



## Answers to the Review Quizzes

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1. Why do we need a units-free measure of the responsiveness of the quantity demanded of a good or service to a change in its price?  
The elasticity of demand is a units-free measure. Compare it as a measure of the responsiveness to some other candidate that depends on the units, such as the slope. The slope of the demand curve changes as the units measuring the same quantity of the good change (going from pounds to ounces, for example). The value of the elasticity is independent of the units used to measure the price and quantity of the product. As a result, the elasticity can be compared across the same good when quantity is measured in different units and/or the price is measured in different currencies. The elasticities of different goods also can be compared even though they are measured in different units.
2. Define the price elasticity of demand and show how it is calculated.  
The price elasticity of demand is units-free measure of the responsiveness of the quantity demanded of a good to a change in its price when all other influences on buying plans remain the same. It equals the absolute value (or magnitude) of the ratio of the percentage change in the quantity demanded to the percentage change in the price. The percentage change in quantity (price) is measured as the change in quantity (price) divided by the average quantity (price).
3. What makes the demand for some goods elastic and the demand for other goods inelastic?  
The magnitude of the price elasticity of demand for a good depends on three main influences:
  - *Closeness of substitutes.* The more easily people can substitute other items for a particular good, the larger is the price elasticity of demand for that good.
  - *The proportion of income spent on the good.* The larger the portion of the consumer's budget being spent on a good, the greater is the price elasticity of demand for that good.
  - *The time elapsed since a price change.* Usually, the more time that has passed after a price change, the greater is the price elasticity of demand for a good.

4. Why is the demand for a luxury generally more elastic (or less inelastic) than the demand for a necessity?  
Demand for a necessity is generally less elastic than demand for a luxury because there are fewer substitutes for a necessity. Because there are more substitutes for a luxury than a necessity, the elasticity of demand for a luxury is larger than the elasticity of demand for a necessity.
5. What is the total revenue test?  
The total revenue test is a method of estimating the price elasticity of demand by observing the change in total revenue, given a change in price, holding all other things constant. The total revenue test shows that a price cut increases total revenue if demand is elastic, decreases total revenue if demand is inelastic, and does not change total revenue if demand is unit elastic.

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1. What does the income elasticity of demand measure?  
The income elasticity of demand measures how the quantity demanded of a good responds to a change in income. The formula for the income elasticity of demand is the percentage change in the quantity of the good demanded divided by the percentage change in income.
2. What does the sign (positive/negative) of the income elasticity tell us about a good?  
The sign of the income elasticity of demand reveals whether a good is a normal good or an inferior good: The income elasticity of demand is positive for normal goods and negative for inferior goods.
3. What does the cross elasticity of demand measure?  
The cross elasticity of demand measures how the quantity demanded of one good responds to a change in the price of another good. The formula for the cross elasticity of demand is the percentage change in the quantity of the good demanded divided by the percentage change in the price of the related good.
4. What does the sign (positive/negative) of the cross elasticity of demand tell us about the relationship between two goods?  
The sign of the cross elasticity of demand reveals whether two goods are substitutes or complements: The cross elasticity of demand is positive for substitutes and negative for complements.

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1. Why do we need a units-free measure of the responsiveness of the quantity supplied of a good or service to a change in its price?  
The elasticity of supply is a units-free measure. We need a units-free measure of the elasticity of supply for the same reason we need a units-free measure of the elasticity of demand: Because the value of the elasticity of supply is independent of the units used to measure the price and quantity of the good, the elasticity of supply can be compared across the same good when quantity is measured in different units and/or the price is measured in different

currencies. In addition, the elasticities of supply of different goods also can be compared even though they are measured in different units.

2. Define the elasticity of supply and show how it is calculated.  
The *elasticity of supply* measures the responsiveness of the quantity supplied to a change in the price of a good when all other influences on selling plans remain the same. The elasticity of supply is calculated by the percentage change in the quantity supplied divided by the percentage change in the price.
3. What are the main influences on the elasticity of supply that make the supply of some goods elastic and the supply of other goods inelastic?  
The main influences on the elasticity of supply are:
  - *Resource substitution possibilities*: the greater the suppliers' ability to substitute resources, the greater will be their ability to react to price changes and the greater the elasticity of supply.
  - *Time frame for the supply decision*: the greater the amount of time available after the price change, the greater is the suppliers' ability to adjust quantity supplied, and the greater the elasticity of supply.
4. Provide examples of goods or services whose elasticities of supply are (a) zero, (b) greater than zero but less than infinity, and (c) infinity.  
Here are some examples:
  - a) The *momentary supply* of wheat is perfectly inelastic. Once farmers have brought their wheat to market, there is no other alternative use for it and they sell it all regardless of the going price.
  - b) The *short-run supply* of wheat. If the farmers already have a mature wheat crop but have not yet harvested it, farmers with both relatively high and low yield fields may choose to harvest both types of fields if the price for wheat is high. However, the farmers will not harvest their low yield fields when the price of wheat is relatively low to economize on added labor costs.
  - c) The *supply of wheat to an individual buyer*. Any one buyer can purchase as much wheat at the going price as he or she desires. However, no quantity of wheat will be supplied at a lower price.
5. How does the time frame over which a supply decision is made influence the elasticity of supply? Explain your answer.  
The momentary supply, short-run supply, and long-run supply all illustrate the response of suppliers to changes in the price, but they differ according to how much time has elapsed after the price change.
  - The *momentary supply* is frequently the least elastic and shows how suppliers cannot easily respond to a price change immediately

after the price change occurs. Changing the quantity produced means changing the inputs into the production process, which takes time to complete. Sometimes the momentary supply is *perfectly inelastic*.

- The *short-run supply* shows suppliers' response after enough time has elapsed for some, but not all, of the possible technological adjustments have occurred. Short-run supply generally is intermediate in elasticity between the momentary supply and the long-run supply.
- The *long-run supply* shows how suppliers react after enough time has passed that *all* possible adjustments to factors of production have been made to accommodate the price change. It usually is the most elastic of the three supplies.

## Answers to the Study Plan Problems and Applications

1. Rain spoils the strawberry crop, the price rises from \$4 to \$6 a box, and the quantity demanded decreases from 1,000 to 600 boxes a week.
- a. Calculate the price elasticity of demand over this price range.  
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 is \$2 divided by \$5 and then multiplied by 100, 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 is 400 divided by 800, which equals 50 percent. The price elasticity of demand for strawberries is 50 percent divided by 40 percent, which equals 1.25.
- b. Describe the demand for strawberries.  
The price elasticity of demand exceeds 1, so the demand for strawberries is elastic.
2. If the quantity of dental services demanded increases by 10 percent when the price of dental services falls by 10 percent, is the demand for dental services inelastic, elastic, or unit elastic?  
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 is 10 percent divided by 10 percent, which equals 1. The demand is unit elastic.
3. The demand schedule for rooms is in the table.
- |   | Price<br>(dollars<br>per night) | Quantity<br>demanded<br>(millions of<br>rooms per<br>night) | hotel<br>revenue<br>from \$400<br>from \$250 |
|---|---------------------------------|---|--|
|   | 200                             | 100   |  |
| When the price is \$400,<br>revenue is equal to \$400<br>million rooms, or \$20   | 250                             | 80  | the total<br>× 50                            |
|   | 400                             | 50  | billion.                                     |
| When the price is \$250,<br>revenue is equal to \$250   | 500                             | 40  | the total                                    |
| million rooms, or \$20 billion. So the total revenue does not change<br>when the price falls from \$400 to \$250 a night.   | 800                             | 25  | × 80   |
| When the price is \$250, the total revenue is equal to \$250 × 80<br>million rooms, or \$20 billion. When the price is \$200, the total<br>revenue is equal to \$200 × 100 million rooms, or \$20 billion. So the<br>total revenue does not change when the price falls from \$400 to \$250<br>a night. |                                 |   |  |
- a. What happens to total when the price falls to \$250 a night and to \$200 a night?  
When the price is \$400, revenue is equal to \$400 million rooms, or \$20 billion. When the price is \$250, the total revenue is equal to \$250 × 80 million rooms, or \$20 billion. When the price is \$200, the total revenue is equal to \$200 × 100 million rooms, or \$20 billion. So the total revenue does not change when the price falls from \$400 to \$250 a night.
- b. Is the demand for hotel rooms elastic, inelastic or unit

elastic?

The total revenue is the same at all prices, \$20 billion. Because a change in price does not change the total revenue at *any* price, the demand is unit elastic at all prices.

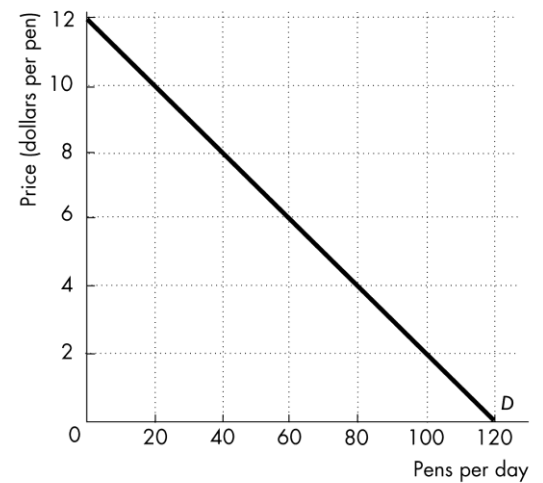
4. The figure shows the demand for pens. Calculate the elasticity of demand when the price rises from \$4 to \$6 a pen. Over what price range is the demand for pens elastic?

The price elasticity of demand is 0.72. When the price of a pen rises from \$4 to \$6, the quantity demanded of pens decreases from 80 to 60 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 \$4 to \$6, an increase of \$2 a pen. The average price is \$5 per pen. So the percentage change in the price equals \$2 divided by \$5 and then multiplied by 100, which equals 40 percent. The quantity decreases from 80 to 60 pens, a decrease of 20 pens. The average quantity is 70 pens. So the percentage change in quantity demanded equals 20 divided by 70 and then multiplied by 100, which equals 28.6 percent. The price elasticity of demand for pens equals 28.6 percent divided by 40 percent, which is 0.72.

The demand for pens is elastic at all prices higher than the price at the midpoint of the demand curve, which indicates that the demand for pens is elastic at prices between \$12 per pen and \$6 per pen.

5. In 2003, when music downloading first took off, Universal Music slashed the average price of a CD from \$21 to \$15. The company expected the price cut to boost the quantity of CDs sold by 30 percent, other things remaining the same.
- What was Universal Music's estimate of the price elasticity of demand for CDs?  
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 equals 33.3 percent. The increase in the quantity demanded was estimated to be 30 percent. The price elasticity of demand equals  $(30.0 \text{ percent}) / (33.3 \text{ percent})$ , or 0.90.
  - If you were making the pricing decision at Universal Music, what would be your pricing decision? Explain your decision.  
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

FIGURE 4.1  
Problem 4



fall in the price of the substitute, downloaded music, decreases the demand for Universal Music's CDs, so the decision to cut prices most likely was forced as the result of the (forecasted) decrease in demand for CDs.

6. The demand for illegal drugs is inelastic. Much of the expenditure on illegal drugs comes from crime. Assuming these statements to be correct,

- a. How will a successful campaign that decreases the supply of drugs influence the price of illegal drugs and the amount spent on them?

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. What will happen to the amount of crime?

On the one hand, purchasing illegal drugs is a criminal activity so 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. What is the most effective way of decreasing the quantity of illegal drugs bought and decreasing the amount of drug-related crime?

If drug users are penalized, then the demand for illegal drugs decreases, so that both the price and quantity of illegal drugs falls. The total expenditure on illegal drugs also falls. The decrease in the quantity of illegal drugs purchased directly reduces the crime rate. Because the total expenditure spent on illegal drugs falls, less crime would be necessary to raise these funds, so the crime rate also falls, albeit indirectly.

#### 7. **The Grip of Gas**

U.S. drivers are ranked as the least sensitive to changes in the price of gasoline. For example, if the price rose from \$3 to \$4 per gallon and stayed there for a year U.S. purchases of gasoline would fall only about 5 percent.

Source: *Slate*, September 27, 2005

- a. Calculate the price elasticity of demand for gasoline. Is the demand for gasoline elastic, unit elastic, or inelastic?

The price rises by \$1.00 and the average price is \$3.50. So the percentage change in the price is  $(\$1.00/\$3.50) \times 100$ , which equals 28.6 percent. The news story says that the change in the quantity demanded is 5 percent. So the price elasticity of demand is  $(5 \text{ percent})/(28.6 \text{ percent})$ , or 0.17.

Because the elasticity of demand is less than 1, the demand for gasoline is inelastic.



- b. Explain how the price rise from \$3 to \$4 a gallon changes the total revenue from gasoline sales.  
If the price of gasoline rises, because the demand is inelastic the total revenue test concludes that the total revenue from gasoline will increase.
8. **Spam Sales Rise as Food Costs Soar**  
Sales of Spam are rising as consumers realize that Spam and other lower-cost foods can be substituted for costlier cuts of meat as a way of controlling their already stretched food budgets.  
Source: *AOL Money & Finance*, May 28, 2008
- a. Is Spam a normal good or an inferior good? Explain.  
Based on the story, Spam is probably an inferior good. The idea of "stretched food budgets" implies that consumers' incomes have fallen. And, as a result, the demand for Spam increased. The demand for Spam increased when income decreased, so Spam is an inferior good.
- b. Would the income elasticity of demand for Spam be negative or positive? Explain.  
If Spam is an inferior good, its income elasticity of demand is negative. When income increases, the demand decreases so the income elasticity of demand divides a negative number (the decrease in demand) by a positive number (the increase in income) thereby resulting in a negative value for the income elasticity of demand.
9. When Judy's income increased from \$130 to \$170 a week, she increased her demand for concert tickets by 15 percent and decreased her demand for bus rides by 10 percent. Calculate Judy's income elasticity of demand for (a) concert tickets and (b) bus rides.  
The income elasticity of demand for (a) concert tickets is 0.56 and (b) bus rides is -0.375. 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 \$40 and the average income is \$150, so the percentage change in income equals 26.7 percent.
- a. The change in the quantity demanded of concert tickets is 15 percent. The income elasticity of demand for concert tickets equals  $15/26.7$ , which is 0.56.
- b. The change in the quantity demanded of bus rides is -10 percent. The income elasticity of demand for bus rides equals  $-10/26.7$ , which is -0.375.
10. If a 12 percent rise in the price of orange juice decreases the quantity of orange juice demanded by 22 percent and increases the quantity of apple juice demanded by 14 percent, calculate the
- a. Price elasticity of demand for orange juice.  
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. Cross elasticity of demand for apple juice with respect to the price of orange juice.

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. 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 percent divided by 12 percent, which is 1.17.

11. If a 5 percent rise in the price of sushi increases the quantity of soy sauce demanded by 2 percent and decreases the quantity of sushi demanded by 1 percent, calculate the

- a. Price elasticity of demand for sushi.

The price elasticity of demand for sushi equals  $1/5$ , which is 0.2.

- b. Cross elasticity of demand for soy sauce with respect to the price of sushi.

The cross elasticity of demand for soy sauce with respect to the price of sushi equals  $2/5$ , which is 0.4.

12. **Swelling Textbook Costs Have College Students Saying 'Pass'**

Textbook prices have doubled and risen faster than average prices for the past two decades. Sixty percent of students do not buy textbooks. Some students hunt for used copies and sell them back at the end of the semester; some buy online, which is often cheaper than the campus store; some use the library copy and wait till it's free; some share the book with a classmate.

Source: *Washington Post*, January 23, 2006

Explain what this news clip implies about

- a. The price elasticity of demand for college textbooks.

The news clip discusses ways students decrease the quantity of textbooks demanded when the price of a textbook rises. It is not possible to determine the precise elasticity of demand for textbooks, but there are substitutes for textbooks listed. In particular, a number of substitutes listed (borrowing, copying, using a library copy) enable students to completely avoid buying textbooks. Additionally other substitutes listed (buying used books, selling books, buying on the Internet) enable students to pay less for their textbooks. The fairly long list of good substitutes indicates that the demand for textbooks might be elastic.

- b. The income elasticity of demand for college textbooks.

The income elasticity of demand measures how the quantity demanded changes when income changes. The news clip does not directly give any information about changes in income, so the news clip gives no information about the income elasticity of demand for college textbooks.

- c. The cross elasticity of demand for college textbooks from the

campus bookstore with respect to the online price of a textbook.

The cross elasticity of demand for textbooks from campus bookstores with respect to the online price of books is positive: the lower the price of online books, the lower the quantity of textbooks demanded from campus bookstores. This sign makes sense because textbooks from campus bookstores are substitutes for textbooks from online stores.

Use the following information to work Problems 13 to 15.

**As Gas Costs Soar, Buyers Flock to Small Cars**

Faced with high gas prices, Americans are substituting smaller cars for SUVs. In April 2008, Toyota Yaris sales increased 46 percent and Ford Focus sales increased 32 percent from a year earlier. SUVs sales decreased 25 percent in 2008 and Chevrolet Tahoe sales fell 35 percent. Full-size pickup sales decreased 15 percent in 2008 and Ford F-Series pickup sales decreased by 27 percent in April 2008. The effect of a downsized vehicle fleet on fuel consumption is unknown. In California in January 2008, gasoline consumption was 4 percent lower and the price of gasoline 30 percent higher than in January 2007.

Source: *The New York Times*, May 2, 2009

13. Calculate the price elasticity of demand for gasoline in California.

The price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in the price of the good. Based on the data in the problem and assuming that the demand curve for gasoline in California did not change, then the price elasticity of demand for gasoline in California equals (4 percent/30 percent), which equals 0.13. If the downsized fleet shifted the demand curve for gasoline leftward, then the price elasticity of demand just calculated is too large because it includes the decrease in the quantity demanded from the higher price of gasoline *plus* the decrease in the quantity from the more fuel efficient fleet.

14. Calculate the cross elasticity of demand for

- a. Toyota Yaris with respect to the price of gasoline.

The cross elasticity of demand for a Toyota Yaris with respect to the price of gasoline equals the percentage change in the quantity demanded of Toyotas divided by the percentage change in the price of gasoline. Based on the data in the problem and assuming that the demand curve for these cars did not change, then the cross elasticity of demand equals (46 percent/30 percent), which equals 1.53.

- b. Ford Focus with respect to the price of gasoline.

The cross elasticity of demand for a Ford Focus with respect to the price of gasoline equals the percentage change in the quantity demanded of Fords divided by the percentage change in the price of gasoline. Based on the data in the problem and assuming that the demand curve for these cars did not change, then the cross

elasticity of demand equals (32 percent/30 percent), which equals 1.07.

15. Calculate the cross elasticity of demand for
- Chevrolet Tahoe with respect to the price of gasoline.  
The cross elasticity of demand for a Chevrolet Tahoe with respect to the price of gasoline equals the percentage change in the quantity demanded of Chevrolets divided by the percentage change in the price of gasoline. Based on the data in the problem and assuming that the demand curve for these cars did not change, then the cross elasticity of demand equals (-35 percent/30 percent), which equals 1.17.
  - A full-size pickup with respect to the price of gasoline.  
The cross elasticity of demand for a full-size pickup with respect to the price of gasoline equals the percentage change in the quantity demanded of these trucks divided by the percentage change in the price of gasoline. Based on the data in the problem and assuming that the demand curve for these trucks did not change, then the cross elasticity of demand equals (-15 percent/30 percent), which equals 0.50.

16. **Home Depot Earnings Hammered**

As gas and food prices increased and home prices slumped, people had less extra income to spend on home improvements. And the improvements that they made were on small inexpensive types of repairs and not major big-ticket items.

Source: CNN, May 20, 2008

- What does this news clip imply about the income elasticity of demand for big-ticket home-improvement items?  
The news clip implies that the income elasticity of demand for big-ticket home-improvement items is positive. In particular "people have less extra income to spend" and, as a result, "fewer people are spending money to renovate their homes."
  - Would the income elasticity of demand be greater or less than 1? Explain.  
The income elasticity of demand is probably greater than 1. Home remodeling is not a necessity; it is more of a luxury. The income elasticity of demand for luxuries is greater than 1.
17. The table sets out the supply schedule of jeans. Calculate the elasticity of supply when
- The price rises from \$125 to \$135 a pair.  
The elasticity of supply equals the percentage change in the quantity supplied divided by the percentage change in price. The percentage change in the quantity demanded equals  $[(36 - 28)/32] \times 100$ , which is 25.0 percent. The percentage change in the price equals  $[(\$135 -$

Price (dollars per pair)	Quantity supplied (millions of pairs per year)
120	24
125	28
130	32
135	36

$\$125)/\$130] \times 100$ , which is 7.7 percent. The elasticity of supply equals  $(25.0 \text{ percent}/7.7 \text{ percent})$ , which is 3.25.

- b. The average price is \$125 a pair.

To find the elasticity at an average price of \$125 a pair, change the price such that \$125 is the average price—for example, a rise in the price from \$120 to \$130 a pair. To calculate the elasticity when the average price is \$125, calculate the elasticity over the price range from \$120 to \$130. The percentage change in the quantity demanded equals  $[(32 - 24)/28] \times 100$ , which is 28.6 percent. The percentage change in the price equals  $[(\$130 - \$120)/\$125] \times 100$ , which is 8.0 percent. The elasticity of supply equals  $(28.6 \text{ percent}/8.0 \text{ percent})$ , which is 3.58.

18. **Study Ranks Honolulu Third Highest for “Unaffordable Housing”**

A study ranks Honolulu number 3 in the world for the most unaffordable housing market in urban locations, behind Los Angeles and San Diego and is deemed “severely unaffordable.” With significant constraints on the supply of land for residential development, housing inflation has resulted.

Source: *Hawaii Reporter*, September 11, 2007

- a. Would the supply of housing in Honolulu be elastic or inelastic?

The supply of housing is probably inelastic because it is limited by the amount of land, which is inelastically supplied. Indeed, the elasticity of supply for housing is probably close to 0.

- b. Explain how the elasticity of supply plays an important role in influencing how rapidly housing prices in Honolulu rise.

The less elastic the supply, the more an increase in demand raises the price. Because the supply of housing is quite inelastic in Honolulu, increases in demand for housing have led to large increases in the price of housing, that is, severe “housing inflation.”

## Answers to Additional Problems and Applications

19. With higher fuel costs, airlines raised their average fare from 75¢ to \$1.25 per passenger mile and the number of passenger miles decreased from 2.5 million a day to 1.5 million a day.

- a. What is the price elasticity of demand for air travel over this price range?

The price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in the price. The quantity demanded changes by 1.0 million passenger miles and the average passenger miles is 2.0 million. The percentage change in the quantity demanded is  $(1.0 \text{ million}) / (2.0 \text{ million}) \times 100$ , which is 50 percent. The price changes by \$0.50 and the average price is \$1.00. The percentage change in the quantity demanded is  $(\$0.50 / (\$1.00)) \times 100$ , which is 50 percent. So the price elasticity of demand is  $(50 \text{ percent}) / (50 \text{ percent})$ , or 1.00.

- b. Describe the demand for air travel.

The demand for air travel between these two prices is unit elastic. The 50 percent price hike leads to a 50 percent decrease in the quantity of air miles traveled.

20. Figure 4.2 shows the demand for DVD rentals.

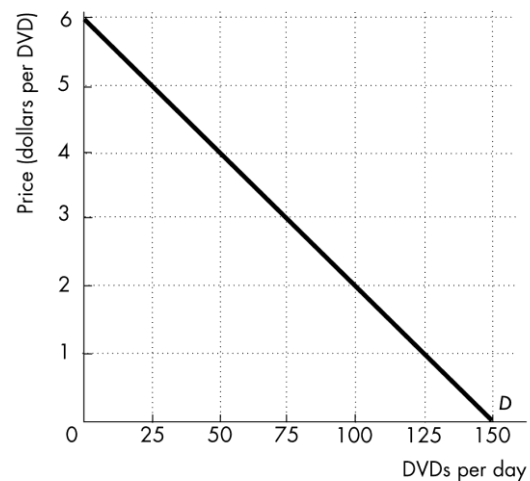
- a. Calculate the elasticity of demand when the price of a DVD rental rises from \$3 to \$5.

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 per DVD. So the percentage change in the price equals \$2 divided by \$4 and then multiplied by 100, 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 demanded equals 50 divided by 50 and then multiplied by 100, which equals 100 percent. The price elasticity of demand for DVD rentals equals 100 percent divided by 50 percent, which is 2.

FIGURE 4.2

Problem 20



- b. At what price is the elasticity of demand for DVD rentals equal to 1?

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 intersects the y-axis. That price is \$3 a DVD.

Use the following table to Problems 21 to 23.

The demand schedule for chips is in the table.

21. a. What happens to revenue if the price \$400 to \$350 a chip \$350 to \$300 a chip?

Price (dollars per chip)	Quantity demanded (millions of chips per year)	at which the intersects is \$3 a DVD. work computer
200	50	
250	45	
300	40	total
350	35	falls from
400	30	and from

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. The total revenue increases when the price falls.

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. The total revenue decreases as the price falls.

- b. At what price is total revenue at a maximum?

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 when 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 when the price rises from \$350 to \$400 a chip. Total revenue is maximized when the price is \$350 a chip.

22. At an average price of \$350, is the demand for chips elastic, inelastic, or unit elastic? Use the total revenue test to answer this question.

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, the total revenue remains at \$12,000 million. So at the average price of \$350 a chip, demand is unit elastic.

23. At \$250 a chip, is the demand for chips elastic or inelastic? Use the total revenue test to answer this question.

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.

24. Your price elasticity of demand for bananas is 4. If the price of bananas rises by 5 percent, what is

a. The percentage change in the quantity of bananas you buy?

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 shows that the percentage change in the quantity demanded equals the price elasticity of demand multiplied by the percentage change in the price. The percentage change in the quantity demanded equals  $4 \times 5$  percent, which is 20 percent.

b. The change in your expenditure on bananas?

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.

25. **As Gasoline Prices Soar, Americans Slowly Adapt**

As gas prices rose in March 2008, Americans drove 11 billion fewer miles than in March 2007. Realizing that prices are not going down, Americans are adapting to higher energy costs. Americans spend 3.7 percent of their disposable income on transportation fuels. How much we spend on gasoline depends on the choices we make: what car we drive, where we live, how much time we spend driving, and where we choose to go. For many people, higher energy costs mean fewer restaurant meals, deferred weekend outings with the kids, less air travel, and more time closer to home.

Source: *International Herald Tribune*, May 23, 2008

a. List and explain the elasticities of demand that are implicitly referred to in the news clip.

The elasticities to which the clip refers are the income elasticity of demand, the price elasticity of demand, and the cross elasticity of demand. The income elasticity of demand is reflected in the news clip's discussion of the fraction of income spent on transportation fuels. More references are made to the factors that influence the price elasticity of demand. The article lists many substitutions households can make in response to higher fuel prices. In particular the type of car a family can drive, where the family lives, and where the family chooses to go reflect substitution methods that households can use to decrease the quantity of gasoline demanded. In addition, discussion of "fewer restaurant meals, deferred weekend outings with the kids, less air travel and more time closer to home" suggest that higher gasoline prices have an income effect that decreases the quantity demanded. It is the strength of these factors that determines the magnitude of the price elasticity of demand for fuel. Additionally these activities, such as smaller cars, more time closer to home, are also the substitutes that people use in place of



gasoline. The news clips suggests that these activities increase in response to the higher price of gasoline, indicating that they are substitutes for gasoline so that their cross elasticity of demand with respect to the price of gasoline is positive.

- b. Why, according to the news clip, is the demand for gasoline inelastic?

One factor listed that helps make the demand for gasoline inelastic is the point that gasoline accounts for only a relatively small fraction of people's incomes. Another factor is more qualitative: none of the substitutions listed for gasoline—the type of car the family drives and so forth—are particularly close substitutes for gasoline. The absence of close substitutes combined with the relatively small fraction of income spent on gasoline combine to make the demand for gasoline inelastic.

Use this information to work Problems 26 and 27.

**Economy Forces Many to Shorten Summer Vacation Plans**

This year Americans are taking fewer exotic holidays by air and instead are visiting local scenic places by car. The global financial crisis has encouraged many Americans to cut their holiday budgets.

Source: *USA Today*, May 22, 2009

26. Given the prices of the two holidays, is the income elasticity of demand for exotic holidays positive or negative? Are exotic holidays a normal good or an inferior good? Are local holidays a normal good or an inferior good?

The income elasticity of demand for exotic holidays is positive so exotic holidays are a normal good. The income elasticity of demand for local holidays is negative so local holidays are an inferior good.

27. Are exotic holidays and local holidays substitutes? Explain your answer.

Exotic holidays and local holidays are substitutes. The article points out that in 2009 Americans were visiting local scenic places rather than visiting exotic locations. So Americans were substituting local holidays for exotic holidays.

28. When Alex's income was \$3,000, he bought 4 bagels and 12 donuts a month. Now his income is \$5,000 and he buys 8 bagels and 6 donuts a month. Calculate Alex's income elasticity of demand for

- a. Bagels.

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. 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 percent)/(50 percent), which is 1.33.

## b. Donuts.

From part (a), the percentage change in income is 50 percent. 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 percent. The income elasticity of demand for donuts equals  $(-66.67 \text{ percent}) / (50 \text{ percent})$ , which is -1.33.

29. **Wal-Mart's Recession-Time Pet Project**

During the recession, Wal-Mart moved its pet food and supplies to in front of its other fast growing business, baby products.

Retail experts point out that kids and pets tend to be fairly recession-resistant businesses—even in a recession, dogs will be fed and kids will get their toys.

Source: CNN, May 13, 2008

## a. What does this news clip imply about the income elasticity of demand for pet food and baby products?

The news clip implies that both pet food and baby food are necessities. Their income elasticities of demand are positive but very small (since they "tend to be fairly recession resistant businesses").

## b. Would the income elasticity of demand be greater or less than 1? Explain.

The income elasticities of demand are less than 1 because they are necessities.

## 30. If a 5 percent fall in the price of chocolate sauce increases the quantity of chocolate sauce demanded by 10 percent and increases the quantity of ice cream demanded by 15 percent, calculate the

## a. Price elasticity of demand for chocolate sauce.

The price elasticity of demand for chocolate sauce equals the percentage change in the quantity of chocolate sauce demanded divided by the percentage change in the price of chocolate sauce. Using the data in the problem, the price elasticity of demand equals  $(10 \text{ percent}) / (-5 \text{ percent})$ , which is 2.0.

## b. Cross elasticity of demand for ice cream with respect to the price of chocolate sauce.

The cross elasticity of demand for ice cream with respect to the price of chocolate sauce equals the percentage change in the quantity of ice cream demanded divided by the percentage change in the price of chocolate sauce. Using the data in the problem, the cross elasticity of demand equals  $(15 \text{ percent}) / (-5 \text{ percent})$ , which is -3.0. Ice cream and chocolate sauce are complements.

31. **Netflix to Offer Online Movie Viewing**

Online movie rental service Netflix has introduced a new feature to allow customers to watch movies and television series on their personal computers. Netflix competes with video rental retailer Blockbuster, which added an online rental service to the in-store rental service.

Source: CNN, January 16, 2007

## a. How will online movie viewing influence the price elasticity of

demand for in-store movie rentals?

The price elasticity of demand for store rental movies will increase because online movie viewing is a substitute for renting movies.

- b. Would the cross elasticity of demand for online movies and in-store movie rentals be negative or positive? Explain.

Online movies and in-store rental movies are substitutes, so their cross elasticity of demand is positive.

- c. Would the cross elasticity of demand for online movies with respect to high-speed Internet service be negative or positive? Explain.

Online movies and high-speed Internet service are complements, so their cross elasticity of demand is negative.

32. **To Love, Honor, and Save Money**

In a survey of caterers and event planners, nearly half of them said that they were seeing declines in wedding spending in response to the economic slowdown; 12% even reported wedding cancellations because of financial concerns.

Source: *Time*, June 2, 2008

- a. Based upon this news clip, are wedding events a normal good or inferior good? Explain.

Based on the news clip, wedding events are a normal good. The economic slowdown means that people's incomes are falling and, as a result, the demand for wedding events is decreasing.

- b. Are wedding events more a necessity or a luxury? Would the income elasticity of demand be greater than 1, less than 1, or equal to 1? Explain.

Wedding events are a luxury. Wedding events are not necessities because couples can marry with plain weddings; indeed, couples can marry using a civil ceremony and with no wedding event at all. If wedding events are a luxury, their income elasticity of demand is greater than 1.

- 33. The supply schedule of distance phone calls table. Calculate the of supply when

Price (cents per minute)	Quantity supplied (millions of minutes per day)
10	200
20	400
30	600
40	800

- a. The price falls from minute.

The elasticity of  
The elasticity of  
percentage change in  
supplied divided by

long-  
is in the  
elasticity

40¢ to 30¢ a

supply is 1.  
supply is the  
the quantity  
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 percent. 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

percent. The elasticity of supply equals  $(28.57 \text{ percent}) / (28.57 \text{ percent})$ , which is 1.

- b. The average price is 20¢ a minute.

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 percent. 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 percent. 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.

34. **Weak Coal Prices Hit China's Third-Largest Coal Miner**

The chairman of Yanzhou Coal Mining reported that the recession had decreased the demand for coal, with its sales falling by 11.9 per cent to 7.92 million tons from 8.99 million tons a year earlier, despite a 10.6 percent cut in the price.

Source: Dow Jones, April 27, 2009

Calculate the price elasticity of supply of coal. Is the supply of coal elastic or inelastic?

The price elasticity of supply of coal equals the percentage change in the quantity of coal supplied divided by the percentage change in the price of coal. Using the data in the problem, the price elasticity of supply equals  $(-11.9 \text{ percent}) / (-10.6 \text{ percent})$ , which is 1.12. The elasticity exceeds 1.0 in value, so the supply of coal is elastic.

**Economics in the News**

35. After you have studied *Reading Between the Lines* on pp. 98–99, answer the following questions.

- a. Which demand is more price elastic and why: tomatoes in general or Florida winter tomatoes?

The price elasticity of demand for Florida winter tomatoes is more price elastic than the demand for tomatoes in general. It is more elastic because there are more substitutes for (the narrowly defined good) Florida winter tomatoes than for (the broadly defined good) tomatoes in general.

- b. When cold weather destroyed the Florida crop and more tomatoes came from Mexico and greenhouses, what happened to the supply of tomatoes and the quantity of tomatoes supplied?

The supply of tomatoes decreased because of the freeze in Florida. The quantity of tomatoes supplied increased because of the higher price of tomatoes.

- c. The news article says the “high demand has driven up prices” and

"wholesalers are buying from Mexico." What does this statement mean? Did demand increase? Did it decrease? Is the news article correct?

This statement means that the initial shortage of tomatoes, which meant there was excess demand, drove the price higher. Contrary to what the article implies, demand did not change; that is, the demand curve did not shift. But the quantity demanded decreased in response to the higher price.

- d. Reggie Brown says "We're obviously losing market share to Mexico, and there's always a price to pay to get the customer to get back into the Florida market." What does he mean and what does that imply about the elasticity of demand for Florida tomatoes when the price rises and when the price falls?

Mr. Brown is suggesting that the demand for Florida tomatoes is inelastic. When the demand is inelastic, the increase in the quantity of Florida tomatoes as growers recover from the cold weather leads to a large fall in the price of tomatoes. With an inelastic demand, the farmers' total revenue decreases and this decrease in total revenue is the "price to pay" to which Mr. Brown refers.