

ELASTICITY OF DEMAND

Price, Income and Cross Elasticity

Elasticity – the concept

- If price rises by 10% - what happens to demand?
- We know demand will fall
- By more than 10%?
- By less than 10%?
- **Elasticity measures the extent to which demand will change**

Elasticity – the concept

- The responsiveness of one variable to changes in another.
- The greater the elasticity, the greater the responsiveness.

Elasticity of Demand : Definition

- The degree of responsiveness of quantity demanded as a result of change in price of the good or income or relative goods' prices.
- Elasticity is expressed in percentages.
- The measure of percentage change in one variable brought out by a one percent change in another variable.

Types of Elasticity of Demand

- **Price elasticity of demand**
- **Income elasticity of demand**
- **Cross elasticity**

General Formula for own price elasticity of demand

- P = Current price of good X
- QD = Quantity demanded at that price
- ΔP = Small change in the current price
- ΔQD = Resulting change in quantity demanded

$$\text{Elasticity} = \frac{\text{Percentage Change in Quantity Demanded}}{\text{Percentage Change in Price}}$$

The **price elasticity of demand** is the percentage change in quantity demanded divided by the percentage change in price.

Categories of Price Elasticity of Demand

- Perfect elastic demand
- Perfect inelastic demand
- Unit elasticity of demand
- Relatively elastic demand
- Relatively inelastic demand

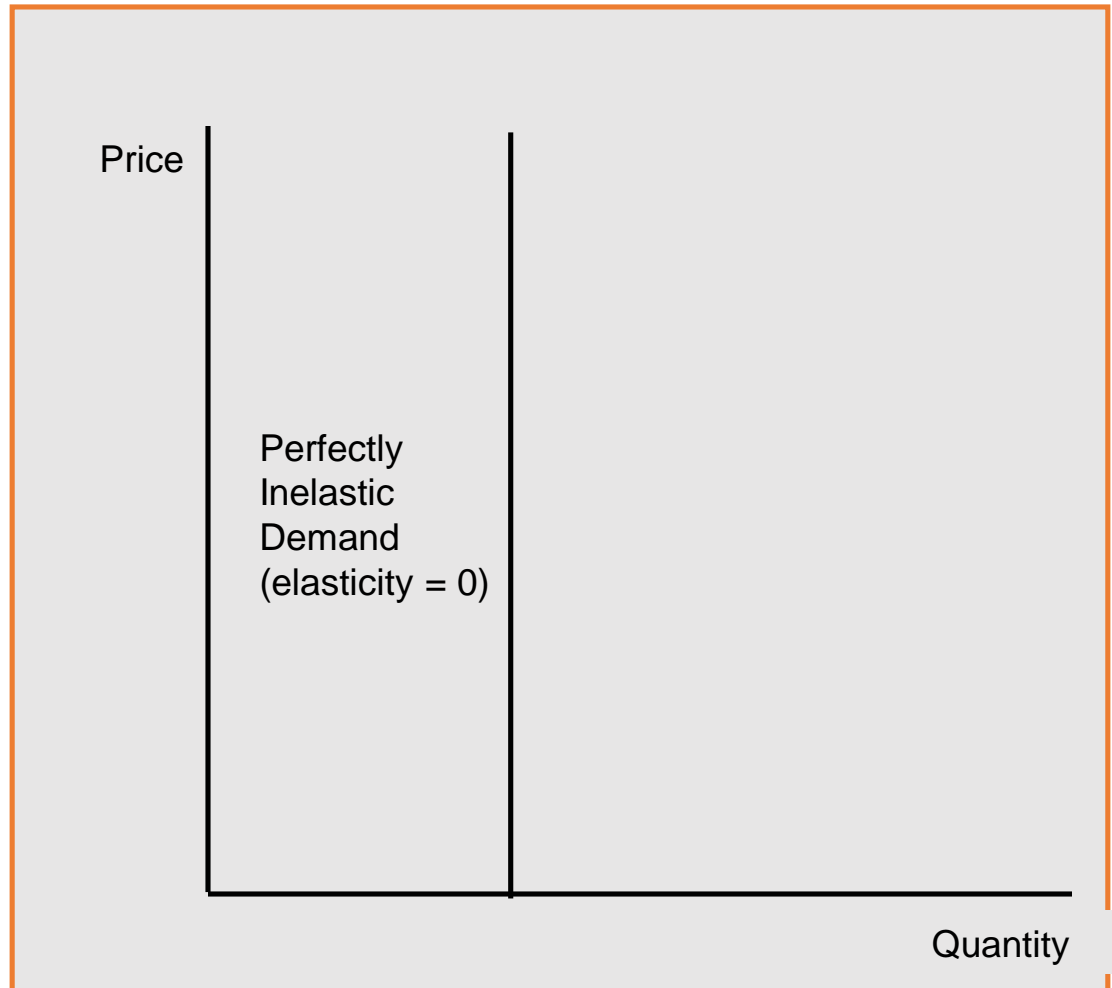
Perfectly Elastic Demand

- We say that demand is perfectly elastic when a 1% change in the price would result in an infinite change in quantity demanded.
- Price elasticity of demand turns infinity



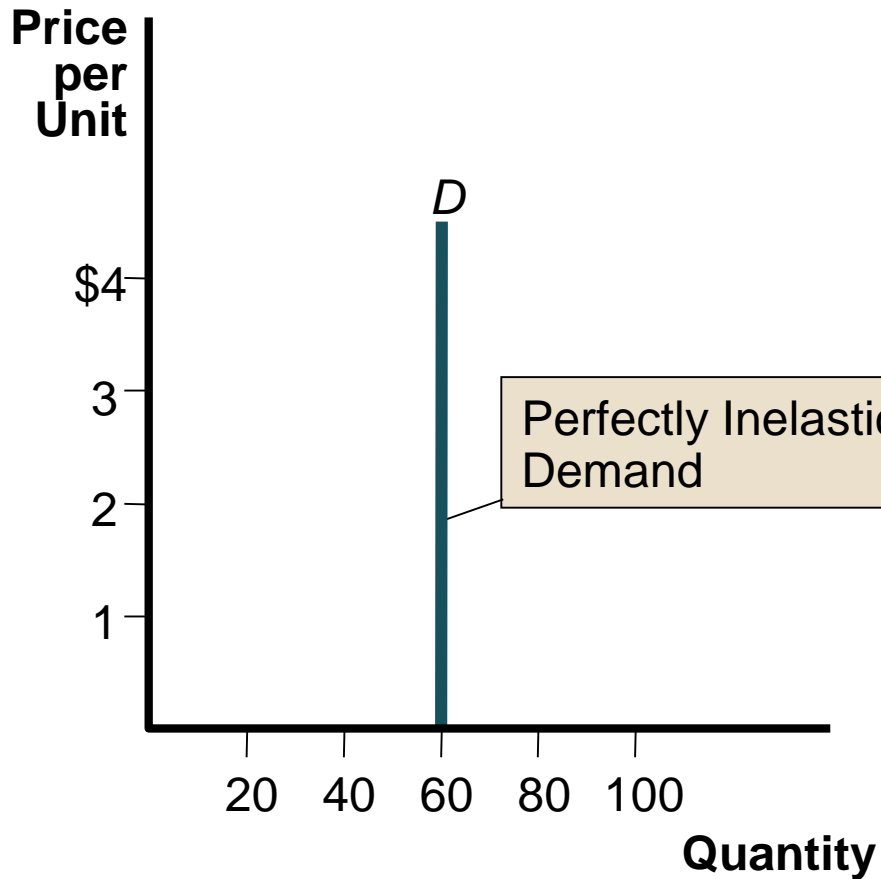
Perfectly Inelastic Demand

- We say that demand is perfectly inelastic when a 1% change in the price would result in no change in quantity demanded.
- Price elasticity turns 0



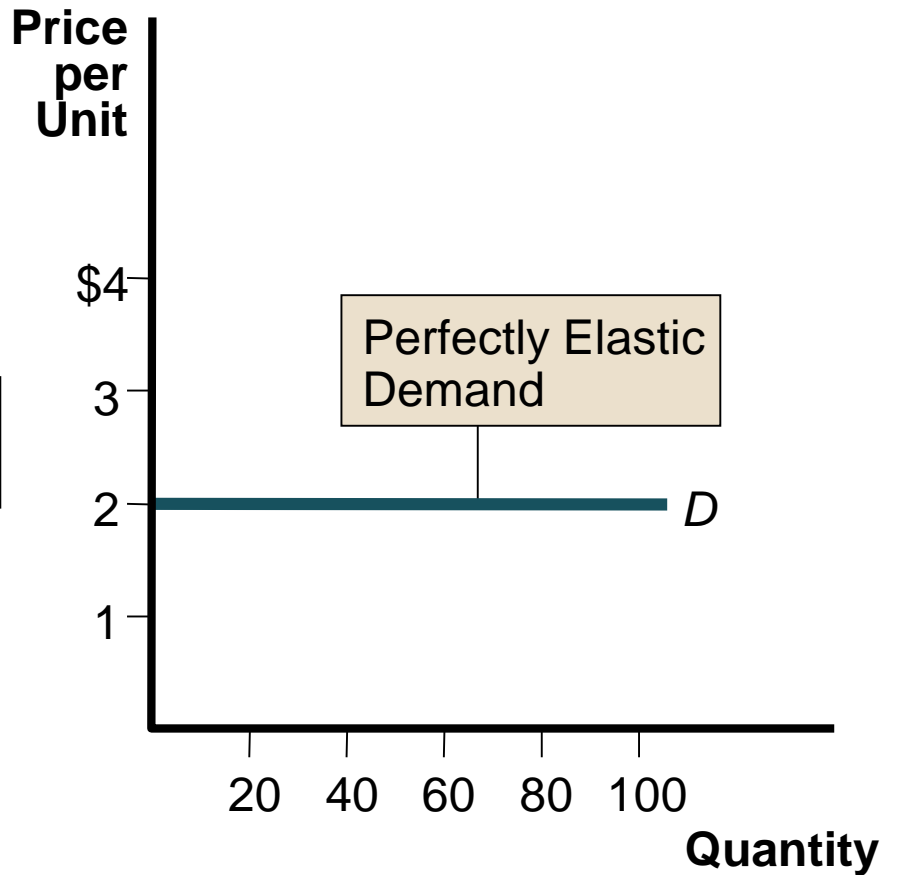
Extreme Cases of Demand

(a)



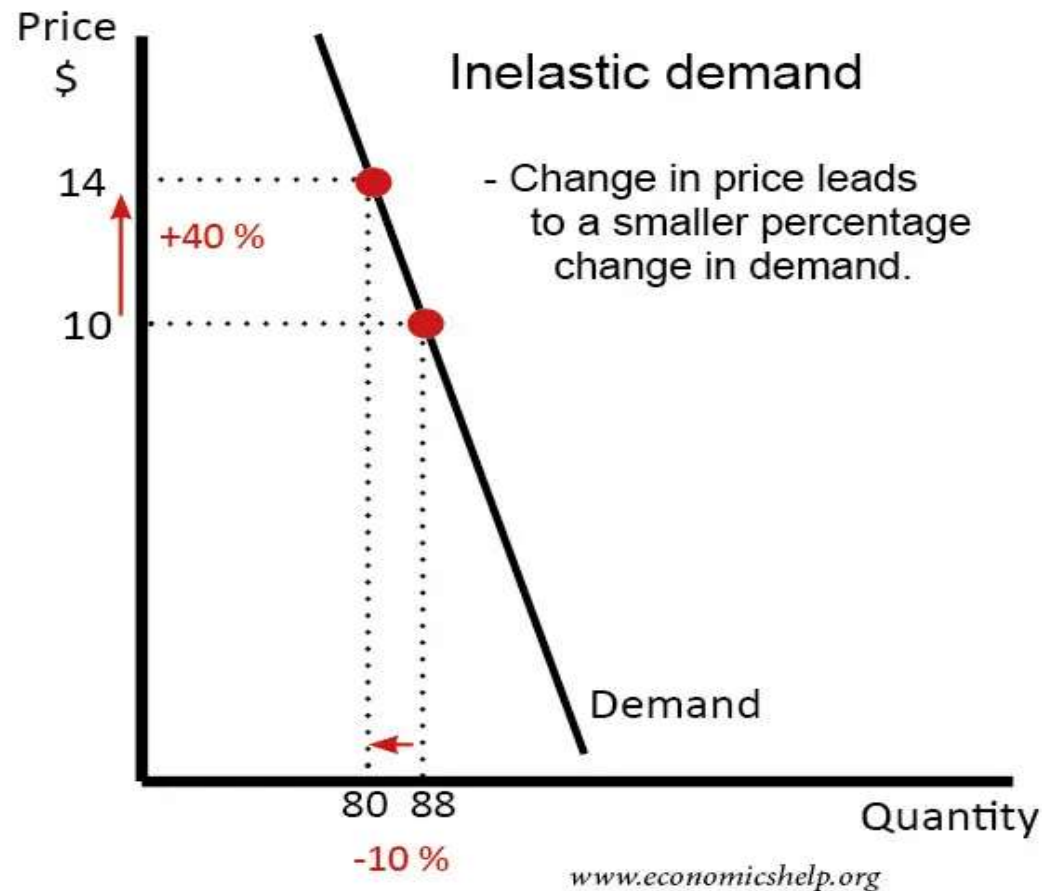
Elasticity is zero

(b)

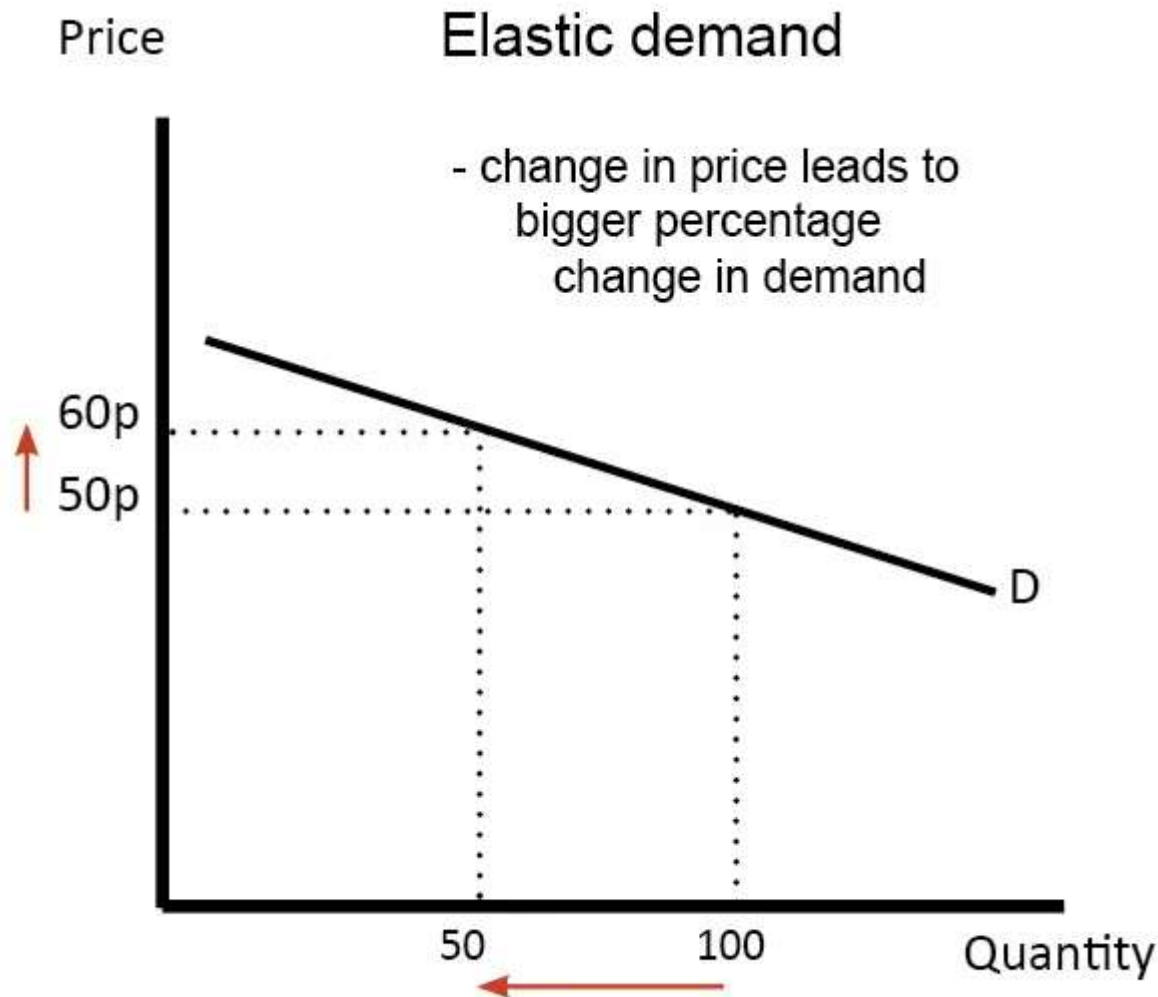


Elasticity is infinity

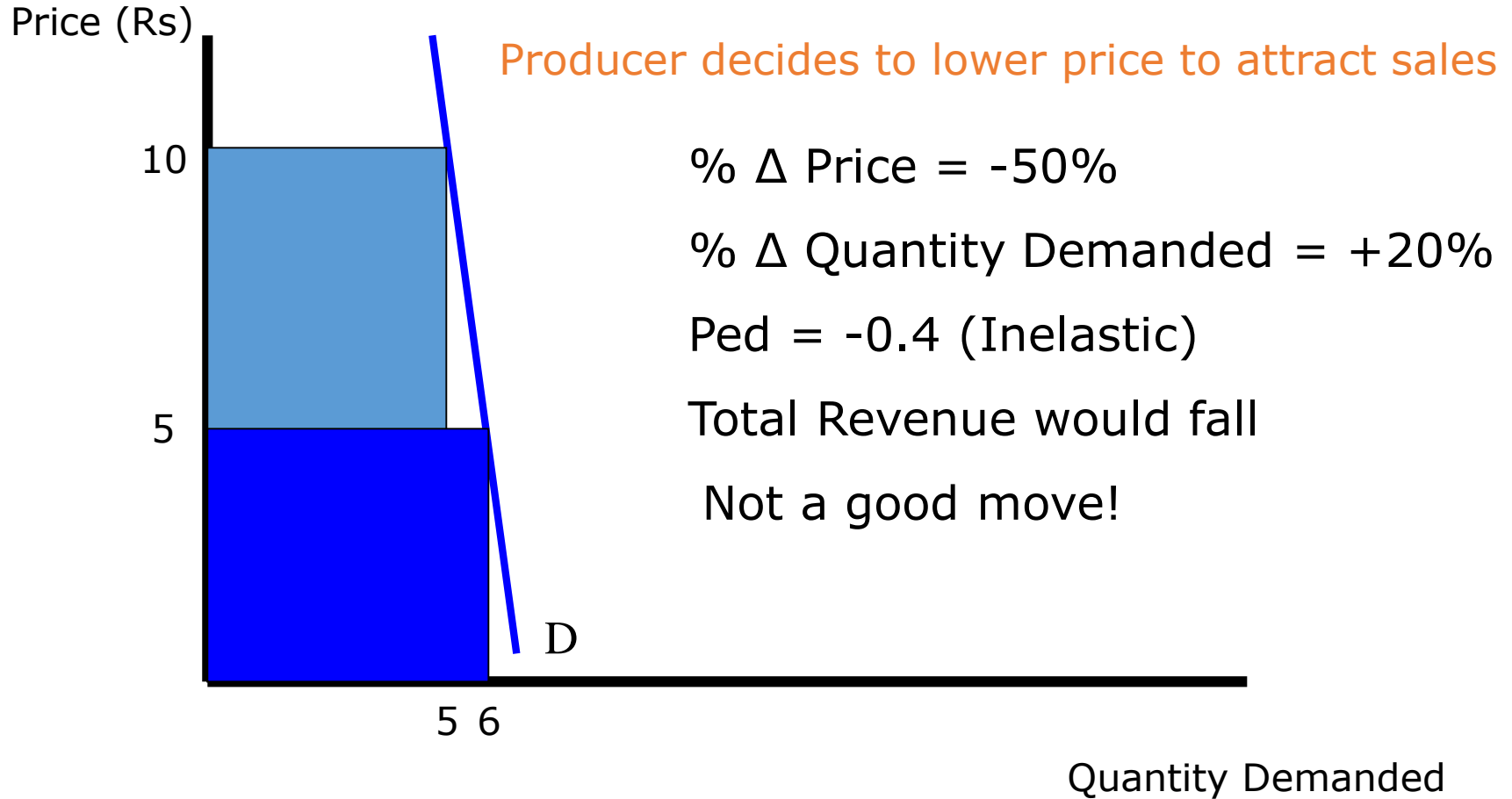
These are goods where a change in price leads to a smaller % change in demand; therefore (price elasticity of demand) $PED < 1$ e.g. -0.5



Demand is price elastic if a change in price leads to a bigger % change in demand; therefore the PED will, therefore, be greater than 1. Calculate the PED in the following case and verify.



Elasticity



Elasticity

Price (Rs)

Producer decides to reduce price to increase sales

$\% \Delta \text{ in Price} = -30\%$

$\% \Delta \text{ in Demand} = +300\%$

$P_{ed} = -10$ (Elastic)

Total Revenue rises

Good Move!

10

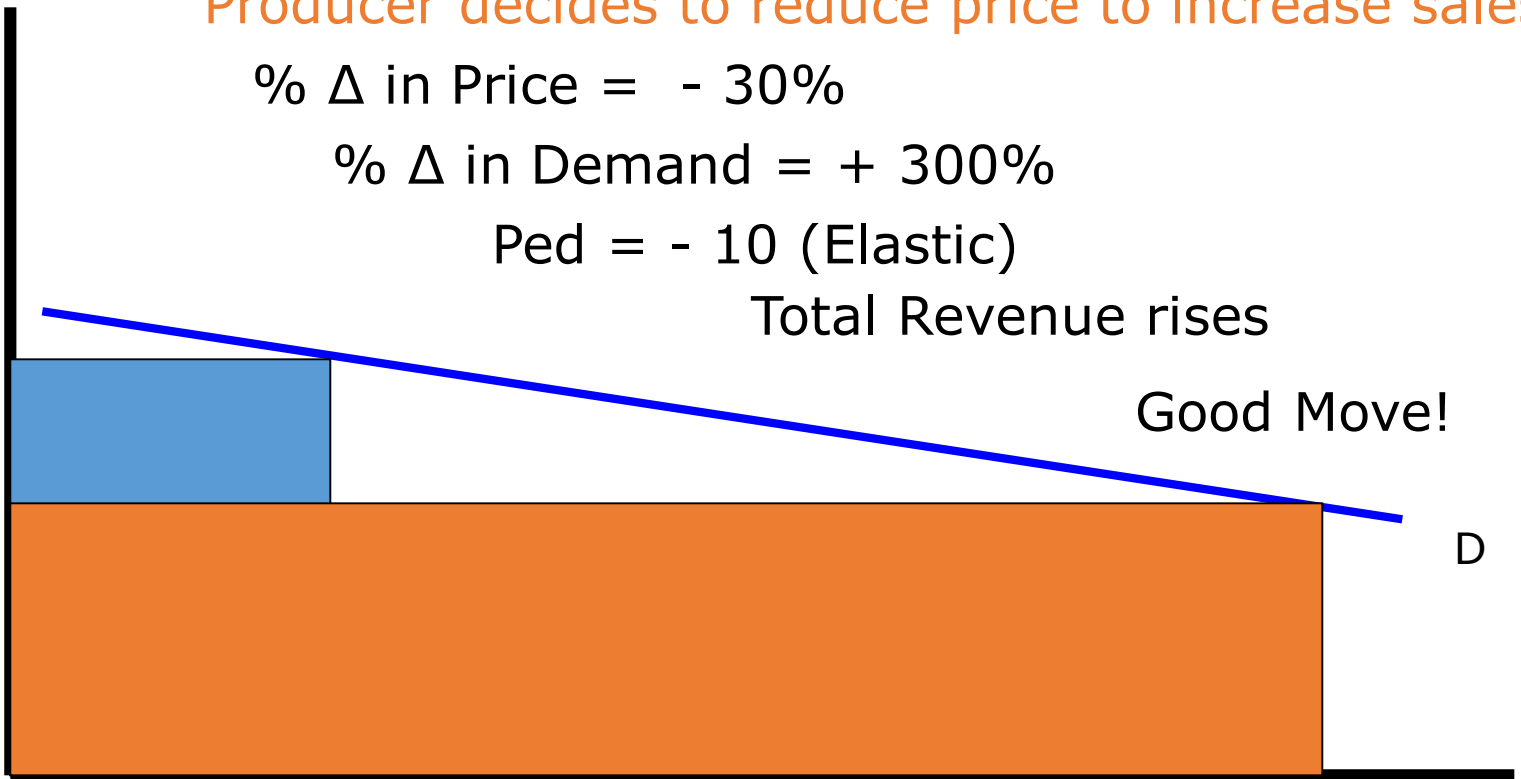
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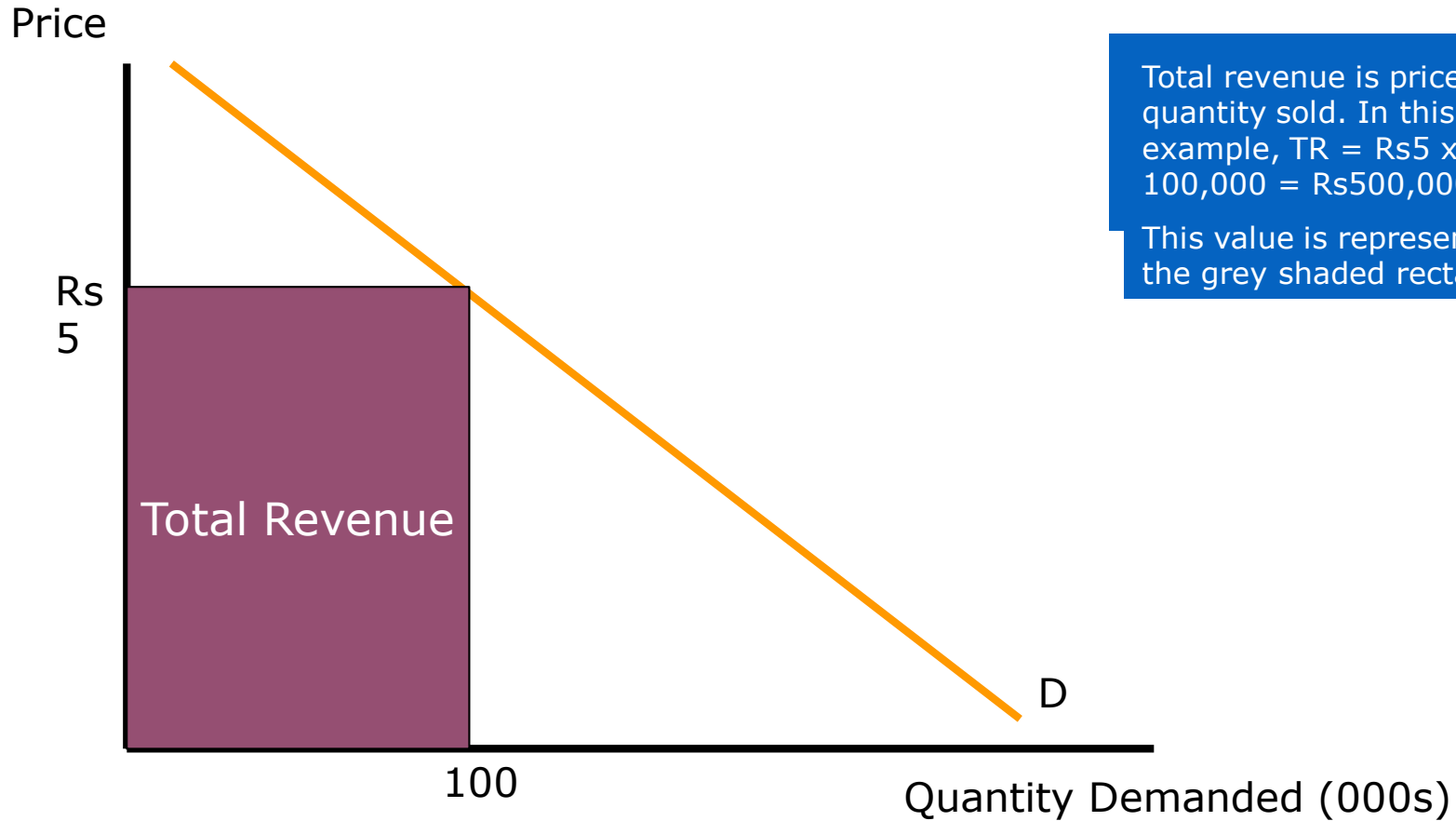
Quantity Demanded

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D



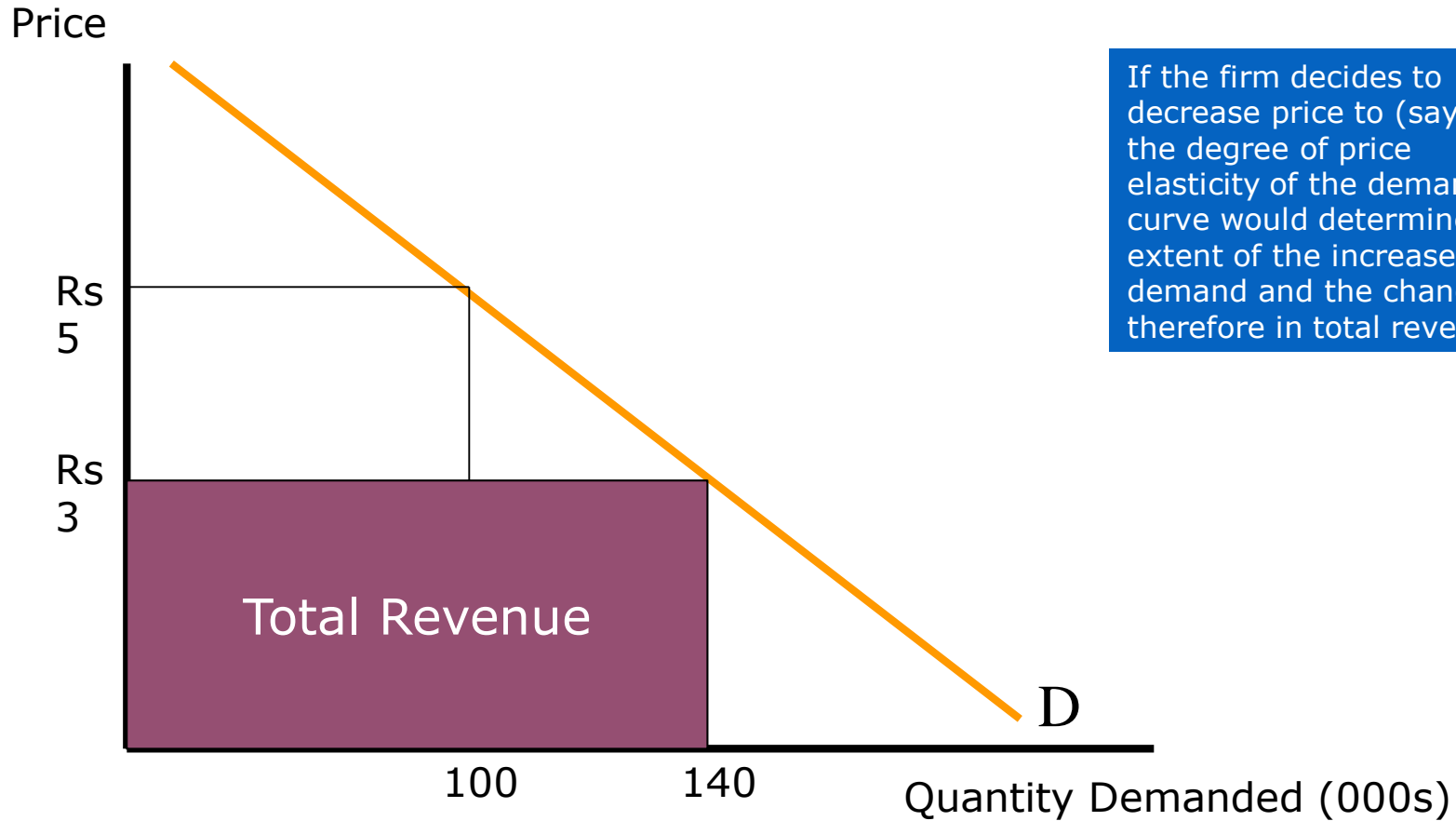
Elasticity



Total revenue is price x quantity sold. In this example, $TR = \text{Rs}5 \times 100,000 = \text{Rs}500,000$.

This value is represented by the grey shaded rectangle.

Elasticity



If the firm decides to decrease price to (say) Rs3, the degree of price elasticity of the demand curve would determine the extent of the increase in demand and the change therefore in total revenue.

Calculating Elasticities

- To determine elasticity, divide the percentage change in quantity demanded by the percentage change in price.
- Change from P_1 to P_2 , quantity changes from Q_1 to Q_2 , we can calculate ΔP and ΔQ and, then apply the formula:
- $\Delta Q / Q_1$ divided by $\Delta P / P_1$
- $\Delta Q / \Delta P$ multiplied by P_1 / Q_1

Elasticity

○ Price Elasticity of Demand

- The responsiveness of demand to changes in price
- Where % change in demand is greater than % change in price – **elastic**
- Where % change in demand is less than % change in price – **inelastic**

Elasticity

The Formula:

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

If answer is between 0 and -1: the relationship is inelastic

If the answer is between -1 and infinity: the relationship is elastic

Note: PED has – sign in front of it; because as price rises demand falls and vice-versa (inverse relationship between price and demand)

Price Elasticity of Demand

For example if the Price of Pepsi goes up by 5% and as a response the Quantity Demanded goes down by 10% then the Price Elasticity of Demand for Pepsi is:

$$E_d = \left| \frac{-10\%}{5\%} \right| = 2$$

This has an interesting interpretation. $E_d=2$ indicates that the percentage change in the quantity demanded is twice as big as the percentage change in the price. In other words, the quantity demanded is very sensitive to changes in the price because in this case the quantity demanded changed more (in percentage terms) than the change in the price.

In the example above $E_d=2$ so we concluded that QD is sensitive to changes in P. In general, whenever the percentage change in the QD demand is greater than the percentage change in P we are going to say the demand is sensitive to changes in the price.

A sensitive demand is called Elastic, and insensitive demand is called Inelastic.

What Information Price Elasticity Provides?

- Price elasticity of demand and supply gives the exact quantity response to a change in price.

Elasticity Is Independent of Units

- Percentages allow us to have a measure of responsiveness that is independent of units.
- This makes comparisons of responsiveness of different goods easier.

Classifying Demand and Supply as Elastic or Inelastic

- Demand is *elastic* if the percentage change in quantity is greater than the percentage change in price.

$$E > 1$$

Classifying Demand and Supply as Elastic or Inelastic

- Demand is *inelastic* if the percentage change in quantity is less than the percentage change in price.

$$E < 1$$

Inelastic Demand

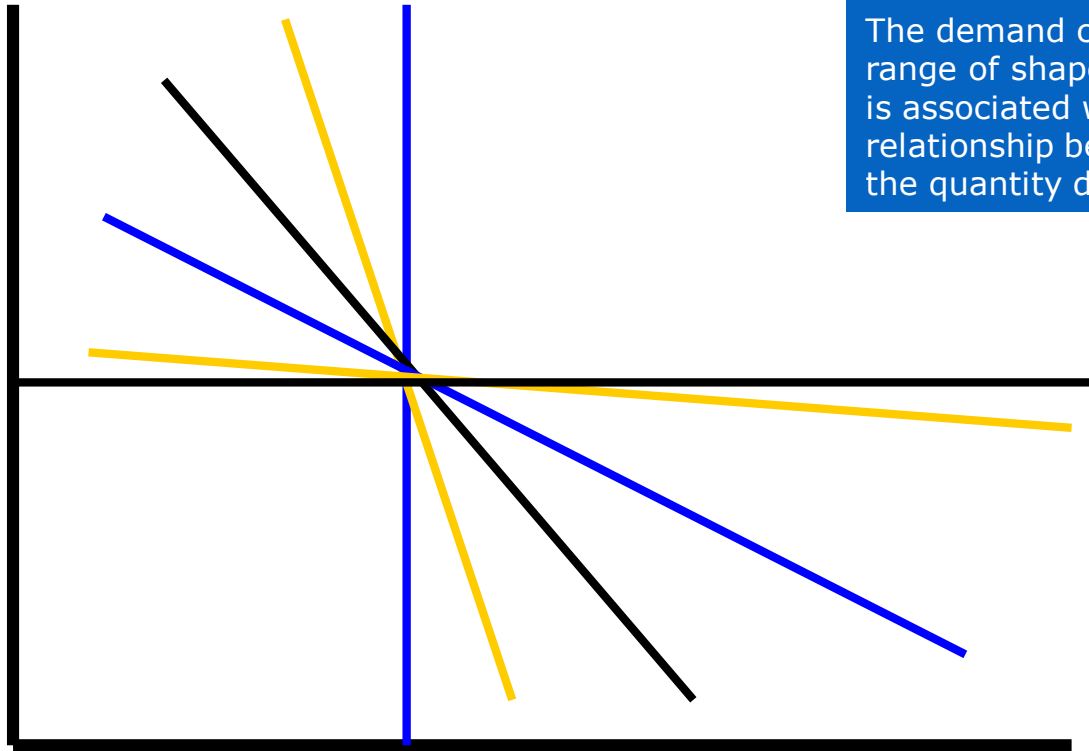
- Inelastic Demand means that quantity doesn't change much with a change in price.

Defining elasticities

- When price elasticity is between zero and -1 we say demand is *inelastic*.
- When price elasticity is between -1 and - infinity, we say demand is *elastic*.
- When price elasticity is -1, we say demand is *unit elastic*.

Elasticity

Price (£)



The demand curve can be a range of shapes each of which is associated with a different relationship between price and the quantity demanded.

Quantity Demanded

Elasticity of demand and Total revenue

- **If demand is price elastic:**
 - Increasing price would **reduce** TR
($\% \Delta Q_d > \% \Delta P$)
 - Reducing price would **increase** TR
($\% \Delta Q_d > \% \Delta P$)
- **If demand is price inelastic:**
 - Increasing price would **increase** TR
($\% \Delta Q_d < \% \Delta P$)
 - Reducing price would **reduce** TR
($\% \Delta Q_d < \% \Delta P$)

Examples of Own Price Demand Elasticities

- When the price of gasoline rises by 1% the quantity demanded falls by 0.2%, so gasoline demand is not very price sensitive.
 - Price elasticity of demand is -0.2
- When the price of gold jewelry rises by 1% the quantity demanded falls by 2.6%, so jewelry demand is very price sensitive.
 - Price elasticity of demand is -2.6

Examples of Unit-free Comparisons

- Gasoline and jewelry
 - It doesn't matter that gas is sold by the gallon for about \$1.09 and gold is sold by the ounce for about \$290.
 - We compare the demand elasticities of **-0.2** (gas) and **-2.6** (gold jewelry).
 - Gold jewelry demand is more price sensitive.

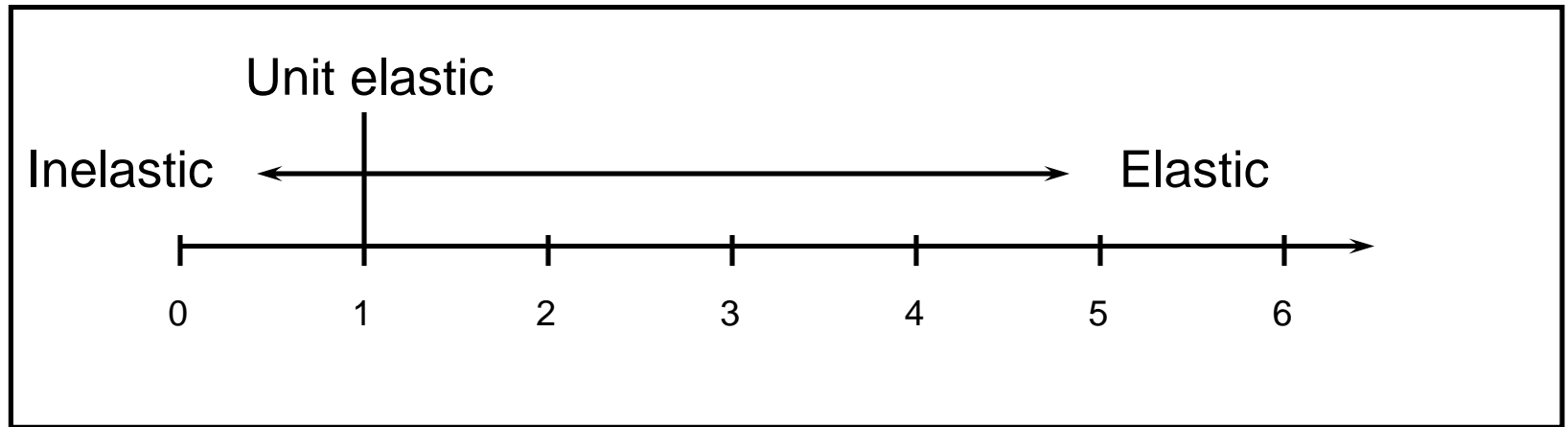
Inelastic Economic Relations

- When an elasticity is small (between 0 and 1 in absolute value), we call the relation that it describes **inelastic**.
 - Inelastic demand means that the quantity demanded is not very sensitive to the price.
 - Inelastic supply means that the quantity supplied is not very sensitive to the price.

Elastic Economic Relations

- When an elasticity is large (greater than 1 in absolute value), we call the relation that it describes **elastic**.
 - Elastic demand means that the quantity demanded is sensitive to the price.
 - Elastic supply means that the quantity supplied is sensitive to the price.

Size of Price Elasticities



- **Unit elastic**: own price elasticity equal to 1
- **Inelastic**: own price elasticity less than 1
- **Elastic**: own price elasticity greater than 1

Income Elasticity of demand

- **Income Elasticity of Demand:**
 - The responsiveness of demand to changes in incomes
 - Percentage change in quantity demanded by percentage change in income.
- **Normal Good** – Demand rises as income rises and vice versa
- **Inferior Good** – demand falls as income rises and vice versa

Income Elasticity of demand

- **Income Elasticity of Demand:**
- A positive sign denotes a normal good
- A negative sign denotes an inferior good

Factors affecting price elasticity of demand

- The Price Elasticity of Demand will vary across goods. The following are the main determinants of E_d :
- Goods with many close substitutes will have higher elasticities: if a good can be easily substituted for another then consumer will be very sensitive to prices. For example if two gas stations are located in the same corner (and the gasoline is roughly the same between the two) then consumers will pay close attention to the price between the two gas stations.

Interpreting income Elasticity of demand

- For example:
- Income ed = - 0.6: Good is an **inferior good** but **inelastic** – a rise in income of 3% would lead to demand falling by 1.8%
- Income ed = + 0.4: Good is a **normal good** but **inelastic** – a rise in incomes of 3% would lead to demand rising by 1.2%
- Income ed = + 1.6: Good is a **normal good** and **elastic** – a rise in incomes of 3% would lead to demand rising by 4.8%
- Income ed = - 2.1: Good is an **inferior good** and **elastic** – a rise in incomes of 3% would lead to a fall in demand of 6.3%

- Luxuries and Necessities: Luxuries will tend to have higher elasticities. Necessities will tend to have lower elasticities.
- In the latter, since the good is a necessity consumer will not be very responsive to price changes, they still have to purchase the good.
- In the case of luxuries since consumers do not really need to buy the good then they will pay attention to the price and therefore will be sensitive to price changes.
- For example, vacations are luxury goods, if the price of a vacation increases most consumer will reduce the number of vacations more than proportionally to the change in price.
- However, if the price of food goes up people will only reduce the amount of food purchased a little bit because without food they will die or get sick.

Determinants of Elasticity

- **Time period** – the longer the time under consideration the more elastic a good is likely to be
- **Number and closeness of substitutes** – the greater the number of substitutes, the more elastic
- **The proportion of income taken up by the product** – the smaller the proportion the more inelastic
- **Luxury or Necessity** - for example, limited edition goods, Medicine

Importance of Elasticity

- Relationship between changes in price and total revenue
- Importance in determining what goods to tax (tax revenue)
- Importance in analysing time lags in production
- Influences the behaviour of a firm

What does the elasticity “measure” really measure?

- The elasticity measure is a **ratio** between two percentage measures: the percentage change in one variable over the percentage change in another variable
- A **price** elasticity of -6.25 means that for each **one percent** change in price the quantity demanded will change by **6.25 percent**.

Income Elasticity of Demand

$$E_I = \% \Delta Q_d / \% \Delta I_d$$

Income elasticity of demand is equal to percentage change in quantity demanded by percentage change in income.

Measures the sensitivity of DEMAND to changes in income.

Luxury Goods

Luxury Goods are Normal Goods but they have an

$$E_I \geq 1$$

Quantity demanded is very sensitive to changes in income

“Necessities”

“Necessities” are Normal Goods but

$$0 < E_I < 1$$

Quantity demand is **not very sensitive** to changes in income

Income Elasticity of Demand

- **Normal Goods ($E_I > 0$)**
 - **Luxury Goods ($E_I \geq 1$)**
 - **Necessitates ($0 < E_I < 1$)**
- **Inferior Goods ($E_I < 0$)**

Cross-Price Elasticity

Measures how sensitive **DEMAND** for a commodity is to changes in the price of a related good, that is with respect to price of its **substitute** or **complement** commodity

The responsiveness of demand of one good to changes in the price of a related good – either a substitute or a complement

$$X_{ed} = \frac{\% \Delta Q_d \text{ of good } X}{\% \Delta \text{ Price of good } y}$$

Cross price elasticity of demand

- Cross price elasticity of demand measures how much the quantity demanded of good X responds to changes in the price of good Y.
- Cross price elasticity of demand is calculated as the percentage change in quantity demanded divided of X by the percentage change in the price of Y.

Cross price elasticity of demand

- **Goods which are complements:**
 - Cross Elasticity will have negative sign (inverse relationship between the two)
- **Goods which are substitutes:**
 - Cross Elasticity will have a positive sign (positive relationship between the two)

Cross-Price Elasticity

$$E_{\text{cp of } x, y} =$$

$$\% \Delta Q_x / \% \Delta P_y$$

Example

The Cross-Price Elasticity of tea and coffee would be calculated as:

$$E_{cp, \text{tea, coffee}} =$$

$$\% \Delta Q_{\text{tea}} / \% \Delta P_{\text{coffee}}$$

Interpretation?

If the

$$E_{cp, \text{tea, coffee}} = + .65$$

Then for every 1% increase in the price of coffee, the Qd of tea would increase .65%. We also would know that tea and coffee are substitutes

Cross-Price Elasticity

$E_{cp} > 0 \Rightarrow$ Substitute

$E_{cp} < 0 \Rightarrow$ Compliment

$E_{cp} = 0 \Rightarrow$ Independent

Slope Compared to Elasticity

- The slope measures the rate of change of one variable (P, say) in terms of another (X, say).
- The elasticity measures the percentage change of one variable (X, say) in terms of another (P, say).

Summing up :

Price elasticity of demand

Price elasticity of demand measures how much the quantity demanded responds to changes in the price.

- Price elasticity of demand is calculated as the percentage change in quantity demanded divided by the percentage change in price.
- If a demand curve is elastic, total revenue falls when the price rises.
- If it is inelastic, total revenue rises as the price rises.

Summing up :

Income & cross price elasticity of demand

The income elasticity of demand measures how much the quantity demanded responds to changes in consumers' income.

- The cross-price elasticity of demand measures how much the quantity demanded of one good responds to the price of another good.