**Chapter- 4**

**ELASTICITY OF DEMAND**

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| **Outline of this Chapter:*** Elasticity of Demand
* Meaning/ Definition of Price Elasticity of Demand; and
* Determinants of Elasticity of Demand.
* Different Types of Elasticity of Demand
* Measurement of Elasticity of Demand
* Outlay or expenditure Method;
* Percentage Method (Point Vs Arc Elasticity); and
* Diagrammatic Method.
* Elasticity on a Linear Demand Curve
* Applications of Elasticity of Demand
* Relationship between Price Elasticity and Revenue
* Importance of Price Elasticity of Demand
* Income Elasticity of Demand
* Types of Income Elasticity of Demand
* Importance of Income Elasticity of Demand
* Cross- price Elasticity of Demand
* Types of Cross-price Elasticity
* Questions for Review.
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**Introduction:**

* The law of demand states the inverse relationship between the price of a good and its quantity demanded. But it does not tell about how much change will be occurred or take place when the price will change.
* The elasticity of demand tells us about this change. How much will be changed in quantity demanded when price is changed.
* Percentage change in one variable due to one percent change in another variable is called *elasticity*.
* Elasticity is of three types:
* Price elasticity of demand;
* Income elasticity of demand; and
* Cross- price elasticity of demand.

**Price Elasticity of Demand:**

* It measures the responsiveness of demand of a good to a change in its price.
* Alfred Marshall was the first economist to formulate the concept of this as ratio of a relative change in quantity demanded to a relative change in price.
* Thus, price elasticity of demand can be defined as percentage change in quantity demanded divided by percentage change in price.

Numerically, price elasticity of demand, Ed or ed or e is calculated as:

Ed $=(-)\frac{Percentage Change in Quantity Demanded}{Percentage Change in Price}$

 $=(-)\frac{∆Q/Q}{∆P/P}$

 = $(-)\frac{∆Q}{∆P}$. $\frac{P}{Q}$

Where

Ed = Coefficient of elasticity of demand. The higher the numerical value of Ed, the larger is the effect of price change on quantity demanded;

 $∆Q= $Change in quantity demanded;

Q = original quantity demanded;

 $∆P= $Change in price;

 P = Original price.

* **Determinants of Price Elasticity of Demand:**
* Availability and closeness of substitutes;
* Adjustment time and availability of substitutes;
* Luxuries versus necessities;
* Cost relative to total income;
* Number of uses of the purchased good;
* Price level; etc.
* **Types of Elasticity of Demand:**
* The absolute value of the coefficient of elasticity of demand ranges from zero to infinity (0 ≤ Ed ≤ ∞).
* The five different magnitudes of elasticity of demand are:
1. Perfectly Inelastic Demand (Ed = 0);
2. Inelastic Demand (0 < Ed < 1);
3. Unitary Elastic Demand (Ed = 1);
4. Elastic Demand (1< Ed < ∞);
5. Perfectly Elastic Demand (Ed = ∞)

***Perfectly Inelastic Demand (Ed = 0):***

|  |  |
| --- | --- |
| In this case if price rises or falls, people consume same quantity of the good. In this case, demand curve will be vertical. **Example:** essentials like life- saving drugs.  | http://xamidea.in/images/learning/ElasticityofDemand_files/image027.gif |

***Inelastic Demand (0 < Ed < 1):***

|  |  |
| --- | --- |
| This occurs when percentage change in quantity demanded is less than percentage change in price. In this case, demand curve is steeper. **Example:** necessities like food, medicines, fuel, etc. | http://xamidea.in/images/learning/ElasticityofDemand_files/image033.gif |

***Unitary Elastic Demand (Ed = 1):***

|  |  |
| --- | --- |
| This occurs when percentage change in quantity demanded is exactly equal to the percentage change in price. In this case, demand curve will be rectangular hyperbola having coefficient of elasticity equal to one at every point on the demand curve. This occurs in case of normal goods. | http://xamidea.in/images/learning/ElasticityofDemand_files/image029.gif |

***Elastic Demand (1< Ed < ∞):***

|  |  |
| --- | --- |
| This occurs when percentage change in quantity demanded is greater than the percentage change in price. In this case, demand curve will be flatter.**Example:** luxury goods. | http://xamidea.in/images/learning/ElasticityofDemand_files/image031.gif |

***Perfectly Elastic Demand (Ed = ∞):***

|  |  |
| --- | --- |
| This is a situation where percentage change in quantity demanded is infinity. For any higher price the demand falls to zero and any lower price the demand rises without limit. In this case, demand curve will be horizontal. | http://xamidea.in/images/learning/ElasticityofDemand_files/image025.gif |

* **Measurement of Price Elasticity of Demand:**
1. Outlay or Expenditure Method;
2. Percentage Method; and
3. Geometric Method
4. **Outlay or Expenditure Method:**
* When price of a good changes, three situations can take place. If the price of a good falls, the total outlay or expenditure of consumers on the good rises when e > 1, remains constant when e = 1 or falls when e < 1.

 **Different Situations of Outlay/Expenditure Method**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. N.** | **If price falls** | **Description** | **Value of Ed** | **Term Used** |
| 1. | Expenditure increases | Quantity demanded rises in a greater proportion | Ed > 1 | Elastic demand |
| 2. | Expenditure remains constant | Quantity demanded rises in the same proportion | Ed = 1 | Unitary elastic demand |
| 3. | Expenditure falls | Quantity demanded rises in a lesser proportion | Ed < 1 | Inelastic demand |

* In symbolic form:

P↓↑ => TE↑↓ => Ed > 1 (opposite relationship between P and TE, i.e., Ed > 1)

P↓↑ => TE remains constant => Ed = 1 (No relationship between P and TE, i.e., Ed = 1)

P↓↑ => TE↓↑ => Ed < 1 (Direct relationship between P and TE, i.e., Ed < 1).

**Example:**

Given two demand schedules, determine their elasticity of demand using the total outlay or expenditure method:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| P | 5 | 4 | 3 | 2 | 1 |
| QX | 200 | 210 | 230 | 255 | 300 |
| QY | 200 | 260 | 370 | 600 | 1300 |

***Solution:***

Calculating total expenditure for good X and good Y, we get:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P | QX | Total Expenditure on X =(P.QX) | QY | Total Expenditure on Y =(P.QY) |
| 5 | 200 | 5×200= 1000 | 200 | 5×200= 1000 |
| 4 | 210 | 4×210= 840 | 260 | 4×260= 1040 |
| 3 | 230 | 3×230= 690 | 370 | 3×370= 1110 |
| 2 | 255 | 2×255= 510 | 600 | 2×600= 1200 |
| 1 | 300 | 1×300= 300 | 1300 | 1×1300= 1300 |

Therefore, good X has inelastic demand (Ed < 1) as expenditure falls with the fall in price. Good Y has elastic demand (Ed > 1) as expenditure rises with fall in price.

1. **Percentage Method:**
* According to the percentage method, Ed is calculated by this formula:

Ed $=(-)\frac{Percentage Change in Quantity Demanded}{Percentage Change in Price}$

 $=(-)\frac{∆Q/Q}{∆P/P}$

 = $(-)\frac{∆Q}{∆P}$. $\frac{P}{Q}$

* The absolute value of the coefficient of elasticity of demand ranges from zero to infinity (0 ≤ Ed ≤ ∞).

**Point Elasticity Vs Arc Elasticity:**

* The percentage formula applies only in case of point elasticity.
* Point elasticity relates to price elasticity at a single point on a demand curve.
* If there are finite change in price and quantity demanded, such that it relates to a stretch over the demand curve, then the percentage formula is modified and it is called arc elasticity.
* Arc elasticity of demand is the price elasticity of demand between two points on a demand curve.
* The value of elasticity depends upon the direction in which elasticity is measured.
* The formula for arc elasticity is:

Ed$=(-)\frac{∆Q}{∆P}$. $\frac{(P1+P2)/2}{(Q1+Q2)/2}$

 = $(-)\frac{∆Q}{∆P}$. $\frac{(P1+P2)}{(Q1+Q2)}$

**Example:**

Calculate price elasticity of demand from A to B, from B to A and at midway between points A and B from the following table:

|  |  |  |
| --- | --- | --- |
| **Point** | **Px (in SR)** | **Qx (in Kg.)** |
| A | 6 | 10 |
| B | 4 | 15 |

**Solution:**

Ed from A to B =$(-)\frac{∆Q}{∆P}$. $\frac{P}{Q}$

= $\frac{5}{2}$.$ \frac{6}{10}$= $\frac{3}{2}$= 1.5

Ed from B to A =$(-)\frac{∆Q}{∆P}$. $\frac{P}{Q}$

= $\frac{5}{2}$.$ \frac{4}{15}$= $\frac{2}{3}$= 0.67

Ed between A and B =$(-)\frac{∆Q}{∆P}$. $\frac{P1+P2}{Q1+Q2}$

 = $\frac{5}{2}$.$ \frac{6+4}{10+15}$= $\frac{5}{2}$.$ \frac{10}{25}$ = 1

1. **Geometric Method:**
* This method is used to find the point elasticity of demand.
* The value of elasticity is the ratio between the lower segment to the upper segment of the demand curve and the price axis.
* The value of elasticity on the quantity axis is the ratio between right- hand side segment to the left- hand side segment.
* Thus price elasticity of demand, Ed = RB/AR = OP/AP = QB/OQ

**Elasticity on a Linear Demand Curve:**

* On a linear downward sloping demand curve the value of elasticity is different at every point on the curve. It can be proved as follows:
* DD1 has constant slope, i.e., $\frac{∆P}{∆Q}$ ratio is the same. Thus, $\frac{1}{Slope}$ or $\frac{∆Q}{∆P}$ ratio must also be constant.
* On comparing second part of the elasticity formula, i.e., P/Q at each point, following result is obtained:
* At the price axis, point D, Q=0. Thus, P/Q is undefined. In other words, as quantity approaches zero, the ratio P/Q approaches infinity.
* But as we move down on the demand curve, price falls and quantity rises thus P/Q ratio falls steadily.
* At the quantity axis, point D1, P=0. Thus, P/Q= 0, i.e., elasticity is
* zero. It is graphically shown in the following figure:

**Applications of Elasticity of Demand:**

* ***Case- I:*** Two linear parallel demand curves have same slope but different elasticities at a given price.
* ***Case- II:*** Two linear parallel demand curves have same slope but different elasticities at a given quantity.

***(Remark:*** *The demand curve nearer to the origin has less elasticity and the one away from the origin has greater elasticity at a given quantity. In terms of slope, both have same slope).*

* ***Case- III:*** Two linear intersecting demand curves have different elasticity at the price corresponding to point of intersection.
* ***Case- IV:*** A straight line from the origin shows equal elasticities at the point of intersection of the two linear parallel demand curves.

***(Remark:*** *A ray from the origin indicates equal elasticities at the point of intersection of two linear, parallel demand curves. In terms of slope, both the demand curves have same slope).*

**Relationship between Price Elasticity and Revenue:**

MR = AR (1- $\frac{1}{e}$)

Or, e = $\frac{AR}{AR-MR}$

Where

MR = Marginal Revenue;

AR = Average Revenue; and

e = Elasticity of Demand

**Importance of Price Elasticity of Demand:**

* Pricing Decisions of Business Firms or of Government Agencies;
* Financial Policy of the Government
* International Trade;
* Paradox of Plenty; etc.

**Income Elasticity of Demand:**

* It is a quantitative measure of the degree to which quantity demanded responds to a change in income, *ceteris paribus*.
* The income elasticity of demand (ey) is calculated as the percentage change in quantity demanded due to percentage change in income. That is,

ey = $\frac{\% change in quantity demanded}{\% change in income}$ = $\frac{∆Q}{∆Y}.\frac{Y}{Q}$

 Where

 ey = Coefficient of Income Elasticity of Demand

 Y = Initial Income;

 Q = Initial Quantity Demanded;

 ∆Q = Change in Quantity demanded; and

 ∆Y = Change in Income;

**Types of Income Elasticity of Demand:**

* Income elasticity can be positive or negative.
* Income elasticity can take five different values:
1. *Greater than one (ey > 1):*
* This occurs when the percentage change in quantity demanded is greater than the percentage change in income.
* It is also called high income elasticity.
* It takes place in case of luxury goods.
1. *Equal to one (ey = 1):*
* This occurs when percentage change in quantity demanded is equal to the percentage change in income.
* It is called unitary income elasticity.
* It holds for those normal goods which fall between the category of necessities and luxuries.
1. *Less than one (ey < 1):*
* This occurs when the percentage change in quantity demanded is less than the percentage change in income.
* It is called low income elasticity.
* It takes place in case of necessities.
1. *Equal to zero (ey = 0):*
* This occurs when there is no change in quantity demanded with change in income.
* It is called zero income elasticity.
* It is difficult to specify the good but the good varies between a necessity and an inferior good.
1. *Less than zero (ey < 0):*
* This occurs when the percentage change in quantity demanded is negative with change in income.
* It is called negative income elasticity.
* It holds in case of inferior or Giffen goods.

**Importance of Income Elasticity of Demand:**

* Demand forecasting;
* Classification of goods.

**Cross- price Elasticity of Demand:**

* The cross-price elasticity of demand (exy) is a quantitative measure of the effect on the quantity demanded of a good (x) due to change in the price of other good (y).
* This is calculated as:

exy = $\frac{\% change in quantity demanded of x}{\% change in price of y}$ = $\frac{∆Qx}{∆Py}.\frac{Py}{Qx}$

Where

 exy = Coefficient of Cross-price Elasticity of Demand;

PY = Initial Price of good Y;

 QX = Initial Quantity Demanded of good X;

 ∆Qx = Change in Quantity demanded of good X; and

 ∆PY = Change in price of good Y.

**Types of Cross-price Elasticity:**

* The value of cross- price elasticity ranges from minus infinity to plus infinity (-∞ ≤ exy ≤ +∞).
* It can take five different values:
1. Equal to plus infinity (exy = +∞)
* If exy = +∞, then x and z are perfect substitutes. Example: pair of socks.
1. Greater than zero (exy > 0)
* This occurs when the two goods x and y are substitutes.
* The higher the numerical value of exy, the greater the degree of substitutability.
* The positive sign on the exy explains the positive relationship between the price of a good and the quantity demanded of its substitute.
1. Equal to zero (exy = 0)
* This occurs when the two goods are unrelated. That means, a change in the price of one good does not affect the quantity demanded of the other good.
1. Less than zero (exy < 0)
* This occurs when the two goods are complements.
* The lower the numerical value of exy, the greater the degree of complementarity.
1. Equal to plus infinity (exy = -∞)
* If exy = -∞, then x and z are perfect complements. Example: pair of shoes.

**QUESTIONS FOR REVIEW**

***Objective type questions:***

1. The concept of elasticity of demand was developed by-

|  |  |
| --- | --- |
| 1. Alfred Marshall,
 | 1. Adam Smith,
 |
| 1. L. Robbins,
 | 1. None of these.
 |
|  |  |

1. The responsiveness (or percentage change) of quantity demanded of a commodity to one percentage change in its price is known as-

|  |  |
| --- | --- |
| 1. Elasticity of demand,
 | 1. Elasticity of supply,
 |
| 1. Law of demand,
 | 1. Law of supply.
 |

1. The formula for calculation of price elasticity of demand, ed is-

|  |  |
| --- | --- |
| 1. Ed = (-) $\frac{∆Q}{∆P}$.$ \frac{P}{Q}$
 | 1. Ed = (+) $\frac{∆Q}{∆P}$.$ \frac{P}{Q}$
 |
| 1. Ed = (-) $\frac{∆P}{∆Q}$.$ \frac{Q}{P}$
 | 1. Ed = (+) $\frac{∆P}{∆Q}$.$ \frac{Q}{P}$
 |

1. The coefficient of elasticity of demand ranges from-

|  |  |
| --- | --- |
| 1. Zero to one,
 | 1. Zero to infinity,
 |
| 1. One to infinity,
 | 1. None
 |

1. If the price of a good falls, the total outlay or expenditure of consumers on the good rises when

|  |  |
| --- | --- |
| 1. Ed = 1,
 | 1. Ed > 1,
 |
| 1. Ed < 1,
 | 1. Ed = 0.
 |

1. The price elasticity of demand between two points on a demand curve is known as –

|  |  |
| --- | --- |
| 1. Point elasticity of demand,
 | 1. Arc elasticity of demand,
 |
| 1. Cross price elasticity
 | 1. Income elasticity of demand.
 |

1. The formula for arc elasticity is:

|  |  |
| --- | --- |
| 1. $(-)\frac{∆Q}{∆P}$. $\frac{(P1+P2)}{(Q1+Q2)}$
 | 1. $(-)\frac{∆Q}{∆P}$. $\frac{(Q1+Q2)}{(P1+P2)}$
 |
| 1. $(-)\frac{∆Q}{∆P}$. $\frac{(P1-P2)}{(Q1-Q2)}$
 | 1. None of these.
 |

1. Geometric method is used to find out the –

|  |  |
| --- | --- |
| 1. Point elasticity of demand,
 | 1. Arc elasticity of demand,
 |
| 1. Cross price elasticity,
 | 1. Income elasticity of demand.
 |

1. The relationship between price elasticity and revenue is –

|  |  |
| --- | --- |
| 1. e = $\frac{AR}{AR-MR}$
 | 1. e = $\frac{AR}{AR+MR}$
 |
| 1. e = $\frac{AR-MR}{AR}$
 | 1. e = $\frac{MR}{AR-MR}$
 |

1. The percentage change in quantity demanded due to percentage change in income is known as –

|  |  |
| --- | --- |
| 1. Point elasticity of demand,
 | 1. Income elasticity of demand,
 |
| 1. Cross price elasticity,
 | 1. Arc elasticity of demand.
 |

1. A quantitative measure of the effect on the quantity demanded of a good (x) due to change in the price of other good (y) is known as-

|  |  |
| --- | --- |
| 1. Point elasticity of demand,
 | 1. Income elasticity of demand,
 |
| 1. Cross price elasticity,
 | 1. Arc elasticity of demand.
 |

1. Which one is **not** correctly matched:

|  |  |
| --- | --- |
| **Term used** | **Coefficient of elasticity of demand** |
| 1. Perfectly inelastic demand:
 | 1. Ed =0
 |
| 1. Perfectly elastic demand:
 | 1. Ed > 1
 |
| 1. Elastic demand:
 | 1. Ed > 1
 |
| 1. Inelastic demand:
 | 1. Ed < 1
 |

***Questions with Answer:***

**Ques: What is price elasticity of demand?**

Ans: Price elasticity of demand can be defined as percentage change in quantity demanded divided by percentage change in price.

**Ques: What is the formula to calculate price elasticity of demand?**

Ans: Price elasticity of demand, Ed or ed or e is calculated as:

Ed $=(-)\frac{Percentage Change in Quantity Demanded}{Percentage Change in Price}$

 $=(-)\frac{∆Q/Q}{∆P/P}$

 = $(-)\frac{∆Q}{∆P}$. $\frac{P}{Q}$

**Ques: What is income elasticity of demand?**

Ans: It is a quantitative measure of the degree to which quantity demanded responds to a change in income, *ceteris paribus*. The income elasticity of demand (ey) is calculated as the percentage change in quantity demanded due to percentage change in income.

**Ques: What is the formula to calculate income elasticity of demand?**

Ans: The income elasticity of demand (ey) is calculated as the percentage change in quantity demanded due to percentage change in income. That is,

ey = $\frac{\% change in quantity demanded}{\% change in income}$ = $\frac{∆Q}{∆Y}.\frac{Y}{Q}$

 Where

 ey = Coefficient of Income Elasticity of Demand

 Y = Initial Income;

 Q = Initial Quantity Demanded;

 ∆Q = Change in Quantity demanded; and

 ∆Y = Change in Income;

**Ques: What is cross price elasticity of demand?**

Ans: The cross-price elasticity of demand (exy) is a quantitative measure of the effect on the quantity demanded of a good (x) due to change in the price of other good (y).

**Ques: What is the formula to calculate cross price elasticity of demand?**

Ans: This is calculated as:

exy = $\frac{\% change in quantity demanded of x}{\% change in price of y}$ = $\frac{∆Qx}{∆Py}.\frac{Py}{Qx}$

Where

 exy = Coefficient of Cross-price Elasticity of Demand;

PY = Initial Price of good Y;

 QX = Initial Quantity Demanded of good X;

 ∆Qx = Change in Quantity demanded of good X; and

 ∆PY = Change in price of good Y.

**Ques: What do you understand by perfectly elastic demand?**

Ans: This is a situation where percentage change in quantity demanded is infinity. For any higher price the demand falls to zero and any lower price the demand rises without limit. In this case, demand curve will be horizontal straight line.

**Ques: What is perfectly inelastic demand?**

Ans: In this case if price rises or falls, people consume same quantity of the good. In this case, demand curve will be vertical.

**Example:** essentials like life- saving drugs.

**Ques: What is elastic demand?**

Ans: This occurs when percentage change in quantity demanded is greater than the percentage change in price. In this case, demand curve will be flatter.

**Example:** luxury goods.

**Ques: What is the relationship between price elasticity of demand, price and revenue?**

Ans: MR = AR (1- $\frac{1}{e}$)

 Or, e = $\frac{AR}{AR-MR}$

Where

MR = Marginal Revenue;

AR = Average Revenue; and

e = Elasticity of Demand