

Answers to the Problems – Chapter 4

1. a. The price elasticity of demand is 1.25.
The price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in the price. The price rises from \$4 to \$6 a box, a rise of \$2 a box. The average price is \$5 a box. So the percentage change in the price equals \$2 divided by \$5, which equals 40 percent.
The quantity decreases from 1,000 to 600 boxes, a decrease of 400 boxes. The average quantity is 800 boxes. So the percentage change in quantity equals 400 divided by 800, which equals 50 percent.
The price elasticity of demand for strawberries equals 50 divided by 40, which is 1.25.
- b. The price elasticity of demand exceeds 1, so the demand for strawberries is elastic.
2. a. The price elasticity of demand is 2.
When the price of a DVD rental rises from \$3 to \$5, the quantity demanded of DVDs decreases from 75 to 25 a day. The price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in the price.
The price increases from \$3 to \$5, an increase of \$2 a DVD. The average price is \$4 a DVD. So the percentage change in the price equals \$2 divided by \$4, which equals 50 percent.
The quantity decreases from 75 to 25 DVDs, a decrease of 50 DVDs. The average quantity is 50 DVDs. So the percentage change in quantity equals 50 divided by 50, which equals 100 percent.
The price elasticity of demand for DVD rentals equals 100 divided by 50, which is 2.
- b. The price elasticity of demand equals 1 at \$3 a DVD.
The price elasticity of demand equals 1 at the price halfway between the origin and the price at which the demand curve hits the y-axis. That price is \$3 a DVD.
3. The demand for dental services is unit elastic.
The price elasticity of demand for dental services equals the percentage change in the quantity of dental services demanded divided by the percentage change in the price of dental services. The price elasticity of demand equals 10 divided by 10, which is 1. The demand is unit elastic.
4. a. Total revenue increases.
When the price of a chip is \$400, 30 million chips are sold and total revenue equals \$12,000 million. When the price of a chip falls to \$350, 35 million chips are sold and total revenue is \$12,250 million. Total revenue increases when the price falls.
- b. Total revenue decreases.
When the price is \$350 a chip, 35 million chips are sold and total revenue is \$12,250 million. When the price of a chip is \$300, 40 million chips are sold and total revenue decreases to \$12,000 million. Total revenue decreases as the price falls.
- c. Total revenue is maximized at \$350 a chip.
When the price of a chip is \$300, 40 million chips are sold and total revenue equals \$12,000 million. When the price is \$350 a chip, 35 million chips are sold and total revenue equals \$12,250 million. Total revenue increases as the price rises from \$300 to \$350 a chip. When the price is \$400 a chip, 30 million chips are sold and total revenue equals \$12,000 million. Total revenue decreases as the price rises from \$350 to \$400 a chip. Total revenue is maximized when the price is \$350 a chip.
- d. The demand for chips is unit elastic.
The total revenue test says that if the price changes and total revenue remains the same, the demand is unit elastic at the average price. For an average price of \$350 a chip, cut the price

from \$400 to \$300 a chip. When the price of a chip falls from \$400 to \$300, total revenue remains at \$12,000 million. So at the average price of \$350 a chip, demand is unit elastic.

5. The demand for chips is inelastic.
The total revenue test says that if the price falls and total revenue falls, the demand is inelastic. When the price falls from \$300 to \$200 a chip, total revenue decreases from \$12,000 million to \$10,000 million. So at an average price of \$250 a chip, demand is inelastic.
6.
 - a. Your total expenditure decreases because your demand is elastic. The fall in expenditure is *approximately* 15 percent, the 5 percent rise in price offset by the 20 percent decrease in the quantity purchased.
 - b. The quantity of bananas you buy decreases by 20 percent.
The price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in the price. Rearranging this formula gives the percentage change in the quantity demanded equals the price elasticity of demand multiplied by the percentage change in the price. In the case at hand, the percentage change in the quantity demanded equals 4×5 percent, which is 20 percent.
7.
 - a. The price elasticity of demand for orange juice is 1.83.
The price elasticity of demand is the percentage change in the quantity demanded of the good divided by the percentage change in the price of the good. So the price elasticity of demand equals 22 percent divided by 12 percent, which is 1.83.
 - b. The cross elasticity of demand between orange juice and apple juice is 1.17.
The cross elasticity of demand is the percentage change in the quantity demanded of one good divided by the percentage change in the price of another good. The rise in the price of orange juice resulted in an increase in the quantity demanded of apple juice. So the cross elasticity of demand is the percentage change in the quantity demanded of apple juice divided by the percentage change in the price of orange juice. The cross elasticity equals 14 divided by 12, which is 1.17.
8. The income elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in income. The change in income is \$2,000 and the average income is \$4,000, so the percentage change in income equals 50 percent.
 - a. The change in the quantity demanded is 4 bagels and the average quantity demanded is 6 bagels, so the percentage change in the quantity demanded equals 66.67 percent. The income elasticity of demand for bagels equals $66.67/50$, which is 1.33.
 - b. The change in the quantity demanded is -6 donuts and the average quantity demanded is 9 donuts, so the percentage change in the quantity demanded is -66.67 . The income elasticity of demand for donuts equals $-66.67/50$, which is -1.33 .
9.
 - a. Using the data in the question, the price elasticity of demand is 0.90.
The change in the price is \$6 and the average of the two prices is \$18, so the percentage change in the price is $(\$6/\$18) \times 100$, which is 33.3 percent. The increase in the quantity demanded was estimated to be 30 percent. The price elasticity of demand equals $30.0/33.3$, or 0.90.
 - b. The demand is inelastic, so if nothing else changes the price cut leads to a decrease in Universal Music's total revenue. However, downloaded music and CDs are substitutes for each other and the quantity of downloaded music was forecast to rise substantially. Effectively, the price of downloading music fell as more people gained access to the Internet and download sites proliferated. The fall in the price of the substitute, downloaded music, decreases the demand for Universal Music's CDs, so the price cut most likely was the result of the (forecasted) decrease in demand for CDs.

10. a. The elasticity of supply is 1.
 The elasticity of supply is the percentage change in the quantity supplied divided by the percentage change in the price. When the price falls from 40 cents to 30 cents, the change in the price is 10 cents and the average price is 35 cents. The percentage change in the price is 28.57.
 When the price falls from 40 cents to 30 cents, the quantity supplied decreases from 800 to 600 calls. The change in the quantity supplied is 200 calls, and the average quantity is 700 calls, so the percentage change in the quantity supplied is 28.57.
 The elasticity of supply equals $28.57/28.57$, which equals 1.
- b. The elasticity of supply is 1.
 The formula for the elasticity of supply calculates the elasticity at the average price. So to find the elasticity at an average price of 20 cents a minute, change the price such that 20 cents is the average price—for example, a fall in the price from 30 cents to 10 cents a minute.
 When the price falls from 30 cents to 10 cents, the change in the price is 20 cents and the average price is 20 cents. The percentage change in the price is 100. When the price falls from 30 cents to 10 cents, the quantity supplied decreases from 600 to 200 calls. The change in the quantity supplied is 400 calls and the average quantity is 400 calls. The percentage change in the quantity supplied is 100.
 The elasticity of supply is the percentage change in the quantity supplied divided by the percentage change in the price. The elasticity of supply is 1.

Critical Thinking

1. a. No, the elasticity of demand for notebook computers is almost surely larger than 1.83.
 The price elasticity of demand measures how the quantity demanded responds to a change in the price when other factors remain the same; that is, the price elasticity of demand is calculated while moving along a single demand curve. But as the analysis points out, other factors did not remain the same. In particular, the price of desktop computers fell. The fall in the price of desktop computers decreased the demand for laptop computers. As a result, the increase in the quantity demanded created by the fall in the price of a laptop computer was offset by the decrease in quantity demanded created by the fall in the price of a desktop computer.
- b. No, the elasticity of demand for desktop computer is almost surely larger than 0.77.
 The price elasticity of demand measures how the quantity demanded responds to a change in the price when other factors remain the same; that is, the price elasticity of demand is calculated while moving along a single demand curve. But as the analysis points out, other factors did not remain the same. In particular, the price of laptop computers fell. The fall in the price of laptop computers decreased the demand for desktop computers. As a result, the increase in the quantity demanded created by the fall in the price of a desktop computer was offset by the decrease in quantity demanded created by the fall in the price of a laptop computer.
- c. To predict the change in demand for personal computers, several elasticities are needed. First, presuming that demands for both laptops and desktops are needed, the price elasticity of demand for both, the income elasticity of demand for both, and the cross elasticity of demand are needed. Then predictions about the changes in price over the next five years for both laptops and desktops are needed as is a prediction for the change in income over the next five years.

2.
 - a. By decreasing the supply, the price of illegal drugs will rise. Because the demand is inelastic, the total amount spent on them will increase.
 - b. On the one hand, because purchasing illegal drugs is a criminal activity, decreasing the amount of illegal drugs bought and sold decreases crime. On the other hand, many consumers of illegal drugs turn to criminal activities to raise the funds necessary to purchase the drugs. Because the total expenditure on these drugs would increase, the total amount of crime necessary to raise these funds would increase.
 - c. If the demand for illegal drugs decreased, then both the price and quantity of illegal drugs would fall. The total expenditure on illegal drugs also would fall. The decrease in the quantity of illegal drugs purchased would directly reduce the crime rate. Because the total expenditure spent on illegal drugs would fall, less crime would be necessary to raise these funds, so the crime rate would also indirectly fall.
3.
 - a. The price elasticity of demand from most studies ranges between 0.1 and 0.2. The price elasticity of demand is the percentage change in the quantity demanded divided by the percentage change in the price. The smallest reported change in the quantity demanded from a 10 percent change in the price is 1 percent, so the smallest price elasticity of demand is $1/10$, or 0.10. The largest reported change in the quantity demanded from a 10 percent change in the price is 2 percent, so the largest price elasticity of demand is $2/10$, or 0.20.
 - b. Using the data for the year to September 2005, the price elasticity of demand is 0.08. The change in the quantity of gasoline is 3.5 percent. The price changed by \$1.03 and the average price is \$2.39, so the percentage change in the price is $(\$1.03/\$2.39) \times 100$, or 43.1 percent. The price elasticity of demand equals $3.5/43.1$, or 0.08.
 - c. The price elasticity of demand for the year to September 2005 is slightly below the lowest estimate of the price elasticity of demand from other studies. The difference is probably not significant as it appears to be within rounding error.
4.
 - a. The price of gasoline rose 53 percent and the quantity of gasoline consumed increased 10 percent. Taken on their face values, these data indicate that a higher price for gasoline *increases* the quantity demanded. However, as the question points out, factors other than the price and quantity consumed changed. In particular, people's incomes rose over the time period. Therefore the data do *not* indicate a violation of the law of demand because the law of demand—the negative relationship between the price of a good and the quantity demanded—applies only when other factors remain the same.
 - b. Using the data in the question, the income elasticity of demand is 1.05. According to the question, a 19 percent increase in income leads to a 20 percent increase in the quantity of gasoline demanded. The income elasticity of demand equals $20/19$, or 1.05.
 - c. Using the data in the question, the price elasticity of demand is 0.19. If the change in income affects the demand for gasoline equally at all prices for gasoline, then if the price of gasoline had not changed, the rise in income would have increased the quantity of gasoline by 20 percent. Because the quantity of gasoline increased only 10 percent, the higher price of gasoline reduced the net increase by –10 percent. This result means that the 53 percent increase in the price of gasoline led to a 10 percent decrease in the quantity demanded so the price elasticity of demand is $10/53$, or 0.19.
 - d. Any factor that affects the demand for gasoline and changed during the period under study would bias the estimate of the price elasticity of demand. Factors that might have changed were the number of demanders, the price of automobiles, and possibly the types of automobiles purchased. An increase in the number of demanders could have occurred because of population growth. Gasoline and automobiles and gasoline are complements, so a

change in the price of automobiles would affect the demand for gasoline. Finally, if people decided they preferred large, SUVs, minivans, and trucks over this time period, the demand for gasoline would have changed because of this change in people's preferences. Most of these possible factors would have led to an increase in the demand for gasoline, which would bias the estimated price elasticity of demand downward.

Web Activities

1.
 - a. The price of gasoline in the summer of 2006 was near \$3.00 a gallon.
 - b. The students' answers will depend on when the question is assigned and what factors are presently influencing the market for gasoline. In their answers, however, the students probably should take account of the fact that demand for gasoline is quite inelastic in the short run.
 - c. The price of crude oil is available at:
http://www.eia.doe.gov/oil_gas/petroleum/info_glance/petroleum.html .
 - d. The students' answers will depend on when the question is assigned and what factors are presently influencing the market for crude oil. In their answers, however, the students probably should take account of the fact that demand for oil is inelastic in the short run.
2.
 - a. A barrel of oil has 42 gallons of oils. When refined, the barrel results in 44 gallons of petroleum products. (The number of gallons increases because there is a reduction in the density during the refining.) A barrel of crude oil, when refined, creates about 20 gallons of gasoline. All these data are from:
<http://www.eia.doe.gov/neic/infosheets/crudeproduction.htm> . Gasoline accounts for about 47 percent of the refined products from a barrel of oil. So the cost of the crude oil in a gallon of gasoline equals the price of crude oil multiplied by 47 percent.
 - b. According to a Department of Energy brochure on the costs of a gallon of gasoline (available at
http://www.eia.doe.gov/bookshelf/brochures/gasolinepricesprimer/eia1_2005primerM.html)
"The cost to produce and deliver gasoline to consumers includes the cost of crude oil to refiners, refinery processing costs, marketing and distribution costs, and finally the retail station costs and taxes. The prices paid by consumers at the pump reflect these costs, as well as the profits (and sometimes losses) of refiners, marketers, distributors, and retail station owners."
 - c. Crude oil accounts for approximately 50 percent of the cost of a gallon of gasoline. So if the price of crude oil falls 10 percent, the price of a gallon of gasoline should fall by approximately 5 percent.
 - d. The demand for oil is probably more elastic than the demand for gasoline because there are more substitutes for oil than for gasoline. Crude oil is a source of energy but there are other sources of energy, such as coal, natural gas, nuclear power, wind power, and so forth. These other sources of energy are substitutes for crude oil. Gasoline is fuel primarily used for transportation, and there are fewer substitutes, such as diesel and ethanol. Because there are more substitutes for oil, the elasticity of demand for crude oil, while probably inelastic, is likely larger than the elasticity of demand for gasoline.