Price Elasticity of Demand

Solutions manual and marking guidance (for learners checking their work, and for instructors).

O1: Explain what price elasticity of demand measures, and why it uses percentages.

Q01 [Foundational · short answer] In one sentence, what does price elasticity of demand measure?

Answer: How strongly the quantity demanded of a good responds to a change in its own price (as a ratio of percentage changes).

1. It compares the percentage change in quantity demanded with the percentage change in price.

Q02 [Foundational · multiple choice] Which formula defines price elasticity of demand? (a) change in P / change in Q (b) % change in P / % change in Q (c) % change in Qd / % change in P (d) Qd / P

Answer: (c)

1. Quantity is on top; both changes are percentages.

Q03 [Core · conceptual] Why do economists measure elasticity with percentage changes rather than changes in kilograms and dollars?

Answer: Percentages do not depend on units, and they allow comparison between different goods.

1. 200 kg = 0.2 tonnes; $1 = 100 cents: absolute numbers change with units, percentages do not.

2. A $1 rise matters a lot for mangoes and little for a car.

Q04 [Core · true/false] True or false: the price elasticity of demand calculated with signed changes is normally negative.

Answer: True

1. Price and quantity demanded move in opposite directions, so the ratio is negative; texts usually report its absolute value.

Q05 [Applied · conceptual] The rubber-band analogy says elastic demand 'stretches a lot'. State one way in which the analogy breaks down.

Answer: Elasticity of demand is not a fixed property: it varies along the demand curve (e.g. along a straight line).

1. A rubber band follows one rule everywhere; a straight demand line is elastic at high prices and inelastic at low prices.

Q06 [Core · numerical] A price rises by 5% and the quantity demanded falls by 15%. Calculate the price elasticity of demand.

Answer: 3

1. 15 / 5 = 3 (absolute value).

O2: Calculate price elasticity of demand with the midpoint method.

Q07 [Foundational · numerical] Using the midpoint method, what is the percentage change in quantity when it falls from 700 kg to 500 kg?

Answer: 33.3%

1. Change 200; average (700 + 500) / 2 = 600.
2. 200 / 600 = 33.3%.

Q08 [Core · numerical] Using Qd = 1100 - 200P and the midpoint method, find the price elasticity of demand between $1 and $2.

Answer: 0.38

1. Qd(1) = 900, Qd(2) = 700; %change in Q = 200 / 800 = 25%.
2. %change in P = 1 / 1.5 = 66.7%.
3. E = 25 / 66.7 = 0.38.

Q09 [Core · numerical] Without the midpoint method, compute the elasticity for a rise from $2 to $3 and for a fall from $3 to $2 on the mango curve. What do you notice?

Answer: 0.57 going up and 1.20 going down: the answers differ.

1. Up: 28.6% / 50% = 0.57.
2. Down: 40% / 33.3% = 1.20.
3. The midpoint method gives 0.83 both ways.

Q10 [Applied · applied] A café sells 400 coffees a day at $3.00 and 300 a day at $3.50. Use the midpoint method to find the price elasticity of demand and classify it.

Answer: 1.86: elastic

1. %change in Q = 100 / 350 = 28.6%.
2. %change in P = 0.5 / 3.25 = 15.4%.
3. E = 28.6 / 15.4 = 1.86 > 1: elastic.

Q11 [Advanced · critical thinking] Show algebraically that the midpoint method gives the same elasticity whether the price rises from P1 to P2 or falls from P2 to P1.

Answer: Both the quantity change and the price change only switch sign, and the averages are unchanged, so the ratio is identical.

1. %dQ = (Q2 - Q1) / ((Q1 + Q2) / 2); reversing gives (Q1 - Q2) / ((Q2 + Q1) / 2) = -%dQ.
2. The same holds for price, so the ratio of the two is unchanged.

G01a [Core · numerical] Demand for bread loaves per day is Qd = 1200 - 200P. Use the midpoint method to find the price elasticity of demand between 2 and 3, and classify it.

Answer: 0.71: inelastic

1. Qd(2) = 800; Qd(3) = 600.
2. %change in Q = 200 / 700 = 28.6%; %change in P = 1 / 2.5 = 40.0%.
3. E = 28.6 / 40.0 = 0.71.

G02a [Core · numerical] Demand for cinema tickets per night is Qd = 900 - 60P. Use the midpoint method to find the price elasticity of demand between 5 and 6, and classify it.

Answer: 0.58: inelastic

1. Qd(5) = 600; Qd(6) = 540.
2. %change in Q = 60 / 570 = 10.5%; %change in P = 1 / 5.5 = 18.2%.
3. E = 10.5 / 18.2 = 0.58.

G03a [Core · numerical] Demand for bus rides per day is Qd = 5000 - 1000P. Use the midpoint method to find the price elasticity of demand between 1 and 2, and classify it.

Answer: 0.43: inelastic

1. Qd(1) = 4000; Qd(2) = 3000.
2. %change in Q = 1000 / 3500 = 28.6%; %change in P = 1 / 1.5 = 66.7%.
3. E = 28.6 / 66.7 = 0.43.

G04a [Core · numerical] Demand for phone cases per week is Qd = 300 - 20P. Use the midpoint method to find the price elasticity of demand between 8 and 10, and classify it.

Answer: 1.50: elastic

1. Qd(8) = 140; Qd(10) = 100.
2. %change in Q = 40 / 120 = 33.3%; %change in P = 2 / 9 = 22.2%.
3. E = 33.3 / 22.2 = 1.50.

O3: Classify demand as elastic, inelastic or unit elastic, and explain why elasticity differs from slope.

Q12 [Foundational · multiple choice] An elasticity of 0.4 means demand is: (a) elastic (b) inelastic (c) unit elastic (d) perfectly elastic

Answer: (b)

1. 0.4 < 1.

Q13 [Foundational · short answer] Describe the shape of a perfectly inelastic demand curve, and say what it means for buyers.

Answer: Vertical: buyers purchase the same quantity whatever the price (elasticity 0).

1. A price change produces no change in quantity demanded.

Q14 [Core · true/false] True or false: inelastic demand means buyers do not change their purchases when the price changes.

Answer: False

1. They do change them, but by a smaller percentage than the price changed. 'No change' is the special case of perfectly inelastic demand.

Q15 [Core · numerical] Find the midpoint elasticity of the mango demand curve between $4 and $5, and classify demand there.

Answer: 4.5: elastic

1. %change in Q = 200 / 200 = 100%; %change in P = 1 / 4.5 = 22.2%.
2. E = 4.5 > 1.

Q16 [Applied · conceptual] The mango demand curve is a straight line with the same slope everywhere. Explain why its elasticity is not the same everywhere.

Answer: Elasticity compares percentage changes; the same absolute changes are different percentages at different points.

1. At low prices, $1 is a big % of the price and 200 kg a small % of the quantity: inelastic.
2. At high prices the reverse: elastic.

Q17 [Applied · numerical] At what price is the mango demand curve unit elastic, and what is the quantity demanded there?

Answer: $2.75; 550 kg

1. Point elasticity 200P / (1100 - 200P) = 1.
2. 400P = 1100, P = 2.75; Q = 550.

G01c [Applied · numerical] At what price is demand for bread loaves per day unit elastic, and what is the maximum total revenue?

Answer: P = 3, TR = 1800

1. Unit elastic at the midpoint of the line: P = a / (2b) = 1200 / 400 = 3.
2. Q = 1200 - 200 x 3 = 600; TR = 3 x 600 = 1800.

G02c [Applied · numerical] At what price is demand for cinema tickets per night unit elastic, and what is the maximum total revenue?

Answer: P = 7.5, TR = 3375

1. Unit elastic at the midpoint of the line: P = a / (2b) = 900 / 120 = 7.5.
2. Q = 900 - 60 x 7.5 = 450; TR = 7.5 x 450 = 3375.

G03c [Applied · numerical] At what price is demand for bus rides per day unit elastic, and what is the maximum total revenue?

Answer: P = 2.5, TR = 6250

1. Unit elastic at the midpoint of the line: P = a / (2b) = 5000 / 2000 = 2.5.
2. Q = 5000 - 1000 x 2.5 = 2500; TR = 2.5 x 2500 = 6250.

G04c [Applied · numerical] At what price is demand for phone cases per week unit elastic, and what is the maximum total revenue?

Answer: P = 7.5, TR = 1125

1. Unit elastic at the midpoint of the line: P = a / (2b) = 300 / 40 = 7.5.
2. Q = 300 - 20 x 7.5 = 150; TR = 7.5 x 150 = 1125.

O4: Use the total revenue test to predict how a price change affects sellers' revenue.

Q18 [Foundational · short answer] Define total revenue and state how it appears on a demand diagram.

Answer: TR = price x quantity sold; the area of the rectangle under the price out to the quantity.

1. It equals buyers' total spending on the good.

Q19 [Core · numerical] Compute total revenue at $2 and at $3 on the mango demand curve. Did revenue rise or fall, and what does this tell you about elasticity?

Answer: $1,400 to $1,500: revenue rose, so demand is inelastic over this range.

1. 2 x 700 = 1,400; 3 x 500 = 1,500.
2. Price and revenue moved together: inelastic.

Q20 [Core · multiple choice] A firm faces elastic demand and cuts its price. Its total revenue will: (a) rise (b) fall (c) stay the same (d) cannot be known

Answer: (a)

1. With elastic demand, price and revenue move in opposite directions.

Q21 [Applied · scenario] A bus company raises fares by 10% and finds that its fare revenue falls. A manager says 'passengers must not care much about price'. Evaluate the claim.

Answer: The claim is wrong: falling revenue after a price rise implies elastic demand, so passengers are quite responsive.

1. Price up, revenue down: the quantity fell by more than 10%.
2. That is elastic demand (elasticity > 1).
3. Possible reasons: substitutes such as cycling, cars, other routes.

Q22 [Applied · numerical] Between $4 and $5 on the mango curve, calculate the revenue gain and loss areas, and the net change in revenue.

Answer: gain +$100, loss -$800, net -$700

1. Gain: $1 x 100 kg still sold.
2. Loss: 200 kg no longer sold x $4.

Q23 [Advanced · critical thinking] Explain why a seller facing a straight-line demand curve would never choose a price in the inelastic range if its only goal were to maximise revenue.

Answer: In the inelastic range a price rise always increases revenue, so revenue can be raised further until the unit-elastic point is reached.

1. Inelastic: price up, revenue up.
2. So revenue is not yet at its maximum; it peaks where demand is unit elastic ($2.75 for mangoes).
3. Note: profit maximisation also considers costs, covered in later lessons.

G01b [Core · numerical] In the same market, compute total revenue at 2 and at 3. Is the change consistent with the total revenue test?

Answer: 1600 to 1800: rises; consistent (inelastic)

1. TR = 2 x 800 = 1600; TR = 3 x 600 = 1800.

2. Inelastic: price and revenue move together.

G02b [Core · numerical] In the same market, compute total revenue at 5 and at 6. Is the change consistent with the total revenue test?

Answer: 3000 to 3240: rises; consistent (inelastic)

1. TR = 5 x 600 = 3000; TR = 6 x 540 = 3240.

2. Inelastic: price and revenue move together.

G03b [Core · numerical] In the same market, compute total revenue at 1 and at 2. Is the change consistent with the total revenue test?

Answer: 4000 to 6000: rises; consistent (inelastic)

1. TR = 1 x 4000 = 4000; TR = 2 x 3000 = 6000.

2. Inelastic: price and revenue move together.

G04b [Core · numerical] In the same market, compute total revenue at 8 and at 10. Is the change consistent with the total revenue test?

Answer: 1120 to 1000: falls; consistent (elastic)

1. TR = 8 x 140 = 1120; TR = 10 x 100 = 1000.

2. Elastic: price and revenue move in opposite directions.

O5: Explain the determinants of price elasticity of demand, and apply them to real goods.

Q24 [Foundational · multiple choice] Which is likely to have the most elastic demand? (a) table salt (b) insulin for a diabetic patient (c) one particular brand of orange juice (d) household electricity

Answer: (c)

1. A single brand has many close substitutes (other brands).

Q25 [Core · short answer] List four determinants of the price elasticity of demand.

Answer: Substitutes; necessity vs luxury; share of budget; time horizon (also: market definition).

1. Any four with a correct direction of effect earn full marks.

Q26 [Core · conceptual] Why is demand for petrol usually more elastic over five years than over one week?

Answer: Over a longer period buyers can change cars, homes, jobs or travel habits, so they find more substitutes.

1. In the short run most trips are fixed; in the long run behaviour and equipment can adjust.

Q27 [Applied · scenario] Rank, from least to most elastic, the demand for: fruit in general; mangoes; mangoes from Kofi's stall. Justify your ranking.

Answer: Fruit in general < mangoes < Kofi's mangoes.

1. Narrower markets have more close substitutes.

2. Other fruit substitutes for mangoes; other stalls substitute for Kofi's mangoes.

Q28 [Applied · applied] A government wants to raise as much tax revenue as possible from a tax on one good, with little change in how much is bought. Should it choose a good with elastic or inelastic demand? Explain, and state one concern.

Answer: Inelastic demand.

1. Quantity falls little, so the tax base stays large and revenue is high.

2. Concern: such goods are often necessities, so the tax may weigh heavily on low-income households (a fairness question beyond this lesson).

Q29 [Advanced · long answer] In about 150 words, explain why a bumper harvest can reduce farmers' total revenue. Use the terms elasticity, inelastic and total revenue, and include a labelled diagram.

Answer: Marking points: food demand is inelastic; supply shifts right; to sell the larger crop the price falls by a larger percentage than the quantity rises; total revenue (P x Q) falls; diagram shows a steep demand curve, supply shift and the two revenue rectangles.

1. 1 mark each: inelastic food demand identified; supply shift right; percentage comparison explained; revenue falls stated; diagram correctly labelled; clear, accurate wording (max 6).

Q30 [Core · true/false] True or false: goods that take a large share of a household's budget tend to have more elastic demand.

Answer: True

1. A price change in a big budget item has a large effect on what the household can afford, so buyers respond more.

Marking scheme: Assignment 1: pricing advice for a market stall (individual, about 600 words)

- Diagram and revenue table correct: 3 marks
- Elasticities computed correctly with the midpoint method and classified: 4 marks
- Revenue maximum at $2.50 or $3.00 (both $1,500) identified and linked to the unit-elastic region: 3 marks
- Recommendation justified, two further factors discussed: 3 marks
- Limitation explained: 2 marks
- Clear, organised writing: 1 mark (total 16)

Marking scheme: Assignment 2: elasticity in the news (individual)

- Accurate summary with source cited: 2 marks
- Correct classification with reasoning: 3 marks
- Two determinants applied correctly: 4 marks
- Confounding factors identified: 2 marks (total 11)