

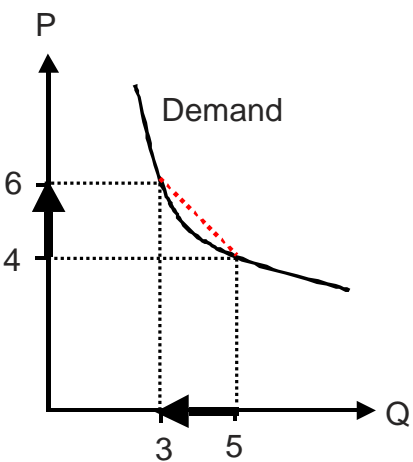
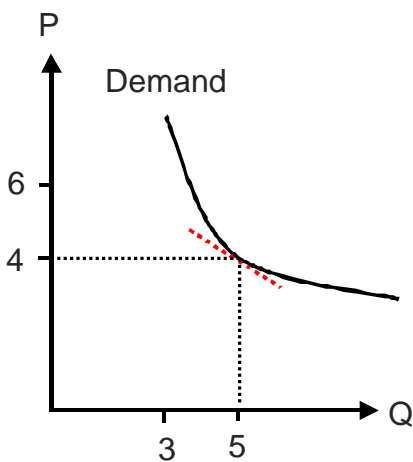
Microeconomics and mathematics (with answers)

3 Elasticities

I Elasticities

Elasticity	Formula (arc elasticity)	Characteristics
Price elasticity of demand (e)	$e = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$ → (e in absolute values)	<ul style="list-style-type: none"> • Perfectly elastic demand (e = infinite) • Perfectly inelastic demand (e = 0) • Unit elastic demand (e = 1) • Elastic demand (e > 1) • Inelastic demand (e < 1)
Cross-price elasticity of demand (Ce)	$C_e = \frac{\% \text{ change in quantity demanded good X}}{\% \text{ change in the price good Y}}$	<ul style="list-style-type: none"> • Substitutes (Ce > 0) • Complements (Ce < 0)
Income elasticity of demand (Ie)	$I_e = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}$	<ul style="list-style-type: none"> • Inferior goods (Ie < 0) • Normal goods (Ie > 0); in addition: <ul style="list-style-type: none"> • Income elastic (Luxuries) (Ie > 1) • Income inelastic (Necessities) (Ie < 1)
Price elasticity of supply (Se)	$S_e = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}$	

II Arc elasticity vs point elasticity

Arc elasticity	Point elasticity
The variables concerned are observed in a certain range, for example changes in price from 4 to 6 which reduces Q from 5 to 3.	The variables concerned are observed at a certain point, for example infinitesimal changes in price at (5,4).
	
<p>Price elasticity of demand (e):</p> $(P \text{ from } 4 \text{ to } 6, Q \text{ from } 5 \text{ to } 3) = \frac{-40\%}{+50\%} = -0.8$ <p>→ e = 0.8</p> <p>In this chapter, point elasticities are to be calculated. ® ® ® ® ® ® ® ® ® ® ® ® ® ® ® ®</p>	<p>[We assume: $P = \frac{1}{Q}$;</p> <p>hence $Q = \frac{1}{P}$ and $\frac{dQ}{dP} = -1/P^2$]</p> <p>Price elasticity of demand at (5,4) =</p> $\frac{dQ/Q}{dP/P} = \frac{dQ}{dP} * \frac{P}{Q} = -\frac{1}{16} * \frac{4}{5} = -\frac{1}{20} \rightarrow e = \frac{1}{20}$

3.1	<p>Price elasticity of demand (e)</p> <p>3.11 Calculate e when $P = 4$ Demand: $Q = 80 - 2P$</p> <p>3.12 Characterize the good (→ Page 1, I Elasticities).</p>
3.2	<p>Price elasticity of demand (e)</p> <p>3.21 Calculate e when $Q = 5$ Demand: $2P = 30 - 2Q$ (Hint: First transform demand into $Q = \dots$)</p> <p>3.22 Characterize the good (→ Page 1, I Elasticities).</p>
3.3	<p>Price elasticity of demand (e)</p> <p>Calculate e when $P = 4$ Demand: $Q = 30 - 4P - 0.25P^2$</p>
3.4	<p>Point elasticities (formulae)</p> <p>Analogous to the formula of the price elasticity of demand, draw up the formulae for the following elasticities:</p> <p>3.41 Price elasticity of supply (S_e)</p> <p>3.42 Income elasticity of demand (I_e)</p> <p>3.43 Cross-price elasticity of demand (C_e)</p>
3.5	<p>Price elasticity of supply (S_e)</p> <p>Calculate S_e when $P = 10$ Supply: $Q = -3 + 0.5P$</p>
3.6	<p>Price elasticity of supply (S_e)</p> <p>Calculate S_e when $P = 50$ Supply: $Q = 30 + 4P - 0.01P^2$</p>
3.7	<p>Price elasticity of demand (e) and income elasticity of demand (I_e)</p> <p>Demand: $Q = 200 - P + 0.02I$ ($P = 5$; I[=income] = 1000)</p> <p>3.71 Calculate e</p> <p>3.72 Calculate I_e</p> <p>3.73 Characterize the good (→ Page 1, I Elasticities).</p>

3.8 Cross-price elasticity of demand (Ce)

All variables refer to the supplier of good X, exception PY (= Price other goods)

$$Q = 200 - P + 0.02I + 0.04PY$$

when $P = 5$, $I = 1000$, $PY = 100$

3.81 Calculate Ce.

3.82 Characterize the good X in relation to good Y (→ Page 1, I Elasticities).

3.9 Price elasticity of demand (e), cross-price elasticity of demand (Ce) and income elasticity of demand (Ie)

All variables refer to the supplier of good X, except PY (= Price other goods).

Demand: $Q = 200 - 5P - 2PY + 0.2I$
when $P = 10$, $PY = 12$, $I = 1000$

3.91 Calculate e.

3.92 Calculate Ce.

3.93 Calculate Ie.

3.94 Characterize good X (→ Page 1, I Elasticities).

3.10 Price elasticity of demand (e), cross-price elasticity of demand (Ce) and income elasticity of demand (Ie)

All variables refer to the supplier of good X, except PY (= Price other goods).

Demand: $Q = 180 - 5P + 10PY + 0.4I$
when $P = 6$, $PY = 8$, $I(= \text{income}) = 2000$

3.101 Calculate e.

3.102 Calculate Ce.

3.103 Calculate Ie.

3.104 Characterize good X (→ Page 1, I Elasticities).

→ [Answers. Click here!](#)

Answers *Microeconomics* and mathematics

3 Elasticities

3.1 Price elasticity of demand (e)

3.11 e:

$$\frac{dQ}{dP} = -2 \quad Q = 80 - 2 \cdot 4 = 72$$

$$\frac{dQ}{dP} \cdot \frac{P}{Q} = -2 \cdot \frac{4}{72} = -\frac{8}{72} = -\frac{1}{9}$$

$$e = \frac{1}{9}$$

3.12 Demand is **inelastic** ($e < 1$).

3.2 Price elasticity of demand (e)

3.21 e:

$$2P = 30 - 2Q$$

$$2Q = 30 - 2P$$

$$Q = 15 - P$$

$$\frac{dQ}{dP} = -1 \quad P: \quad Q = 15 - P \rightarrow 5 = 15 - P \rightarrow P = 10$$

$$\frac{dQ}{dP} \cdot \frac{P}{Q} = -1 \cdot \frac{10}{5} = -2$$

$$e = 2$$

3.22 Demand is **elastic** ($e > 1$).

3.3 Price elasticity of demand (e)

e:

$$\frac{dQ}{dP} = -4 - 0.5P = -4 - 0.5 \cdot 4 = -6 \quad Q: \quad Q = 30 - 16 - 4 = 10$$

$$\frac{dQ}{dP} \cdot \frac{P}{Q} = -6 \cdot \frac{4}{10} = -2.4$$

$$e = 2.4$$

3.4 Point elasticities

(where not stated otherwise, Q refers to the quantity demanded)

$$3.41 \quad S_e = \frac{dQ}{dP} \cdot \frac{P}{Q} \quad (Q = \text{quantity supplied})$$

$$3.42 \quad I_e = \frac{dQ}{dI} \cdot \frac{I}{Q}$$

$$3.43 \quad C_e = \frac{dQ_x}{dP_y} \cdot \frac{P_y}{Q_x} \quad (x, y: \text{goods})$$

3.5	<p>Price elasticity of supply (Se) (Q refers to the quantity supplied)</p> <p>Se: $\frac{dQ}{dP} = 0.5$ $Q = -3 + 0.5 \cdot 10 = 2$</p> <p>Se = $\frac{dQ}{dP} \cdot \frac{P}{Q} = 0.5 \cdot \frac{10}{2} = 2.5$</p>
3.6	<p>Price elasticity of supply (Se) (Q refers to the quantity supplied)</p> <p>Se: $\frac{dQ}{dP} = 4 - 0.02P = 4 - 0.02 \cdot 50 = 3$ $Q = 30 + 4 \cdot 50 - 0.01 \cdot 50^2 = 30 + 200 - 25 = 205$</p> <p>Se = $\frac{dQ}{dP} \cdot \frac{P}{Q} = 3 \cdot \frac{50}{205} = 0.73$</p>
3.7	<p>Price elasticity of demand (e) and income elasticity of demand (le)</p> <p>3.71 e: $\frac{dQ}{dP} = -1$ $Q = 200 - 5 + 20 = 215$ $\frac{dQ}{dP} \cdot \frac{P}{Q} = -1 \cdot \frac{5}{215} = -0.02$ e = 0.02</p> <p>3.72 le: $\frac{dQ}{dI} = 0.02$ le = $\frac{dQ}{dI} \cdot \frac{I}{Q} = 0.02 \cdot \frac{1000}{215} = 0.09$</p> <p>3.73 Demand is inelastic ($e < 1$); the good is a normal good ($le > 0$); the demand is income-inelastic ($le < 1$), hence the good is a necessity.</p>
3.8	<p>Cross-price elasticity of demand (Ce)</p> <p>3.81 Ce: $\frac{dQ}{dPY} = 0.04$ $Q = 200 - 5 + 0.02 \cdot 1000 + 0.04 \cdot 100 = 219$ Ce = $\frac{dQ}{dPY} \cdot \frac{PY}{Q} = 0.04 \cdot \frac{100}{219} = 0.02$</p> <p>3.82 The goods X and Y are substitutes ($Ce > 0$).</p>
3.9	<p>Price elasticity of demand (e), cross-price elasticity of demand (Ce) and income elasticity of demand (le)</p> <p>$Q = 200 - 5 \cdot 10 - 2 \cdot 12 + 200 = 200 - 50 - 24 + 200 = 326$</p>

3.9
cont.

3.91 e:
$$\frac{dQ}{dP} = -5 \quad e = \frac{dQ}{dP} * \frac{P}{Q} = -5 * \frac{10}{326} = -0.15 \rightarrow \quad \mathbf{e = 0.15}$$

3.92 Ce:
$$\frac{dQ}{dPY} = -2$$
$$\mathbf{Ce} = \frac{dQ}{dPY} * \frac{PY}{Q} = -2 * \frac{12}{326} = -0.07$$

3.93 le:
$$\frac{dQ}{dI} = 0.2$$
$$\mathbf{le} = \frac{dQ}{dI} * \frac{I}{Q} = 0.2 * \frac{1000}{326} = \mathbf{0.61}$$

3.94 e = 0.15 → The demand is **inelastic** (e < 1).
Ce = - 0.07 → X and Y are **complements** (Ce < 0).
le = 0.61 → X is a **normal good** and it is **income-inelastic** (necessity) (0 < le < 1).

3.10 Price elasticity of demand (e), cross-price elasticity of demand (Ce) and income elasticity of demand (le)

$$Q = 180 - 5*6 + 10*8 + 0.4*2000 = 180 - 30 + 80 + 800 = 1030$$

3.101 e:
$$\frac{dQ}{dP} = -5 \quad \frac{dQ}{dP} * \frac{P}{Q} = -5 * \frac{6}{1030} = -0.03$$
$$\mathbf{e = 0.03}$$

3.102 Ce:
$$\frac{dQ}{dPY} = 10$$
$$\mathbf{Ce} = \frac{dQ}{dPY} * \frac{PY}{Q} = 10 * \frac{8}{1030} = \mathbf{0.08}$$

3.103 le:
$$\frac{dQ}{dI} = 0.4$$
$$\mathbf{le} = \frac{dQ}{dI} * \frac{I}{Q} = 0.4 * \frac{2000}{1030} = \mathbf{0.78}$$

3.94 e = 0.03 → The demand is **inelastic** (e < 1).
Ce = 0.08 → X and Y are **substitutes** (Ce > 0).
le = 0.78 → X is a **normal good** and it is **income-inelastic** (necessity) (0 < le < 1).

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