possible explanations for this pattern of price and quantity changes.

Any factor increasing demand and leaving the remainder of the market unchanged will increase both market price and quantity sold. If demand were to increase at the same time as supply changed, both market price and quantity sold could increase if the change in demand is large relative to the change in supply (in either direction).
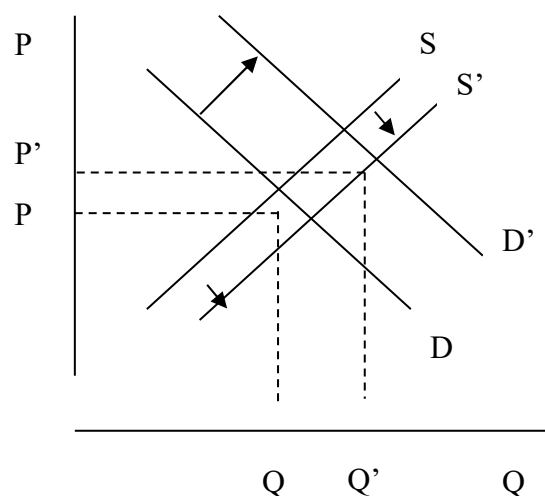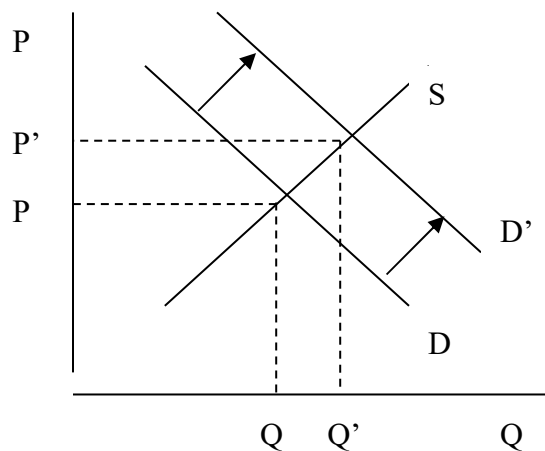
4.   A 10 percent increase in the price of automobiles reduces the quantity of automobiles demanded by 8 percent. What is the price elasticity of demand for automobiles?

$$\varepsilon_{Q,P} = \frac{\%\Delta Q}{\%\Delta P} = \frac{-8}{10} = -0.80$$

5.   A linear demand curve has the equation $Q = 50 - 100P$. What is the choke price?

The choke price is the price where $Q = 0$. Using the given demand curve we have
$$Q = 50 - 100P$$
$$0 = 50 - 100P$$
$$100P = 50$$
$$P = \$0.50$$

6.   Explain why we might expect the price elasticity of demand for speedboats to be more negative than the price elasticity of demand for light bulbs.

Speedboats could probably be categorized as a luxury item whereas light bulbs are more likely categorized as a necessity. For the necessity, the change in quantity demanded will be relatively small for any percent change in price. The change in quantity demanded may be quite large, however, for a luxury item. Since the percent change in quantity demanded is likely higher for the luxury item for any given percent change in price, the elasticity of demand would be less (more negative).

7.   Many business travelers receive reimbursement from their companies when they travel by air, whereas vacation travelers typically pay for their trips out of their own pockets. How would this affect the comparison between the price elasticity of demand for air travel for business travelers versus vacation travelers?

Because business travelers receive reimbursement for expenses, they will probably be less sensitive to price changes than the vacation traveler who pays out of her own pocket. This implies the price elasticity for vacationers would be less (more negative/smaller number) than for business travelers.

8.   Explain why the price elasticity of demand for an entire product category (such as yogurt) is likely to be less negative than the price elasticity of demand for a typical brand (such as Dannon) within that product category.

If the prices for a particular product, such as Dannon, within a product category changes (say it increases) then it is easy for a consumer to switch to another brand, implying a relatively high percent change in quantity demanded for the product. On the other hand, if prices for the entire product category change, substitutes are not as easily found and the percent change in quantity demanded for the category will be relatively lower. This implies the elasticity for the entire product category will be higher (less negative) than the elasticity for a single product.

9.   What does the sign of the cross-price elasticity of demand between two goods tell us about the nature of the relationship between those goods?

When the cross-price elasticity is positive we have

$$\frac{\%\Delta Q_A}{\%\Delta P_B} > 0$$

Either a) both Q_A and P_B increased or b) they both decreased. Since they are moving in the same direction, the product must be substitutes. Take coffee and tea for example; if the price of tea increases, the quantity of coffee demanded will increase.

When the cross-price elasticity is negative, Q_A and P_B are moving in the opposite direction, implying the products are complements. Take coffee and cream for example; if the price of cream increases, the quantity of coffee demanded will decrease.

10.   Explain why a shift in the demand curve identifies the supply curve and not the demand curve.
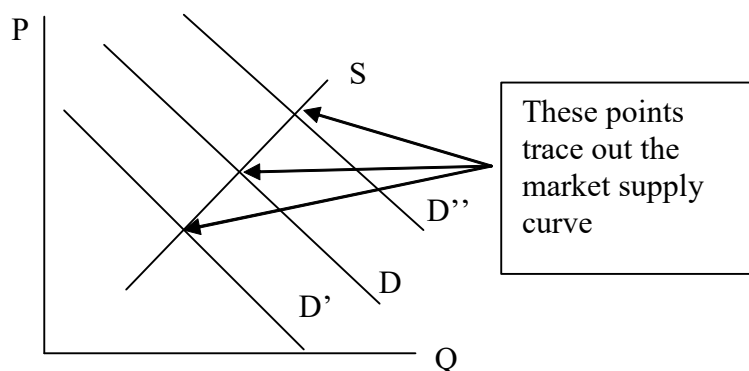
As the demand curve shifts, the market will reach a new equilibrium. Each new equilibrium occurs at a new price and quantity. These price/quantity combinations trace out the market supply curve. Thus, in order to identify the market supply curve one needs to observe shifts in the demand curve.

Solutions to Problems

2.1.   The demand for beer in Japan is given by the following equation: $Q^d = 700 - 2P - P_N + 0.1I$, where P is the price of beer, P_N is the price of nuts, and I is average consumer income.
a) What happens to the demand for beer when the price of nuts goes up? Are beer and nuts demand substitutes or demand complements?
**b) What happens to the demand for beer when average consumer income rises?**
c) Graph the demand curve for beer when $P_N = 100$ and $I = 10, 000$.

a)   When the price of nuts goes up, the beer quantity demanded falls for all levels of price (demand shifts left). Beer and nuts are demand complements.
b)   When income rises, quantity demanded increases for all levels of price (demand shifts rightward).
c)   Now: $Q^d = 700 - 2P - 100 + 0.1*10,000 = 1,600 - 2P \implies P = 800 - 0.5\ Q^d$
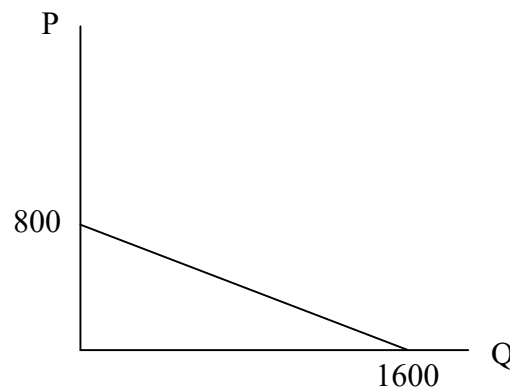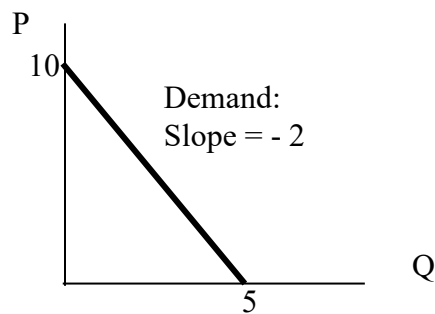

2.2.   Suppose the demand curve in a particular market is given by $Q = 5 - 0.5P$.
a) Plot this curve in a graph.
b) At what price will demand be unitary elastic?

a)   The inverse demand function is $P = 10 - 2Q$

b)   We know that the value of the price elasticity of demand is given by

for a linear demand function: $Q = a - bP$, then $\dfrac{\Delta Q}{\Delta P} = -b$ and $\varepsilon_{Q,P} = \dfrac{\Delta Q}{\Delta P}\dfrac{P}{Q} = -b\dfrac{P}{Q}$

Here, $-b = -1/2$. For demand to be unitary elastic it must be that
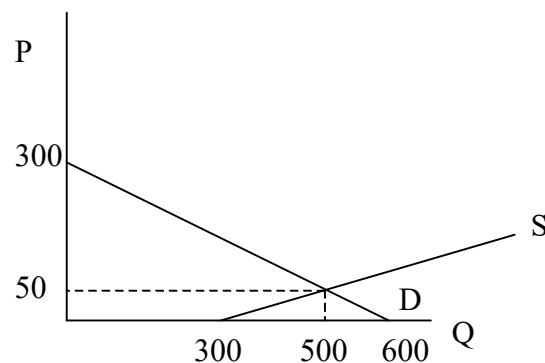
$$-\tfrac{1}{2}\left[\frac{P}{5-\frac{P}{2}}\right] = -1$$

which implies that $P = 5$.

2.3.   The demand and supply curves for coffee are given by $Q^d = 600 - 2P$ and $Q^s = 300 + 4P$.
a) Plot the supply and demand curves on a graph and show where the equilibrium occurs.
b) Using algebra, determine the market equilibrium price and quantity of coffee.

a)

b)
$$600 - 2P = 300 + 4P$$
$$300 = 6P$$
$$50 = P$$

Plugging $P = 50$ back into either the supply or demand equation yields $Q = 500$.

2.4.   Suppose that demand for bagels in the local store is given by equation $Q^d = 300 - 100P$. In this equation, P denotes the price of one bagel in dollars.
a) Fill in the following table:

P	0.10	0.45	0.50	0.55	2.50
Q^d					
εQ,P					

b) At what price is demand inelastic?
c) At what price is demand elastic?

P	0.10	0.45	0.50	0.55	**2.50**
Q^d	290	255	250	245	**50**
$\varepsilon_{Q,P}$	–0.035	–0.176	–0.2	–0.225	–5

We can find elasticities of demand using the following formula

$$\varepsilon_{Q,P} = \frac{\Delta Q^d}{\Delta P} \frac{P}{Q^d} = -100 \cdot \frac{P}{300 - 100 \cdot P} = \frac{P}{P-3}.$$

This demand curve is linear. The inverse demand function is $P = 3 - 1/100\ Q^d$
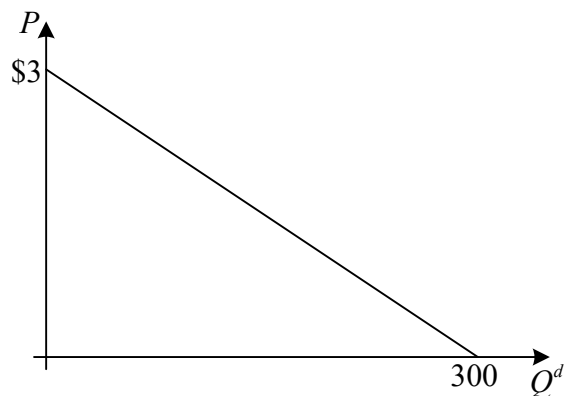
Observe that for price $1.50 the elasticity of demand is equal to

$$\varepsilon_{Q,P} = \frac{1.5}{1.5 - 3} = -1.$$

For all prices below $1.50, the demand is inelastic, while for all prices above $1.50, the demand is elastic.

2.5.   **The demand curve for ice cream in a small town has been stable for the past few years. In most months, when the equilibrium price is $3 per serving for the most popular ice cream, customers buy 300 servings per month. For one month the price of materials used to make ice cream increased, shifting the supply curve to the left. The equilibrium price in that month increased to $4, and customers bought only 200 portions in the month. With these data draw a graph of a linear demand curve for ice cream in the town. Find price elasticity of demand for prices equal to $3 and $4. At what price would the demand be unitary elastic?**

Using the data from the problem we can graph the demand curve. The slope of the demand curve is equal to

$$\Delta P / \Delta Q = -1/100$$

So the equation of the demand curve is $P = A - 0.01Q$.

We can find the vertical intercept A substituting $P = 3$ and $Q = 300$.

$3 = A - 0.01(300)$, so $A = 6$. The vertical intercept (choke price) is $P = \$6$.

The equation of the demand curve is then $P = 6 - 0.01Q$.
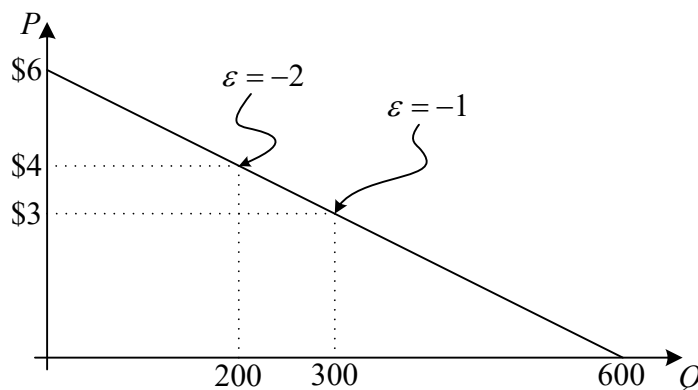
Elasticity of demand can be computed using formula

$$E_{Q,P} = \frac{\Delta Q}{\Delta P} \frac{P}{Q} = -100 \frac{P}{Q} = -100 \frac{6 - 0.01Q}{Q}$$

When the elasticity is -1, $Q = 300$ and $P = \$3$.

Thus demand is unitary elastic at a price $P = \$3$.

Based on the data from the problem the graph of the demand curve is

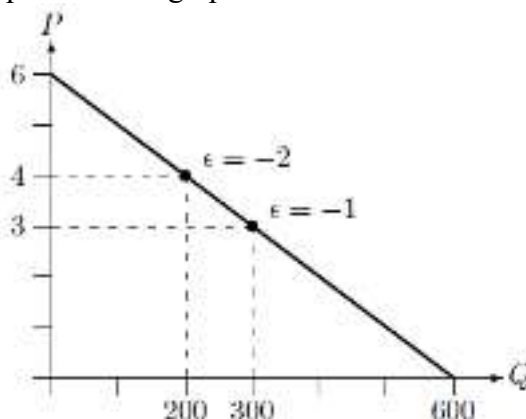The slope of the demand curve is equal to $\dfrac{\Delta P}{\Delta Q} = \dfrac{3-4}{300-200} = -\dfrac{1}{100} = -0.01$

Find the vertical intercept in the graph or by substituting into $P(Q) = m - 0.01Q$ one of the two points. The inverse demand function is $P(Q) = 6 - 0.01Q$.

The elasticity is $\varepsilon_i = \dfrac{1}{\Delta P/\Delta Q} \cdot \dfrac{P}{Q} = \dfrac{1}{-0.01} \cdot \dfrac{6-0.01Q}{Q} = \dfrac{600-Q}{-Q}$.

The function is unit-elastic at

$\dfrac{600-Q}{-Q} = -1 \quad \Leftrightarrow \quad 600 - Q = Q \quad \Leftrightarrow \quad Q = 300, \quad P = 3$.

At $P = 4$ and $Q = 200$, the elasticity is $\varepsilon_i = \dfrac{600-Q}{-Q} = \dfrac{600-200}{-200} = -2$

2.6.   Granny's Restaurant sells apple pies. Granny knows that the demand curve for her pies does not shift over time, but she wants to learn more about that demand. She has tested the market for her pies by charging different prices. When she charges $4 per pie, she sells 30 pies per week. When she charges $5, she sells 24 pies per week. If she charges $4.50, she sells 27 apple pies per week.
a) With this data draw a graph of the linear demand curve for Granny's apple pies.
b) Find the price elasticity of demand at each of the three prices.

The demand for apple pies is $Q^d = 54 - 6P$.
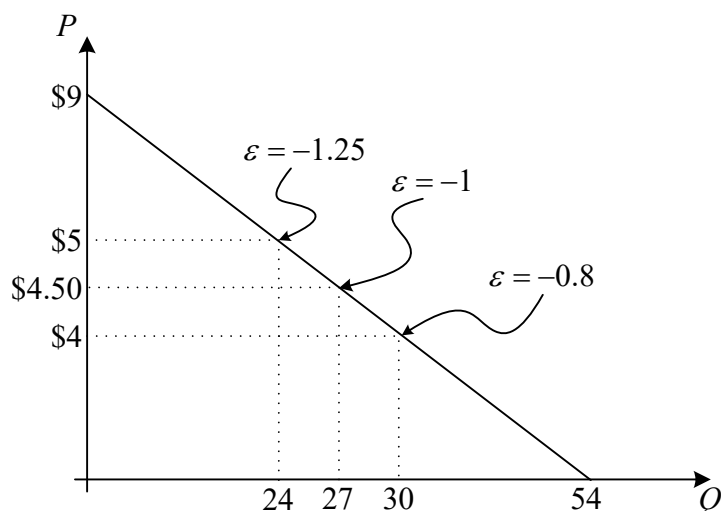
To find the equation of the demand curve, observe that when she drops the price by $0.50, she sells 3 more pies. So, movement along the demand occurs so that

$$\Delta Q / \Delta P = -3 / 0.5 = -6$$

The demand curve then has the form $Q^d = A - 6P$, where A is a constant. We can determine the value of A using any one of the three data points on the demand curve. For example, if we use the point $P = 5$ and $Q = 24$, we see that $24 = A - 6(5)$, so that $A = 54$. So the demand curve can be described by the equation $Q^d = 54 - 6P$.

To find elasticity of demand at any point on the demand curve, we use formula

$$E_{Q,P} = \frac{\Delta Q}{\Delta P} \frac{P}{Q} = -6 \frac{P}{Q}$$

2.7. Every year there is a shortage of Super Bowl tickets at the official prices P_0. Generally, a black market (known as scalping) develops in which tickets are sold for much more than the official price. Use supply and demand analysis to answer these questions:
a) What does the existence of scalping imply about the relationship between the official price P_0 and the equilibrium price?
b) If stiff penalties were imposed for scalping, how would the average black market price be affected?

a)   Since the price is being bid up above the official price, quantity demanded must exceed quantity supplied at the official price. This is a situation of excess demand and the official price must be below the equilibrium price.
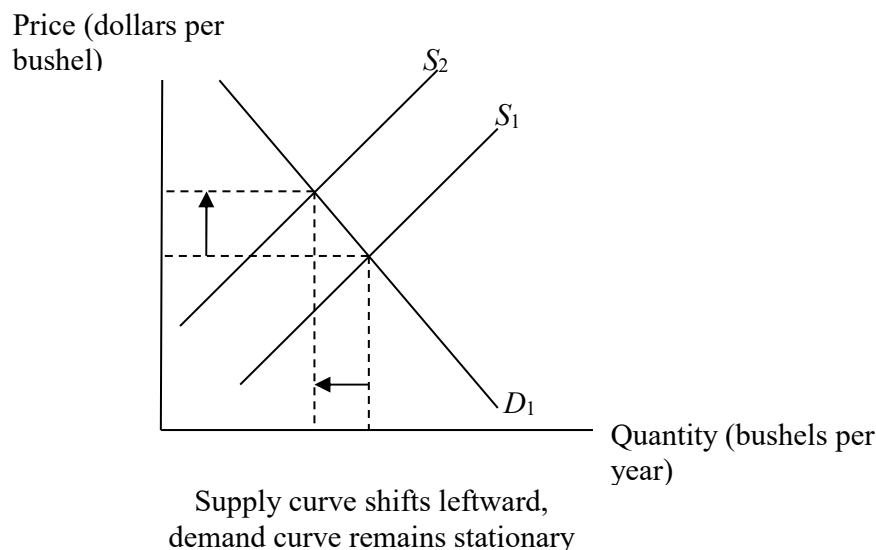b)   Lowering the official price would increase the amount of excess demand, but would have no effect on the demand or supply curves. Thus the equilibrium price would remain unchanged.
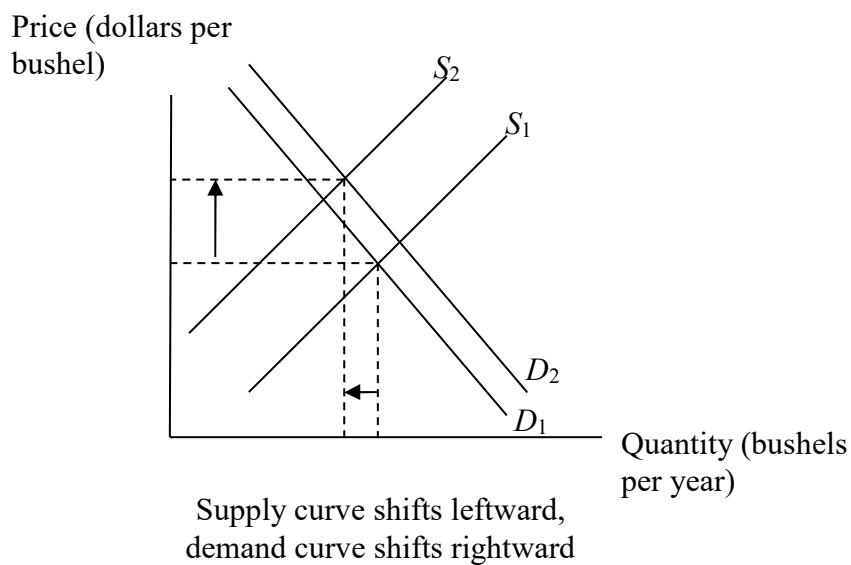
2.8   You have decided to study the market for fresh picked cherries. You learn that over the last 10 years, cherry prices have risen, while the quantity of cherries purchased has also risen. This seems puzzling because you learned in microeconomics that an increase in price usually decreases the quantity demanded. What might explain this seemingly strange pattern of prices and consumption levels?

This could occur as a result of the demand curve shifting to the right, increasing both equilibrium price and quantity. This would not contradict what was learned regarding downward sloping demand curves.

2.9   Suppose that, over a period of six months, the price of corn increased. Yet, the quantity of corn sold by producers decreased. Does this contradict the law of supply? If not, why not?

This does not contradict the law of supply. For example, farmers may have experienced something that shifted the supply curve for corn leftward (such as a flooding or a drought). This would have the effect of increasing the equilibrium price of corn, while decreasing the quantity of corn sold by producers. This is shown in the figure below. Another possibility is that Or, alternatively, the supply curve for corn could have shifted leftward, and the demand curves for could have also shifted, but in such a way that the overall effect is to increase the equilibrium price and decrease the equilibrium quantity. These cases are also shown in the figure below.

Supply curve shifts leftward,
demand curve remains stationary

Supply curve shifts leftward, demand curve also shifts leftward

Supply curve shifts leftward, demand curve shifts rightward
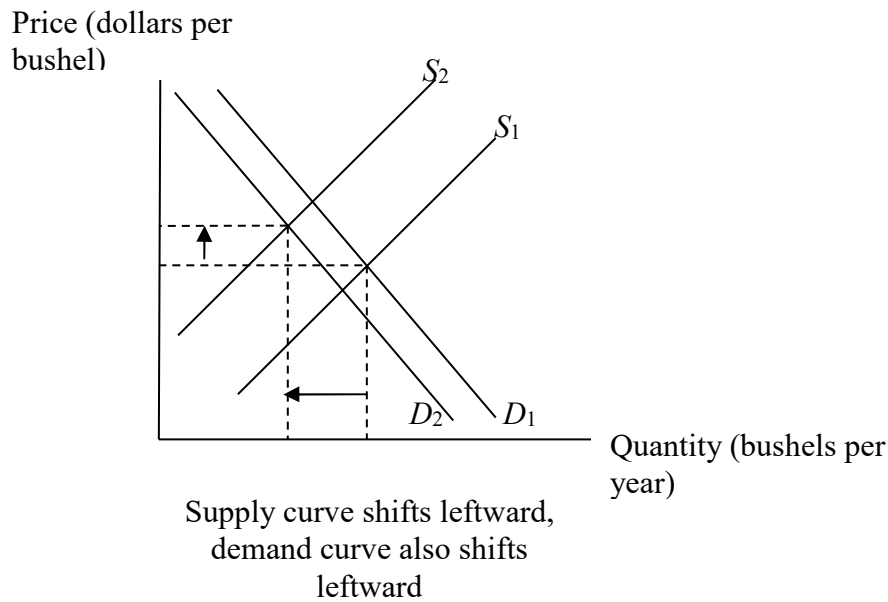
2.10   Explain why a good with a positive price elasticity of demand must violate the law of demand.

The law of demand states that, holding other factors fixed, there is an inverse relationship between price and quantity demanded, i.e. that an increase in price decreases quantity and vice versa. If a good has a positive price elasticity of demand, it must be that an increase in the price

of that good leads to an increase in the quantity demanded. Therefore, such a good violates the law of demand.

2.11   Suppose that the quantity of corn supplied depends on the price of corn (P) and the amount of rainfall (R). The demand for corn depends on the price of corn and the level of disposable income (I). The equations describing the supply and demand relationships are $Q^s = 20R + 100P$ and $Q^d = 4000 - 100P + 10I$.
a) Sketch a graph of demand and supply curves that shows the effect of an *increase* in rainfall on the equilibrium price and quantity of corn.
b) Sketch a graph of demand and supply curves that shows the effect of a *decrease* in disposable income on the equilibrium price and quantity of corn.

a)
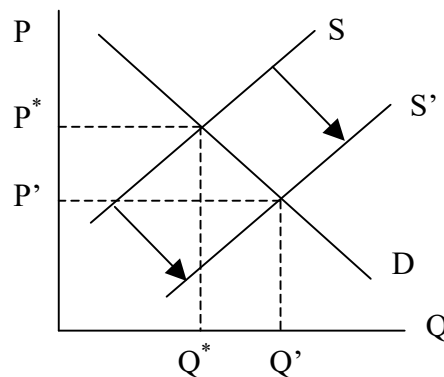
An increase in rainfall will increase supply, lowering the equilibrium price and increasing the equilibrium quantity.

b)
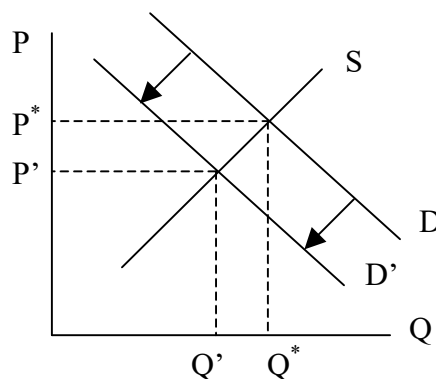
A decrease in disposable income will reduce demand, shifting the demand schedule left, reducing both the equilibrium price and quantity.

2.12   Recall that when demand is perfectly inelastic, $\varepsilon Q, P = 0$.
a) Sketch a graph of a perfectly inelastic demand curve.
b) Suppose the supply of 1961 Roger Maris baseball cards is perfectly inelastic. Suppose, too, that renewed interest in Maris's career caused by Mark McGwire and Sammy Sosa's quest to break his home run record in 1998 caused the demand for 1961 Maris cards to go up. What will happen to the equilibrium price? What will happen to the equilibrium quantity of Maris baseball cards bought and sold?

a)   A perfectly inelastic demand curve will be vertical.
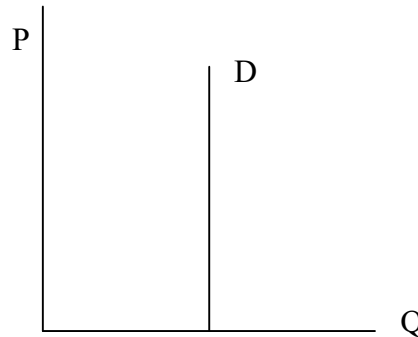
b)   The renewed interest will shift demand to the right, raising the equilibrium price. Since supply is perfectly inelastic (and therefore vertical) there will be no change in the quantity supplied; the quantity is fixed.
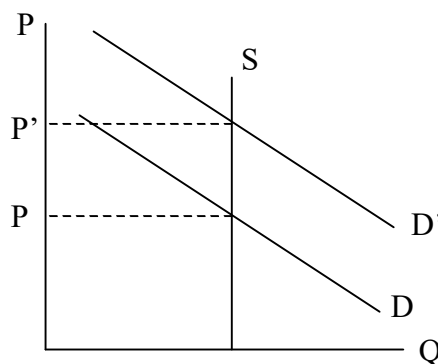
2.13   Consider a linear demand curve, $Q = 350 - 7P$.
a) Derive the inverse demand curve corresponding to this demand curve.
b) What is the choke price?
c) What is the price elasticity of demand at $P = 50$?

$$Q = 350 - 7P$$
a) $$7P = 350 - Q$$
$$P = 50 - \tfrac{1}{7}Q$$

b)   The choke price occurs at the point where $Q = 0$. Setting $Q = 0$ in the inverse demand equation above yields $P = 50$.

c)   At $P = 50$, the choke price, the elasticity will approach negative infinity.

2.14   Suppose that the quantity of steel demanded in France is given by Q$_s$ = 100 – 2P$_s$ + 0.5Y + 0.2P$_A$, where Q$_s$ is the quantity of steel demanded per year, P$_s$ is the market price of steel, Y is real GDP in France, and P$_A$ is the market price of aluminum. In 2011, Ps = 10, Y = 40, and PA = 100. How much steel will be demanded in 2011? What is the price elasticity of demand, given market conditions in 2011?

We are given that $Y = 40$, and $P_A = 100$, and so substituting these values into the equation that determines the quantity demanded gives us

$$Q_S = 100 - 2P_S + 0.5(40) + 0.2(100)$$

or

$$Q_S = 140 - 2P_S.$$

This is the equation for the demand curve for steel in France. When the price of steel is 10, the quantity of steel demanded is thus 120.

From equation (2.4) in the text, the price elasticity of demand for steel when the price is 10 is given by

$$\epsilon_{Q,P} = -2\frac{10}{120} = -0.167.$$

Suppose that in 2011, the global market for hard drives for notebook computers consists of a large number of producers. It is relatively easy for new producers to enter the industry, and when the market for notebook hard drives is booming, new producers do, in fact, enter.

2.15   A firm currently charges a price of $100 per unit of output, and its revenue (price multiplied by quantity) is $70,000. At that price it faces an elastic demand ($\epsilon Q, P < -1$). If the firm were to raise its price by $2 per unit, which of the following levels of output could the firm possibly expect to see? Explain.
a) 400
b) 600
c) 800
d) 1000

Recall that for an elastic good, a higher price charged by the firm leads to a decrease in total revenue. Therefore, the firm should expect a level of output such that its revenue at a price of

$102 is less than $70,000. Only if the output level is 400 or 600 is this possible (102*400 = $40,800) and (102*600 = $61,200). At the other quantities the revenue would rise.

2.16   Gina usually pays a price between $5 and $7 per gallon of ice cream. Over that range of prices, her monthly total expenditure on ice cream increases as the price decreases. What does this imply about her price elasticity of demand for ice cream?

Gina's expenditure on ice-cream is $P*Q$, where P is the price and Q is the number of units of ice cream that she buys. We know that $P*Q$ increases as P decreases which can only mean that Q increases at a faster rate than the rate at which P decreases. This is equivalent to saying that demand is very sensitive to price changes, or that her demand for ice cream is quite elastic ($\varepsilon_{Q,P}$ < -1) . More generally, recall that when price and total revenue ($P*Q$) move in opposite directions, it is because demand is elastic over that price range.

2.17   Consider the following demand and supply relationships in the market for golf balls: $Q^d = 90 - 2P - 2T$ and $Q^s = -9 + 5P - 2.5R$, where T is the price of titanium, a metal used to make golf clubs, and R is the price of rubber.
a) If $R = 2$ and $T = 10$, calculate the equilibrium price and quantity of golf balls.
b) At the equilibrium values, calculate the price elasticity of demand and the price elasticity of supply.
c) At the equilibrium values, calculate the cross-price elasticity of demand for golf balls with respect to the price of titanium. What does the sign of this elasticity tell you about whether golf balls and titanium are substitutes or complements?

a)   Substituting the values of R and T, we get

$$Demand: Q^d = 70 - 2P$$
$$Supply: Q^s = -14 + 5P$$

In equilibrium, $70 - 2P = -14 + 5P$, which implies that $P = 12$. Substituting this value back, $Q = 46$.

b)   Elasticity of Demand $= -2(12/46)$, or -0.52. Elasticity of Supply $= 5(12/46) = 1.30$.

c) $\varepsilon_{golf, titanium} = -2(\dfrac{10}{46}) = -0.43$. The negative sign indicates that titanium and golf balls are complements, i.e., when the price of titanium goes up the demand for golf balls decreases.

2.18   In Metropolis only taxicabs and privately owned automobiles are allowed to use the highway between the airport and downtown. The market for taxi cab service is competitive. There is a special lane for taxicabs, so taxis are always able to travel at 55

miles per hour. The demand for trips by taxi cabs depends on the taxi fare P, the average speed of a trip by private automobile on the highway E, and the price of gasoline G. The number of trips supplied by taxi cabs will depend on the taxi fare and the price of gasoline.
a) How would you expect an increase in the price of gasoline to shift the demand for transportation by taxi cabs? How would you expect an increase in the average speed of a trip by private automobile to shift the demand for transportation by taxi cabs? How would you expect an increase price of gasoline to shift the demand for transportation by taxi cabs?
b) Suppose the demand for trips by taxi is given by the equation Q^d = 1000 + 50G - 4E - 400P. The supply of trips by taxi is given by the equation Q^s = 200 - 30G + 100P. On a graph draw the supply and demand curves for trips by taxi when G = 4 and E =30. Find equilibrium taxi fare.
c) Solve for equilibrium taxi fare in a general case; that is, when you do not know G and E. Show how the equilibrium taxi fare changes as G and E change.

a)   When the price of gasoline goes up, it becomes more expensive to drive a private automobile; because private automobiles and taxis are substitutes, the demand for taxi service should increase (shift to the right). On the other hand, when the average speed of a trip by automobile increases, commuters are more likely to use their cars instead of public transportation; the demand for taxi service should shift to the left. On the supply side, a higher price of gasoline increases to cost of providing taxi service; the supply curve for taxi service should shift to the left.

b)   Substituting G = 4 and E = 30 into equations for the supply and demand curves we have

$$Q^d = 1080 - 400 \cdot P,$$

$$Q^s = 80 + 100 \cdot P.$$

Solving equation $Q^d = Q^s$ we have P = 2, Q = 280. Supply and demand curves are graphed below.
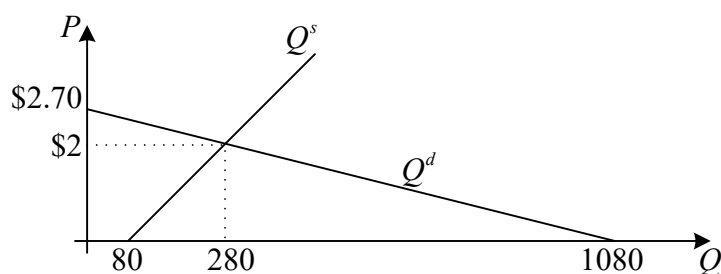
c)   In equilibrium $Q^d = Q^s$. When we

$$P = \frac{1}{125}(200 - E + 20 \cdot G).$$

The equilibrium taxi fare goes up as gasoline price increases and goes down when it private automobiles can travel faster.

2.19   For the following pairs of goods, would you expect the cross-price elasticity of demand to be positive, negative, or zero? Briefly explain your answers.
a) Tylenol and Advil
b) DVD players and VCRs
c) Hot dogs and buns

a)   Since the two goods are rather close substitutes for each other, you would expect that the demand for Tylenol would go up if the price of Advil increases and vice versa. Therefore, the cross price elasticity will be positive.

b)   Similar to part (a). Although VCRs and DVD players are not very close substitutes, if the price of VCRs were to go up substantially, potential buyers would probably decide to pay a little bit more and get the higher-end DVD player. Similarly if the latter becomes expensive, some consumers will not be able to afford it and will switch to the VCR instead. The elasticity will be positive.

c)   Since the two usually go together, a sharp increase in the price of one will lead to a decline in the demand for the other, and the cross-price elasticity will be negative.

2.20   For the following pairs of goods, would you expect the cross-price elasticity of demand to be positive, negative, or zero? Briefly explain your answer.
a) Red umbrellas and black umbrellas
b) Coca-Cola and Pepsi
c) Grape jelly and peanut butter
d) Chocolate chip cookies and milk
e) Computers and software

a)   Assuming red and black umbrellas are substitutes, we would expect the cross-price elasticity of demand to be positive.

b)   Coca-cola and Pepsi are substitutes. We would expect the cross-price elasticity of demand to be positive.

c)   Grape jelly and peanut butter are typically complements (people want both on their sandwiches!). We would expect the cross-price elasticity of demand to be negative.

d)   Chocolate chip cookies and milk are typically complements (people want to consume them together). We would expect the cross-price elasticity of demand to be negative.

e)   Computers and software are complements (consumers want to use them together). We would expect the cross-price elasticity of demand to be negative.

2.21.   Suppose that the market for air travel between Chicago and Dallas is served by just two airlines, United and American. An economist has studied this market and has estimated that the demand curves for round-trip tickets for each airline are as follows: Q^d_U = 10,000 − 100P_U + 99P_A (United's demand) Q^d_A = 10,000 − 100P_A + 99P_U (American's

demand) where P_U is the price charged by United, and P_A is the price charged by American.
a) Suppose that both American and United charge a price of $300 each for a round-trip ticket between Chicago and Dallas. What is the price elasticity of demand for United flights between Chicago and Dallas?
b) What is the market-level price elasticity of demand for air travel between Chicago and Dallas when both airlines charge a price of $300? (*Hint:* Because United and American are the only two airlines serving the Chicago–Dallas market, what is the equation for the total demand for air travel between Chicago and Dallas, assuming that the airlines charge the same price?)

a)
$$Q_U^d = 10000 - 100(300) + 99(300)$$
$$Q_U^d = 9700$$

Using $P_U = 300$ and $Q_U^d = 9700$ gives

$$\varepsilon_{Q,P} = -100\left(\frac{300}{9700}\right) = -3.09$$

b)   Market demand is given by $Q^d = Q_U^d + Q_A^d$. Assuming the airlines charge the same price we have

$$Q^d = 10000 - 100P_U + 99P_A + 10000 - 100P_A + 99P_U$$
$$Q^d = 20000 - 100P + 99P - 100P + 99P$$
$$Q^d = 20000 - 2P$$

When $P = 300$, $Q^d = 19400$. This implies an elasticity equal to

$$\varepsilon_{Q,P} = -2\left(\frac{300}{19400}\right) = -.0309$$

2.22.   You are given the following information:
• Price elasticity of demand for cigarettes at current prices is −0.5.
• Current price of cigarettes is $0.05 per cigarette.
• Cigarettes are being purchased at a rate of 10 million per year.
Find a linear demand that fits this information, and graph that demand curve.

We know that along a linear demand curve

$$\varepsilon_{Q,P} = -b\left(\frac{P}{Q}\right)$$

Using the given information this implies

$$-.5 = -b\left(\frac{.05}{10,000,000}\right)$$
$$b = 100,000,000$$

Plugging this result into a demand equation using the known price and quantity then implies

$$Q^d = A - bP$$
$$10,000,000 = A - 100,000,000(.05)$$
$$A = 15,000,000$$

So a demand equation that fits this information is given by

$$Q^d = 15,000,000 - 100,000,000 P$$

Graphically, the demand curve looks like
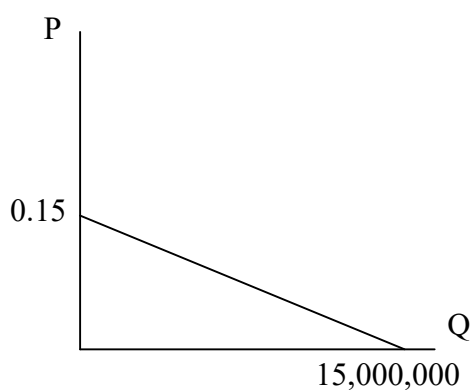
2.23   For each of the following, discuss whether you expect the elasticity (of demand or of supply, as specified) to be greater in the long run or the short run.
a) The supply of seats in the local movie theater.
b) The demand for eye examinations at the only optometrist in town.
c) The demand for cigarettes.

a)   More elastic in the long run as the theatre owner can increase space or add another screen if the price remains high, but cannot easily adjust the number of seats at short notice.
b)   More elastic in the short run as people can be relatively flexible about when to undergo an eye exam, but in the long run the need for eye exams is fixed.
c)   More elastic in the long run. Cigarettes tend to be addictive and so smokers are less likely to be able to reduce their demand in response to short term fluctuations in price. However if the price remains high for a long time they will consider giving up the habit as it becomes too expensive.

2.24   In February 2011, there is an unexpected temporary surge in the demand for notebook hard drives, increasing the monthly demand for hard drives by 25 percent at any possible price. As a result of this, the price of notebook hard drives increased by $5 per

megabyte by the end of February. This surge in demand ended in March 2011, and the price of notebook hard drives fell back to its level just before the temporary demand surge occurred.
Later that year, in August 2011, a permanent increase in the demand for notebook computers occurs, increasing the monthly demand for hard drives by 25 percent per month at any possible price. Nine months later, the price of notebook hard drives had increased, by $1 per unit.
**In both circumstances, the market experienced a shift in demand of exactly the same magnitude. Yet, the change in the equilibrium price appears to have been different. Why?**

When demand surges temporarily, putting upward pressure on price, the quantity supplied expands along the short-run supply curve SS, as shown in the figure below. If demand increases by the identical rate, but the increase is permanent, the industry would expand along the long-run supply curve LS. The long-run supply curve is likely to be more price elastic than the short-run supply curve. If the demand increase and the resulting upward pressure on price is temporary, producers may be able to do very little to increase supply except to utilize their existing production facilities more intensively (perhaps by hiring some temporary labor). If the demand increase is permanent, industry supply can increase in response to upward pressure on price in a number of ways: existing firms can produce more output in their existing facilities; existing firms can expand their plants; and new firms can enter the industry and produce. Thus, over a longer horizon, the industry's supply response when prices begin to rise is more flexible than it is over a shorter horizon.

Supply curve shifts leftward,
demand curve shifts rightward
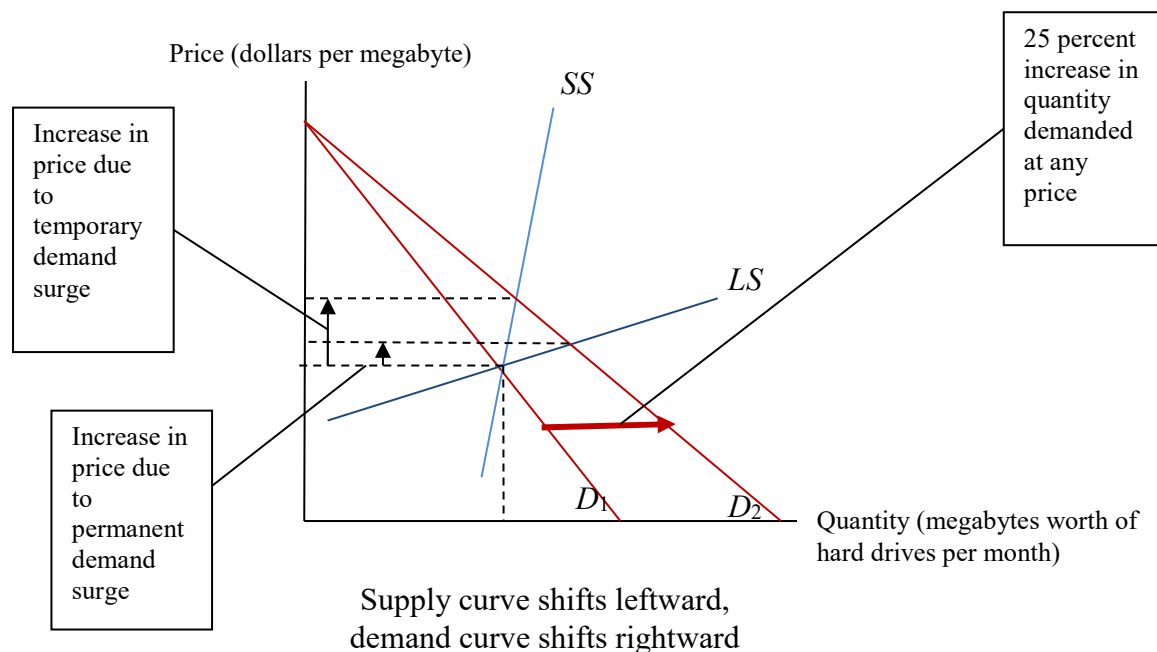
2.25.   The demand for dinners in the only restaurant in town has a unitary price elasticity of demand when the current average price of a dinner is $8. At that price 120 people eat dinners at the restaurant every evening.
a) Find a linear demand curve that fits this information and draw it on a clearly labeled graph.
b) Do you need the information on the price elasticity of demand to find the curve? Why?

a)   In case of the linear demand $Q = A - bP$, we know that $\varepsilon_{Q,P} = -b\dfrac{P}{Q} = -1$

Using the values of P and Q given in the problem we have

$$-1 = -b\frac{8}{120} \quad \Rightarrow \quad b = \frac{120}{8} = 15.$$

Now we can solve for the second parameter of the linear demand curve
$$120 = a - 15(8) \quad \Rightarrow \quad a = 240.$$

Hence the linear demand curve is given by equation $Q^d = 240 - 15P$.
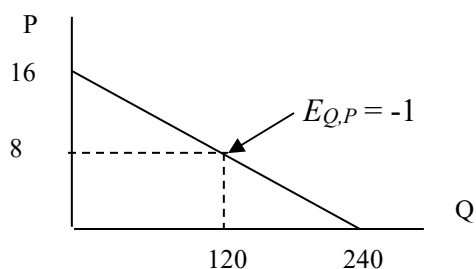
b)   There exist several linear demand curves for which the demand is equal to 120 at price of $8. Information about elasticity of demand lets us determine exactly one of those. More formally, we need second equation to solve for both parameters of the linear demand curve.

2.26.   In each of the following pairs of goods, identify the one which you would expect to have a greater price elasticity of demand. Briefly explain your answers.
a) Butter versus eggs
b) Trips by your congressman to Washington (say, to vote in the House) versus vacation trips by you to Hawaii
c) Orange juice in general versus the Tropicana brand of orange juice

a)   Butter has some reasonably close substitutes such as margarine or cheese, while eggs have no immediate substitutes. Therefore we would expect the demand for butter to be more elastic.

b)   Vacation trips are sensitive to price because leisure travelers can be relatively flexible about when to fly. Your congressman, however, has fixed dates on which to be in Washington and would be prepared to pay more to ensure that he flies on the day of his choosing. Therefore, demand for vacation trips is likely to be more elastic (i.e. the price elasticity will be more negative) than the demand for trips by your congressman.

c)   As discussed in the chapter, market level elasticities tend to be lower (less negative) than the elasticity of a particular brand. Thus, expect the demand for Tropicana to be more elastic than the demand for generic orange juice.

**2.27.   In a city, the price for a trip on local mass transit (such as the subway or city buses) has been 10 pesos for a number of years. Suppose that the market for trips is characterized by the following demand curves: in the long run: $Q = 30 - 2P$; in the short run: $Q = 15 - P/2$. Verify that the long-run demand curve is "flatter" than the short-run curve. What does this tell you about the sensitivity of demand to price for this good? Discuss why this is the case.**

First, consider each demand curve in its "inverse" form: long run demand is $P = 15 - 0.5Q$, and short run demand is $P = 30 - 2Q$. Thus, the slope of the long run demand is –0.5, which is closer to zero than that of the short run demand, –2. Thus, long run demand is flatter. Second, consider the graph below:
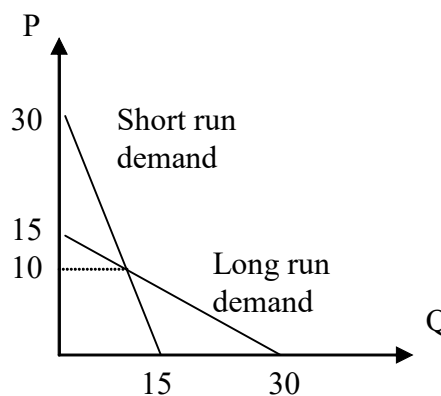
Again, long run demand is flatter and thus more sensitive to changes in price. Consider, for instance a price of $10. Quantity demanded is equal in both the long and short runs at $P = 10$. However, consider increasing the price to, say, $15. Although this will reduce quantity demanded in the short run by a little, it would reduce quantity demanded all the way to zero in the long run.

2.28.   Consider the following sequence of events in the U.S. market for strawberries during the years 1998–2000:
• 1998: Uneventful. The market price was $5.00 per bushel, and 4 million bushels were sold.

• 1999: There was a scare over the possibility of contaminated strawberries from Michigan. The market price was \$4.50 per bushel, and 2.5 million bushels were sold.
• 2000: By the beginning of the year, the scare over contaminated strawberries ended when the media reported that the initial reports about the contamination were a hoax. A series of floods in the Midwest, however, destroyed significant portions of the strawberry fields in Iowa, Illinois, and Missouri. The market price was \$8.00 per bushel, and 3.5 million bushels were sold.
Find linear demand and supply curves that are consistent with this information.

The scare in 1999 would shift demand to the left, identifying a second point on the supply curve. The information implies that price fell \$0.50 while quantity fell 1.5 million. This implies

$$b = \frac{-.5}{-.15} = \frac{1}{3}$$

Using a linear supply curve we then have

$$P = a + \frac{1}{3}Q^s$$

$$5 = a + \frac{1}{3}(4)$$

$$a = \frac{11}{3}$$

Finally, plugging these values for a and b into the supply equation results in

$$P = \frac{11}{3} + \frac{1}{3}Q^s$$

$$3P = 11 + Q^s$$

$$Q^s = -11 + 3P$$

The floods in 2000 will reduce supply. The shift in supply will identify a second point along the demand curve. Because the scare of 1999 is over, assume that demand has returned to its 1998 state. The change in price and quantity in 2000 imply that price increased \$3.00 and that quantity fell 0.5 million.

Performing the same exercise as above we have

$$-b = \frac{3}{-0.5} = -6$$

Using the 1998 price and quantity information along with this result yields

$$P = a - bQ^d$$
$$5 = a - 6(4)$$
$$a = 29$$

Finally, plugging these values for a and b into a linear demand curve results in

$$P = 29 - 6Q^d$$
$$6Q^d = 29 - P$$
$$Q^d = \frac{29}{6} - \frac{1}{6}P$$

2.29   Consider the following sequence of changes in the demand and supply for cab service in some city. The price P is a price per mile, while quantity is the total length of cab rides over a month (in thousands of miles).
January: Initial demand and supply are given by the equations $Q^s = 30P$ - 30 (when $P \geq 1$), and $Q^d = 120$ - 20P
February: Due to higher prices of gasoline, the supply of cab service changed to $Q^s = 30P$ - 60 (when $P \geq 2$).
March: Over the spring break, the demand for taxi service was higher and therefore demand curve was given by the equation $Q^d = 140$ - 20P.
a) For each month find equilibrium price and quantity.
b) Illustrate your answer with a graph. Illustrate the equilibrium prices and quantities on the graph.

The equilibrium price in January is equal to $P = 3$ and equilibrium quantity is equal to $Q = 60$. We find equilibrium price by solving $Q^s = Q^d$, which is $30 \cdot P - 30 = 120 - 20 \cdot P$. When we have equilibrium price we can substitute it to either the demand function or supply function, since they have to give the same quantity at that price, and obtain equilibrium quantity equal to $Q = 60$. After the supply decreases in February, new equilibrium price is per mile is equal to $P = \$3.60$, while the demanded quantity is equal to $Q = 48$. When the demand goes up in March, the quantity in equilibrium is the same as in January but price is even higher and equal to $P = \$4$. All those changes are illustrated on the graph below.
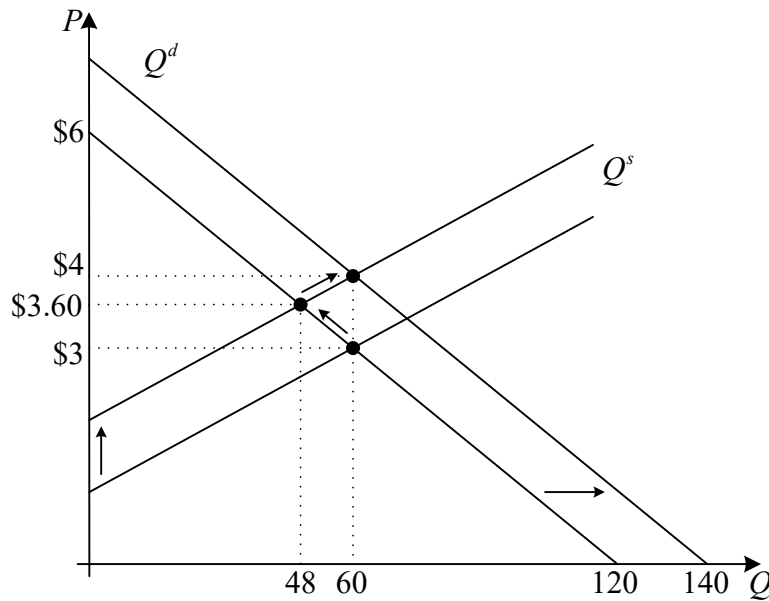
2.30 **Consider the demand curve for pomegranates in two countries. In one country, pomegranates are a critical part of the diet and are central to eh preparation of many popular food recipes. For most of these dishes, there is no feasible substitute for pomegranates. In the second country, households will purchase pomegranates if the price is right, but they are not considered by consumers to be particularly special or unique, and few popular dishes rely on pomegranates in their recipes.**

Suppose pomegranates are native to both countries. Suppose, further, that due to inherent limitations of shipping options, there is no inter-country trade in pomegranates. Each country's market for pomegranates is independent of the other countries. Finally, suppose that in both countries, droughts and other weather-related shocks periodically cause unexpected changes in supply conditions.

The graph below shows the time paths of pomegranate prices over a 10-year period in each country (the blue (solid) line is the time path in one country; the red (dashed) line is the time path in the other country.) Based on the information provided, which is the time path for each country?
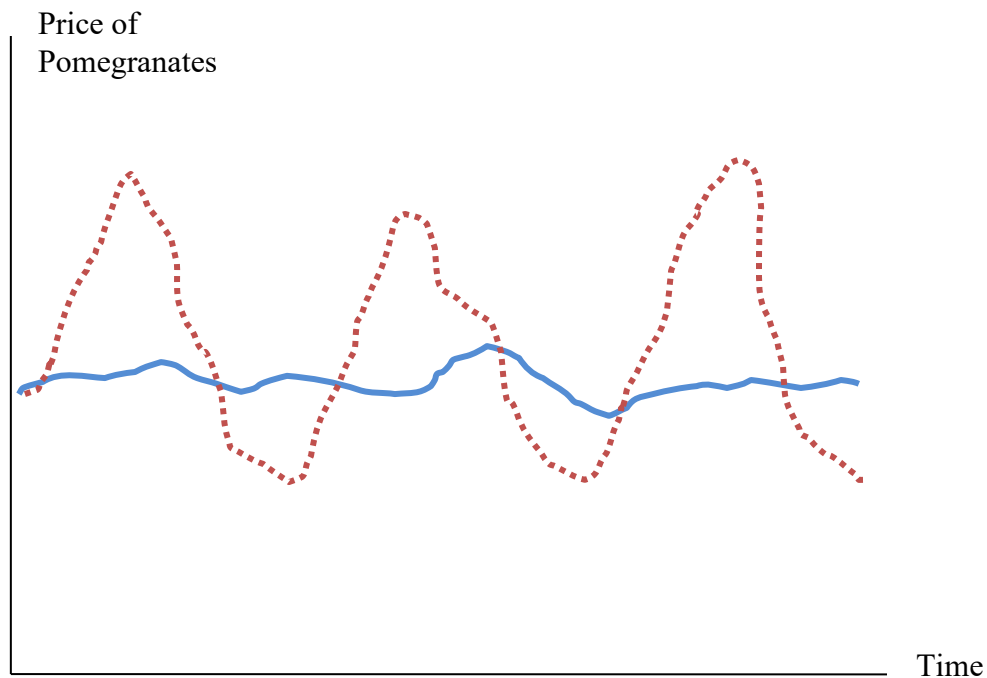
The price path for Country A is the one in which there is substantial price variation over time, while the price path for Country B is the one on in which there is more modest price variation over time. Here is why.

Based on the information given, we can infer that the demand for pomegranates is probably less sensitive to price in Country A (where pomegranates have few good substitutes) than it is in country B. Thus, if the demand curve for pomegranates in country A look likes what is shown below in the first panel, the demand curve for country B would look more like what is shown in the second panel. For a given shift in the supply curve in each country, the change in the equilibrium price in country A will be larger than the change in the equilibrium price in country B.

Demand Curve
Qd = 5.3 - 0.1P

Quantity	Price
5.3	$0.00
0	$53.00

Coordinates of Vertices Along Guidelines when Price is $2.00

Quantity	Price
0	$15.00
3.80	$15.00
3.80	$0.00

Choose Price

$15.00 ◄ ► 30

Coordinates of Vertices along Guidelines

Quantity	Price
0	$15.00
3.80	$15.00
3.80	$0.00

Instructions for students:
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Price

$60.00

$15.00

$0.00

0

Determining Demand

Quantity

3.80   6

Legend	
——	Demand Curve
—●—	Current Price
—●—	Quantity Demanded
— ·	Guide Lines
—●—	Price of $15.00
—●—	Quantity Demanded when Price is $15.00
— ·	Guidelines when Price is $15.00
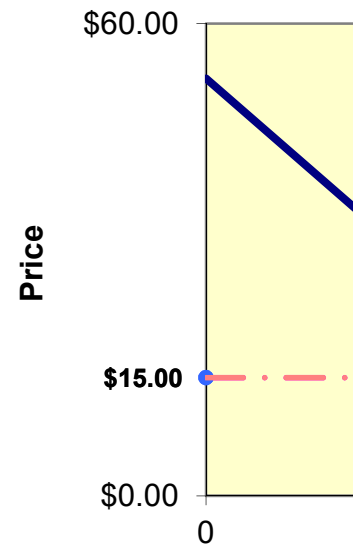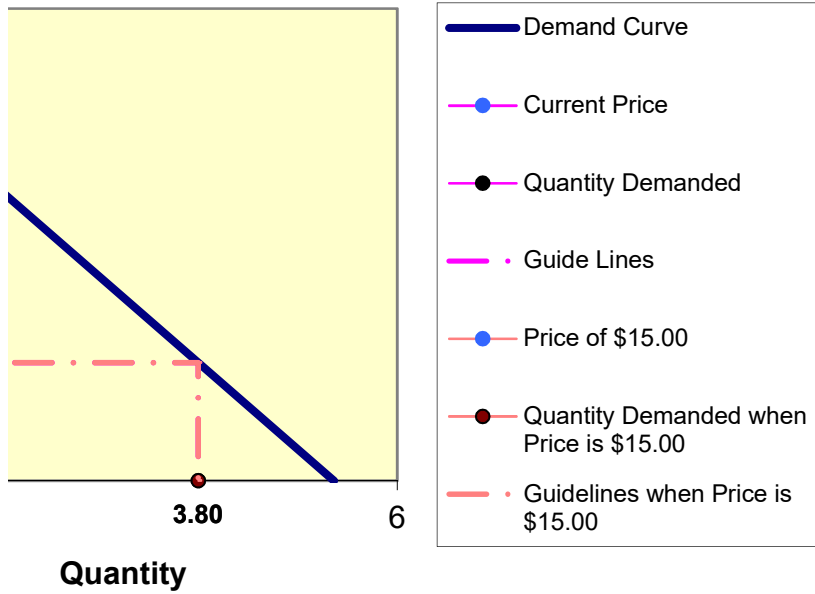
Supply Curve

Qs = 0.15 + P

Quantity	Price
0.15	$0.00
100.15	$100.00

**Coordinates of Vertices
Along Guidelines when
Price is $2.00**

Quantity	Price
0	$2.00
2.15	$2.00
2.15	$0.00

Choose Price

$2.00 ◄ ►   20

**Coordinates of Vertices
along Guidelines**

Quantity	Price
0	$2.00
2.15	$2.00
2.15	$0.00

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$10.00

Price

$2.00

$0.00

0   2.15

Determining Supply

Quantity

10

Legend:
- Supply Curve
- Current Price
- Quantity Supplied
- Guide Lines
- Price of $2.00
- Quantity Supplied when Price is $2.00
- Guidelines when Price is $2.00
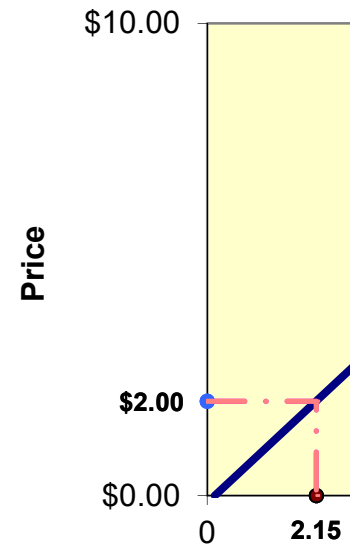
Price =	65	◄	►
	0	$65.00	
	500	$65.00	

Demand Curve Qd= 500 - 4P

	Quantity	Price
P Intercept	0	$125.00
Q Intercept	500	$0.00

Supply Curve Qs = -100 + 2P

	Quantity	Price
Q Intercept	0	$50.00
Q = 500	500	$300.00

Quantity Demanded		Quantity Supplied	
$240.00	$65.00	$30.00	$65.00
$240.00	0	$30.00	0

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Determinir

Price

$130.00

$65.00

$0.00

0 30   240

Quan

ng Equilibrium

— ·	Price Line
—	Demand Curve
—	Supply Curve
— ·	Quantity Demanded
— ·	Quantity Supplied

600
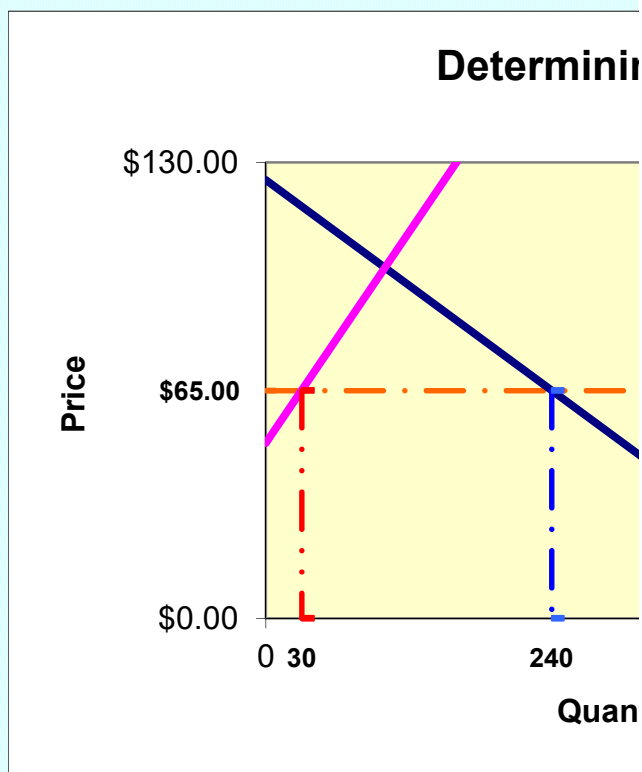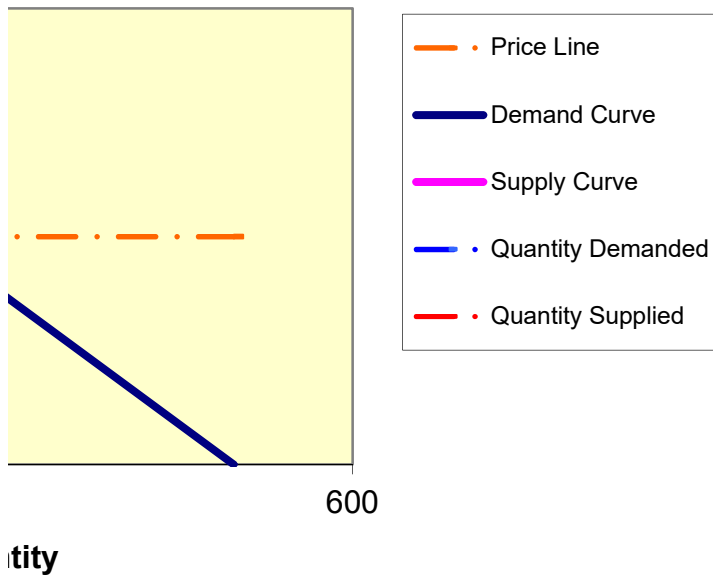
ntity

I= 15 ◄ ►

Demand Curve

	Quantity	Price
P Intercept	0	$13.00
Q Intercept	650	$0.00

Supply Curve

	Quantity	Price
P Intercept	0	$8.00
Q = 400	400	$16.00

Equilibrium

Quantity	Price
$125.00	$10.50

Instructions for students:
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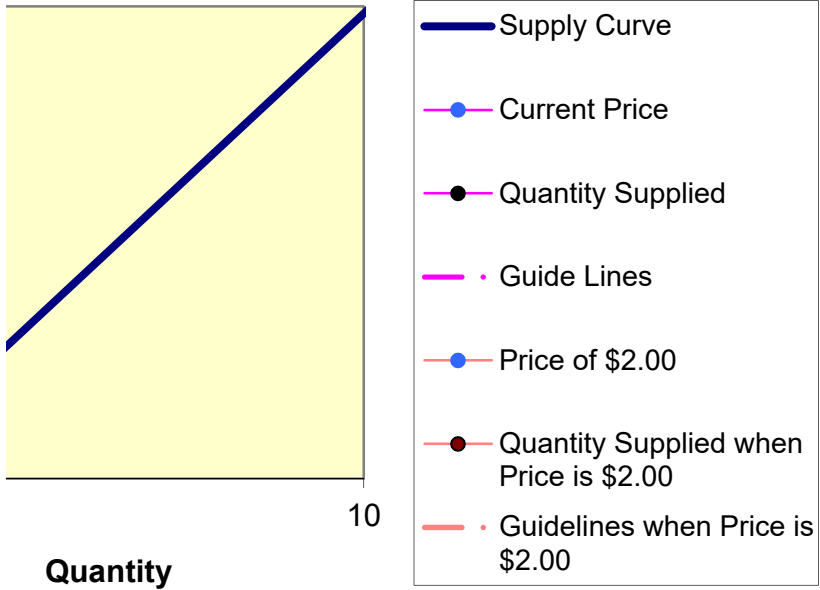When you save the file to your disk, your notes will be saved along with the other data in the spreadsheet.

Alumin

Price

$20.00

$15.00

$10.00 ● $10.50

$5.00

$0.00

0   200   400

Quant

ıum Market

Demand Curve
Supply Curve
Equilibrium

600   800

tity

Q	P
1000	$5.00
800	$5.75

**Unitary Elastic Demand
Through Chosen Point**

Q	P
1,042	$4.80
1,040	$4.81
1,037	$4.82
1,035	$4.83
1,033	$4.84
1,031	$4.85
1,029	$4.86
1,027	$4.87
1,025	$4.88
1,022	$4.89
1,020	$4.90
1,018	$4.91
1,016	$4.92
1,014	$4.93
1,012	$4.94
1,010	$4.95
1,008	$4.96
1,006	$4.97
1,004	$4.98
1,002	$4.99
1,000	$5.00
998	$5.01
996	$5.02
994	$5.03
992	$5.04
990	$5.05
988	$5.06
986	$5.07
984	$5.08
982	$5.09
980	$5.10
978	$5.11
977	$5.12
975	$5.13
973	$5.14
971	$5.15
969	$5.16
967	$5.17
965	$5.18
963	$5.19
962	$5.20
960	$5.21
958	$5.22
956	$5.23
954	$5.24

Chosen Point

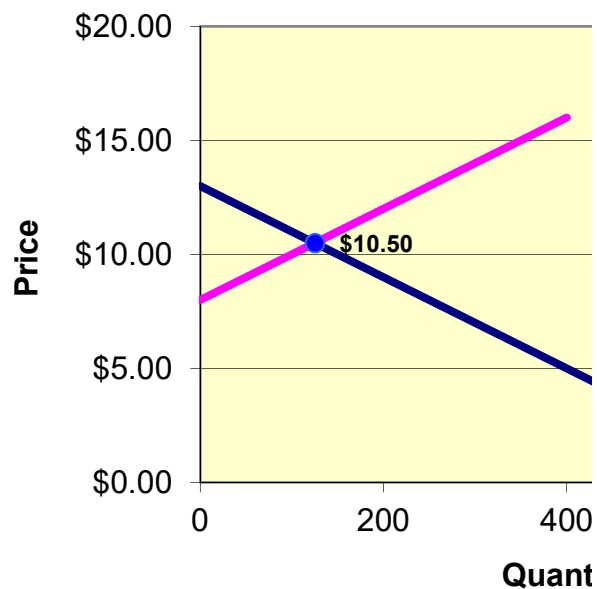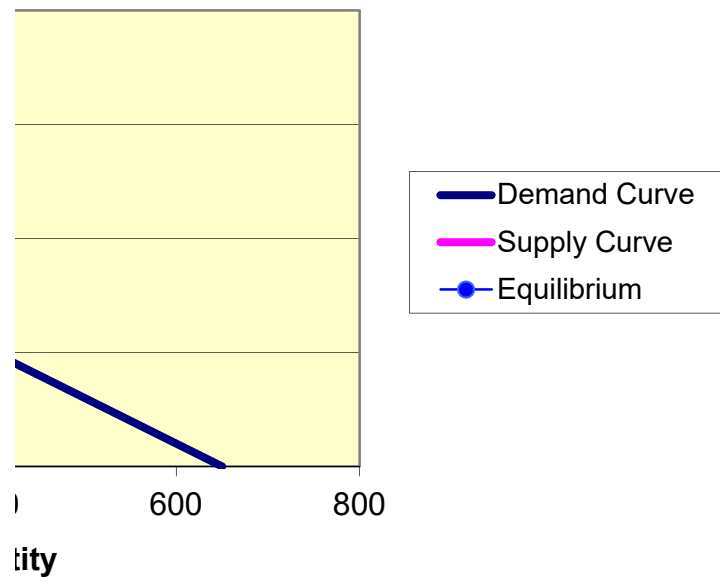|	Q	P
0 ◀ ▶	1000	$5.00

Instructions for students:
This space is for you to take
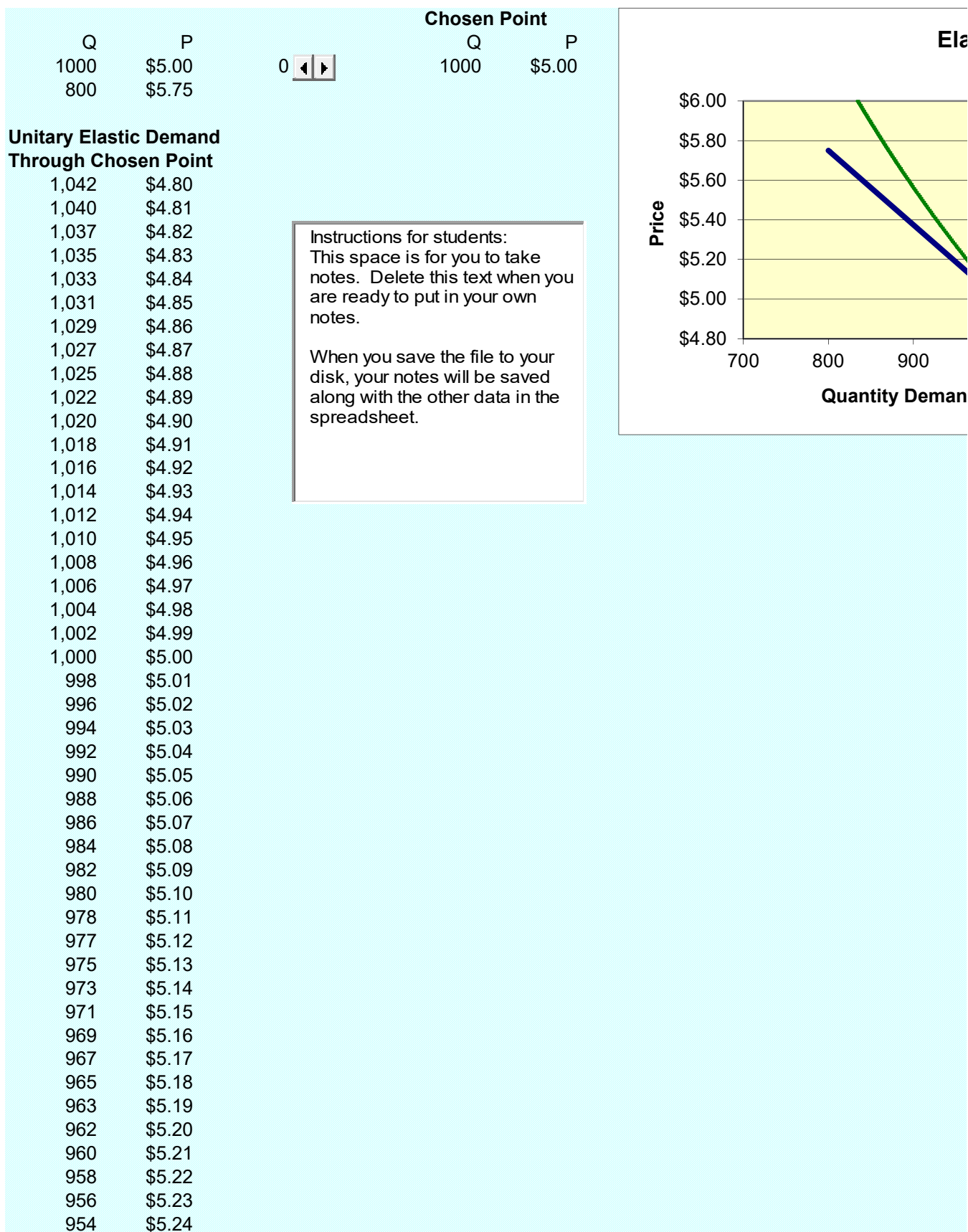notes. Delete this text when you
are ready to put in your own
notes.

When you save the file to your
disk, your notes will be saved
along with the other data in the
spreadsheet.

Ela

Price vs Quantity Demanded chart with price axis from $4.80 to $6.00.

952	$5.25
951	$5.26
949	$5.27
947	$5.28
945	$5.29
943	$5.30
942	$5.31
940	$5.32
938	$5.33
936	$5.34
935	$5.35
933	$5.36
931	$5.37
929	$5.38
928	$5.39
926	$5.40
924	$5.41
923	$5.42
921	$5.43
919	$5.44
917	$5.45
916	$5.46
914	$5.47
912	$5.48
911	$5.49
909	$5.50
907	$5.51
906	$5.52
904	$5.53
903	$5.54
901	$5.55
899	$5.56
898	$5.57
896	$5.58
894	$5.59
893	$5.60
891	$5.61
890	$5.62
888	$5.63
887	$5.64
885	$5.65
883	$5.66
882	$5.67
880	$5.68
879	$5.69
877	$5.70
876	$5.71
874	$5.72
873	$5.73
871	$5.74
870	$5.75
868	$5.76

867	$5.77
865	$5.78
864	$5.79
862	$5.80
861	$5.81
859	$5.82
858	$5.83
856	$5.84
855	$5.85
853	$5.86
852	$5.87
850	$5.88
849	$5.89
847	$5.90
846	$5.91
845	$5.92
843	$5.93
842	$5.94
840	$5.95
839	$5.96
838	$5.97
836	$5.98
835	$5.99
833	$6.00

asticity

▬▬▬	Observed Demand
─●─	Chosen Point
───	Unitary Elastic Demand

1000   1100

ided

$Q = 200 \cdot P^{-b}$

	Q	P
11 ◄ ►	113	$1.60
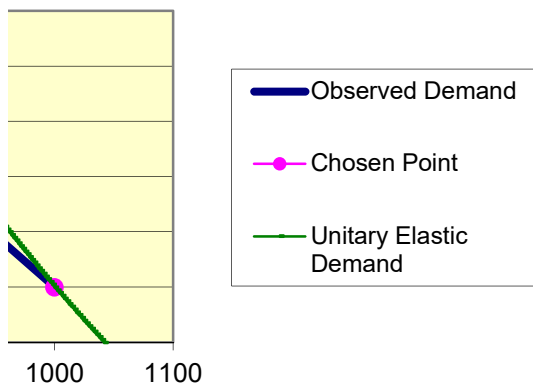
	b
46 ◄ ►	1.22

**Iso Elastic Demand
Through Chosen Point**

3,319	$0.10
1,425	$0.20
869	$0.30
612	$0.40
466	$0.50
373	$0.60
309	$0.70
263	$0.80
227	$0.90
200	$1.00
178	$1.10
160	$1.20
145	$1.30
133	$1.40
122	$1.50
113	$1.60
105	$1.70
98	$1.80
91	$1.90
86	$2.00
81	$2.10
76	$2.20
72	$2.30
69	$2.40
65	$2.50
62	$2.60
60	$2.70
57	$2.80
55	$2.90
52	$3.00
50	$3.10
48	$3.20
47	$3.30
45	$3.40
43	$3.50
42	$3.60
41	$3.70
39	$3.80
38	$3.90
37	$4.00
36	$4.10
35	$4.20
34	$4.30
33	$4.40
32	$4.50

Instructions for students:
This space is for you to take notes. Delete this text when you are ready to put in your own notes.

When you save the file to your disk, your notes will be saved along with the other data in the spreadsheet.

**Linear Demand through
Chosen Point**

Q	P
0	$2.91
250	0
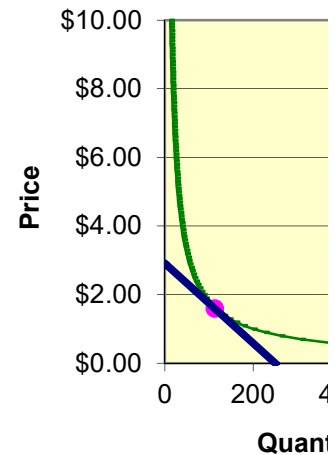
31	$4.60
30	$4.70
30	$4.80
29	$4.90
28	$5.00
27	$5.10
27	$5.20
26	$5.30
26	$5.40
25	$5.50
24	$5.60
24	$5.70
23	$5.80
23	$5.90
22	$6.00
22	$6.10
22	$6.20
21	$6.30
21	$6.40
20	$6.50
20	$6.60
20	$6.70
19	$6.80
19	$6.90
19	$7.00
18	$7.10
18	$7.20
18	$7.30
17	$7.40
17	$7.50
17	$7.60
17	$7.70
16	$7.80
16	$7.90
16	$8.00
16	$8.10
15	$8.20
15	$8.30
15	$8.40
15	$8.50
14	$8.60
14	$8.70
14	$8.80
14	$8.90
14	$9.00
14	$9.10
13	$9.20
13	$9.30
13	$9.40
13	$9.50
13	$9.60
13	$9.70

12	$9.80
12	$9.90
12	$10.00
12	$10.10
12	$10.20

Iso Elastic Demand

Legend:
- Iso Elastic Demand
- Chosen Point
- Linear Demand through Chosen Point

400   600   800   1,000

tity Demanded