Chapter 4 Elasticity

Solutions to Problems

1a. 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.

1b. The price elasticity of demand exceeds 1, so the demand for strawberries is elastic.

2a. The price elasticity of demand is 1.5.

The price elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in the price. The price falls from $7 to $5 a basket, a fall of $2 a basket. The average price is $6 a basket. So the percentage change in the price equals $2 divided by $6, which equals 33.3 percent.

The quantity increases from 300 to 500 baskets, an increase of 200 baskets. The average quantity is 400 baskets. So the percentage change in quantity equals 200 divided by 400, which equals 50 percent.

The price elasticity of demand for tomatoes equals 50 divided by 33.3, which is 1.5.

2b. The price elasticity of demand exceeds 1, so the demand for tomatoes is elastic.

3a. The price elasticity of demand is 2.

When the price of a videotape rental rises from $3 to $5, the quantity demanded of videotapes 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 videotape. The average price is $4 a videotape. So the percentage change in the price equals $2 divided by $4, which equals 50 percent.

The quantity decreases from 75 to 25 videotapes, a decrease of 50 videotapes. The average quantity is 50 videotapes. So the percentage change in quantity equals 50 divided by 50, which equals 100 percent.

The price elasticity of demand for videotape rentals equals 100 divided by 50, which is 2.

3b. The price elasticity of demand equals 1 at $3 a videotape.

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 videotape.

4a. The price elasticity of demand is 2.

When the price of a pen rises from $6 to $10, the quantity demanded of pens decreases from 60 to 20 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 rises from $6 to $10, an increase of $4 a pen. The average price is $8 a pen. So the percentage change in the price equals $4 divided by $8, which equals 50 percent.

The quantity decreases from 60 to 20 pens, a decrease of 40 pens. The average quantity is 40 pens. So the percentage change in quantity equals 40 divided by 40, which equals 100 percent.

The price elasticity of demand for pens equals 100 divided by 50, which is 2.
4b. The price elasticity of demand equals 1 at $6 a pen. The price elasticity of demand is greater than 1 at prices greater than $6 a pen. The price elasticity of demand is less than 1 at prices less than $6 a pen.

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 $6 a pen.

The demand curve is linear. Along a linear demand curve, the price elasticity of demand is greater than 1 at points above the midpoint and less than 1 at points below the midpoint. The price elasticity of demand is greater than 1 at prices above $6 a pen and less than 1 at prices below $6 a pen.

5. 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.

6. The demand for haircuts is elastic.

The price elasticity of demand for haircuts equals the percentage change in the quantity of haircuts demanded divided by the percentage change in the price of a haircut.

The price elasticity of demand equals 10 divided by 5, which is 2. The demand for haircuts is elastic.

7a. 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 as the price falls.

7b. 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.

7c. Total revenue is at a maximum 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 at a maximum when the price is $350 a chip.

7d. Demand is unit elastic when the price is $350 a chip.

Total revenue is maximized when demand is unit elastic.

8a. Total revenue increases.

When the price of a kilogram of sugar is $5, 25 million kilograms are sold and total revenue equals $125 million. When the price of a kilogram of sugar rises to $15, 15 million kilograms are sold and total revenue is $225 million. Total revenue increases.

8b. Total revenue decreases.

When the price of a kilogram of sugar is $15, 15 million kilograms are sold and total revenue is $225 million. When the price of a kilogram of sugar is $25, 5 million kilograms are sold and total revenue is $125 million. Total revenue decreases.

8c. Total revenue is at a maximum at $15 a kilogram.

The total revenue test says that if the price rises and total revenue remains the same, total revenue is maximized and demand is unit elastic at the average price. Total revenue is at a maximum at the price at which price elasticity of demand is 1.

Draw the graph and extend the demand curve (which is linear) until it cuts the y-axis. The price halfway between the origin and the price at which the demand curve cuts the y-axis is the price at which elasticity is 1. The demand curve will cut the y-axis at $30 a kilogram. So the elasticity of demand for sugar equals 1 at a price of $15 a kilogram.
You can check your answer by calculating the elasticity at an average price of $15 a kilogram. When the price rises from $10 to $20 a kilogram, the average price is $15 a kilogram.

The price rises from $10 to $20, an increase of $10 a kilogram. The average price is $15 a kilogram. So the percentage change in the price equals $10 divided by $15, which is 66.67 percent.

The quantity decreases from 20 to 10 kilograms, a decrease of 10 kilograms. The average quantity is 15 kilograms. So the percentage change in quantity equals 10 divided by 15, which is 66.67 percent.

The price elasticity of demand equals 66.7/66.7, which is 1.

8d. The demand for sugar is elastic.

The total revenue test says that if the price rises and total revenue decreases, the demand is elastic at the average price. For an average price of $20 a kilogram, raise the price from $15 to $25 a kilogram. Question 8(b) has calculated the change in total revenue when the price rises from $15 to $25 a kilogram. Total revenue decreases from $225 million to $125 million. So at the average price of $20 a kilogram, demand is elastic.

9. The demand for chips is inelastic.

The total revenue test says that if the price falls and total revenue decreases, 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.

10. The demand for sugar is inelastic.

The total revenue test says that if the price rises and total revenue increases, the demand is inelastic at the average price. For an average price of $10 a kilogram, raise the price from $5 to $15 a kilogram. Question 8(a) has calculated the change in total revenue when the price rises from $5 to $15 a kilogram. Total revenue increases from $75 million to $225 million. So at the average price of $10 a kilogram, demand is inelastic.

11. The cross elasticity of demand between orange juice and apple juice is 7.

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 results 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 2, which is 7.

12. The cross elasticity of demand between chicken and beef is 4.

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 fall in the price of chicken results in a decrease in the quantity demanded of beef. So the cross elasticity of demand is the percentage change in the quantity demanded of beef divided by the percentage change in the price of chicken. The cross elasticity equals 20 divided by 5, which is 4.

13. Income elasticity of demand for (i) bagels is 1.33 and (ii) doughnuts is \(-1.33\).

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.

(i) The change in the quantity demanded of bagels is 4 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.

(ii) The change in the quantity demanded of doughnuts is \(-6\) and the average quantity demanded is 9 doughnuts, so the percentage change in the quantity demanded is \(-66.67\). The income elasticity of demand for doughnuts equals \(-66.67/50\), which is \(-1.33\).

14. Income elasticity of demand for (i) concert tickets is 0.56 and (ii) bus rides is \(-0.375\).
Income elasticity of demand equals the percentage change in the quantity demanded divided by the percentage change in income. The change in income is $4,000 and the average income is $15,000, so the percentage change in income equals 26.67 percent.

(i) Demand for concert tickets increases by 15 percent. At the current price of a concert ticket, the quantity demanded of concert tickets increases by 15 percent. The income elasticity of demand for concert tickets equals 15/26.67, which is 0.56.

(ii) Demand for bus rides decreases by 10 percent. At the current price of a bus ride, the quantity demanded of bus rides decreases by 10 percent. The income elasticity of demand for bus rides equals −10/26.67, which is −0.375.

15a. 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.

15b. 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 20 cents, change the price such that 20 cents is the average price—for example, a fall in the price from 30 cents to 10 cents.

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.

16a. The elasticity of supply is 3.25.

The elasticity of supply is the percentage change in the quantity supplied divided by the percentage change in the price. When the price rises from $125 to $135, the change in the price is $10 and the average price is $130. The percentage change in the price is 7.7.

When the price rises from $125 to $135, the quantity supplied increases from 2,800 to 3,600 million pairs. The change in the quantity supplied is 800 million pairs, and the average quantity is 3,200 million pairs, so the percentage change in the quantity supplied is 25.

The elasticity of supply equals 25/7.7, which equals 3.25.

16b. The elasticity of supply is 3.57.

The formula for the elasticity of supply calculates the elasticity at the average price. So to find the elasticity at $125, change the price such that $125 is the average price—for example, a fall in the price from $130 to $120.

When the price falls from $130 to $120, the change in the price is $10 and the average price is $125. The percentage change in the price is 8. When the price falls from $130 to $120, the quantity supplied decreases from 3,200 to 2,400 million pairs. The change in the quantity supplied is 800 million pairs and the average quantity is 2,800 million pairs. The percentage change in the quantity supplied is 28.57.

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 3.57.