

UNIT 2

Elasticity of Demand and Supply

(6 Hrs) — Applied Economics (CAEC353), BCA III/VI

⚠ Please Take Care — This May Contain Errors

These notes were prepared from the course syllabus and may contain errors, omissions or over-simplifications — including in numerical examples, diagrams, and Nepal-specific facts and figures (which change over time). Please take care: cross-check every formula, number and definition with your prescribed textbook, class notes and the official syllabus before relying on it for study or examination.

2.1 Concept of Elasticity

The **law of demand** says only that quantity demanded moves opposite to price; it does not say *by how much*. **Elasticity** measures the **degree of responsiveness** of quantity demanded (or supplied) to a change in one of its determinants — price, income or the price of a related good. Because it uses *percentage* changes, elasticity is a pure number, independent of units of measurement.

Type of elasticity	Formula	What it measures
Price elasticity of demand (Ed)	$E_d = \% \text{ change in } Q_d \div \% \text{ change in own price}$	Response of demand to the good's own price.
Income elasticity of demand (Ey)	$E_y = \% \text{ change in } Q_d \div \% \text{ change in income}$	Response of demand to consumer income.
Cross elasticity of demand (Exy)	$E_{xy} = \% \text{ change in } Q_x \div \% \text{ change in } P_y$	Response of demand for X to the price of another good Y.
Price elasticity of supply (Es)	$E_s = \% \text{ change in } Q_s \div \% \text{ change in price}$	Response of quantity supplied to price.

2.2 Price Elasticity of Demand

Definition: Price elasticity of demand is the ratio of the percentage change in quantity demanded to the percentage change in price.

$$E_d = (\Delta Q / Q) \div (\Delta P / P) = (\Delta Q / \Delta P) \times (P / Q)$$

Since price and quantity demanded move in opposite directions, E_d is negative; by convention we usually take the **absolute value** $|E_d|$.

2.2.1 Five Types of Price Elasticity of Demand

Type	Value	Meaning	Shape of demand curve
Perfectly elastic	$ Ed = \infty$	A tiny price rise reduces quantity demanded to zero.	Horizontal straight line
Relatively (highly) elastic	$ Ed > 1$	% change in Q is greater than % change in P.	Flat (gentle slope)
Unitary elastic	$ Ed = 1$	% change in Q equals % change in P.	Rectangular hyperbola
Relatively (less) inelastic	$ Ed < 1$	% change in Q is smaller than % change in P.	Steep slope
Perfectly inelastic	$ Ed = 0$	Quantity demanded does not change at all.	Vertical straight line

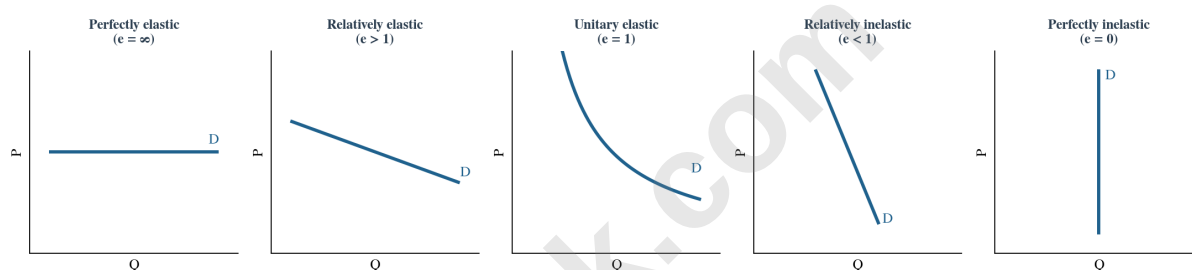


Figure 2.1 — Five types of price elasticity of demand

Note: Perfectly elastic and perfectly inelastic demand are extreme theoretical cases. Real-world goods are relatively elastic or inelastic.

2.2.2 Factors Determining Price Elasticity of Demand

- **Nature of the good** — necessities (salt, rice) are inelastic; luxuries (air travel, smartphones) are elastic.
- **Availability of substitutes** — more and closer substitutes → more elastic.
- **Proportion of income spent** — items that take a large share of income (laptops) are more elastic than trivial items (matchbox).
- **Time period** — demand is more elastic in the long run because consumers can adjust habits.
- **Habits and addictions** — reduce elasticity.
- **Alternative uses** — goods with many uses (electricity) have more elastic demand.
- **Price level** — very high-priced and very low-priced goods tend to be less elastic than medium-priced goods.

2.3 Measurement of Price Elasticity of Demand

2.3.1 Total Outlay (Expenditure) Method — Alfred Marshall

Total outlay (total expenditure) = **Price × Quantity demanded**. Compare total outlay before and after a price change:

Price change	Total outlay change	Elasticity
P falls	TE rises	$ E_d > 1$ (elastic)
P rises	TE falls	$ E_d > 1$ (elastic)
P falls or rises	TE remains unchanged	$ E_d = 1$ (unitary)
P falls	TE falls	$ E_d < 1$ (inelastic)
P rises	TE rises	$ E_d < 1$ (inelastic)

Example 2.1 — Total outlay method

A firm reduces the price of a data plan from Rs. 10 to Rs. 8 per unit. Quantity demanded rises from 100 to 150 units. Find the nature of elasticity.

Solution

Total outlay before = $10 \times 100 = \text{Rs. } 1,000$

Total outlay after = $8 \times 150 = \text{Rs. } 1,200$

Price fell and total outlay **rose** → demand is **elastic** ($|E_d| > 1$).

2.3.2 Point Method (Geometric Method)

Used to measure elasticity at a **particular point** on a demand curve. For a straight-line demand curve:

$E_d = \text{Lower segment of the curve} \div \text{Upper segment of the curve}$ (measured from the point)

Equivalently, for a straight-line demand curve that meets the price axis at $P_{\max}$, the elasticity at price P is **$E_d = P \div (P_{\max} - P)$** . For a demand function $Q = a - bP$, the general formula is **$E_d = (dQ/dP) \times (P/Q)$** , where $dQ/dP = -b$ is the reciprocal of the slope.

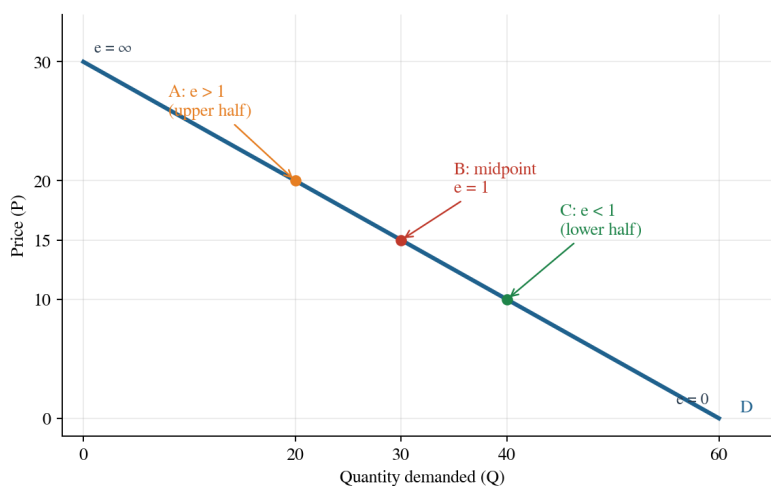


Figure 2.2 — Elasticity at different points of a linear demand curve

- At the midpoint, lower segment = upper segment → $|Ed| = 1$.
- Above the midpoint (nearer the price axis) → $|Ed| > 1$; at the price-axis intercept $|Ed| = \infty$.
- Below the midpoint (nearer the quantity axis) → $|Ed| < 1$; at the quantity-axis intercept $|Ed| = 0$.
- A single straight demand curve therefore has **different elasticities at different points**.

Example 2.2 — Point method

Demand function: $Q = 60 - 2P$. Find elasticity at $P = 10, 15$ and 20 .

Solution

$dQ/dP = -2$. Formula: $|Ed| = 2 \times (P / Q)$.

At $P = 10$: $Q = 60 - 20 = 40 \rightarrow |Ed| = 2 \times 10/40 = \mathbf{0.5}$ (inelastic).

At $P = 15$: $Q = 60 - 30 = 30 \rightarrow |Ed| = 2 \times 15/30 = \mathbf{1.0}$ (unitary — the midpoint; maximum price is 30).

At $P = 20$: $Q = 60 - 40 = 20 \rightarrow |Ed| = 2 \times 20/20 = \mathbf{2.0}$ (elastic).

2.3.3 Percentage (Proportionate) and Arc Methods

Percentage method: $Ed = (\Delta Q/Q) \div (\Delta P/P)$, using the original price and quantity. When a price change is large, the answer differs depending on the direction of change. The **arc method** avoids this by using averages: $Ed = (\Delta Q/\Delta P) \times [(P_1 + P_2) / (Q_1 + Q_2)]$.

Example 2.3 — Percentage and arc method

Price falls from Rs. 10 to Rs. 8 and quantity rises from 100 to 150 (data of Example 2.1).

Solution

Percentage method: $\Delta Q/Q = 50/100 = 0.50$; $\Delta P/P = -2/10 = -0.20 \rightarrow Ed = 0.50 \div (-0.20) = -2.5$, $|Ed| = 2.5$.

Arc method: $\Delta Q/\Delta P = 50/(-2) = -25$; $(P_1+P_2)/(Q_1+Q_2) = 18/250 = 0.072 \rightarrow Ed = -25 \times 0.072 = -1.8$, $|Ed| = 1.8$.

Both show elastic demand (consistent with the total outlay result).

2.4 Income Elasticity of Demand

$E_y = (\Delta Q / Q) \div (\Delta Y / Y) = (\Delta Q / \Delta Y) \times (Y / Q)$, where Y = consumer income.

Type	Value	Nature of good	Example
Positive, greater than unity	$E_y > 1$	Luxury good	Air travel, branded phones, gold
Positive, equal to unity	$E_y = 1$	Proportionate demand	Demand rises in the same proportion as income
Positive, less than unity	$0 < E_y < 1$	Necessity (normal good)	Food grains, clothes, cooking fuel
Zero	$E_y = 0$	Neutral good	Salt, newspaper (for many)
Negative	$E_y < 0$	Inferior good	Coarse grains, low-quality goods when income rises

Example 2.4 — Income elasticity

Monthly income rises from Rs. 20,000 to Rs. 25,000 and monthly purchases of a good rise from 50 to 60 units. Find E_y .

Solution

$\% \Delta Q = 10/50 = 20\%$; $\% \Delta Y = 5,000/20,000 = 25\%$.

$E_y = 20\% \div 25\% = 0.8 \rightarrow$ positive but less than 1 $\rightarrow$ the good is a **necessity (normal good)**.

2.5 Cross Elasticity of Demand

$E_{xy} = (\Delta Q_x / Q_x) \div (\Delta P_y / P_y)$ — response of the quantity demanded of good X to a change in the price of a *related* good Y.

Value	Relationship	Example
$E_{xy} > 0$ (positive)	Substitutes — rise in P_y raises demand for X	Tea and coffee; Pepsi and Coke; Android and iOS phones
$E_{xy} < 0$ (negative)	Complements — rise in P_y reduces demand for X	Car and petrol; printer and ink cartridge
$E_{xy} = 0$	Unrelated goods	Rice and laptops

Example 2.5 — Cross elasticity

- (a) Price of tea (Y) rises from Rs. 40 to Rs. 50 and demand for coffee (X) rises from 200 to 230 units.
- (b) Price of petrol (Y) rises from Rs. 100 to Rs. 120 and demand for cars (X) falls from 80 to 68 units.

Solution

- (a) $\% \Delta Q_x = 30/200 = 15\%$; $\% \Delta P_y = 10/40 = 25\% \rightarrow E_{xy} = 15 \div 25 = +0.6 \rightarrow$ substitutes.
- (b) $\% \Delta Q_x = -12/80 = -15\%$; $\% \Delta P_y = 20/100 = 20\% \rightarrow E_{xy} = -15 \div 20 = -0.75 \rightarrow$ complements.

2.6 Uses (Importance) of Elasticity

Price Elasticity

- **Pricing by firms:** for elastic demand, a price cut raises total revenue; for inelastic demand, a price rise raises total revenue. A monopolist always operates on the elastic part of its demand curve.
- **Taxation:** taxes on goods with inelastic demand (cigarettes, liquor, fuel) raise more revenue; the tax burden falls more on the side (buyers/sellers) with the lower elasticity.
- **Price discrimination:** a higher price is charged in the market with less elastic demand.
- **Farmers' paradox:** agricultural goods have inelastic demand, so a bumper harvest can *reduce* farmers' total income.
- **International trade:** affects gains from devaluation/depreciation (Marshall–Lerner condition: $|E_{dx}| + |E_{dm}| > 1$) and the terms of trade.
- **Factor pricing and wages:** unions' bargaining power depends on the elasticity of demand for labour.

Income Elasticity

- Forecasting demand as national income grows; planning capacity of industries with high E_y .

- Identifying growth industries ($E_y > 1$) and declining industries ($E_y < 0$).
- Government planning of taxation and welfare policies; classification of goods as necessities, luxuries or inferior.

Cross Elasticity

- Pricing of related products (substitutes and complements) by a multi-product firm.
- Defining the boundaries of an industry/market; a high positive cross elasticity indicates close competitors.
- Competition policy — assessing market power and the effect of mergers.

2.7 Elasticity of Supply

Price elasticity of supply measures the responsiveness of quantity supplied to a change in price: $E_s = (\Delta Q_s / Q_s) \div (\Delta P / P) = (\Delta Q_s / \Delta P) \times (P / Q_s)$. E_s is normally positive because supply curves slope upward.

Type	Value	Description
Perfectly elastic	$E_s = \infty$	Horizontal supply curve; any quantity supplied at one price.
Relatively elastic	$E_s > 1$	% change in Q_s greater than % change in P .
Unitary elastic	$E_s = 1$	% change in Q_s equals % change in P .
Relatively inelastic	$E_s < 1$	% change in Q_s smaller than % change in P .
Perfectly inelastic	$E_s = 0$	Vertical supply curve; quantity fixed (e.g., land, a day's fresh fish stock).

Measurement

- **Percentage method:** $E_s = \% \Delta Q_s \div \% \Delta P$.
- **Point (geometric) method:** for a straight-line supply curve — (i) if it starts from the origin, $E_s = 1$; (ii) if it cuts the price axis (positive intercept), $E_s > 1$; (iii) if it cuts the quantity axis, $E_s < 1$.

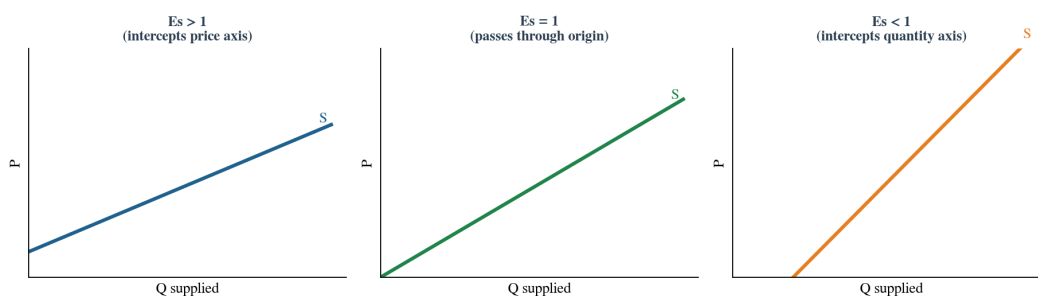


Figure 2.3 — Point method for straight-line supply curves

Factors Affecting Elasticity of Supply

- **Time period** — supply is inelastic in the market period (fixed stock), more elastic in the short run and most elastic in the long run.
- **Nature of the good** — perishable goods are less elastic than durable goods.
- **Availability of inputs and spare capacity** — unused capacity raises elasticity.
- **Technology and cost conditions** — flexible production methods raise elasticity; rising costs of expansion reduce it.
- **Storage possibilities** — easily stored goods have more elastic supply.

Example 2.6 — Elasticity of supply

Price of a product rises from Rs. 20 to Rs. 25 and quantity supplied rises from 80 to 110 units. Find E_s .

Solution

$$\% \Delta Q_s = 30/80 = 37.5\%; \% \Delta P = 5/20 = 25\%.$$

$$E_s = 37.5 \div 25 = 1.5 \rightarrow \text{supply is relatively elastic.}$$

2.8 Numerical Exercise Using Excel

Elasticity calculations are easy to automate in a spreadsheet. Lay out the data as below (row 2 is the 'before' state and row 3 the 'after' state; columns B and C hold price and quantity).

Cell	Content	Formula / Entry
A1:D1	Headings	Period, Price, Quantity, Total outlay
B2, C2	Initial price, quantity	10 ; 100
B3, C3	New price, quantity	8 ; 150
D2 / D3	Total outlay	=B2*C2 ; =B3*C3

Cell	Content	Formula / Entry
F2	% change in Q	= $(C3-C2)/C2$
F3	% change in P	= $(B3-B2)/B2$
F4	Price elasticity (percentage)	=F2/F3 → -2.5
F5	Arc elasticity	= $((C3-C2)/(B3-B2))*((B2+B3)/(C2+C3))$ → -1.8
F6	Nature of demand	=IF(ABS(F4)>1,"Elastic",IF(ABS(F4)=1,"Unitary","Inelastic"))
G2	Point elasticity for Q = a – bP	= $b*P/(a-b*P)$ (e.g., = $2*10/(60-2*10)$ → 0.5)

Note: Use =ABS() to convert to absolute values, and fill the formulas downward to compute elasticity for a whole price schedule; a line chart of |Ed| against price shows how elasticity changes along a demand curve.

Key Takeaways — Unit 2

- ✓ Elasticity = percentage change in quantity ÷ percentage change in a determinant; it is unit-free.
- ✓ Price elasticity of demand: perfectly elastic (∞), elastic (>1), unitary ($=1$), inelastic (<1), perfectly inelastic (0).
- ✓ Measures: total outlay method, point method (lower segment ÷ upper segment) and percentage/arc methods.
- ✓ Income elasticity: >1 luxury, $0-1$ necessity, <0 inferior. Cross elasticity: >0 substitutes, <0 complements.
- ✓ Elasticity guides pricing, taxation, forecasting and trade policy; supply elasticity depends chiefly on time and spare capacity.

— End of Unit 2 —

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