

Elasticity of Demand



Sugyanta Priyadarshini
KSOH, KIIT



Contents of Chapter

- PRICE ELASTICITY OF DEMAND
- TYPES OF PRICE ELASTICITY DEMAND
- INCOME ELASTICITY OF DEMAND
- CROSS ELASTICITY OF DEMAND
- GEOMETRICAL METHOD OF ELASTICITY
- MID POINT METHOD OF ELASTICITY
- TOTAL EXPENDITURE METHOD
- FACTORS AFFECTING ELASTICITY OF DEMAND
- NUMERICALS

Types of Elasticity of Demand

```
graph TD; A[Types of Elasticity of Demand] --> B[Price Elasticity of Demand]; A --> C[Income Elasticity of Demand]; A --> D[Cross Elasticity of Demand]; A --> E[Advertising Elasticity of Demand];
```

**Price
Elasticity of
Demand**

**Income
Elasticity of
Demand**

**Cross
Elasticity of
Demand**

**Advertising
Elasticity of
Demand**

Price elasticity of demand is an economic measure of the change in the quantity demanded or purchased of a product in relation to its price change. Expressed mathematically, it is:

- Formula for **price elasticity of demand**

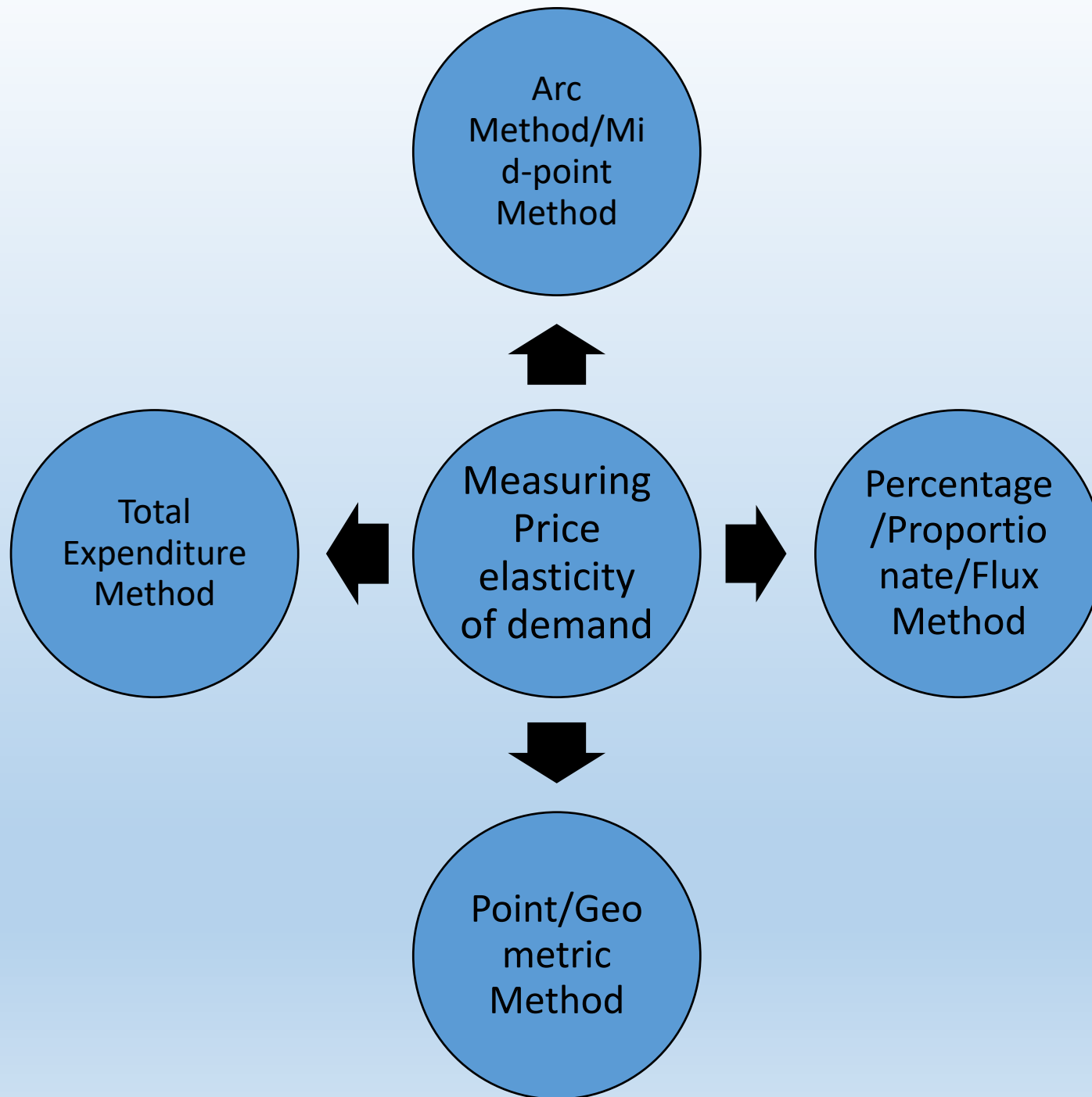
$$E_d = \frac{\text{percentage change in quantity demanded of product X}}{\text{percentage change in price of product X}}$$

$$\text{Price Elasticity of Demand} = \frac{\frac{Q_1 - Q_0}{Q_0}}{\frac{P_1 - P_0}{P_0}}$$

Q1 – Final quantity
Q0- Initial Quantity
P1- Final Price
P0- Initial Price

price elasticity of demand

$$\epsilon = \frac{\% \Delta Q}{\% \Delta P} = - \frac{\Delta Q / Q}{\Delta P / P} = \left| - \frac{\Delta Q}{\Delta P} \frac{P}{Q} \right|$$



QUESTION 1

When price of a good is 12 per unit, the consumer buys 24 units of that good. When price rises to 14 per unit, the consumer buys 20 units. Calculate Price Elasticity of Demand.

Ans.

Given, $P = ₹ 12$; $P_1 = ₹ 14$; $\Delta P = P_1 - P = 14 - 12 = ₹ 2$

$Q = 24$ units; $Q_1 = 20$ units

$\Delta Q = Q_1 - Q = 20 - 24 = (-) 4$ units

$$E_d = (-) \frac{P}{Q} \times \frac{\Delta Q}{\Delta P} = (-) \frac{12}{24} \times \frac{-4}{2} = 1$$

\therefore Price Elasticity of Demand $E_d = 1$

QUESTION 2

A 5% fall in price of a good leads to 10% rise in its demand. A consumer buys 40 units of a good at a price of 10 per unit. How many units will he buy at a price of 12 per unit? Calculate.

Ans.

$$E_d = \frac{\text{Percentage Change in Quantity Demanded}}{\text{Percentage Change in Price}} = \frac{10}{5} = 2$$

Here, $P = ₹ 10$ per unit; $P_1 = ₹ 12$ per unit; $\Delta P = P_1 - P = 12 - 10 = ₹ 2$ per unit

$Q = 40$ units; $Q_1 = ?$; $\Delta Q = Q - 40$

$$E_d = (-) \frac{P}{Q} \times \frac{\Delta Q}{\Delta P}$$

$$2 = \frac{10}{40} \times \frac{Q_1 - 40}{2}$$

$$16 = -Q_1 + 40$$

$$Q_1 = 40 - 16$$

$$Q_1 = 24 \text{ units}$$

\therefore He will buy 24 units.

QUESTION 3

A 5% rise in price of a good leads to 5% fall in its demand. A consumer buys 100 units of a good when price is 5 per unit. At what price will he buy 120 units? Calculate.

Ans.

$$E_d = \frac{\% \text{ Change in Quantity Demanded}}{\% \text{ Change in Price}} = \frac{5}{5} = 1$$

Here,

$$P = ₹ 5 \text{ per unit; } P_1 = x; \Delta P = P_1 - P = x - 5$$

$$Q = 100 \text{ units; } Q_1 = 120 \text{ units}$$

$$\Delta Q = Q_1 - Q = 120 - 100 = 20 \text{ units}$$

$$E_d = (-) \frac{P}{Q} \times \frac{\Delta Q}{\Delta P}$$

$$E_d = - \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$1 = - \frac{5}{100} \times \frac{20}{x - 5}$$

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

$$x - 5 = -1$$

$$x = -1 + 5$$

$$x = 4$$

∴ He will buy 120 units at a price of ₹ 4 per unit.

QUESTION 4

Price Elasticity of Demand of a good is $(-)$ 2. The consumer buys a certain quantity of this good at a price of Rs 8 per unit. When the price falls he buys 50% more quantity. What is the new price?

Ans.

Given, $E_d = (-) 2$, $P = ₹ 8$, $P_1 = ?$.

Change in quantity = 50%.

$$E_d = \frac{\text{Percentage Change in Demand}}{\text{Percentage Change in Price}}$$

$$(-) 2 = \frac{50\%}{\text{Percentage change in price}}$$

$$\text{percentage change in price} = \frac{50}{2}$$

Percentage change in price = 25%

So,

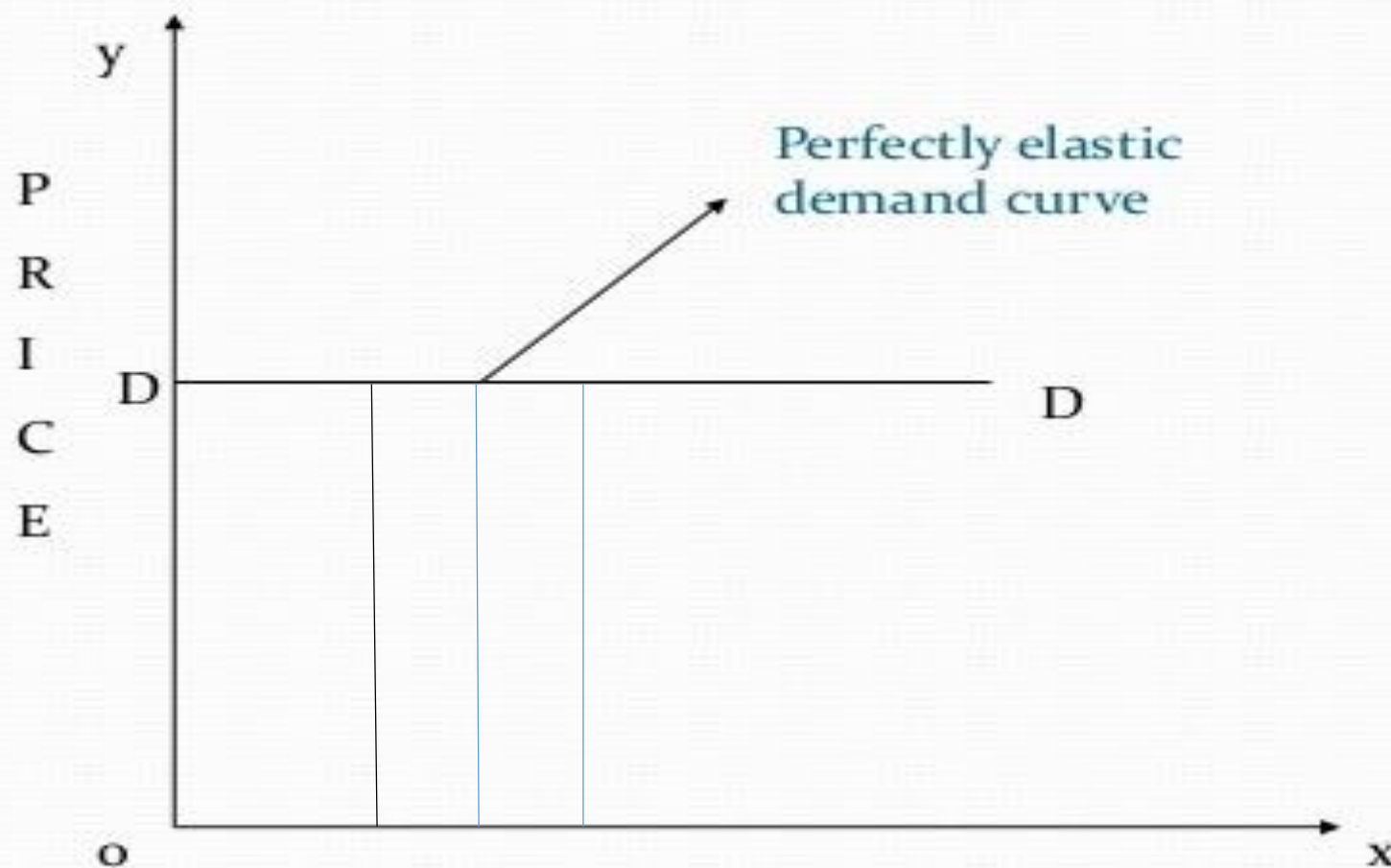
$$\begin{aligned} P_1 &= P - 25\% \text{ of } P \\ &= 8 - 8 \times \frac{25}{100} \quad \text{or} \quad 8 - 2 \\ &= ₹ 6 \text{ per unit} \end{aligned}$$

Types of Price Elasticity of Demand

- Perfectly elastic demand
- Perfectly inelastic demand
- Relatively elastic demand
- Relatively inelastic demand
- Unitary elastic demand

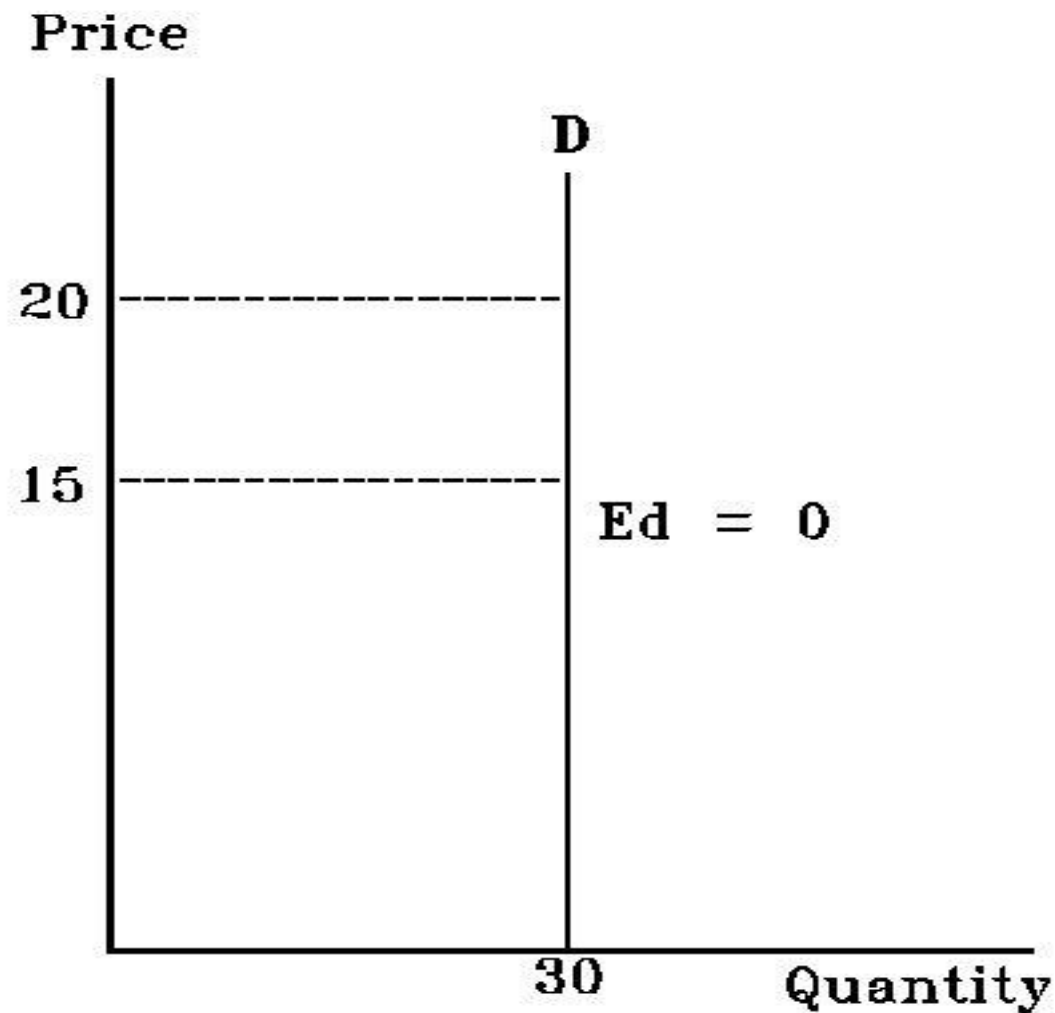
Perfectly elastic demand

$$E_d = \infty$$



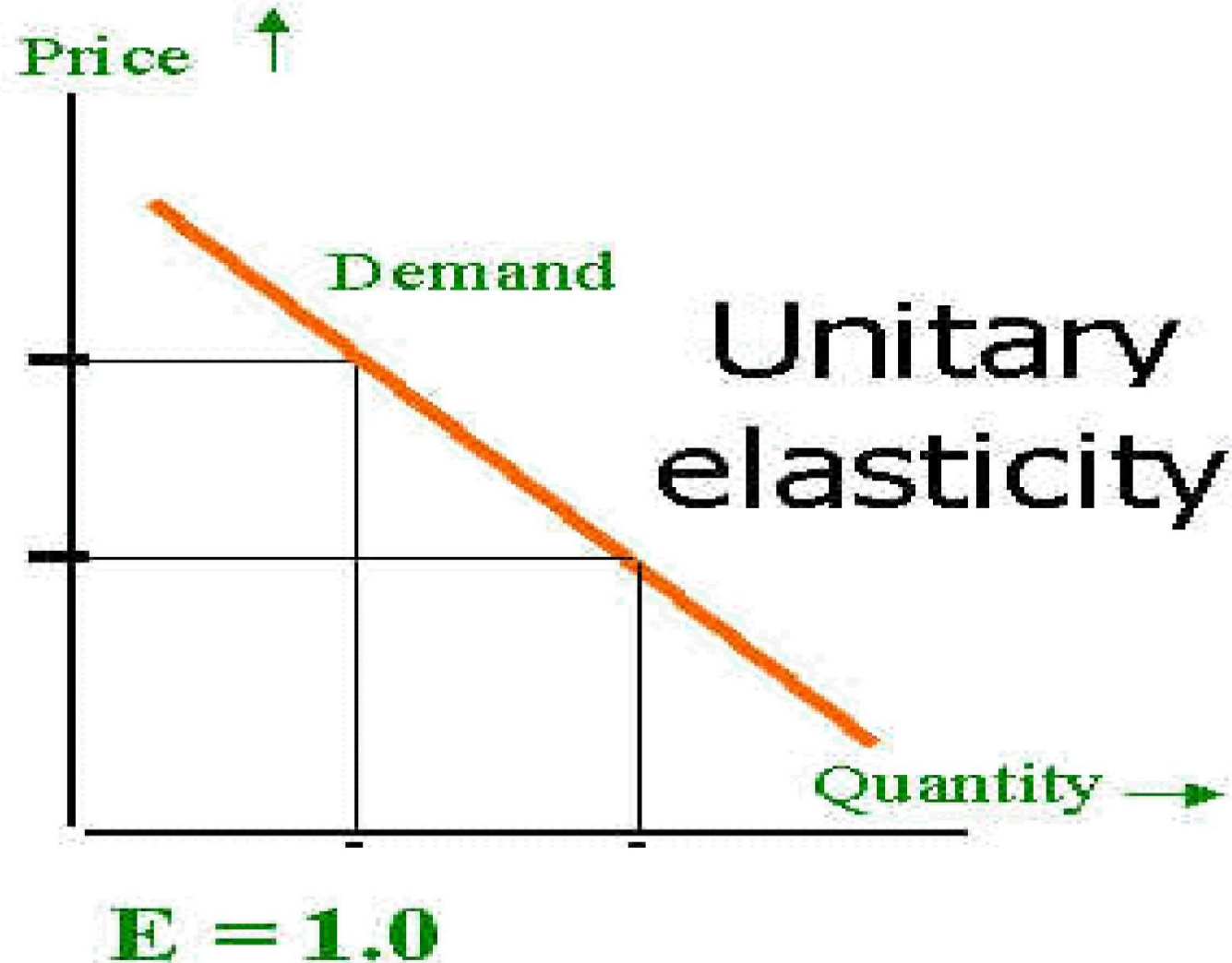
When the demand for a product changes –increases or decreases even when there is no change in price, it is known as **perfectly elastic demand**.

Figure 7: Perfectly inelastic demand



- If demand is perfectly inelastic a change in price causes no change in quantity demanded.
- Buyers are completely insensitive to price changes because they cannot do without the product:
- **Examples of goods that could have a perfectly elastic demand are:**
- Medicine when a person's life is in danger like insulin for a diabetic.

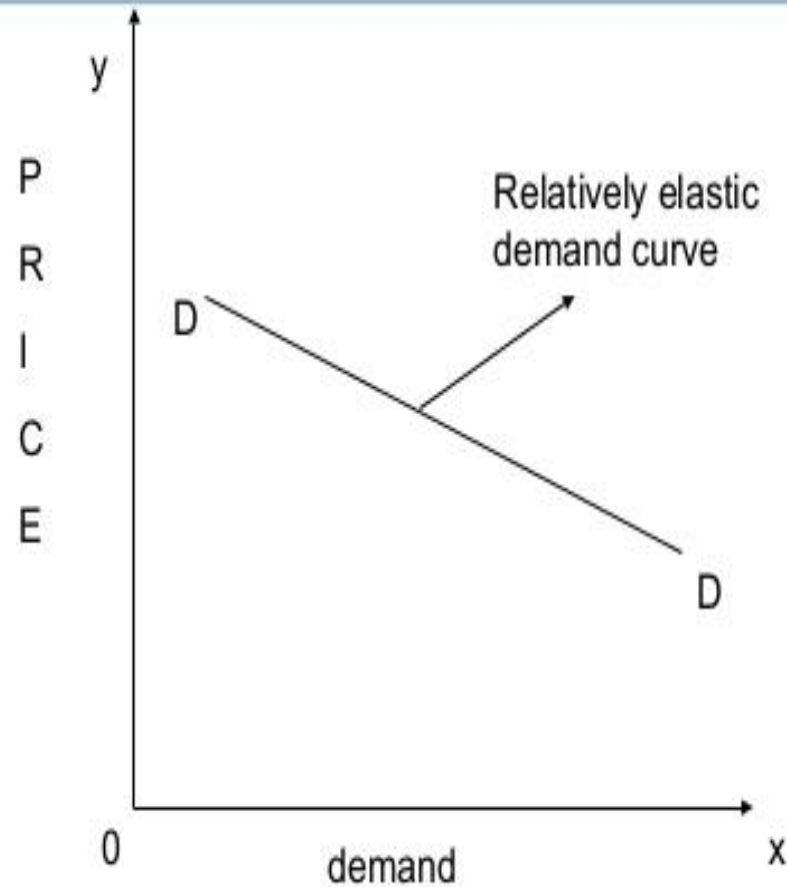
UNITARY ELASTIC



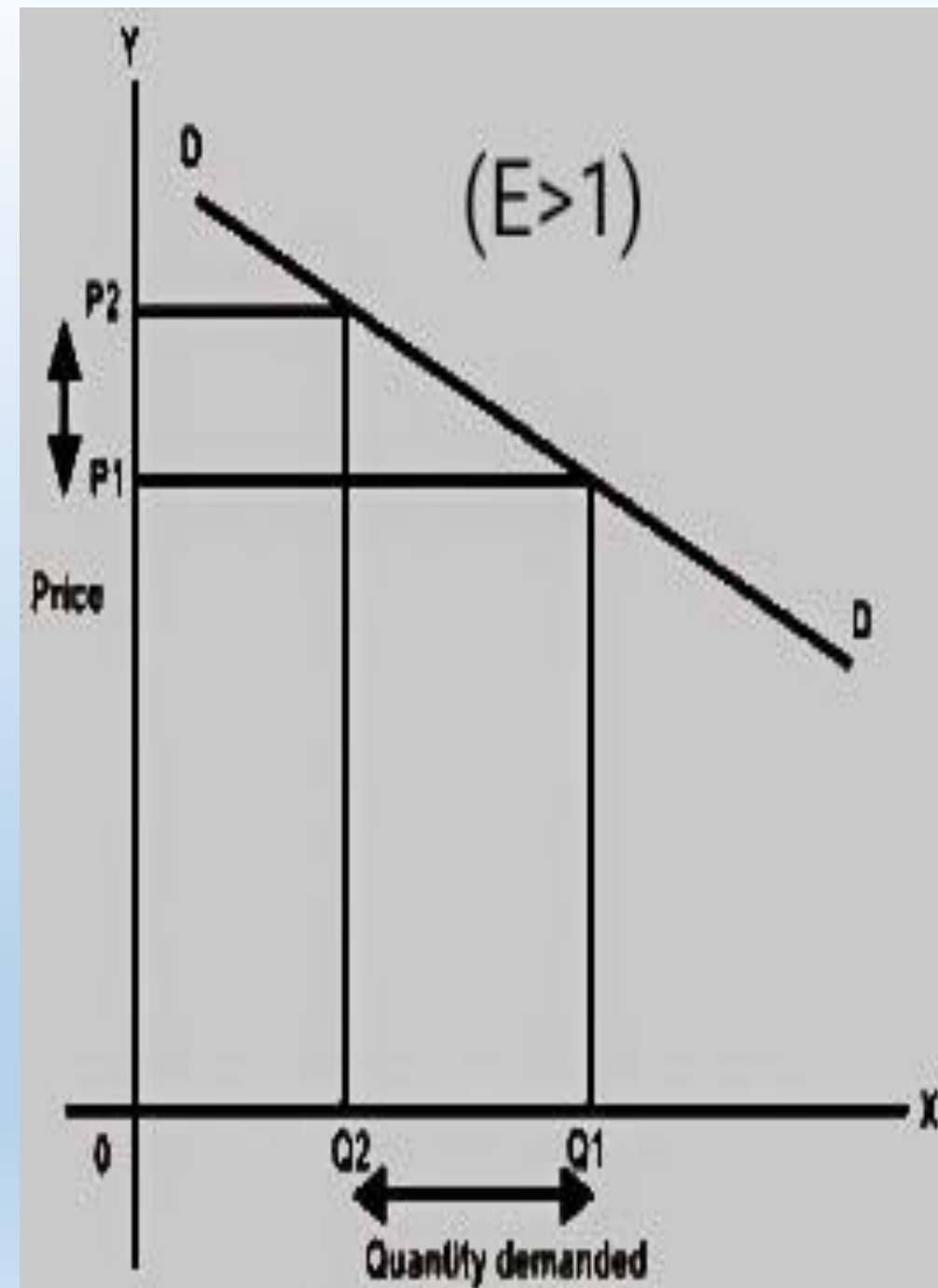
When the proportion of change in demand is exactly the same as the change in price, the demand is said to be UNITARY ELASTIC

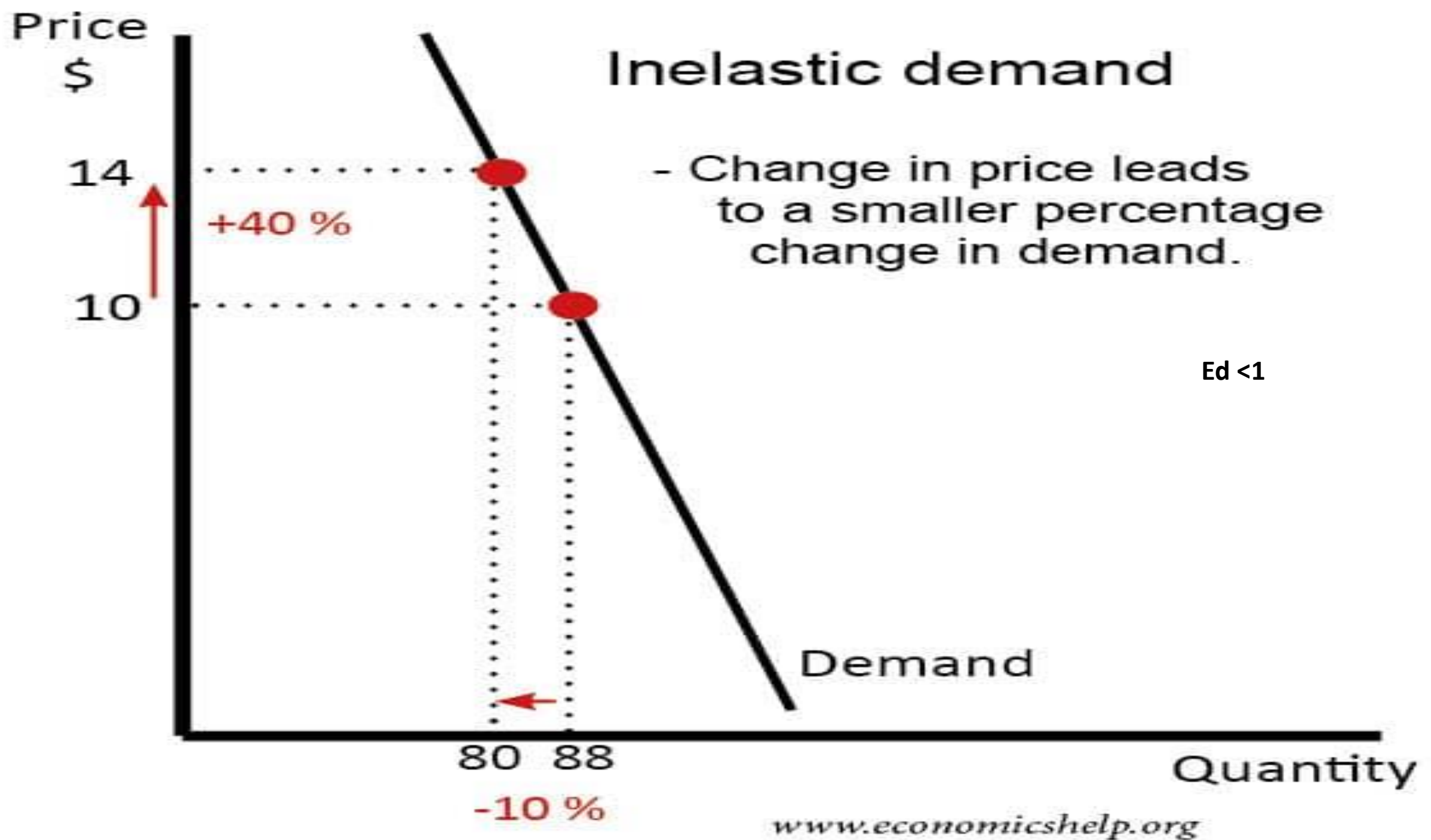
$$e = 1$$

Relatively elastic demand



When the proportionate change in demand is more than the proportionate changes in price, it is known as relatively elastic demand.





Income Elasticity of Demand Formula

$$\text{Income Elasticity of Demand} = \frac{\text{Percentage Change in Quantity Demand } (\Delta D/D)}{\text{Percentage Change in Income } (\Delta I/I)}$$

$$\begin{aligned} E_y &= \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}} \\ &= \frac{\frac{\text{change in quantity demanded}}{\text{initial quantity demanded}} \times 100\%}{\frac{\text{change in income}}{\text{initial income}} \times 100\%} \\ &= \frac{\frac{Q_2 - Q_1}{Q_1}}{\frac{Y_2 - Y_1}{Y_1}} \\ &= \left| \frac{\Delta Q}{\Delta Y} \times \frac{Y_1}{Q_1} \right| \end{aligned}$$

QUESTION 5

If a consumer's demand for a commodity increases from 100 units/week to 200 units/week when his income rises from 2000 to 3000 Rs. Find income elasticity of demand.

$$Q_0 = 100$$

$$Q_1 = 200$$

$$\Delta Q = 100$$

$$Y_0 = 2000$$

$$Y_1 = 3000$$

$$\Delta Y = 1000$$

$$\begin{aligned} E_Y &= \Delta Q / \Delta Y * Y_0 / Q_0 \\ &= 100 / 1000 * 2000 / 100 \\ &= 2 \end{aligned}$$

Cross-Price Elasticity

- While studying demand determinants, we learned that two goods can be related.
- Recall the intuition of substitute and complement goods.
- Cross-price elasticity
 - Measures the responsiveness of the quantity demanded of one good to a change in the price of *another* good

$$E_c = \frac{\% \Delta Q_d(A)}{\% \Delta P(B)}$$

Cross Price Elasticity

- Two goods are **substitutes** if an increase (decrease) in the price of Good 1 results in an increase (decrease) in the quantity demanded of Good 2, holding other factors constant, such as the price of Good 2, other prices, income, and so on, or vice versa-(pepsi/coke)
- Similarly, two goods are **complements** if an increase in the price of Good 1 results in a decrease in the quantity demanded of Good 2. An increase in the price of DVD players would have the effect of decreasing the demand for DVDs, *ceteris paribus*. (petrol/cars, shoes/socks)

$$E_D = \left| \frac{\Delta Q_{D_A}}{\Delta P_B} \frac{P_B}{Q_{D_A}} \right|$$

Where ΔQ_{D_A} = change in quantity demanded of Good A
 ΔP_B = change in price of Good B

Substitutes have a positive cross price elasticity: Butter & Margarine (+0.81)

Complements have a negative cross price elasticity: VCR machines and the rental price of tapes, computer hardware and software (-0.5)

When the cross price elasticity is zero or insignificant, the products are **not related**.

$$e_{xy} = \frac{\frac{\text{Absolute change in quantity demanded of goods X}}{\text{Initial quantity demanded of goods X}}}{\frac{\text{Absolute change in price of goods Y}}{\text{Initial price of goods Y}}}$$

Symbolically,

$$e_{xy} = \left| \frac{\frac{\Delta Q_x}{Q_x}}{\frac{\Delta P_y}{P_y}} \right|$$

QUESTION 6

The price of X increases from Rs 50/kg to Rs 70/kg and as a result, the demand for Y increases from 5kg to 10kg. What is the Cross Elasticity of demand of Y for X? Which type of goods are X and Y?

$$Q_0 = 5$$

$$Q_1 = 10$$

$$\Delta Q = 5$$

$$P_0 = 50$$

$$P_1 = 70$$

$$\Delta P = 20$$

$$E_p = \Delta Q / \Delta P * P_0 / Q_0$$

$$= 5/20 * 50/5$$

$$= 2.5$$

As elasticity of demand is positive so X and Y are substitute goods.

POINT/GEOMETRIC METHOD

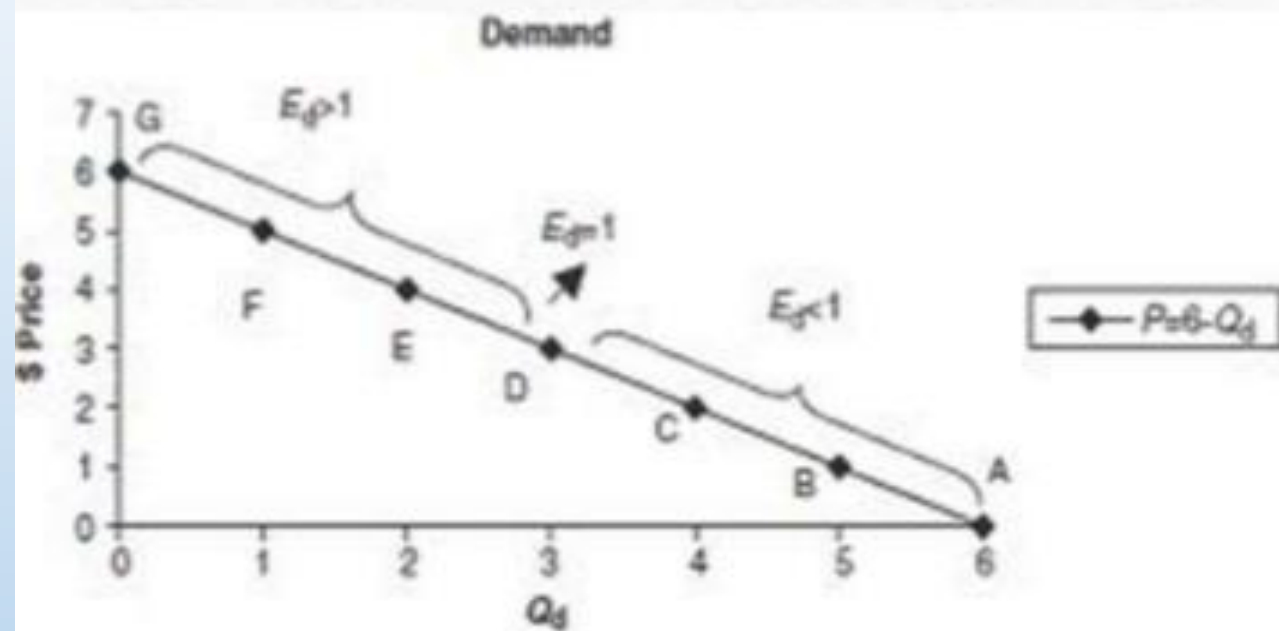
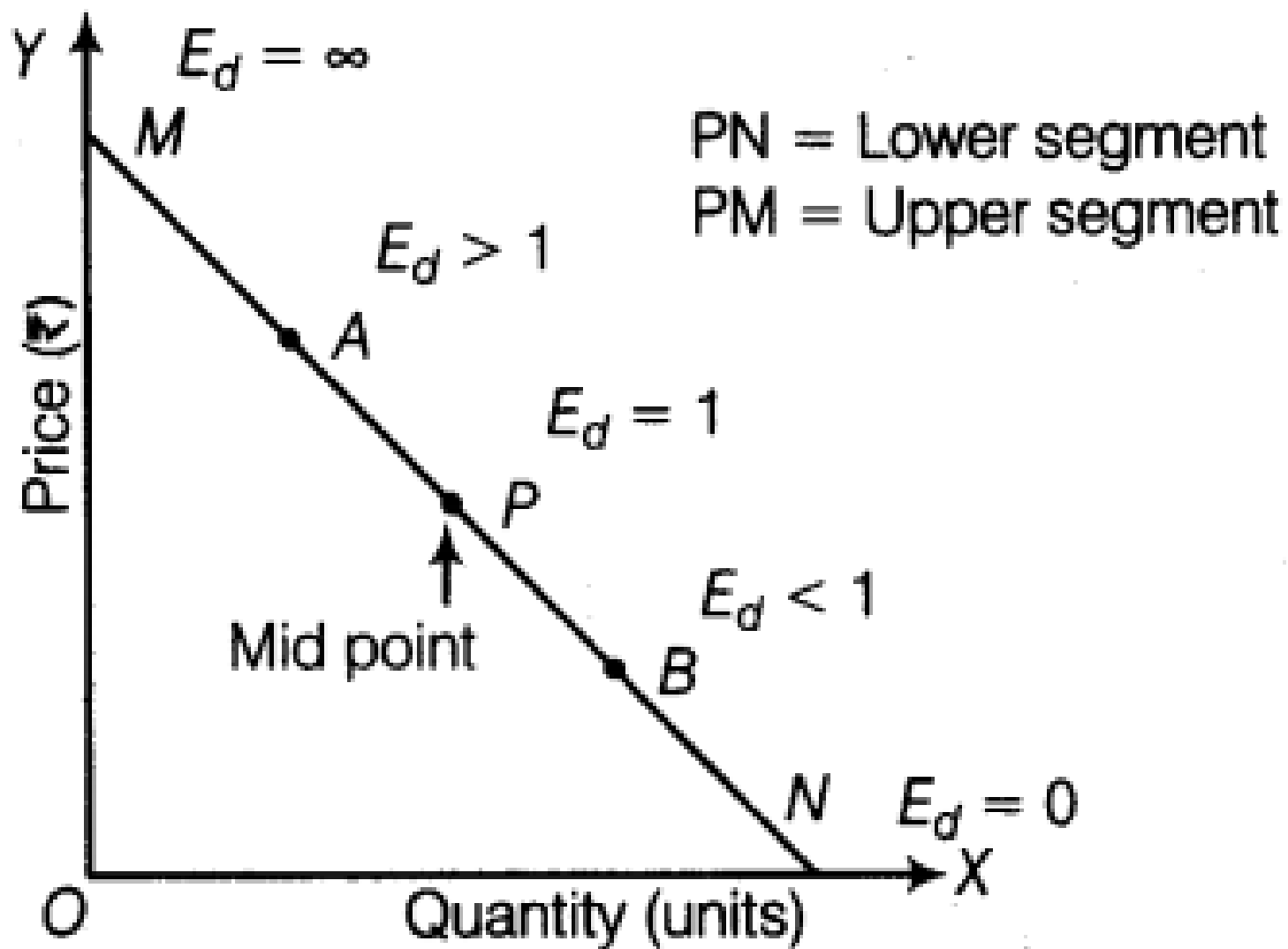


Figure 7.1

This method attempts to measure the price elasticity of demand at a particular point on demand curve

Point Elasticity = $\frac{\text{Lower segment of demand curve below the point}}{\text{Upper segment of demand curve below the point}}$



Geometric method

$$N = 0/MN$$

$$B = BN/BM$$

$$P = PN/PM$$

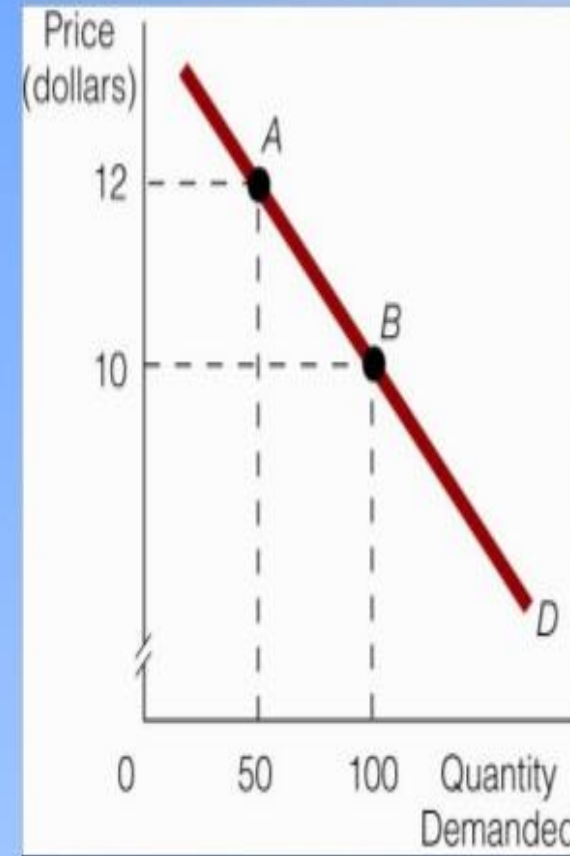
$$A = AN/AM$$

$$M = MN/0$$

MID-POINT/ARC METHOD OF ELASTICITY

Any two points on a **demand** curve make an **arc**, and the coefficient of **price elasticity of demand** of an **arc** is known as **arc elasticity of demand**. This **method** is used to find out **price elasticity of demand** over a certain range of **price** and **quantity**.

Calculating Price Elasticity of Demand - Arc Method (Contd.)



When calculating price elasticity of demand, we use the average of the two prices and the average of the two quantities demanded. The formula for price elasticity of demand is:

$$E_d = \frac{\frac{\Delta Q_d}{Q_{d \text{ Average}}}}{\frac{\Delta P}{P_{\text{Average}}}}$$

Computing the Price Elasticity of Demand

$$\text{Price Elasticity of Demand} = \frac{(Q_2 - Q_1) / [(Q_2 + Q_1) / 2]}{(P_2 - P_1) / [(P_2 + P_1) / 2]}$$

Example: If the price of an ice cream cone increases from 2.00 to 2.20 and the amount you buy falls from 10 to 8 cones the your elasticity of demand, using the **midpoint formula**, would be calculated as:

$$\left(- \right) \frac{\frac{(10 - 8)}{(10 + 8) / 2}}{\frac{(2.20 - 2.00)}{(2.20 + 2.00) / 2}} = \left| \frac{22 \text{ percent}}{9.5 \text{ percent}} \right| = 2.32$$

TOTAL OUTLAY METHOD

Dr. Marshall has evolved the total expenditure method to measure the elasticity of demand.

According to this method, elasticity of demand can be measured by considering the change in the price and the subsequent change in the total quantity of goods purchased and the total amount of money spent on it.

$$\text{Total Outlay} = \text{Price} * \text{Quantity}$$

Total Outlay Method

Unit Price (Rs)	Quantity	TE = P*Q (Rs)
A. 10	10	100
5 ↓	25	125 ep>1
B. 10	10	100
5 ↓	20	100 ep=1
C. 10	10	100
5 ↓	15	75 ↓ ep<1

Total Outlay Method

- Total Outlay is a way to calculate the price elasticity of demand method by looking at the effect of changes in price on the revenue earned by the producer.
- If price and revenue move in the same direction, demand is inelastic.
- If price and revenue move in the opposite direction, demand is elastic
- If revenue remains unchanged in response to a price change, demand is unit elastic

QUESTION 7

When price of a good rises from Rs 5 per unit to 6 per unit, its demand falls from 20 units to 10 units. Compare expenditure on the good to determine whether demand is elastic or inelastic.

Ans.

Price (₹)	Quantity (units)	TE (₹) ($P \times Q$)
5	20	100
6	10	60

Price increases and TE decreases. It shows inverse relationship between price and Total Expenditure. So, it shows that demand is elastic or greater than unity.

QUESTION 8

8 units of a good are demanded at a price of ? 7 per unit. Price Elasticity of Demand is (-) 1. How many units will be demanded if the price rises to ? 8 per unit? Use expenditure approach of Price Elasticity of Demand to answer this question.

Ans.

Price (₹)	Quantity (units)	Total Expenditure (₹)
7	8	56
8	7	56

Given $E_d = -1$

In this case, when Elasticity of Demand is (-1) , Total Expenditure will remain constant.

Total Expenditure (TE) = $7 \times 8 = ₹ 56$

∴ TE does not change.

∴ When price is ₹ 8 per unit

Quantity demanded = $56 \div 8 = 7$ units

QUESTION 9

A consumer buys 10 units of a good at a price of ? 6 per unit. Price Elasticity of Demand is (-) 1. At what price will he buy 12 units? Use expenditure approach of Price Elasticity of Demand to answer this question

Ans.

Price (₹)	Quantity (units)	Total Expenditure (₹)
6	10	60
5	12	60

Given $E_d = (-) 1$

In this case when Elasticity of Demand is $(-) 1$, Total Expenditure will remain constant.

Total Expenditure (TE) = $10 \times 6 = ₹ 60$

∴ TE does not change.

∴ When quantity is 12 units

Price = $60 \div 12 = ₹ 5$ per unit

FACTORS AFFECTING PRICE ELASTICITY OF DEMAND

- **Nature of commodity**
- **Availability of substitutes**
- **Income Level**
- **Level of price**
- **Postponement of Consumption**
- **Time Period**
- **Habits**

Nature of commodity

Elasticity of demand of a commodity is influenced by its nature. A commodity for a person may be a necessity, a comfort or a luxury.

- When a commodity is a necessity like medicines, its demand is generally inelastic as it is required for human survival and its demand does not fluctuate much with change in price.
- When a commodity is a comfort like refrigerator, its demand is generally elastic as consumer can postpone its consumption
- When a commodity is a luxury like AC, its demand is generally more elastic as compared to demand for comforts.

The term 'luxury' is a relative term as any item (like AC), may be a luxury for a poor person but a necessity for a rich person.

Availability of substitutes

- Demand for a commodity with large number of substitutes will be more elastic. The reason is that even a small rise in its prices will induce the buyers to go for its substitutes.
- For example, a rise in the price of Pepsi encourages buyers to buy Coke and vice-versa

Income Level

Elasticity of demand for any commodity is generally less for higher income level groups in comparison to people with low incomes. It happens because rich people are not influenced much by changes in the price of goods.

But, poor people are highly affected by increase or decrease in the price of goods. As a result, demand for lower income group is highly elastic.

Level of Price

Costly goods like laptop, Plasma TV, etc. have highly elastic demand as their demand is very sensitive to changes in their prices.

Demand for inexpensive goods like needle, match box, etc. is inelastic as change in prices of such goods do not change their demand by a considerable amount.

Postponement of Consumption

Commodities like biscuits, soft drinks, etc. whose demand is not urgent, have highly elastic demand as their consumption can be postponed in case of an increase in their prices.

Commodities with urgent demand like life saving drugs, have inelastic demand because of their immediate requirement.

TIME PERIOD

Elasticity of demand varies directly with the time period. Demand is generally inelastic in the short period.

It happens because consumers find it difficult to change their habits, in the short period, in order to respond to a change in the price of the given commodity. However, demand is more elastic in long run as it is comparatively easier to shift to other substitutes, if the price of the given commodity rises.

Habits

Commodities, which have become habitual necessities for the consumers, have less elastic demand. It happens because such a commodity becomes a necessity for the consumer and he continues to purchase it even if its price rises. Alcohol, tobacco, cigarettes, etc. are some examples of habit forming commodities.

QUESTION 10

Let demand function be $Q=225-15P$. Find demand elasticity when price equals Rs 5.

If $p=5$, then

$$Q = 225 - 15 * 5 = 150$$

$$\Delta Q / \Delta P = -15$$

$$E_p = (-) (-15) * (5/150) \\ = 0.5$$

QUESTION 11

The demand for personal computers is characterized by the following:

Price elasticity= -1.9 ; Cross elasticity (within software)= -1.1 ; Income elasticity= +2.1

Answer the following with adequate explanations:

- (i) A price reduction for personal computer will increase both the number of units demanded. Yes/No. Explain your answer.
- (ii) Given the above Cross elasticity, how much will be the change in quantity demanded to a 10% reduction in price.
- (iii) What type of good does the Personal Computer represent. Explain your answer.
- (iv) Falling price for software will definitely increase the number of computers brought. Yes/No. Explain your answer
- (v) If the demand for personal computer has increased by 3.8%, what and how much was the change in Price given?

Price elasticity= -1.9 ; Cross elasticity (within software)= -1.1 ; Income elasticity= +2.1

(i) Yes, the number of units demanded will increase as the price elasticity shows an inverse relationship.

Revenue will increase because $|e_p| = 1.9$. So demand is elastic, and so have an inverse relation with price change.

(ii) Given the cross elasticity as -1.1, a 10% change in price will change the quantity by 11%.

(iii) Personal computers are elastic and luxury good as income elasticity = +2.1

(iv) Yes, because they are complementary goods as $E_c = -1.1$

(v) % change in quantity = 3.8% . So with price elasticity = -1.9, the percentage change in price will be 2%.



Thank You...