Elasticity

Demand

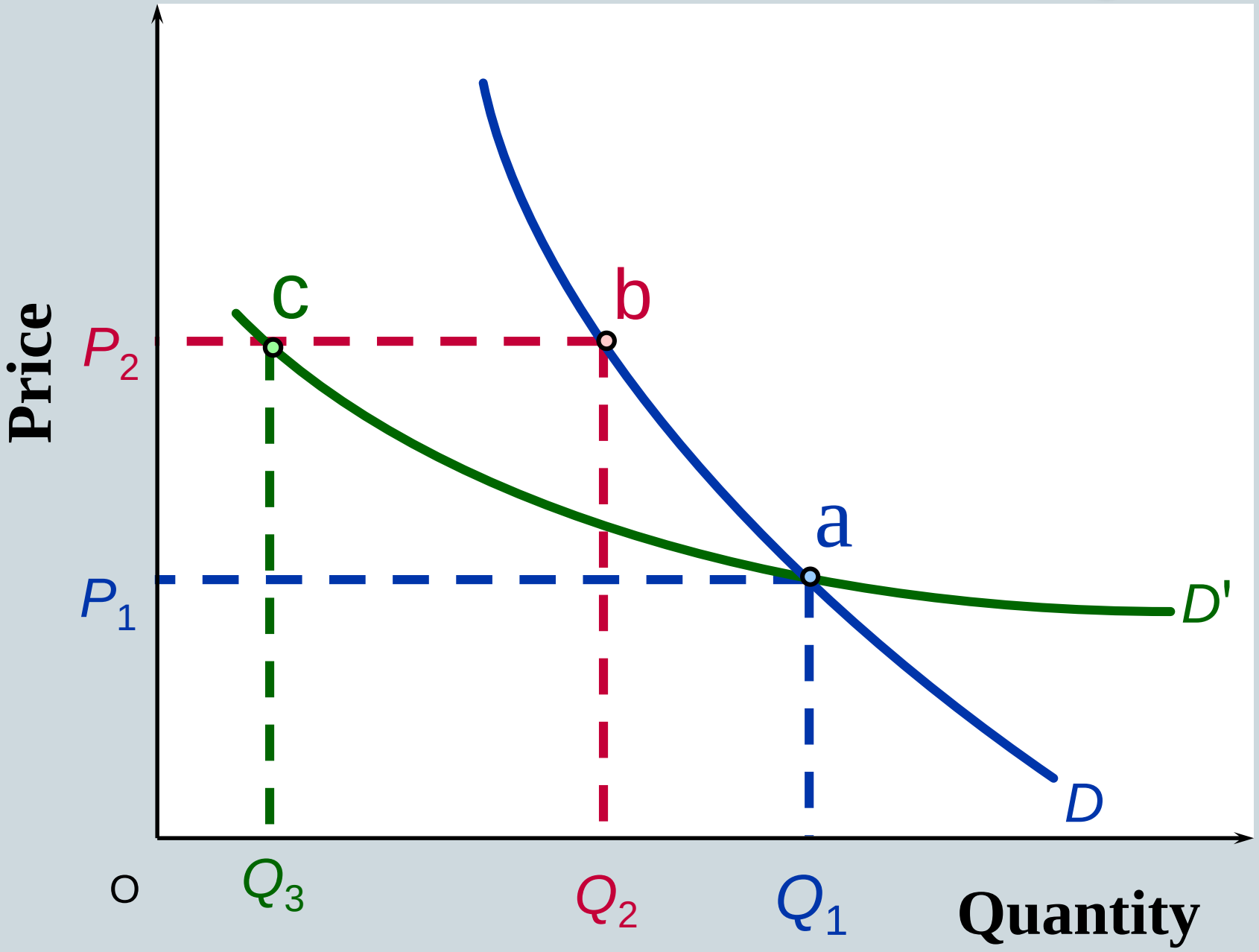
- The market we are going to examine is highly competitive with many competing firms and many consumers.

  - ✓ This means that firms and consumers are price takers

Introduction

- As pointed out earlier, when the price of a good rises (or falls), quantity demanded falls (rises).
- Economists would like to know by how much quantity demanded falls or rises in response to a price change
- In other words, we would like to know how responsive demand is to price changes.
- For instance, consumers' response to a change in the price of oil would differ from that of Voltic Mineral Water.

Market demand and Price Change



Elasticity

- Elasticity of demand measures the degree of responsiveness of quantity demanded to changes in the determinants of demand.

- Since not all the factors that affect demand can be measured quantitatively, we will discuss three types of demand elasticity:
  - **Price Elasticity of Demand**
  - **Income Elasticity of Demand and**
  - **Cross-Price Elasticity of demand**

Price Elasticity of demand

- Price elasticity of demand measures the degree of responsiveness of quantity demanded to changes in the commodity's own price.

- Elasticity compares the size of the change in quantity demanded to that price.

- Since quantity and price are measured in different units, the only sensible way to measure elasticity is to use proportionate or percentage changes.

Measurement of Price Elasticity:

$$Price\ Elasticity\ of\ Demand$$

$$= \frac{\%\boldsymbol{Change\ in\ Quantity\ Demanded}}{\%\ \boldsymbol{Change\ in\ Price}}$$

Or

$$\boldsymbol{PED} = \frac{\%\Delta \boldsymbol{Q_D}}{\%\ \Delta \boldsymbol{P}}$$

Measurement of Price Elasticity:

Percentage change in quantity is given as:

$$\frac{Q_1 - Q_0}{Q_0} \times 100\%$$

Percentage change in Price is given as:

$$\frac{P_1 - P_0}{P_0} \times 100\%$$

Price Elasticity of demand

- An alternative method, which is derived from the percentage changes is often used

- This is given as:

$$PED = \frac{Q_1 - Q_0}{P_1 - P_0} \times \frac{P_0}{Q_0}$$

Price Elasticity of demand: Example

- Assume that the price of Yam decreases from GH¢5 to GH¢4 per tuber and this causes the quantity demanded to increase from 5 tubers per day to 10 tubers. What is the price elasticity of demand?

- From this information,

$P_0 = 5$, $P_1 = 4$, $Q_0 = 5$ $Q_1 = 10$

Price Elasticity of demand: Example

$$PED = \frac{10-5}{4-5} \times \frac{5}{5}$$

$$= \frac{5}{-1} \times 1$$

$$= \frac{5}{-1}$$

$$= -5$$

Price Elasticity of demand: Example

Percentage change in quantity is given as:

$$\frac{10-5}{5} \times 100\% = 100\%$$

Percentage change in Price is given as:

$$\frac{4-5}{5} \times 100\% = -20\%$$

$$PED = \frac{\%\Delta Q_D}{\%\,\Delta P} = \frac{100\%}{-20\%} = 5$$

Interpretation of Elasticity Figures

- Since demand curves are generally downward sloping, it implies that percentage change in price and that of quantity would have opposite signs.
- That is, a percentage increase in price would be accompanied by a percentage decrease in price and vice versa.
- Either way, the price elasticity of demand is always negative**. *In this class, I would ignore the negative sign and interpret the absolute values.***

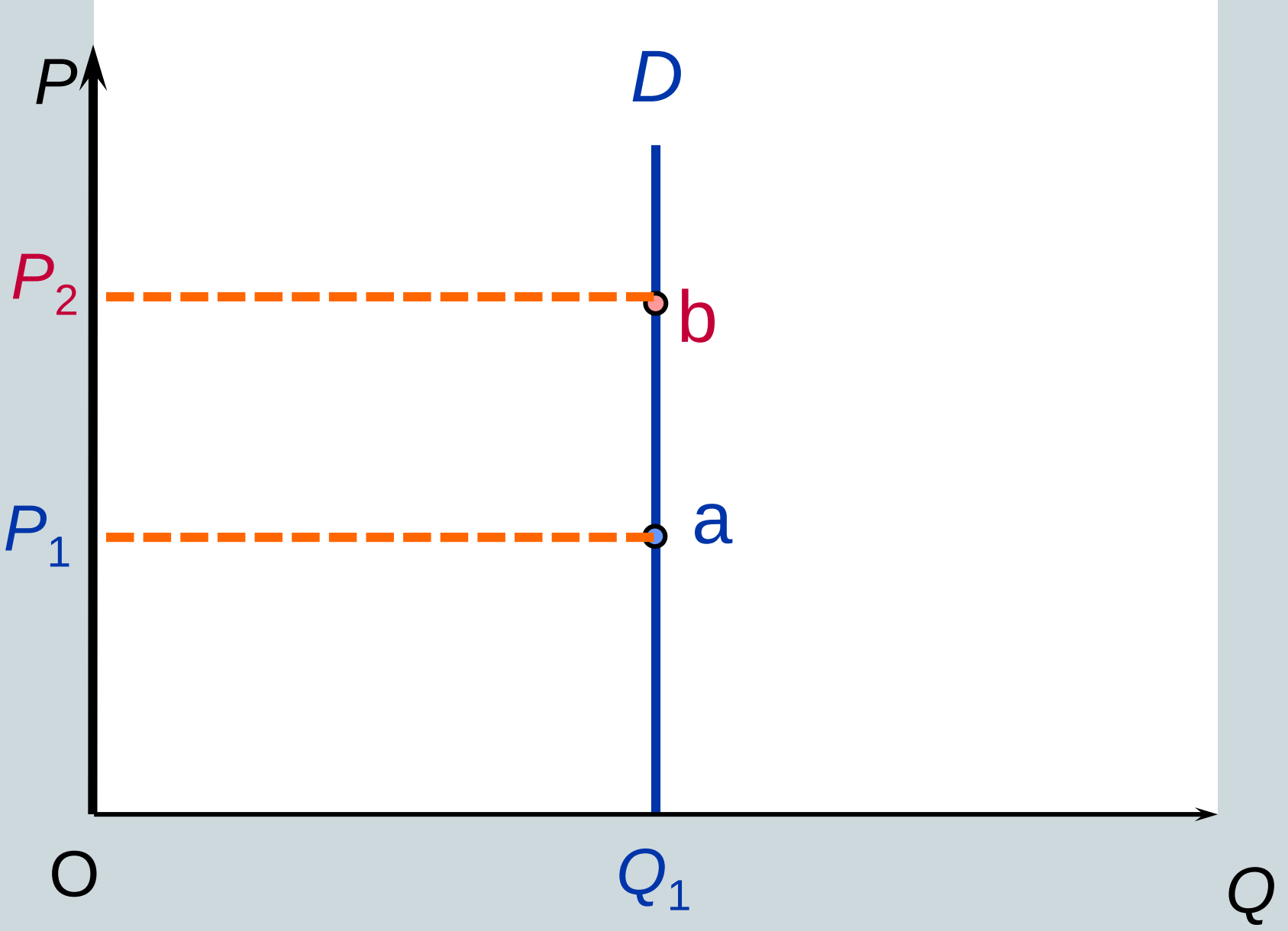
Interpretation of Elasticity Figures

- ***If PED = 0, then demand is Perfectly inelastic.***

- This means that demand does not respond at all to changes in price. That is, no matter the price, quantity demanded is the same.

- The demand curve is thus vertical as shown below:

Perfectly inelastic demand ($P\hat{I}_D = 0$)



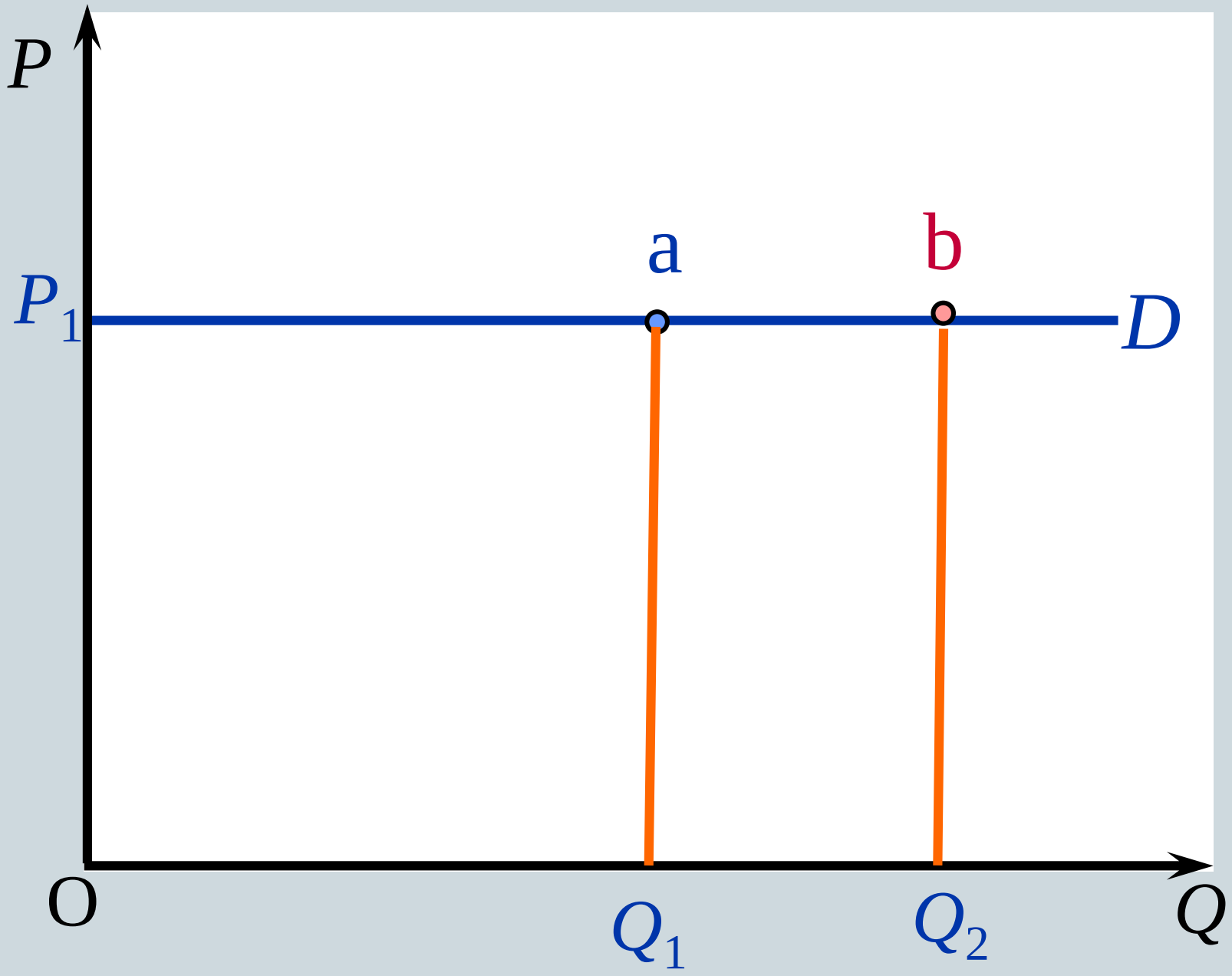
Interpretation of Elasticity Figures

- ***If PED = -∞, then demand is Perfectly Elastic.***

- This means that demand responds to a small change in price. That is, a small change in price brings about infinitely large change in quantity demanded.

- This is shown by a horizontal demand curve

Infinitely elastic demand ($P\hat{I}_D = ¥$)

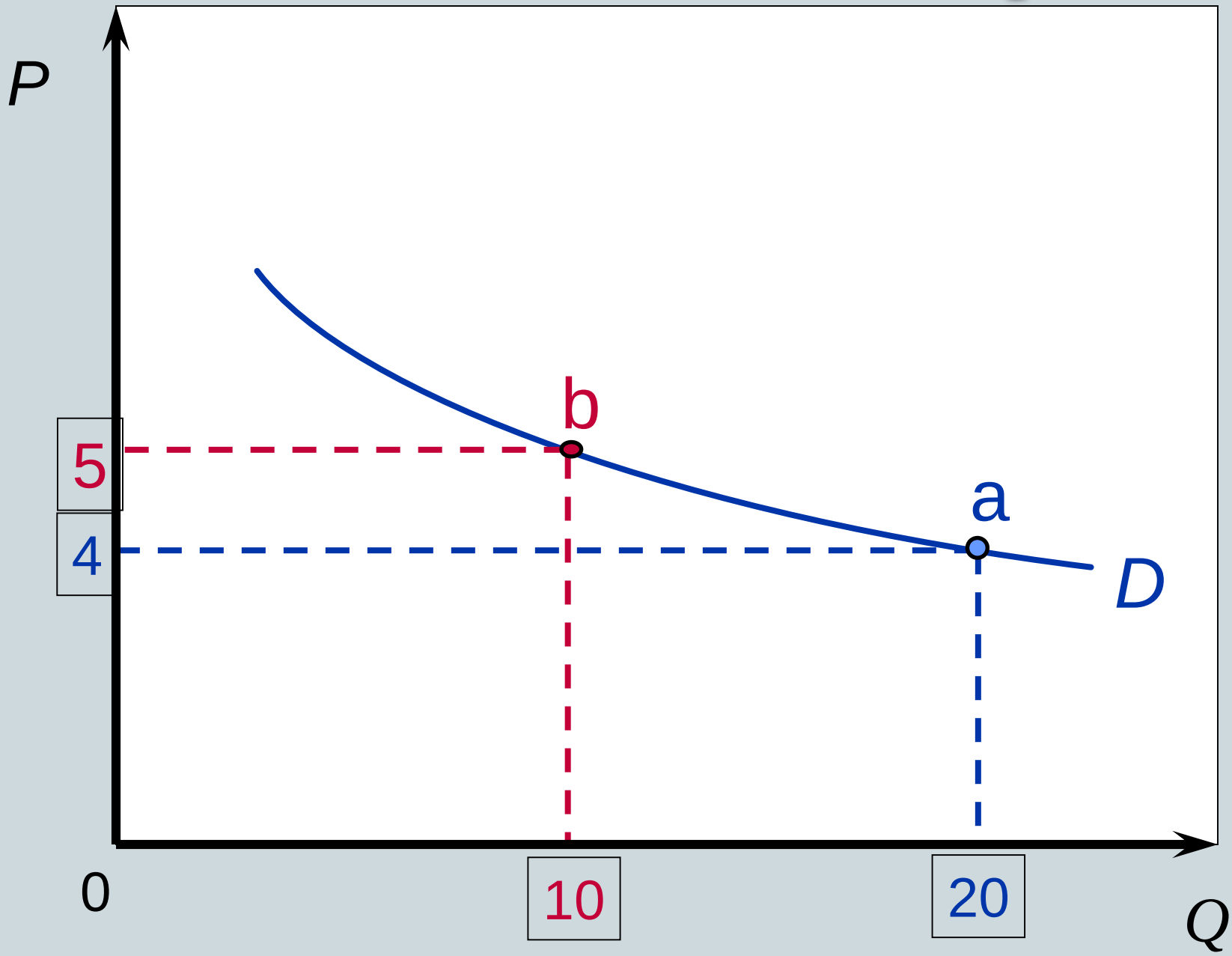


Interpretation of Elasticity Figures

- ***If PED>1, then demand is Elastic.***
- This is where a change in price causes proportionately larger change in the quantity demanded. In this case, the value of elasticity will be greater than 1 since we are dividing a larger figure by a smaller figure.

- This is shown by a relatively flatter demand curve

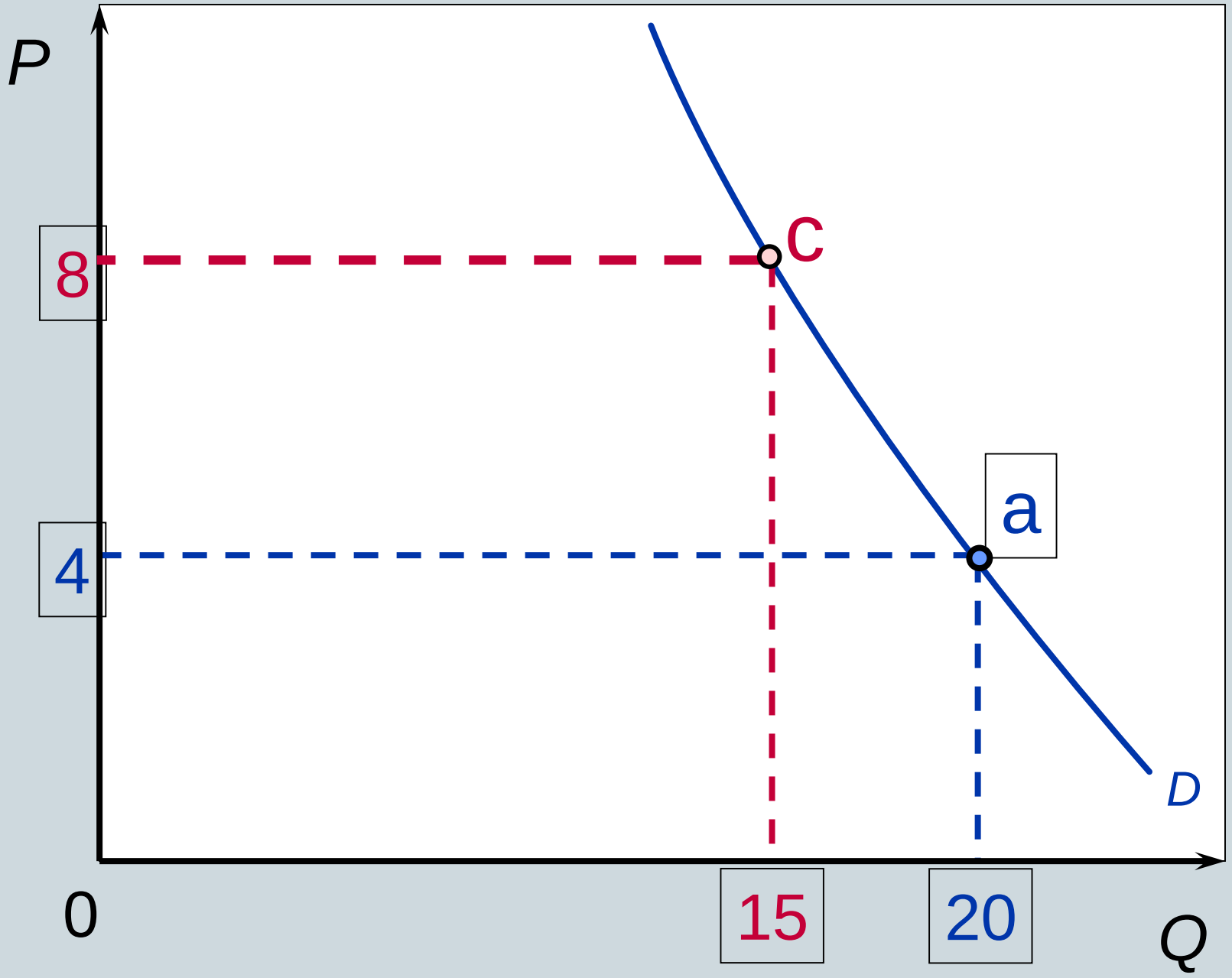
Elastic demand between two points



Interpretation of Elasticity Figures

- ***If PED<1, then demand is Inelastic.***
- This is where a change in price causes proportionately smaller change in the quantity demanded. In this case, the value of elasticity will be less than 1 since we are dividing a smaller figure by a larger figure.
- This is shown by a relatively steeper demand curve

Inelastic demand between two points



Interpretation of Elasticity Figures

- ***If PED =1, then demand is said to be unitary Elastic.***
- This is where price and quantity demanded change by the same proportion. In this case, the value of elasticity will be 1 since we are dividing a figure by itself.
- The demand curve is a rectangular hyperbola:

Summary of Price Elasticity of Demand

- Elastic Demand - Ed will be > 1
- Inelastic Demand - Ed will be < 1
- Unit Elastic Demand - Ed will be = 1
- Perfectly Inelastic Demand - Ed will be = 0
- Perfectly Elastic Demand - Ed will be = ∞

Determinants of price elasticity of demand

- number and closeness of substitute goods
- the proportion of income spent on the good
- Definition of the product (or market)
- time

Price elasticity of demand and consumer expenditure

- ***Total Revenue (expenditure) = P x Q***

- A price increase has two effects on revenue:
  - **Higher *P* means <u>more revenue</u>** on each unit you sell.
  - **But you sell <u>fewer units</u> (lower *Q*),** due to Law of Demand.
- Which of these two effects is bigger?
  It depends on the price elasticity of demand.

Determinants of price elasticity of demand

- If demand is elastic, then

price elasticity of demand > 1

% change in ***Q*** > % change in ***P***

- ***The fall in revenue from lower Q is greater than the increase in revenue from higher P, so revenue falls.***

Determinants of price elasticity of demand

- If demand is **inelastic**, then

price elasticity of demand $<$ 1

% change in Q $<$ % change in P

- ***The fall in revenue from lower Q is smaller than the increase in revenue from higher P, so revenue rises.***

Determinants of price elasticity of demand

- If demand is Perfectly **inelastic**, then

price elasticity of demand = 1

% change in Q = % change in P

- ***The fall in revenue from lower Q is the same as the increase in revenue from higher P, so revenue remains the same.***

Determinants of price elasticity of demand

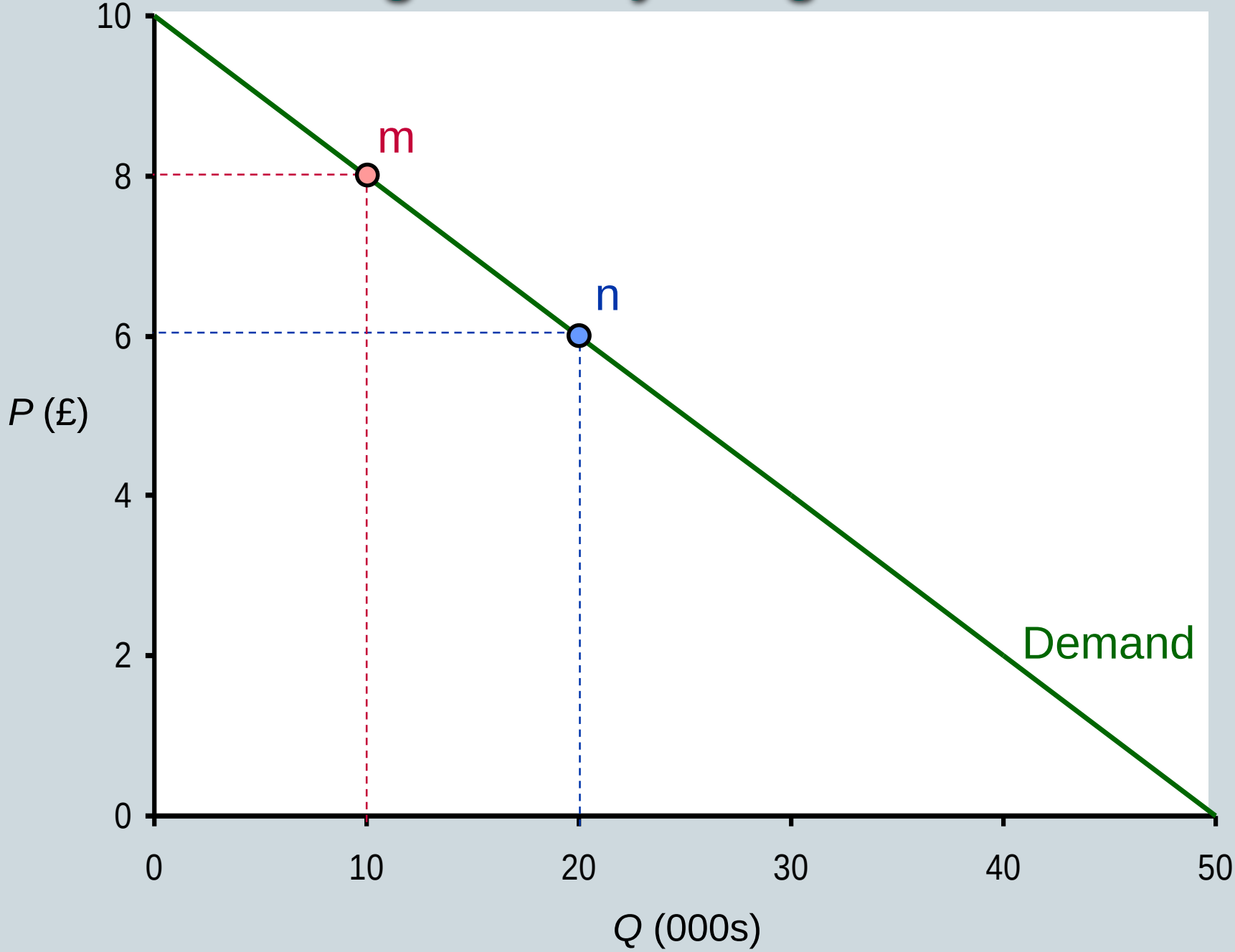
	Price Rise	Price Decline
Elastic ($E_D > 1$)	TR decreases	TR increases
Unit Elastic ($E_D = 1$)	TR constant	TR constant
Inelastic ($E_D < 1$)	TR increases	TR decreases

Arc Elasticity

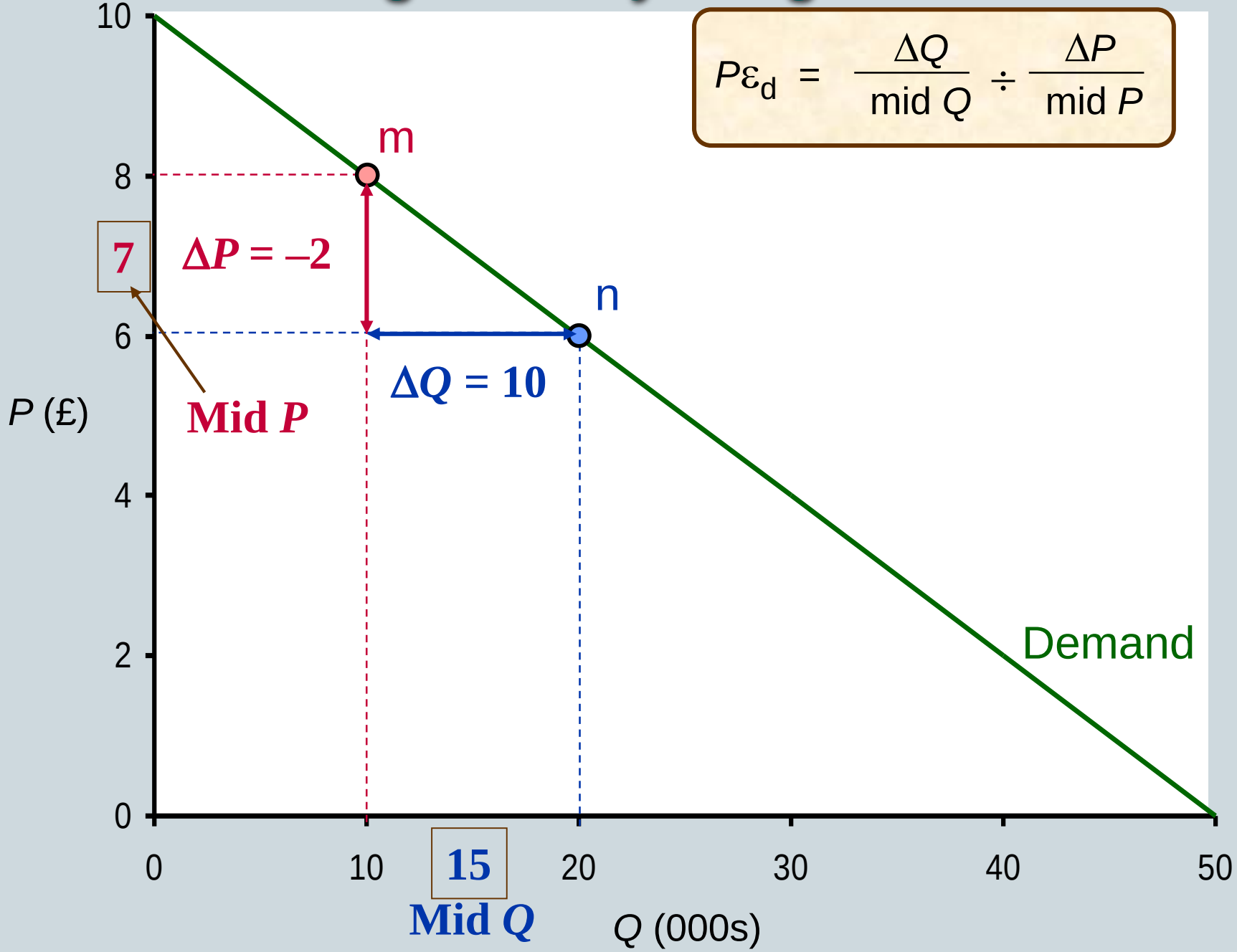
- Arc elasticity measures elasticity between two point on the demand curve.
- We $\Delta Q/averageQ \div \Delta P/average\ P$
- *Or* $$Arc\ Price\ elasticity\ of\ demand = \frac{\Delta Q}{\Delta P} \times \frac{(P_1 + P_2)}{(Q_1 + Q_2)}$$

$$Arc\ Price\ elasticity\ of\ demand = \frac{(Q_2 - Q_1)}{(P_2 - P_1)} \times \frac{(P_1 + P_2)}{(Q_1 + Q_2)}$$

Measuring elasticity using the arc method



Measuring elasticity using the arc method



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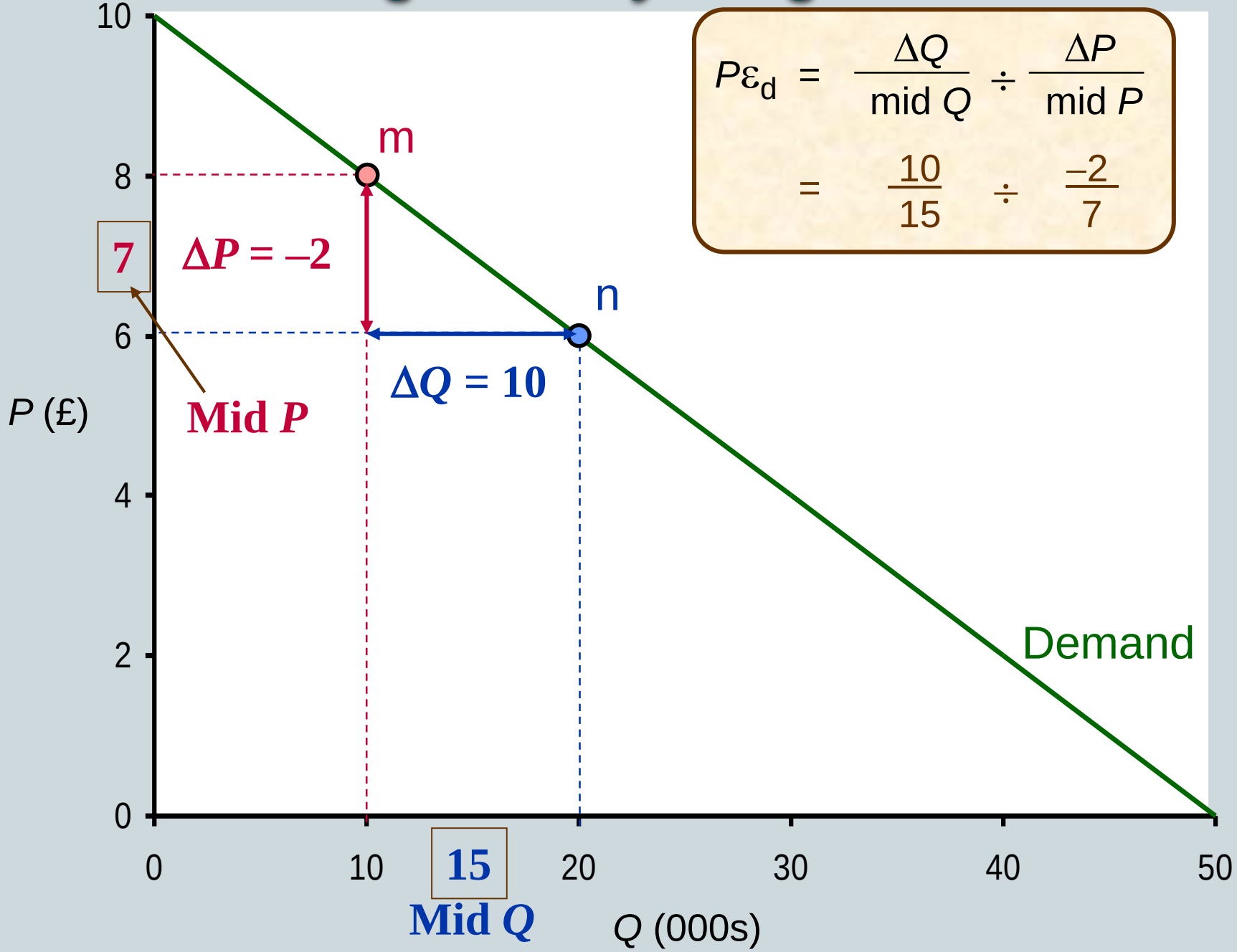

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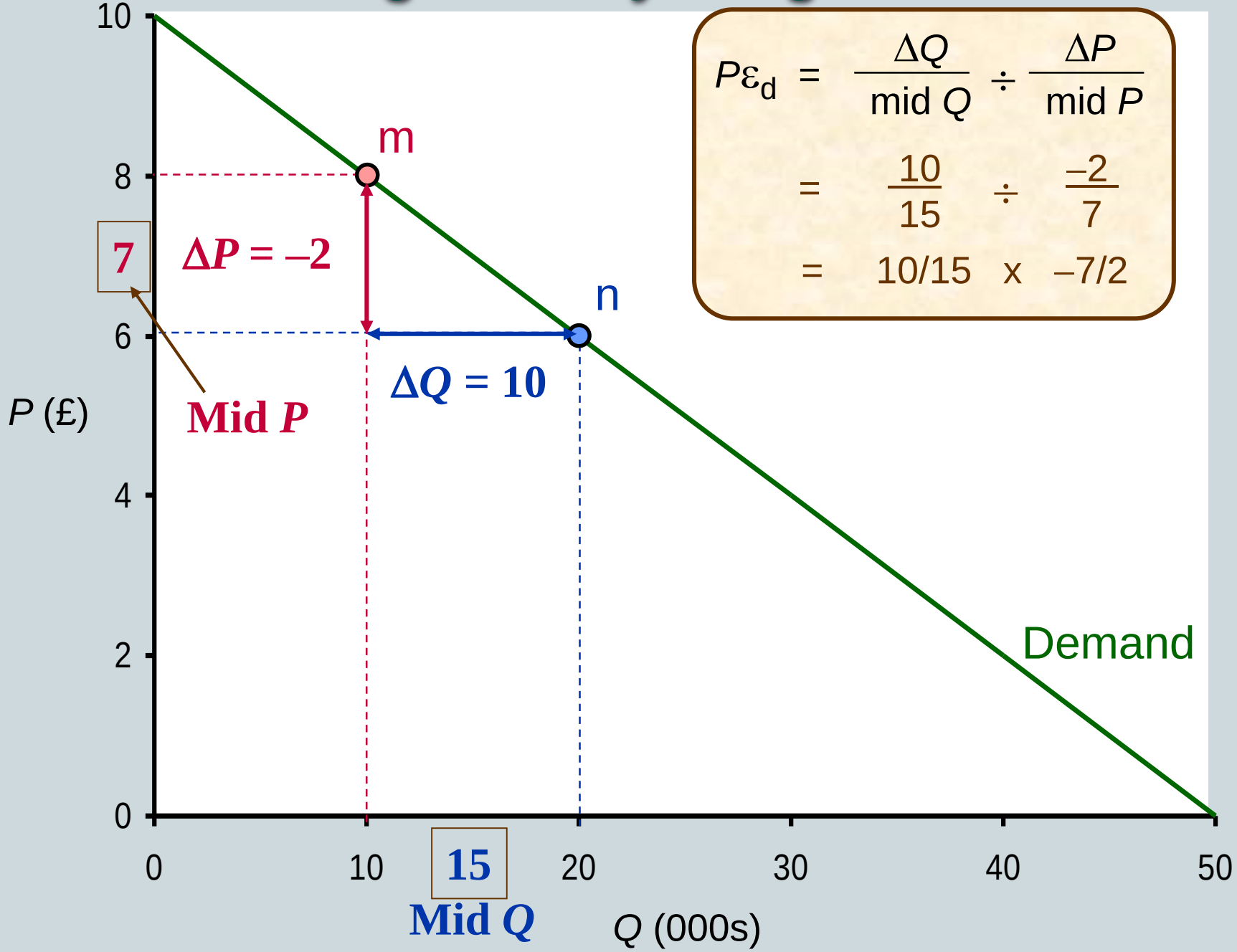
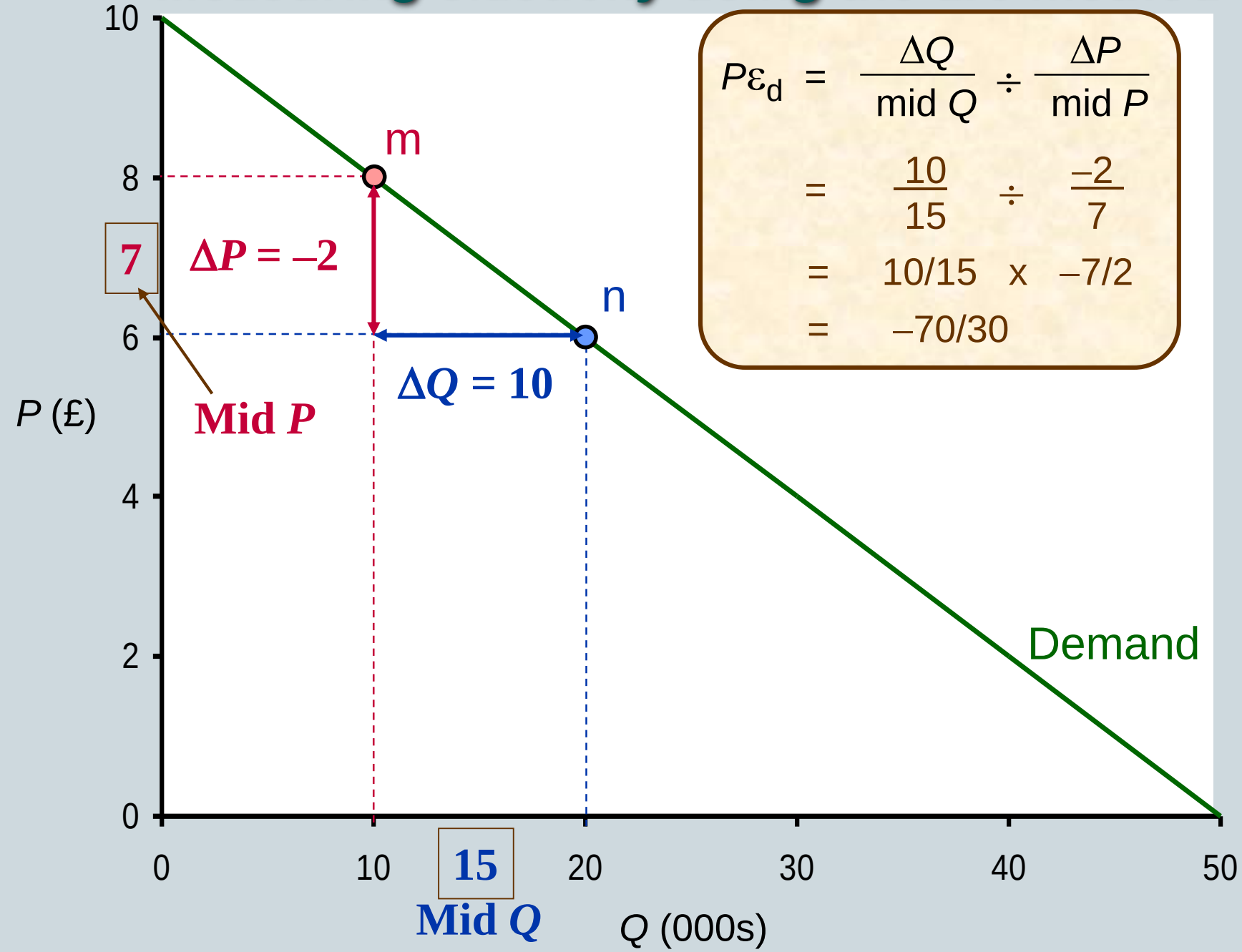


Measuring elasticity using the arc method



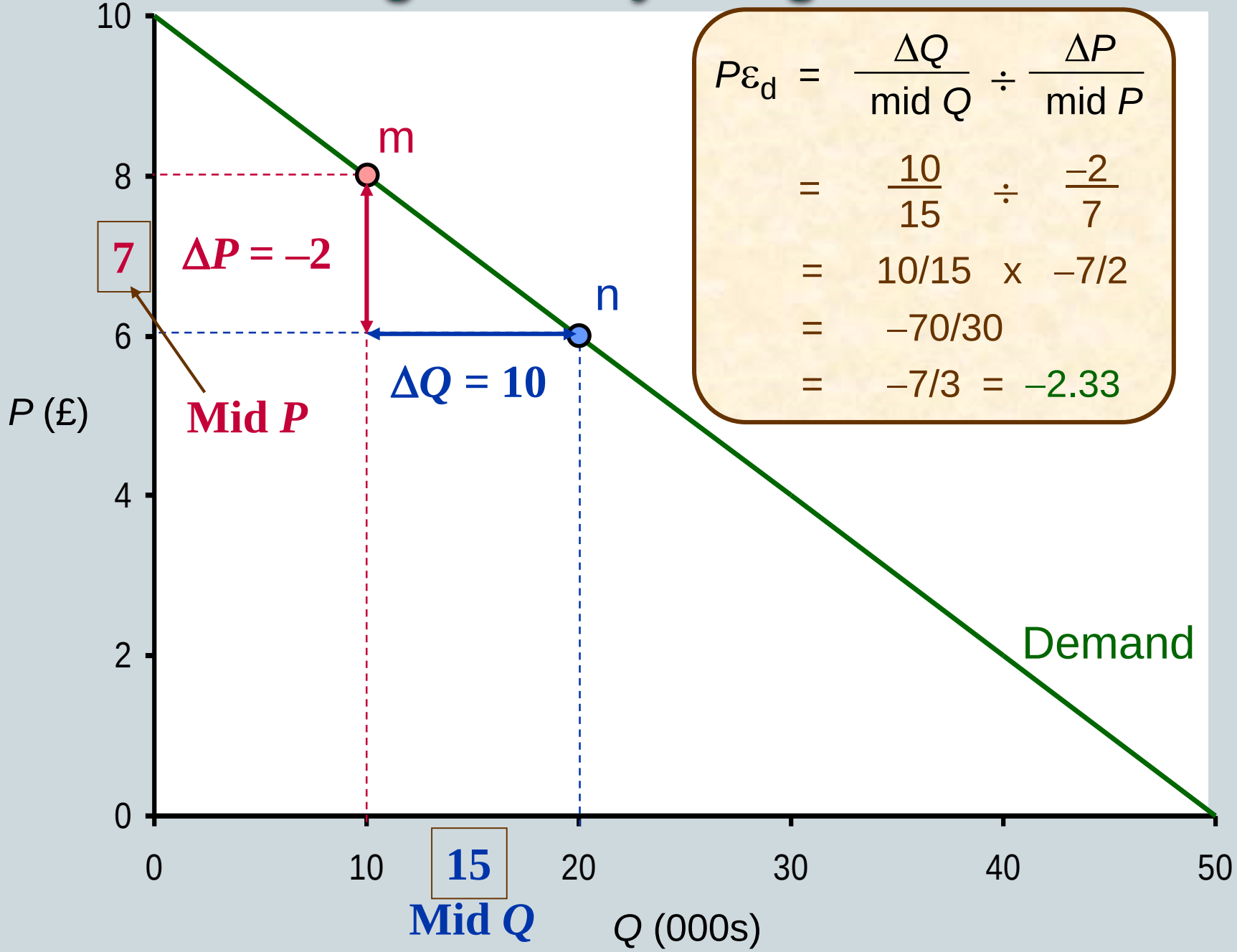
$$P\varepsilon_d = \frac{\Delta Q}{\text{mid } Q} \div \frac{\Delta P}{\text{mid } P}$$

$$= \frac{10}{15} \div \frac{-2}{7}$$

$$= 10/15 \times -7/2$$

$$= -70/30$$

Measuring elasticity using the arc method



$$P\varepsilon_d = \frac{\Delta Q}{\text{mid } Q} \div \frac{\Delta P}{\text{mid } P}$$

$$= \frac{10}{15} \div \frac{-2}{7}$$

$$= 10/15 \times -7/2$$

$$= -70/30$$

$$= -7/3 = -2.33$$

Q If the price of good X rises from £9 to £11 and as a result quantity demanded falls from 100 units to 60 units, what is the price elasticity of demand between these prices?

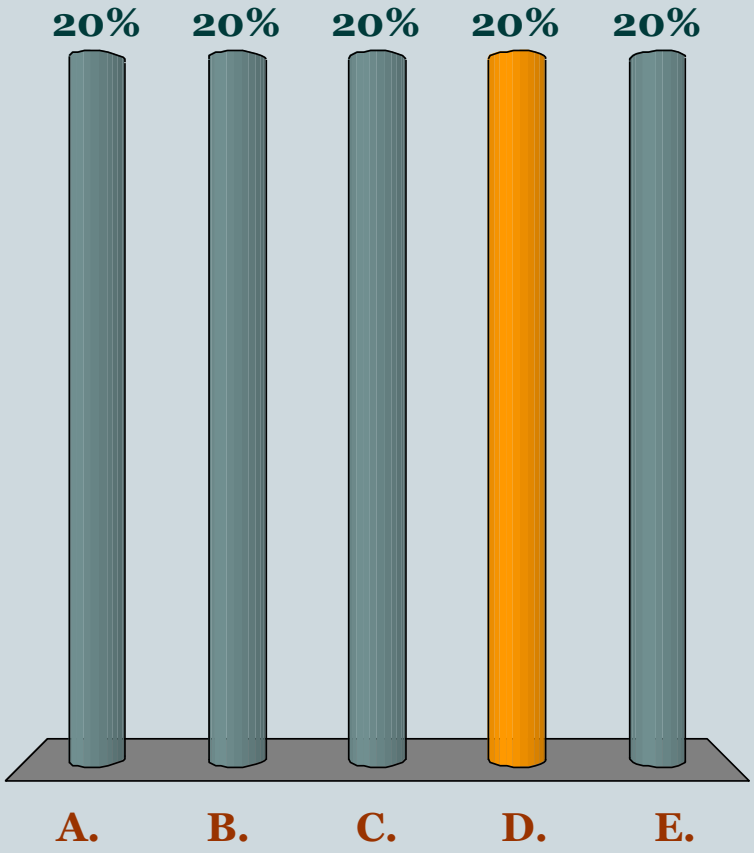
A. $2/-80 = -0.025$

B. $-80/2 = -40$

C. $0.2/-0.5 = -0.4$

D. $-0.5/0.2 = -2.5$

E. -1



Price elasticity of supply

Measure the degree of responsiveness of quantity supplied to changes in the price of the commodity.

For point elasticity,

$$PES = \frac{\%Change\ in\ Quantity\ Supplied}{\%\ Change\ in\ Price}$$

Or

$$PED = \frac{\%\Delta Q_S}{\%\ \Delta P}$$

Price elasticity of supply

$$PES = \frac{Q_{S1} - Q_{S0}}{P_1 - P_0} \times \frac{P_0}{Q_{S0}}$$

For Arc Elasticity:

$$PES = \frac{Q_{S1} - Q_{S0}}{P_1 - P_0} \times \frac{P_1 + P_0}{Q_{S1} + Q_{S0}}$$

Determinants of Price elasticity of supply

- The more easily sellers can change the quantity they produce, the greater the price elasticity of supply.

- For many goods, price elasticity of supply is greater in the long run than in the short run, because firms can build new factories, or new firms may be able to enter the market.

Q In which one of the following cases is good X likely to have a more price-elastic supply than good Y?

A. It is more costly to shift from producing X to another product than from Y to another product.

B. The supply of Y is considered over a longer period of time than X.

C. X is a minor by-product of Y.

D. Consumers find it easier to find alternatives to Y than to X.

E. The cost of producing extra units increases more rapidly in the case of Y than in the case of X.

Income Elasticity of Demand

- Measure the degree of responsiveness of quantity demanded to changes in the income of the consumer

For point elasticity,

$$IED = \frac{\%\textit{Change in Quantity Demanded}}{\%\ \textit{Change in Income}}$$

Or

$$IED = \frac{\%\Delta Q_D}{\%\ \Delta I}$$

Income Elasticity of Demand

$$IED = \frac{Q_{D1} - Q_{D0}}{I_1 - I_0} \times \frac{I_0}{Q_{D0}}$$

For Arc Elasticity:

$$IED = \frac{Q_{D1} - Q_{D0}}{I_1 - I_0} \times \frac{I_1 + I_0}{Q_{D1} + Q_{D0}}$$

Interpretation of Income Elasticity Figures

- If the value is negative then the good is an inferior good
- If the value is positive, then the commodity is a normal good
- For normal goods, if the value is grater than one, then it is said to be a luxury
- If it is less than one, then it is a necessity

Determinants of Income Elasticity

- degree of necessity
- proportion of income spent on the good

Q The data in the table refer to the income elasticities of demand for various commodities. Which one is a normal good and income inelastic?

Wine and spirits	2.60
Travel abroad	1.14
Dairy produce	0.53
Bread and cereals	–0.50
Coal	–2.02

A. Wine and Spirits
B. Travel Abroad
C. Dairy Produce
D. Bread and cereals
E. Coal

Cross-Price Elasticity of Demand

- Measure the degree of responsiveness of quantity demanded of one commodity to changes in the price of another commodity.

$$CPED = \frac{\%\,Change\ in\ Quantity\ Demanded\ of\ Good\ X}{\%\ Change\ in\ the\ Price\ of\ Good\ Y}$$

Or

$$IED = \frac{\%\Delta Q_{DX}}{\%\ \Delta P_Y}$$

Cross-Price Elasticity of Demand

$$CPED = \frac{Q_{DX1} - Q_{DX0}}{P_{Y1} - P_{Y0}} \times \frac{P_{Y0}}{Q_{DX0}}$$

For Arc Elasticity:

$$CPED = \frac{Q_{DX1} - Q_{DX0}}{P_{Y1} - P_{Y0}} \times \frac{P_{Y1} + P_{Y0}}{Q_{DX1} + Q_{DX0}}$$

Interpretation

- If the value is positive, then the two goods are substitutes implying that percentage increase in the price of one good lea to an increase in the demand for the other good, and vice versa all things equal

Interpretation

- If the value is negative, then the two goods are complements implying that percentage increase in the price of one good leads to a decrease in the demand for the other good, and vice versa, all things equal

- If the value is zero, then the two goods are said to be unrelated

Q If a rise in the price of good X results in the amount of money spent on good Y remaining the same, then

A. X and Y are perfect substitutes.

B. X and Y are perfect complements.

C. the cross-price elasticity of demand for Y with respect to X is infinite.

D. the cross-price elasticity of demand for Y with respect to X is 1.

E. the cross-price elasticity of demand for Y with respect to X is 0.