

# **Elasticity of Demand**

# Elasticity of Demand

- The demand and supply analysis helps us to understand the direction in which price and quantity would change in response to shifts in demand or supply.
- What economists would like to know is ‘what will happen to demand when price, income, price of the related goods changes?’
  - How the sensitivity of quantity demanded to a change in price is measured by the elasticity of demand and what factors influence it.
  - How elasticity is measured at a point or over a range.
  - How income elasticity is measured and how it varies with different types of goods.

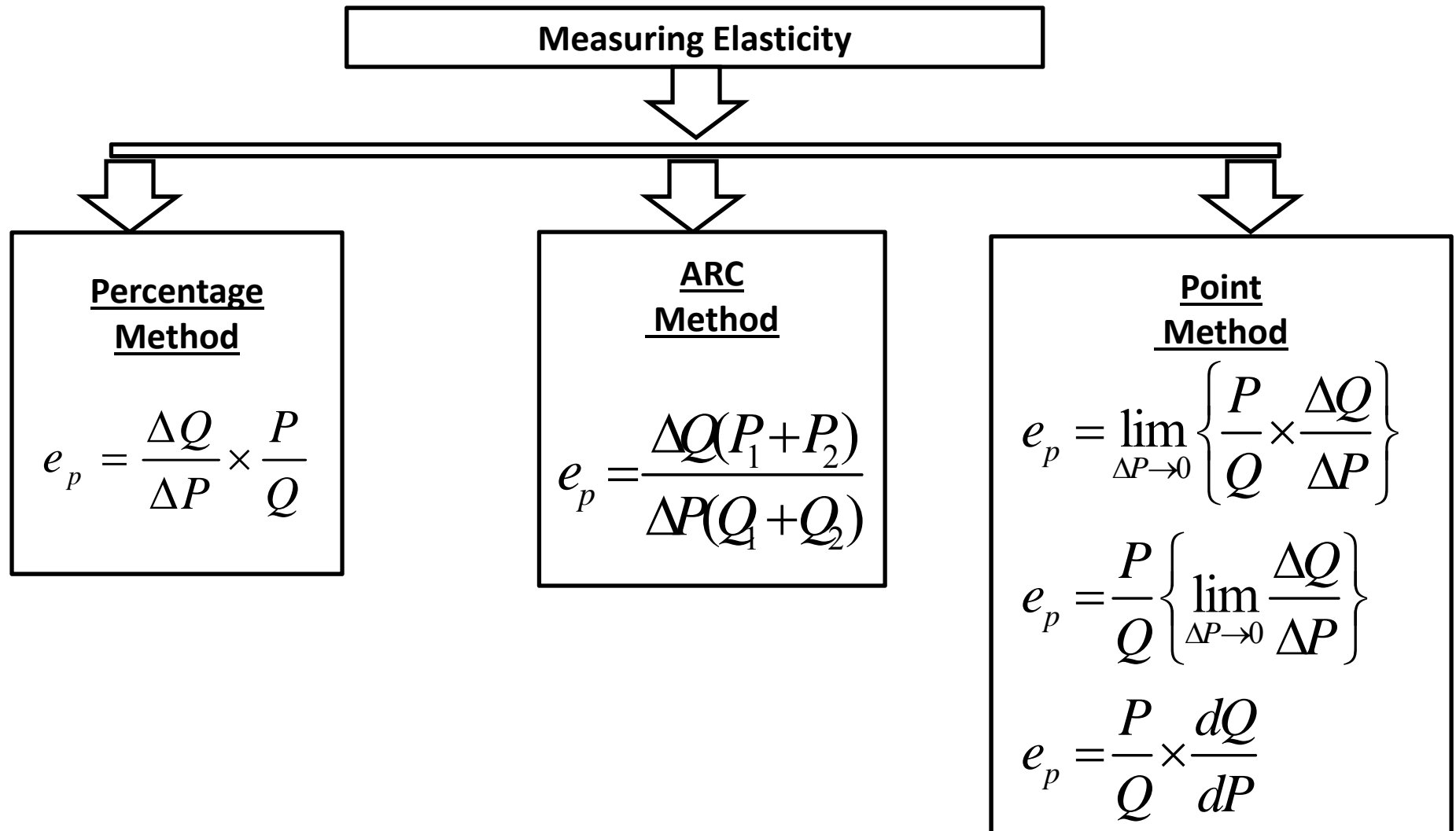
# Defining & Measuring Price Elasticity of Demand

- Demand elasticity is measured by a ratio: the percentage change in quantity demanded divided by the percentage change in price that brought it about.

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

<i>GOOD A</i>	Original	New	% Change	Elasticity
Quantity	100 (Q)	95 (Q <sub>1</sub> )	-5%	-5%/10% = -0.5%
Price	1 (P)	1.10 (P <sub>1</sub> )	10%	

# Measuring Elasticity of Demand



# Measuring Elasticity of Demand

$$e_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$e_p = \frac{1}{\text{Slope}} \times \frac{P}{Q}$$

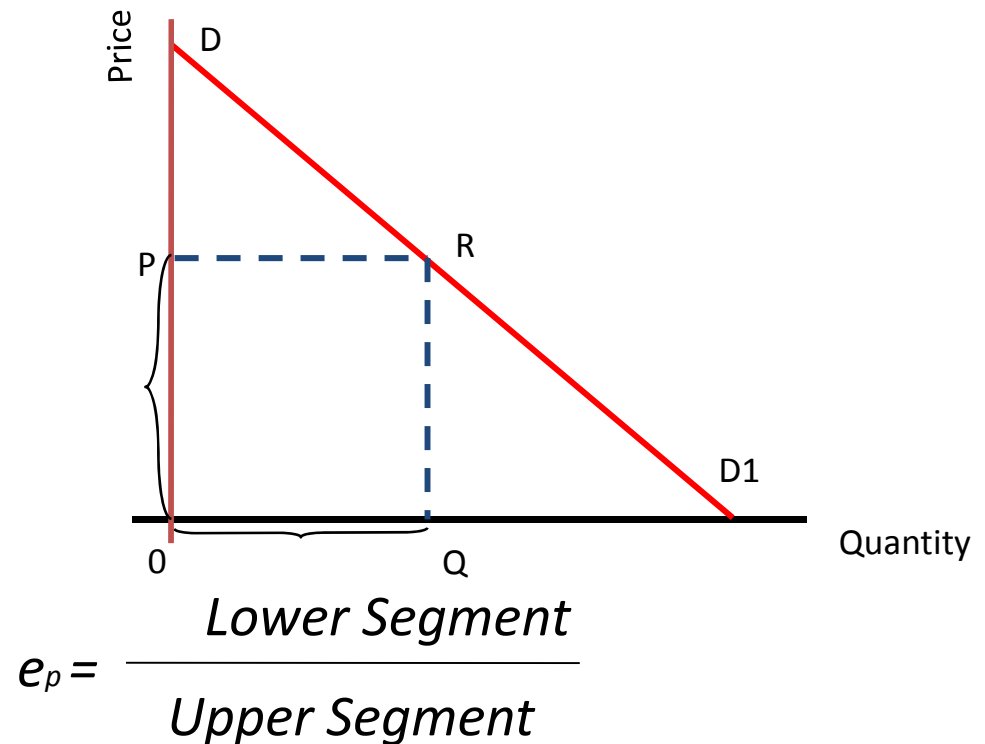
$$e_p = \frac{1}{PD/PR} \times \frac{P}{Q}$$

$$e_p = \frac{PR}{PD} \times \frac{OP}{OQ}$$

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$$e_p = \frac{OQ}{PD} \times \frac{OP}{OQ} \Rightarrow \frac{OP}{PD}$$

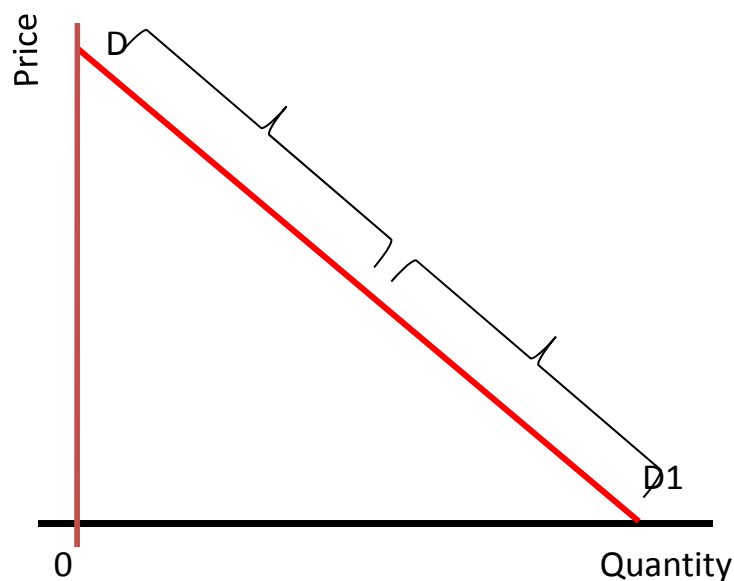
$$e_p = \frac{OP}{PD} = \frac{RD_1}{RD}$$



This ratio is zero where the curve intersects the quantity axis and 'infinity' where it intersects the price axis.

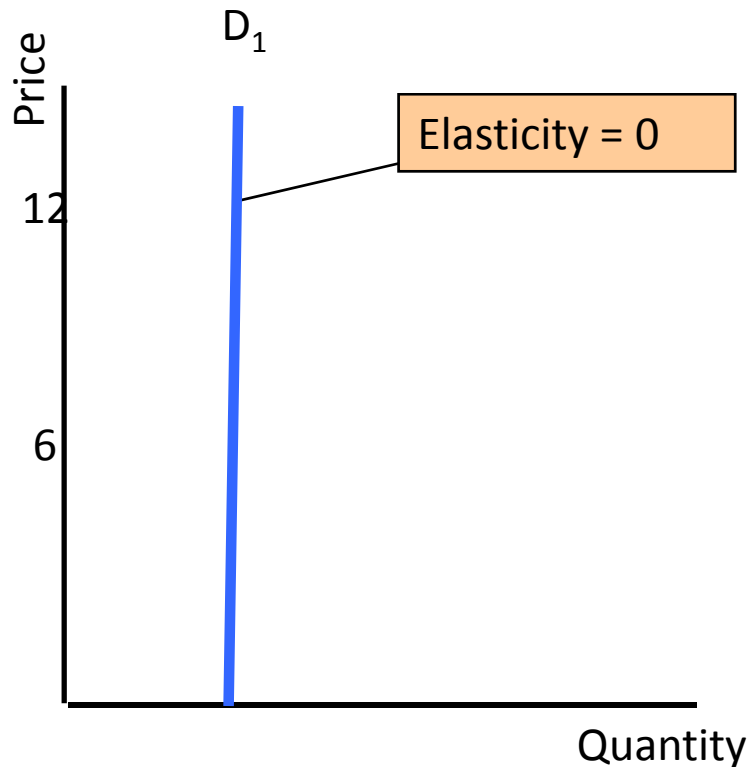
Vertical axis formula **PR** is Parallel to **OD<sub>1</sub>** in **ODD<sub>1</sub>**  $\triangle$

# Elasticity along a Linear Demand Curve



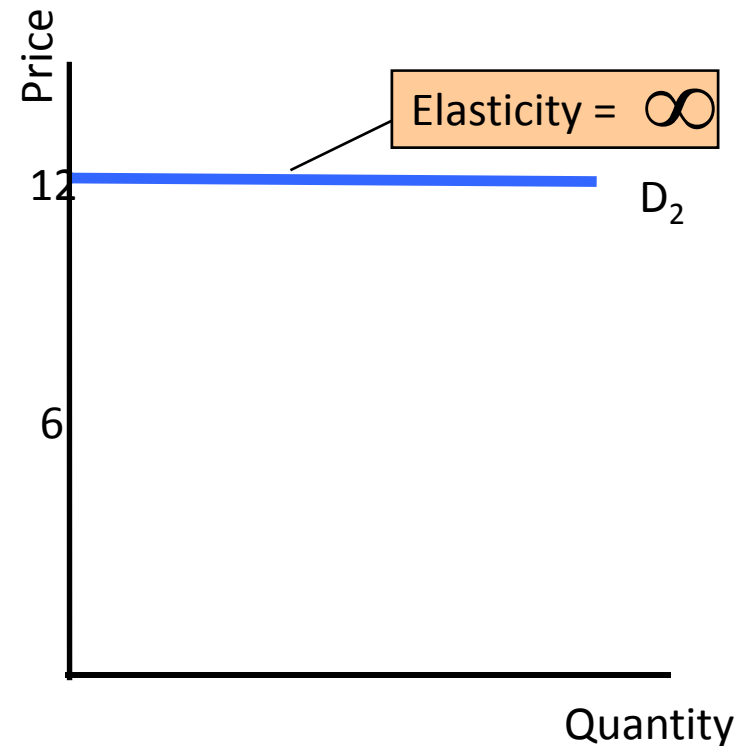
- Perfectly inelastic (Elasticity=0)
- Inelastic ( $0 < \text{Elasticity} < 1$ )
- Unit elastic (Elasticity=1)
- Elastic ( $1 < \text{Elasticity} < \infty$ )
- Perfectly elastic (Elasticity=  $\infty$ )

# Elastic and Inelastic



## Perfectly Inelastic

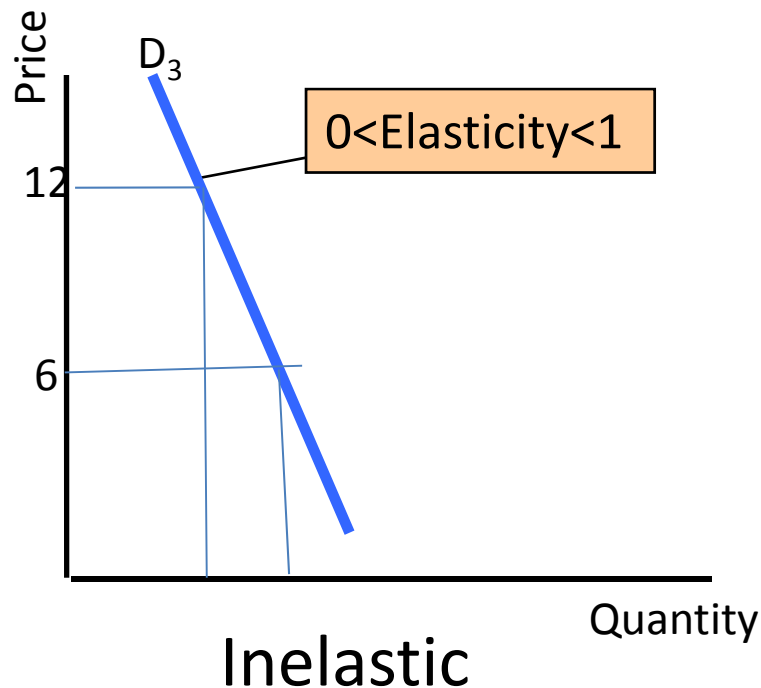
- Implies that quantity demanded remains constant when price changes occur.
- Price elasticity of demand = 0



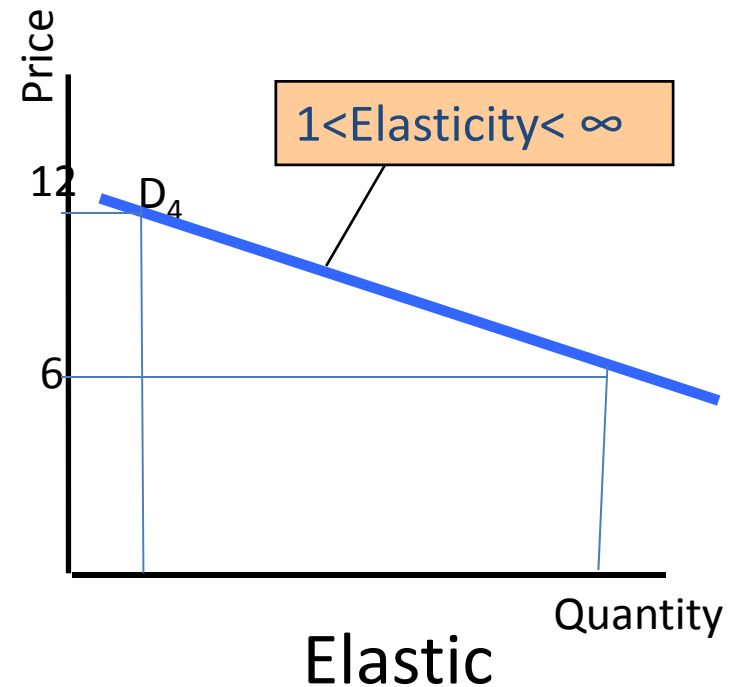
## Perfectly Elastic

- Implies that if price changes by any percentage quantity demanded will fall to 0.
- Price elasticity of demand =  $\infty$

# Elastic and Inelastic



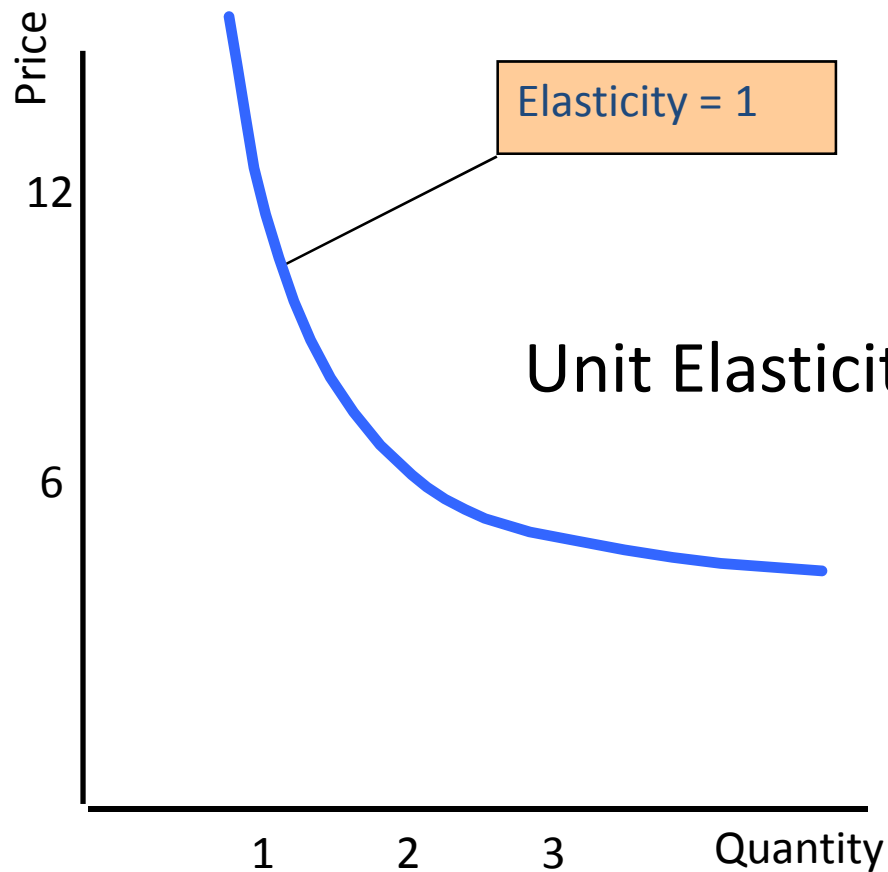
- Implies the percentage change in quantity demanded is less than the percentage change in price.
- Price elasticity of demand  $> 0$  and  $< 1$



- Implies the percentage change in quantity demanded is greater than the percentage change in price.
- Price elasticity of demand  $> 1$  and  $< \infty$



# Elastic and Inelastic



- Implies that the percentage change in quantity demanded equals the percentage change in price.
- Price elasticity of demand = 1

# The Factors that Influence the Elasticity of Demand

- Nature of the Goods
  - Essential goods are highly inelastic
  - Luxury goods are highly elastic
- Availability of Substitutes
  - Higher the number of substitutes greater is the elasticity
- Number of uses of a good
  - The demand for multi-used goods is more elastic
- Distribution of Income
  - Demand for products is inelastic by the high income group
- Level of Prices
  - Demand for high and low priced goods is inelastic
- Proportion of Total Expenditure
- Time factor
  - Longer the time period higher the elasticity
- Complementary goods

# Some Real-World Price Elasticities of Demand

Good or Service	Elasticity
<b>Elastic Demand</b>	
Metals	1.52
Electrical engineering products	1.30
Mechanical engineering products	1.30
Furniture	1.26
Motor vehicles	1.14
Instrument engineering products	1.10
Professional services	1.09
Transportation services	1.03
<b>Inelastic Demand</b>	
Gas, electricity, and water	0.92
Oil	0.91
Chemicals	0.89
Beverages (all types)	0.78
Clothing	0.64
Tobacco	0.61
Banking and insurance services	0.56
Housing services	0.55
Agricultural and fish products	0.42
Books, magazines, and newspapers	0.34
Food	0.12

# Significance of Elasticity of Demand

- Useful for Business
  - Fixation of Prices
- Significant for Government Economic Policies
  - Controlling business cycles, removing inflationary and deflationary gaps, price stabilization
  - Goods with inelastic demand are taxed more
  - Fixation of wages
  - Incidence of taxes
- International Trade
  - Import commodities with more elastic demand, Export commodities with less elastic demand
- Market forms and Determination of Price of Public Utilities
- Paradox of Poverty and Effects on Employment

# Elasticity and Total Revenue

- Total revenue = Price x Quantity
- Marginal Revenue =  $\Delta TR / \Delta Q$
- Price elasticity of demand:  $e_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$
- What happens to total revenue if the price rises?

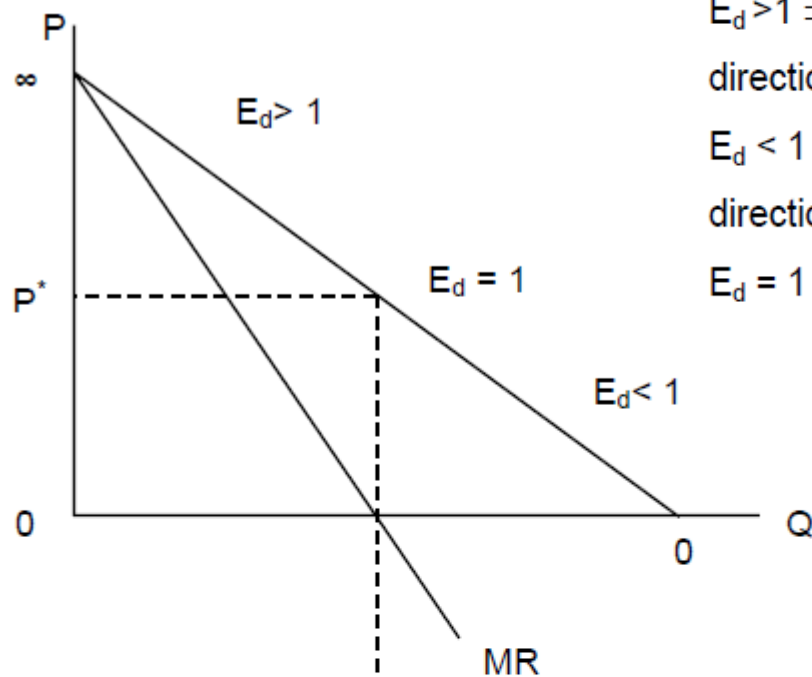
# Elasticity and Total Revenue

P	Q	TR	MR	$E_d$
10	1	10	---	--
9	2	18	8	6.33
8	3	24	6	3.40
7	4	28	4	2.14
6	5	30	2	1.44
5	6	30	0	1.00
4	7	28	-2	0.69
3	8	24	-4	0.47
2	9	18	-6	0.29
1	10	10	-8	0.16

$E_d > 1$  (elastic demand)

$E_d = 1$  (unitary elastic), TR is  
max and MR is zero

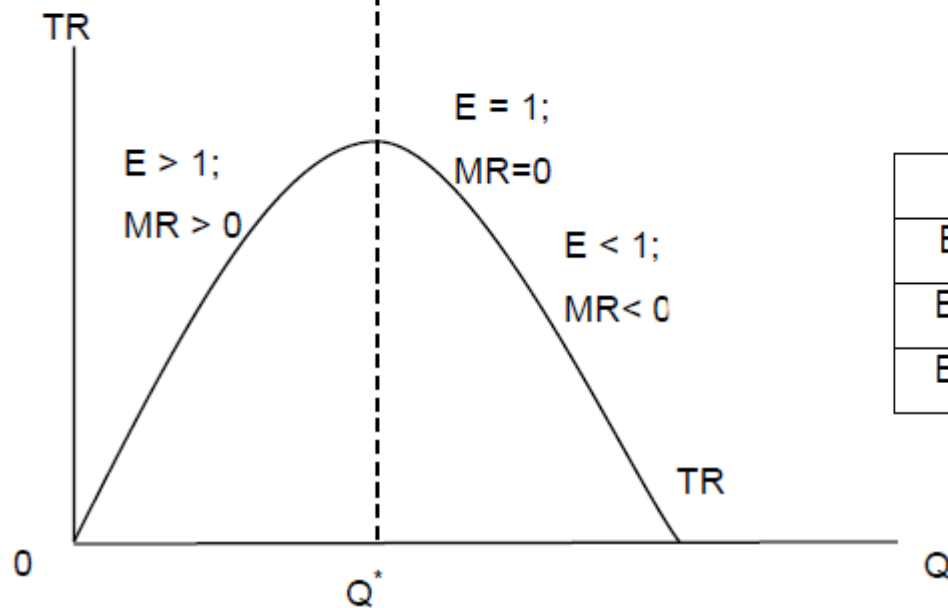
$E_d < 1$  (inelastic demand)



$E_d > 1 \Rightarrow$  Demand elastic  $\Rightarrow MR > 0 \Rightarrow P$  and TR move in the opposite direction (negative relationship)

$E_d < 1 \Rightarrow$  Demand inelastic  $\Rightarrow MR < 0 \Rightarrow P$  and TR move in the same direction (positive relationship)

$E_d = 1 \Rightarrow$  Demand unit elastic  $\Rightarrow MR = 0 \Rightarrow TR$  is maximum



$E_d$	Demand	MR	P	TR
$E_d > 1$	Elastic	$MR > 0$	$\uparrow$	$\downarrow$
$E_d < 1$	Inelastic	$MR < 0$	$\uparrow$	$\uparrow$
$E_d = 1$	Unit elastic	$MR = 0$	-	Max.

# Elasticity and Marginal Revenue

$$TR = P.Q$$

$$MR = \frac{d(P.Q)}{dQ}$$

$$MR = P + Q \cdot \frac{dP}{dQ} = P \left[ 1 + \frac{dP}{dQ} * \frac{Q}{P} \right] = P \left[ 1 + \frac{1}{Ep} \right]$$



# Defining & Measuring Income Elasticity of Demand

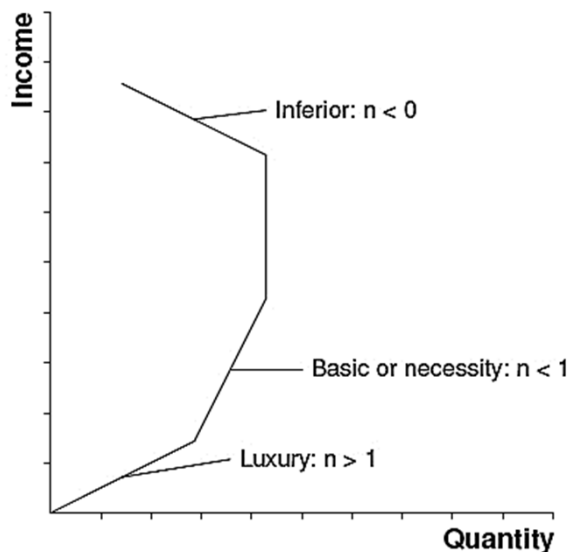
The responsiveness of demand for a product to changes in income is termed **income elasticity of demand**, and is defined as

$$\text{Income elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in Income}}$$

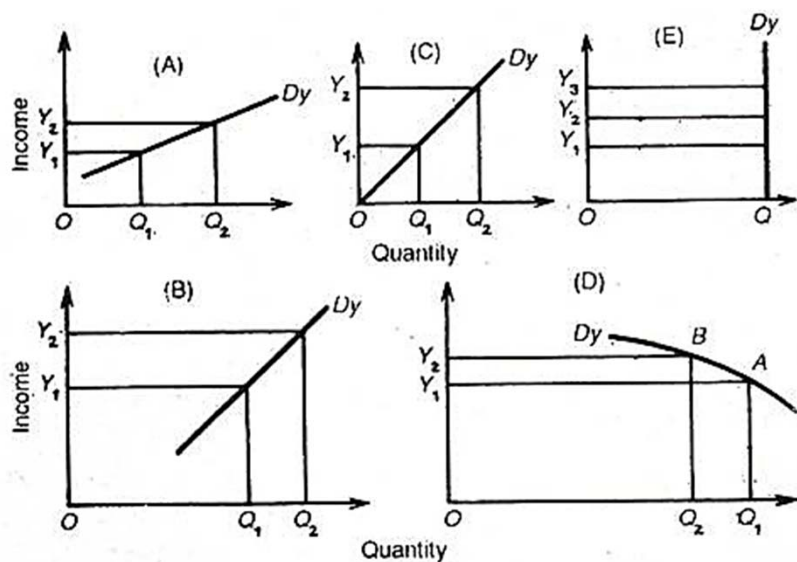
$$e_i = \frac{\Delta Q}{\Delta I} \times \frac{I}{Q} \quad \text{or} \quad e_i = \frac{I}{Q} \times \frac{dQ}{dI}$$

- A good is a **normal good** if income elasticity  $> 0$ .
- A good is an **inferior good** if income elasticity  $< 0$ .
- A good is a **luxury good** if income elasticity  $> 1$ .
- A good is a **necessity good** if income elasticity  $< 1$  and  $< 0$ .

# Defining & Measuring Income Elasticity of Demand



Normal Good			
↑	An increase in income...	↑	increases demand.
↓	A decrease in income...	↓	decreases demand.
Inferior Good			
↑	An increase in income...	↓	decreases demand.
↓	A decrease in income...	↑	increases demand.



Normal Luxury	Normal Necessity	Inferior Good
International air travel	Fresh vegetables	Frozen vegetables
Fine wines	Instant coffee	Cigarettes
Luxury chocolates	Natural cheese	Processed cheese
Private education	Fruit juice	Margarine
Private health care	Spending on utilities	Tinned meat
Antique furniture	Shampoo / toothpaste / detergents	Value "own-brand" bread
Designer clothes	Rail travel	Bus travel

# Defining & Measuring Cross Elasticity of Demand

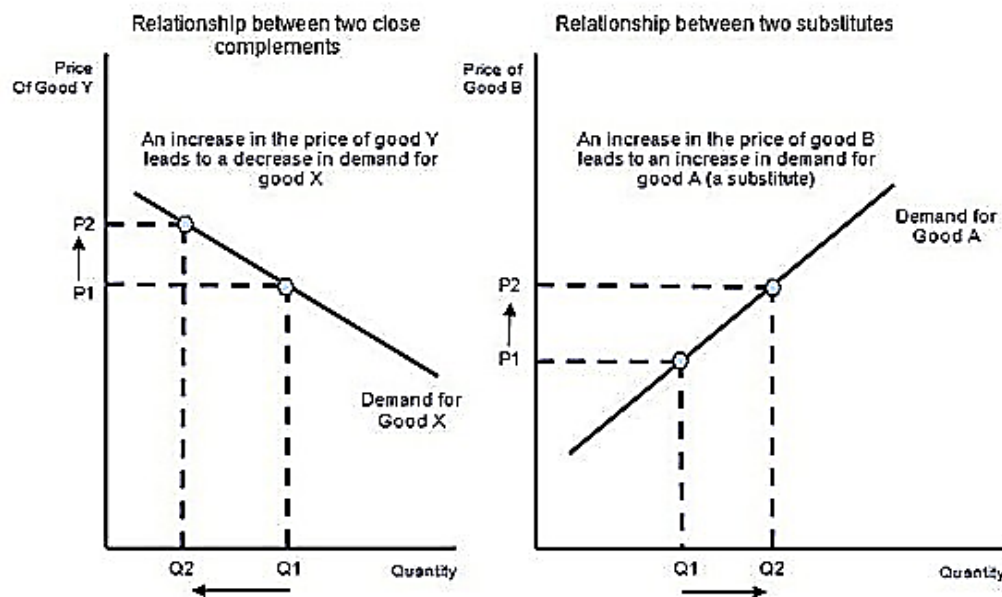
The responsiveness of **quantity demanded of one product** to changes in the **prices of other products** is often of considerable interest.

$$\text{Cross elasticity of demand} = \frac{\text{Percentage change in quantity demanded of } X}{\text{Percentage change in Price of } Y}$$

$$e_{xy} = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{Q_x} \quad \text{or} \quad e_{xy} = \frac{P_y}{Q_x} \times \frac{dQ_x}{dP_y}$$

- Products are **substitute** if cross **elasticity**  $> 0$ .
- Products are **complimentary** if cross **elasticity**  $< 0$ .

# Defining & Measuring Cross Elasticity of Demand

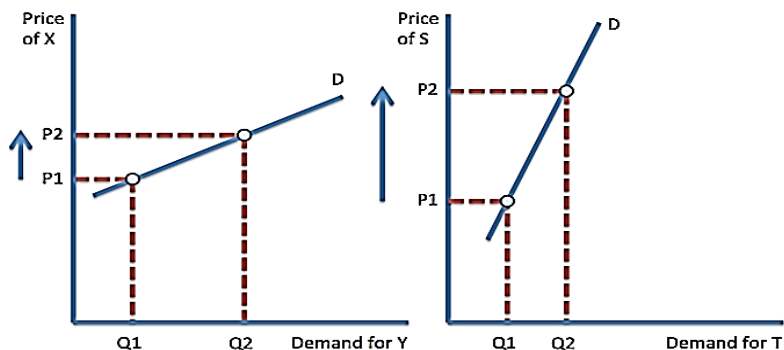


Substitutes	
↑ An increase in $P_B$ ...	↑ increases demand for good A.
↓ A decrease in $P_B$ ...	↓ decreases demand for good A.
Complements	
↑ An increase in $P_B$ ...	↓ decreases demand for good A.
↓ A decrease in $P_B$ ...	↑ increases demand for good A.

## Cross Price Elasticity of Demand - Substitutes

**Close substitutes** – small rise in price of X causes large rise in demand for Y

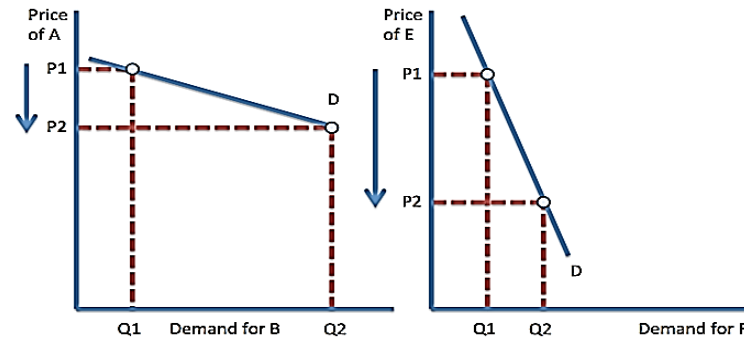
**Weak substitutes** – large rise in price of S leads to small increase in demand for T



## Cross Price Elasticity of Demand - Complements

**Close complements:** A small fall in price of A causes a large rise in demand for B

**Weak complements:** A large drop in price of E causes only small rise in demand for F



# **Summary**

## **Price Elasticity of demand**

Perfectly inelastic, Inelastic , Unit elastic,  
Elastic , Perfectly elastic

## **Income Elasticity of demand**

Normal , Inferior, Luxury, Necessity

## **Cross Elasticity of demand**

Substitute , Complimentary

# Examples

**Q1.** Find the elasticity if the demand function is

**$Q = 25 - 4P + P^2$**  where Q is the demand for commodity at price P. Find out elasticity at (i)  $P = 4$ , (ii)  $P = 8$ , (iii)  $P = 5$

Ans: (i)  $P = 4$ ,  $ep = 0.64$  (inelastic)

(ii)  $P = 8$ ,  $ep = 1.7$  (elastic)

(iii)  $P = 5$   $ep = 1$  (unitarily elastic)

**Q2.** The demand function is given  **$X = 10 - P$**  at  $X = 4$ ,  $P = 6$ .

If the price increased by 5% determine the percentage decrease in demand and hence an approximation to the elasticity of demand.

Ans: Decrease in demand is 7.5% and elasticity is 1.5

# Examples

**Q3.** If the current demand for economics books is 10,000 per year for a publishing house. The elasticity of demand is 0.75. The price increased by Rs 50 per book, calculate the change in the quantity of books demanded where price is Rs 150.

Ans:  $\Delta Q = 2500$

**Q4.** Suppose demand for cars in a city as a function of income is given by the following equations.  $Q = 20,000 + 5M$ , where  $Q$  is quantity demanded and  $M$  is Per capita income. Find out income elasticity of demand when per capita annual income is Rs 15,000.

Ans:  $e_i = 0.8$  (Normal)

**Q5.** Suppose the following demand function for coffee in terms of price of tea is given  $Q_c = 100 + 2.5P_t$ . Find out the cross elasticity of demand when price of tea rises from Rs 50 per 250gm pack to Rs 55 per 250gm pack.

Ans:  $e_{ct} = 0.51$  (Substitute)