Subject: Management

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- Content for Post Graduate Courses

Paper: 11, Managerial Economics
Module: 05, Elasticity of Demand

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**Module 04: Elasticity of demand**

1. Learning Outcome
2. What does Elasticity of demand mean?
3. Price Elasticity of demand and Methods to Price Elasticity of demand
4. Income, Cross and Advertisement Elasticity of demand
5. Applications of Elasticity of demand in Management Decision Making Process
6. Factors affecting the Elasticity of demand
7. Limitations of Elasticity of demand
8. Summary

**1. Learning Outcome:**

After completing this module the students will be able to:

- Understand the various concepts of Elasticity of demand.
- Use the concept of Elasticity of demand in taking pricing and costing decisions.
1.0 Concept of Elasticity of Demand

Law of demand tells the type of relationship between price and quantity demanded and illustrate that a fall in price will lead to an increase in quantity demanded and vice versa. However, given any change in price or income of the consumer or price of other goods or advertisement expenditure, in addition to the direction of the change in quantity demanded, managers are more interested in finding the magnitude of the change or the degree of responsiveness of consumers to a change in any determinants or variable. To measure this, they use the concept of elasticity of demand. Elasticity of demand measures how much the quantity demanded changes with a given change in a particular determinant of demand (i.e., price of the item, change in consumers’ income, or change in price of related product and advertisement etc.).

1.1 Price Elasticity of Demand

The degree of responsiveness or sensitivity of consumers to a change in price is measured by the concept of price elasticity of demand. There are two situations:

1. If consumers are relatively responsive to price changes, demand is said to be elastic.
2. If consumers are relatively unresponsive to price changes, demand is said to be inelastic.

Measurement and Interpretation of Price Elasticity of Demand

The Price Elasticity of Demand is the ratio with which demand for a product will contract or expand with rise or fall in its prices. It is calculated as follow:

\[ E_d = (-) \frac{\% \text{ change in Quantity Demanded}}{\% \text{ change in the Price of the product}} \]

Where:

<table>
<thead>
<tr>
<th>% change in Quantity Demanded = ( Q_1 - Q_0 / Q_0 ) * 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Q_1 ) = Quantity Demanded after the change in the price</td>
</tr>
<tr>
<td>( Q_0 ) = Quantity Demanded before the change in the price</td>
</tr>
</tbody>
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<th>% change in the Price of the product = ( P_1 - P_0 / P_0 ) * 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_1 ) = Current Price</td>
</tr>
<tr>
<td>( P_0 ) = Previous Price</td>
</tr>
</tbody>
</table>
For Example: Puja Sandal advertises to sell cookies for ₹4 a dozen. She sells 50 dozen, and decides that she can charge more. She raises the price to ₹6 a dozen and sells 40 dozen. In this case the price elasticity of demand for cookies will be;

\[
Ed = \frac{(40 - 50/50 \times 100)}{(6 - 4/4 \times 100)} = (-) 0.4
\]

The price elasticity of demand falls into three categories:

1. **Elastic demand**
   
   If the price elasticity of demand for a good is greater than one (\(E_d > 1\)), the demand is price elastic which means that a change in the price will lead to a larger percentage/proportionate change in the quantity demanded. A good with a price elastic demand has a relatively flat demand curve given in Figure 1.

   ![Figure 1 Elastic Demand Curve](image1)

2. **Unit elastic demand**
   
   If price elasticity of demand for a good is equal to one (\(E_d = 1\)), the demand is unit price elastic which means that a change in the price will lead to the same percentage/proportionate change in the quantity demanded. The demand curve for a good with a unit price elastic demand is a rectangular hyperbola as given in Figure 2.

   ![Figure 2 Unitary Elastic Demand Curve](image2)
3. **Inelastic demand**
If the price elasticity of demand for a good is less than one \((E_d < 1)\), the demand is price inelastic which means that a change in the price will lead to a smaller percentage/proportionate change in the quantity demanded. A good with a price inelastic demand has a relatively steep demand curve as given in Figure-3.

There are two extreme cases:

4. **Perfectly elastic demand**
If the price elasticity of demand for a good is zero \((E_d = 0)\), the demand is perfectly price inelastic which means that a change in the price will not lead to any change in the quantity demanded. A good with a perfectly price inelastic demand has a vertical demand curve as given in figure-4.

5. **Perfectly inelastic demand**
If the price elasticity of demand for a good is infinity \((E_d = \infty)\), the demand is perfectly price elastic which means that a rise in the price will lead to an infinite decrease in the quantity demanded. In theory, this means that the quantity demanded will fall from infinity to zero. A good with a perfectly price elastic demand has a horizontal demand curve as given in table-5.
1.3 Methods of Measuring Price Elasticity of Demand

There are five methods to measure Price Elasticity of Demand (E_d):

1. Total Expenditure Method
2. Proportionate Method
3. Point Elasticity Method
4. Arc Elasticity Method
5. Revenue Method

1. Total Expenditure Method

Dr. Marshall has evolved the total expenditure method and elasticity of demand can be measured by considering the change in price and the subsequent change in the total amount of money spent on it.

Total Expenditure = Price * Quantity Demanded

1. Demand is **elastic** if a fall in price results in a rise in total Expenditure, or if an increase in price results in a decline in total Expenditure. (Price and expenditure move in opposite directions).

2. Demand is **inelastic** if a fall in price results in a fall in total expenditure or an increase in price results in a rise in expenditure. (Price and expenditure move in same direction).

3. Demand has **unit elasticity** if total expenditure does not change due to change in the price of a good.

### Table 1 Total Expenditure Method

<table>
<thead>
<tr>
<th>Quantity Demanded</th>
<th>Price of Product</th>
<th>Expenditure (Q*P)</th>
<th>Elasticity of Demand</th>
<th>Test of Total Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7 (Fall)</td>
<td>14 (Increase)</td>
<td>5.00</td>
<td>Elastic (&gt; 1)</td>
</tr>
<tr>
<td>3</td>
<td>6 (Fall)</td>
<td>18 (Increase)</td>
<td>2.60</td>
<td>Elastic (&gt; 1)</td>
</tr>
<tr>
<td>4</td>
<td>5 (Fall)</td>
<td>20 (Increase)</td>
<td>1.57</td>
<td>Elastic (&gt; 1)</td>
</tr>
</tbody>
</table>
2. Proportionate Method:

This method also known as the Percentage Method, Flux Method, Ratio Method, and Arithmetic Method is also associated with the name of Dr. Marshall. According to this method, “price elasticity of demand is the ratio of percentage change in the amount demanded to the percentage change in price of the commodity.”

It is. Its formula is as under:

$$E_d = \left( \frac{-\% \text{ change in Quantity Demanded}}{\% \text{ change in the Price of the product}} \right)$$

3. Point Elasticity Method

Point elasticity of demand refers to the Price Elasticity of Demand ($E_d$) at any point of the demand curve and is different at different points on a demand curve. As given in the figure below $E_d$ is elastic at the upper segment of the demand curve, unitary at the midpoint and inelastic at the lower segment. Demand is more elastic toward the top of the curve, and more inelastic toward the bottom.

In this we take a straight line demand curve, which connects the demand curve with both the axes OX and OY. In the diagram OX axis represents the quantity demanded and OY axis represents the price.
In Fig. 6 MN is a straight line demand curve. Initially, at point A the price is OP or QA and the demand is OQ or PA is the initial demand. The elasticity of demand will be AN/AM and the same can be known with the help of the following formula;

As we know;

\[ E_d = \frac{P}{Q} \times \frac{\Delta Q}{\Delta P} \]  

………………. (equation –I)

It is evident from figure 6 that;

\[ P = OP (=AQ); Q = OQ (AP) \]

Change in P = PP1 (=AB); Change in Q = QQ1 (=BC);

Because AQ/AP × BC/AB since\( \Delta \) ABC and\( \Delta \) AQN are similar triangles, so the ratio of their sides will also be equal.

i.e. BC/AB = QN/AQ

by putting QN/AQ in place of BC/AB in equation –I, we have;

\[ E_d = AQ/AP \times QN/AQ = QN/AP = QN/OQ (AP= OQ) \]

Since \( \Delta \) ABC and\( \Delta \) AQN are similar triangles, so the ratio of their sides will also be equal.

\[ E_d = QN/OQ = QN/AP = AN/AM \] i.e. lower portion of Demand curve / Upper portion of Demand curve.

Thus, it is cleared from the demand curve given in figure 6 that, as we move above the midpoint of the demand curve elasticity of demand become greater than unitary and near to OY- axes it advance towards infinity (∞). On the hand as we move below the midpoint of the demand curve elasticity of demand become less than unitary and near to OX- axes it advance towards zero or inelastic demand (0).

\[ E_d = \frac{\Delta \text{In Demand}}{\text{Orginal demand}} \div \frac{\Delta \text{In Price}}{\text{Orginal Price}} \]
4. **Arc Elasticity Method**

Arc elasticity of demand measures elasticity between two points on a curve. On most curves the elasticity of a curve varies depending upon where you are. Therefore elasticity needs to measure a certain sector of the curve.

“Arc elasticity is a measure of the average responsiveness to price change exhibited by a demand curve over some finite stretch of the curve” Prof. Baumol

In figure 7 price elasticity of demand at point A on Demand curve DD is to be measured. Due to change in price two situations that arise are shown by point B and C. At point B the price falls from initial price OP to OP₁ and at point C it further falls to OP₂. In first situation demand extend from OQ to OQ₁ and in the second from OQ₁ to OQ₂. It is obvious that by proportionate method two different price elasticity of demand may be computed at point A. One will relate to point B and other to Point C. Under these circumstances; Arc method of measuring price elasticity of demand curve is the most appropriate method. The stretch between two points A and C on Demand curve DD is called Arc elasticity of demand.

In this method we use Average price i.e. \( \frac{P₁ + P₀}{2} \) rather than \( P \) and Average Quantity i.e. \( \frac{Q₁ + Q₀}{2} \) rather than \( Q \) and;

\[
Ed = \frac{\text{Change in Demand}}{\text{Average Demand}} \times \frac{\text{Change in Price}}{\text{Average Price}}
\]

\[
d = \frac{Q₁ - Q₀}{Q₁ + Q₀} \times \frac{P₁ - P₀}{P₁ + P₀}
\]

Where

- \( Q₁ \) = New Quantity demanded
- \( Q₀ \) = Original Quantity demanded
- \( P₁ \) = New Price
- \( P₀ \) = Original Price

Suppose price of Chocolate is ₹4.00 (\( P₀ \)) per piece per Chocolate and its demand (\( Q₀ \)) is of 1 Chocolate only. If the price falls to ₹2.00 (\( P₁ \)) per piece per Chocolate and its demand (\( Q₁ \)) extend to 4 Chocolates, then,
It is clear from the above example that according to Arc Elasticity method, if the prices of goods rises or falls in the same ratio and consequently demand also contracts or extends in the same ratio, then Ed will remain the same. But if the Point Elasticity method is used, then the Ed in respect of above example will be different. In first case it will be greater than one (6) and in the second case it will be less than unity (3/4). Arc Elasticity method is therefore, more realistic and dependable method than Point elasticity method.

\[
Ed = \frac{Q_1 - Q_0}{Q_2 + Q_0} \times \frac{P_2 + P_0}{P_1 - P_0}
\]

\[
Ed = \frac{4 - 1}{4 + 1} \times \frac{4 + 2}{4 - 2}
\]

\[
Ed = \frac{3}{5} \times \frac{6}{2} = \frac{9}{5} = > 1
\]

5. **Revenue Method**

Mrs. Joan Robinson has given this method and elasticity of demand is measured with the help of average revenue and marginal revenue. Therefore, sale proceeds that a firm obtains by selling its products are called its revenue. However, when total revenue is divided by the number of units sold, we get average revenue.

On the contrary, when addition is made to the total revenue by the sale of one more unit of the commodity is called marginal revenue. Therefore, the formula to measure elasticity of demand can be written as,

\[
Ed = \frac{AR}{AR-MR}
\]

Where Ed represents elasticity of demand, AR = average revenue and MR = marginal revenue.
For example by selling 10 oranges a person gets ₹ 50 than ₹ 50 will be his total revenue and ₹ 50/ 10 will be his Average Revenue AR i.e. ₹ 5 per orange. Suppose, if he sold one more orange and his total revenue increased to 54, than his extra revenue from one extra unit will be his marginal revenue (MR) i.e ₹ 4 (54-50).

\[
E_d = \frac{AR}{AR - MR}
\]

\[
E_d = \frac{5}{5-4} = \text{> 1 or greater than unitary}
\]

This method can be explained with the help of Figure 7. Revenue has been shown on OY-axis and quantity of goods on OX- axes. AB is average revenue curve or demand curve and AN is marginal revenue curve. At point P on demand curve, the Ed will be calculated as follow:

\[
Ed = \frac{\text{Lower Portion}}{\text{Upper Portion}} = \frac{PB}{PA}
\]

Since ABC and AQN are similar triangles, so the ratio of their sides will also be equal.

\[
Ed = \frac{PB}{PA} = \frac{PM}{AE} \quad \text{...........(i)}
\]

Since AET and TPL are congruent triangles, so PL = AE. By putting PL in place of AE in equation (i) the Ed = \frac{PM}{PL}

Because PL = PM – LM

Hence Ed is = \frac{PM}{PM - LM} = \frac{AR}{AR - MR}

If we use the above formula the Ed is more than one, it means that price elasticity of demand is unitary. If it is more than one than, price elasticity of demand is greater than unitary and if it is less than one than, price elasticity of demand is less than unitary.
1.4 Determinants of Price Elasticity of Demand

1. The availability of close substitutes
   If a product has many close substitutes, for example, cold drink, then people tends to react strongly to a price increase of one firm's cold drink. Thus, the price elasticity of demand of this firm's product is high. The more the number of substitutes of the good, higher is likely to be the $E_d$ of that good. This is so because the consumer can easily shift from one substitute to another in case of price change.

2. The importance of the product's cost in one's budget
   If a product, such as salt, is very inexpensive, consumers are relatively indifferent about a price increase. Therefore, salt has a low price elasticity of demand. Cars are expensive and a 10% increase in the price of a car may make the difference whether people will choose to buy the car or not. Therefore, cars have a higher price elasticity of demand. Higher the proportion of income of consumer spends on a good, higher is the $E_d$ of that good and vice versa.

3. Number of uses of the good: More the number of uses of a good more likely are to be the $E_d$ of that good. For example electricity has many uses and can be used for lighting, heating, cooling etc. So the demand for electricity is more elastic as any increase in electricity charges will reduce the demand for it because consumer will use it only for heating and not for heating and cooling.

4. Income of consumer: Richer the consumer, more likely the demand for a good by him is less elastic. A rich consumer is less likely to reduce consumption of a good when its price rises.

5. How high the price of the good is: Higher the price of the good, higher is the elasticity. It is so because a change in price of a high priced good affects the total budget significantly.

6. Nature of the good: The elasticity of demand also depends on the nature of commodity or how important or necessary the good is for the consumer.
   In case of essential goods like salt, kerosene oil or match box or wheat or rice the demand will be less than unitary elastic i.e. inelastic. In case of luxury goods like air-conditioner, costly TV or furniture, gold etc. the demand will be more than unitary elastic i.e. elastic.
However, in case of comfort goods like fans, coolers, heaters etc., the demand will be unitary elastic. It is a matter of habit also. If the consumer is habitual to a certain product like liquor or cigarettes etc., he is less likely to shift to other goods in case of rise in price of the good thus demand for these products are inelastic.

7. **The period of time under consideration**
   Price elasticity of demand is greater if you study the effect of a price increase over a period of three years rather than one week. Over a longer period of time, consumers have more time to adjust to the price change. If the price of petrol increases considerably, buyers may not decrease their consumption much after one week. However, after three years, they have the ability to move closer to work or school, arrange carpools, use public transportation, or buy a more fuel-efficient vehicle.

8. **Joint Demand**
   Goods demanded jointly have inelastic demand than demanded separately. For example car and petrol pen and ink and camera and film, house and cement. Rise in price of cement may not contract its demand if there is no fall in the demand for houses.

9. **Time elapsed since a price change**
   The longer the time that has elapsed since a price change, the more elastic is demand.

1.5 **Application of Price Elasticity of Demand in Business Decision**

- **Price Determination**
  The concept of elasticity of demand is of considerable importance in pricing decisions or price determination. A businessman has to consider the elasticity of demand of that product. He should consider whether a lowering of price will stimulate demand for his product, and if so to what extent and whether his profits will also increase a result thereof. If the increase in his sales is more than proportionate, to the reduction in price, his total revenue will increase and his profits might be larger.
  On the other hand, if increase in demand is less than proportionate to fall in price, his total revenue will fall and his profits would be certainly less.
Therefore, knowledge of elasticity of demand may help the businessman to make a decision whether to cut or increase the price of his product or to shift the burden of any additional cost of production on to the consumers by charging high price.

*Note: In imperfect competition, for items having inelastic demand, the producer will fix a higher price and items whose demand is elastic the businessman will fix a lower price.*

- **Pricing of factors of production**

  The concept of elasticity of demand is useful in the determination of price of factors of production."If the demand for factors of production are more inelastic, the producers are prepare to pay more price for these factors. Likewise, if the demand for the factors of production is more elastic, the producers are prepared to pay fewer prices for the factors. For example, if the demand for labour in an industry is inelastic, the labour unions can easily increase wages. But if demand is elastic, the wages cannot be raised too much.

- **Pricing of joint products**

  Some goods are produced jointly due to some reasons such as meat and wool production in sheep farming or sugar and wine production in a sugar industry. It is difficult to separate the cost of production of these two goods. This makes it difficult to determine the price on the basis of cost. In such a situation, the price is determined on the basis of the elasticity of demand of these two products i.e high price is set up for the good having inelastic demand and low price for the good having elastic demand.

- **Price discrimination**

  Price discrimination refers to the act of selling the technically same products at different prices to different section of consumers or in different in sub-markets. The policy of price-discrimination is profitable to the monopolist when elasticity of demand for his product is different in different sub-markets. Those consumers whose demand is inelastic can be charged a higher price than those with more elastic demand.

- **Shifting of tax burden**

  To what extent a producer can shift the burden of indirect tax to the buyers by increasing price of his product depends upon the degree of elasticity of demand. If the demand is inelastic the larger part of the indirect tax can be shifted upon buyers by increasing price.
On the other hand if the demand is elastic than the burden of tax will be more on the producer.

- **Taxation and subsidy policy**
  The government can impose higher taxes and collect more revenue if the demand for the commodity on which a tax is to be levied is inelastic. On the other hand, in case of a commodity with elastic demand high tax rates may fail to bring in the required revenue for the government. Government should provide subsidy on those goods whose demand is elastic and in the production of the commodity the law of increasing returns operates.

- **Importance in international trade**
  The concept of elasticity of demand is of crucial importance in many aspects of international trade. The success of the policy of devaluation to correct the adverse balance of payment depends upon the elasticity of demand for exports and imports of the country.
  The policy of devaluation would be beneficial when demand for exports and imports is price-elastic. A country will benefit from international trade when: (i) it fixes lower price for exports items whose demand is price elastic and high price for those exports whose demand is inelastic (ii) the demand for imports should be inelastic for a fall in price and inelastic for an increase in price.
  The terms of trade between the two countries also depend upon the elasticity of demand of exports and imports of two countries. If the demand is inelastic, the terms of trade will be in favour of the seller country.

- **Designing of Marketing policies and strategies**
  Super Markets is a market where in a variety of goods are sold by a single organization. These items are generally of mass consumption. Therefore, the organization is supposed to sell commodities at lower prices than charged by shopkeepers in the other bazaars. Thus, the policy adopted is to charge a slightly lower price for items whose demand is relatively elastic and the costs are covered by increased sales.

  Similarly the levels of price elasticity of demand can also be used as a basis of market segment and then devising marketing mix for each segment according separately. For example, most of the airlines find that business travellers have relatively price inelastic
demand, while tourists have price elastic demand. Airlines take advantage of these differences by offering a stable and high price to business travellers with additional facilities like incentives for total business volume and better service. In contrast, they offer low prices to tourists who are able to plan their holidays well in advance. Also, there is a third segment comprising of customers ready to travel on holidays at very short notice provided they are offered very low prices. This third segment is used to fill up seats in aircrafts which remain unsold to the other two segments till very close to the flight time. This enables airlines to get some revenue, against spare capacity, which would have otherwise been totally wasted.

- **Effect of use of machines on employment**
  Ordinarily it is thought that use of machines reduces the demand for labour. Therefore, trade unions often oppose the use of machines fearing unemployment. But this fear is not always true because use of machines may not reduce demand for labour. It depends on the price elasticity of demand for the products. The use of machines may reduce the cost of production and price. If the demand of the product is elastic then the fall in price will increase demand significantly. As a result of increased demand the production will also increase and more workers will be employed. In such cases, concept of elasticity of demand helps the management to pacify the trade unions. However, if the demand of the product is inelastic then use of more machines will cause unemployment.

- **Public utilities**
  The nationalization of public utility services can also be justified with the help of elasticity of demand. Demand for public utilities such as electricity, water supply, post and telegraph, public transportation etc. is generally inelastic in nature. If the operation of such utilities is left in the hand of private individuals, they may exploit the consumers by charging high prices. Therefore, in the interest of general public, the government owns and runs such services. The public utility enterprises decide their price policy on the basis of elasticity of demand. A suitable price policy for public utility enterprises is to charge from consumers according to their elasticity of demand for public utility.
• **Explanation of paradox of poverty**
  Exceptionally good harvest brings poverty to the farmers and this situation is called ‘Paradox of Poverty’. This paradox is easily explained by the inelastic nature of demand for most farm products. Since the demand is inelastic, prices of farm products fall sharply as a result of large increase in their supply in the year of bumper crops. Due to sharp fall in prices, the farmers get less income even by selling larger quantity. This paradox of poverty is the basis of regulation and control of farm products prices. Government fixes the minimum prices of farm products because the demand for farm products is inelastic. Thus, the concept of elasticity of demand helps the government in determining its agricultural policies.

• **Output decisions**

  The elasticity of demand helps the businessman to decide about production. A businessman chooses the optimum product-mix on the basis of elasticity of demand for various products. The products having more elastic demand are preferred by the businessmen. The sale of such products can be increased with a little reduction in their prices.
1.6 Income Elasticity of Demand (YED)

Others things such as price of the given good or related goods, taste of the consumers etc., being remain constant, Income elasticity of demand measures the percentage change in a buyer's purchase of a product as a result of a percentage change in her/his income. So income elasticity of demand is;

\[
E_y = \frac{\% \text{ change in Quantity Demanded}}{\% \text{ change in income}}
\]

Where;

\% change in Quantity Demanded = \( \frac{Q_1 - Q_0}{Q_0} \times 100 \)

\( Q_1 \) = Quantity Demanded after the change in the price
\( Q_0 \) = Quantity Demanded before the change in the price

\% change in income = \( \frac{Y_1 - Y_0}{Y_0} \times 100 \)

\( Y_1 \) = Current income
\( Y_0 \) = Previous income

or

\[
E_y = \frac{\text{change in demand}}{\text{average demand}} / \frac{\text{change in income}}{\text{average income}}
\]

**Example**

If a person decides to buy 30% more apples because of a 15% increase in his/her income, the person's income elasticity of demand for apples is 30% / 15%, or 3.

Unlike price elasticity of demand, we cannot leave off the minus sign for income elasticity of demand, because income elasticity of demand can be either positive (for a normal good), or negative (for an inferior product).

**Characteristics:**

- \( E_y > 1 \), QD and income are directly related. This is a normal good and it is income elastic.
- \( 0 < E_y < 1 \), QD and income are directly related. This is a normal good and it is income inelastic.
- \( E_y < 0 \), QD and income are inversely related. This is an inferior good.
Ey approaches $0$, $Q_D$ stays the same as income changes, indicating a necessity.

### 1.7 Applications of Income Elasticity of Demand

The concept of YED allows a firm to determine the future size of the market for the good and hence its production capacity. Suppose that the YED for a good is positive. If a firm predicts an economic expansion which is a period of time during which national income is rising, it should increase its production capacity in order to be able to meet the higher demand when the economic expansion comes. Furthermore, the higher the YED is, the larger will be the increase in the demand and hence the larger the extent the firm should increase its production capacity. Conversely, if the firm predicts an economic contraction which is a period of time during which national income is falling, it should decrease its production capacity to minimise excess capacity when the economic contraction comes.

The concept of YED may enable a firm to determine how to formulate its marketing strategy. Suppose that a firm sells two goods. Further suppose that one of the goods is a normal good and the other good is an inferior good. If the economy is expanding and hence national income is rising, the firm should focus its marketing strategy on the normal good. Conversely, if the economy is contracting and hence national income is falling, the firm should focus its marketing strategy on the inferior good.

*(Note: It is important to note increasing production capacity is not the same as increasing production. Increasing production capacity does not lead to an increase in current output. Rather, it enables the firm to increase future output.)*
1.8 Cross Price Elasticity of Demand (XED)

In the case of a product that has a substitute (like oranges and apples), the price change of one product affects the demand for the other. Cross price elasticity of demand measures this effect.

So Cross elasticity of demand is:

\[
E_{c} = \frac{\% \text{ change in Quantity Demanded for A}}{\% \text{ change in price of product B}}
\]

Where:

\[
\% \text{ change in Quantity Demanded} = \frac{Q_{d}}{Q_{0}} \times 100
\]

\[
Q_{d} = \text{Quantity Demanded of A after the change in the price of B}
\]

\[
Q_{0} = \text{Quantity Demanded of A before the change in the price of B}
\]

\[
\% \text{ change in price of product B} = \frac{P_{1} - P_{0}}{P_{0}} \times 100
\]

\[
P_{1} = \text{Current price of product B}
\]

\[
P_{0} = \text{Previous price of product B}
\]

or

\[
E_{c} = \frac{\text{change in the quantity demanded of product A}}{\text{the average of the quantity of product A}} / \frac{\text{change in the price of product B}}{\text{the average price of product B}}
\]

Cross price elasticity of demand (XED) for substitute goods

If the demand for Pepsi decreases by 10% after the price of Coke decreases by 5%, the cross elasticity of demand for Pepsi will be calculated as follow;

As Coke and Pepsi are substitute products. If Pepsi's demand decreases by 10% because Coke's price decreases by 5%, and assuming no change in the price of Pepsi and no change in other variables in the economy (ceteris paribus), then the cross price elasticity of demand for Pepsi relative to a price change in Coke is
Elasticity of Demand

Cross price elasticity of demand (XED) for complementary goods

Cross price elasticity of demand can also be computed for complementary goods. Complementary products are products that are consumed together. Computer software and personal computers are complementary products.

Example

What will be the cross price elasticity of demand for computer software if the demand for computer software increases by 45% because of a decrease of 15% in the price of personal computers?

Solution: The cross price elasticity of demand for computer software relative to a price change in personal computers is;

\[
E_c = \frac{+45}{-15} = -3 \text{(negative)}.
\]

Characteristics:

- XED > 0, QD of X and Price of Y are directly related. X and Y are substitutes.
- XED approaches 0, QD of X stay the same as the Price of Y changes. X and Y are not related.
- XED < 0, Qd of X and Price of Y are inversely related. X and Y are complements.

Positive coefficient indicates that the two goods are substitutes. A negative coefficient indicates the goods are complements. A zero or near zero coefficient indicates that the two goods are independent.

1.9 Applications of Cross Elasticity of Demand (XED)

The concept of XED allows a firm to determine how a change in the price of a related good produced by another firm will affect the demand for its good. For example, if a rival firm decreases its price, the demand for the good produced by the first firm will fall due to the positive XED between substitutes. To avoid a decrease in sales, the firm may need to decrease its price. However, if this is likely to lead to a price war, the firm may consider engaging in non-price competition such as product promotion and product development instead of decreasing its price. If a rival firm increases its price, the demand for the good produced by the first firm will increase if it keeps its
price constant. However, the firm may not experience an increase in sales if it has no or little excess capacity.

The concept of XED may enable a firm that produces two or more goods which are complements to increase total revenue. For example, a telecommunications firm may reduce the price of its mobile devices even if the demand is price inelastic. Although the revenue from the sale of its mobile devices will fall as the quantity demanded will rise by a smaller proportion, the demand and hence the revenue from the provision of its mobile network services will rise due to the negative XED between mobile network services and mobile devices. Therefore, the total revenue of the telecommunications firm may increase.

1.10 Advertising elasticity of demand

Advertising elasticity of demand (or simply advertising elasticity, often shortened to AED) measure the effect of an increase or decrease in advertising on a sales or market of a product. The advertising elasticity of demand measures the percentage change in demand that occurs given a 1 percent change in advertising expenditure. Although traditionally considered as being positively related, demand for the good that is subject of the advertising campaign can be inversely related to the amount spent if the advertising is negative.

Good advertising will result in a positive shift in the demand of a product. AED is used to measure the effectiveness of this strategy in increasing demand versus its cost.

Mathematically, then, AED measures the percentage change in the quantity of a good demanded induced by a given percentage change in spending on advertising in that product;

So Advertising Elasticity of Demand is:

\[
AED = \frac{\text{% change in Quantity sold for a product}}{\text{% change in spending on advertisement of that product}}
\]

Where:

- % change in Quantity sold = \( \frac{Q_1 - Q_0}{Q_0} \times 100 \)
- \( Q_1 \) = Quantity sold after the advertisement
- \( Q_0 \) = Quantity sold before the advertisement
- % change in spending on advertisement of A = \( \frac{A_1 - A_0}{A_0} \times 100 \)
- \( A_1 \) = Current spending on advertisement of A
A\_0 = \text{Previous spending on advertisement of } A

In other words, the percentage by which sales will increase after a 1% increase in advertising expenditure assuming all other factors remain equal. AED is usually positive. Negative advertising may, however, result in a negative AED.

**Examples**

What will be the Advertising Elasticity of Demand for a good if the sale of that good has increased by 20% because of 5% increase in advertising expenditure?

Solution: The Advertising Elasticity of Demand for the product relative to a change in advertising expenditure is;

\[
\text{AED} = \frac{(+20)}{(+5)} = 4 \text{(positive)}.
\]

1.11 Application of Advertising Elasticity of Demand

Advertising Elasticity of Demand helps the manager in evaluating the effectiveness and usefulness of company’s advertisement. If the increased spending on advertisement resulted in more percentage increase in firm’s revenue as compared to percentage increase in advertising spending or AED is positive, the advertisement is effective and useful. Up to certain point, an increase in advertising or promotional spending will lead to more than proportionate increase in company’s sale. But beyond this point, an increase in advertising or promotional spending will lead to less than proportionate increase in company’s sale till the saturation point is reached, after that there will be no increase in sales. At this point company should either stop advertising or redesign its advertisement policies.
1.12 Limitations of the Concepts of Elasticity of Demand

The concepts of elasticity of demand are subject to several limitations.

Irrelevant and Unreliable Data

The data that are used to calculate elasticity of demand may be irrelevant or unreliable. Data from past records may no longer be relevant to calculating elasticity of demand as some of the determinants of demand may have changed. Although data from current market surveys are relevant to calculating elasticity of demand, they may not be reliable as the respondents may not be truthful in their responses. Furthermore, if the sample sizes of the market surveys are small, the results may not be reliable as they may not be reflective of the actual markets for the goods.

Unrealistic Assumption

The assumption of ceteris paribus that is made in calculating elasticity of demand is unlikely to hold in reality. In reality, many factors such as the level of income, the price of the good and the prices of related goods are changing simultaneously.
1.13 Summary

Elasticity of demand measures how much the quantity demanded changes with a given change in a particular determinant of demand (i.e. price of the item, change in consumers’ income, or change in price of related product and advertisement etc.). Price elasticity of demand is of great significance in making business decisions. This insight helps the managers to determine the prices of different products that will yield maximum profit for their businesses. In fact, a manager must take into account the factors that influence the demand of a product to be more or less elastic.

The concept of XED allows a firm to determine how a change in the price of a related good produced by another firm will affect the demand for its good. Advertising Elasticity of Demand helps the manager in evaluating the effectiveness and usefulness of company’s advertisement. If the increased spending on advertisement resulted in more percentage increase in firm’s revenue as compared to percentage increase in advertising spending or AED is positive, the advertisement is effective and useful.