

# 3

## DEMAND ANALYSIS—II: ELASTICITY OF DEMAND

### Learning Objectives

**After completing this chapter, you should be able to understand**

- elasticity of demand and its types
- factors affecting elasticity of demand
- measurement of elasticity
- significance of elasticity of demand

### INTRODUCTION

In the previous chapter, you have studied the laws governing consumer behaviour, concepts of demand, laws governing demand and changes in price and quantity demanded. There, you were concerned only with direction of changes in prices and quantities demanded. These changes are not so far quantified. Measuring these changes is necessary to study the changes in quantity demanded in relation to changes in price, income or prices of substitutes/ complementaries and there by take important decision whether to increase the price or reduce the price without suffering a loss in demand for goods and services.

This chapter explains the concept of elasticity of demand, its types, factors affecting elasticity of demand, how to measure elasticity and make use of the concept of elasticity of demand in our day-to-day life.

### ELASTICITY OF DEMAND

Most of the times, it is not enough to understand the increase or decrease in price and its consequential impact of change in the quantity demanded. It is necessary to find out the extent of increase or decrease in each of the variables for taking certain managerial decisions. This paves the way for the concept of elasticity of demand.

The term 'elasticity' is defined as *the rate of responsiveness in the demand of a commodity for a given change in price or any other determinants of demand*. In other words, it explains the extent of change in



quantity demanded because of a given change in the other determining factors, may be price or any other factor(s).

### Measurement of Elasticity

The elasticity is measured in the following ways:

- (a) Perfectly elastic demand
- (b) Perfectly inelastic demand
- (c) Relatively elastic demand
- (d) Relatively inelastic demand
- (e) Unity elasticity

These are explained below.

**(a) Perfectly Elastic Demand** When any quantity can be sold at a given price, and when there is no need to reduce price, the demand is said to be *perfectly elastic*. In such cases, even a small increase in price will lead to complete fall in demand. This is illustrated in Fig. 3.1(a).

Figure 3.1(a) reveals that the quantity demanded increases from  $OQ$  to  $OQ_1$ , from  $OQ_1$  to  $OQ_2$  even though there is no change in price. Price is fixed at  $OP$ .

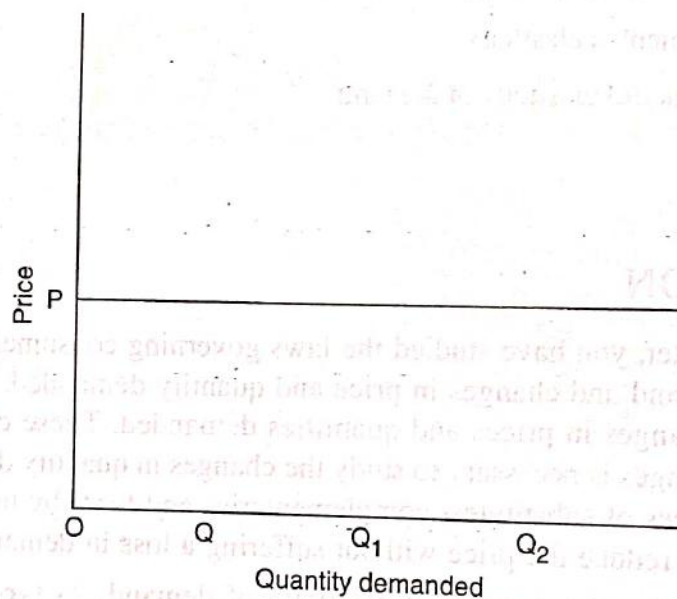


Fig. 3.1(a) Perfectly Elastic Demand

**(b) Perfectly Inelastic Demand** When a significant degree of change in price leads to little or no change in the quantity demanded, then the elasticity is said to be *perfectly inelastic*.

In other words, the demand is said to be perfectly inelastic when there is no change in the quantity demanded even though there is a big change (increase or decrease) in price.

Figure 3.1(b) reveals that there is no change in the quantity demanded though there is change in price, say increase or decrease. In other words, despite the increase in price from  $OP$  to  $OP_1$ , the quantity demanded has not fallen down. Similarly, though there is a fall in the price from  $OP_3$  to  $OP_2$ , the quantity demanded remains unchanged.

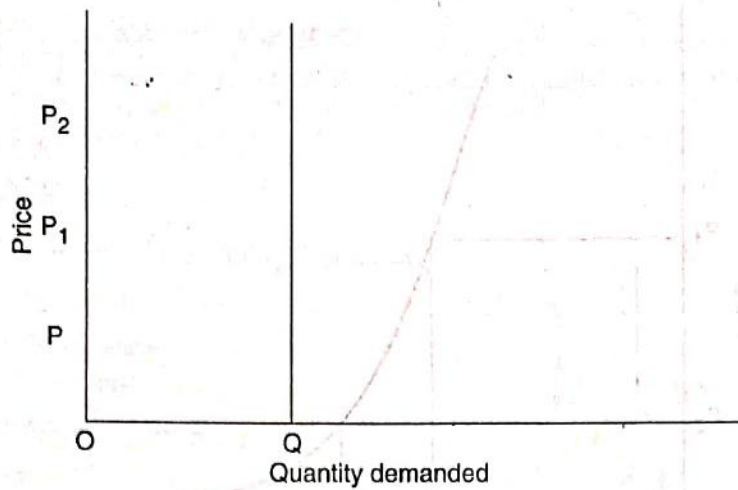


Fig. 3.1(b) Perfectly Inelastic Demand

The concepts of perfectly elastic and perfectly inelastic demand do not manifest in real life.

**(c) Relatively Elastic Demand** The demand is said to be relatively elastic when the change in demand is more than the change in the price. Figure 3.1(c) reveals that the quantity demanded increases from  $OQ_1$  to  $OQ_2$  because of a decrease in price from  $OP_1$  to  $OP_2$ . The extent of increase in the quantity demanded is greater than the extent of fall in the price.

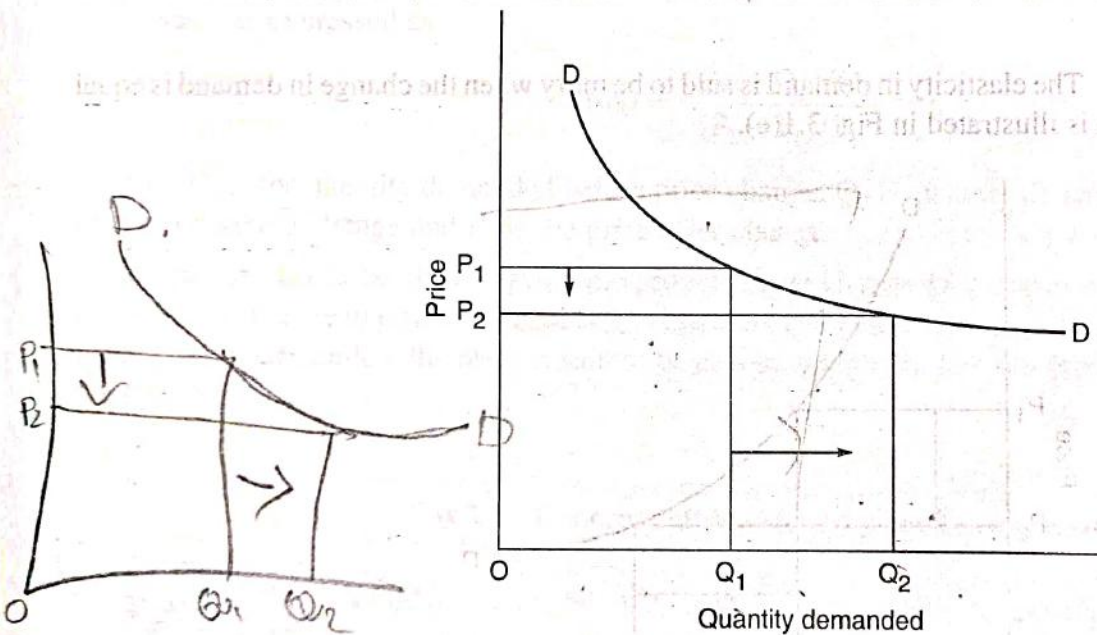
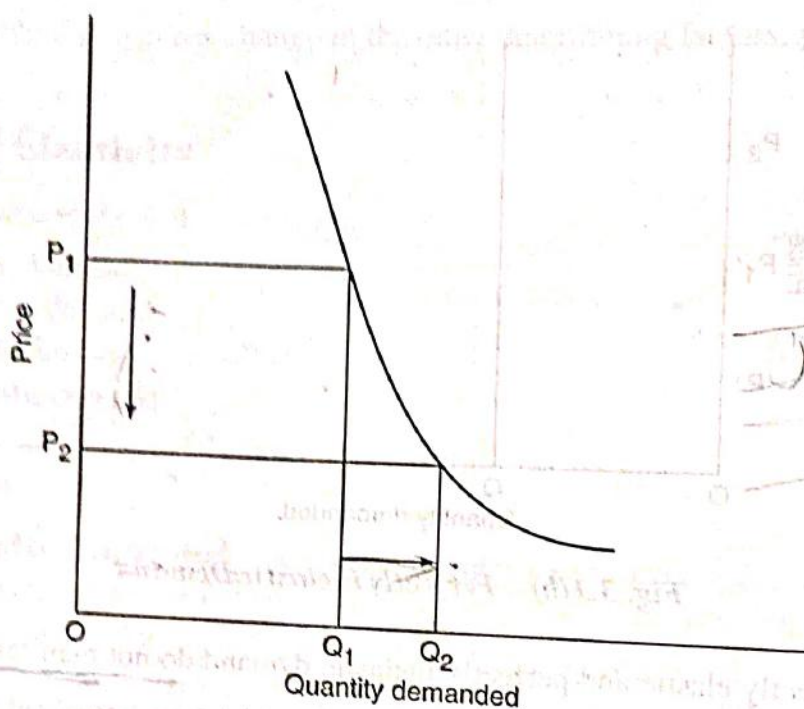


Fig. 3.1(c) Relatively Elastic Demand

**(d) Relatively Inelastic Demand** The demand is said to be relatively inelastic when the change in demand is less than the change in the price. This is illustrated in Fig. 3.1(d).

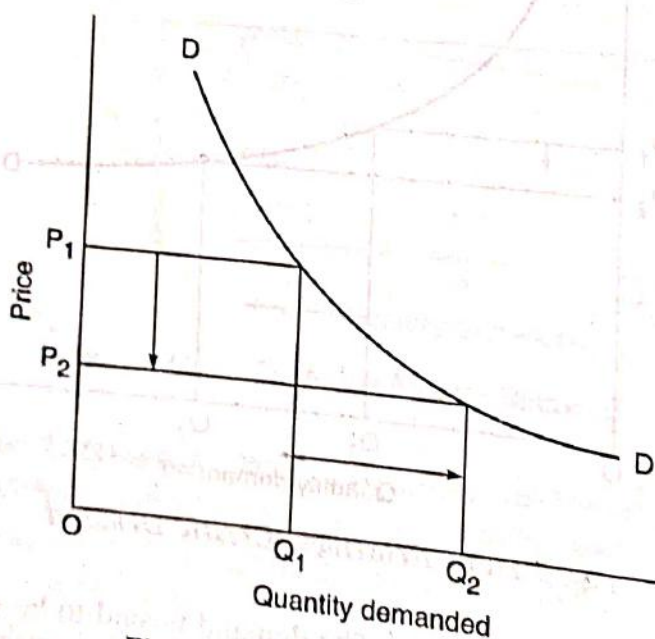




**Fig. 3.1(d) Relatively Inelastic Demand**

Figure 3.1(d) reveals that the quantity demanded increases from  $OQ_1$  to  $OQ_2$  because of a decrease in price from  $OP_1$  to  $OP_2$ . The extent of increase in the quantity demanded is lesser than the extent of fall in the price.

**(e) Unity Elasticity** The elasticity in demand is said to be unity when the change in demand is equal to the change in price. This is illustrated in Fig. 3.1(e).



**Fig. 3.1(e) Unity Elasticity**



Figure 3.1(e) reveals that the quantity demanded increases from  $OQ_1$  to  $OQ_2$  because of a decrease in price from  $OP_1$  to  $OP_2$ . The extent of increase in the quantity demanded is equal to the extent of fall in the price.

### Types of Elasticity

The following are the four types of elasticity of demand:

- Price elasticity of demand
- Income elasticity of demand
- Cross elasticity of demand
- Advertising elasticity of demand

These are explained below:

**(a) Price Elasticity of Demand** Elasticity of demand in general refers to price elasticity of demand. In other words, it refers to the quantity demanded of a commodity in response to a given change in price. Price elasticity is always negative which indicates that the customer tends to buy more with every fall in the price. The relationship between the price and the demand is inverse.

It is measured as follows:

$$\text{Price elasticity of demand} = \frac{\text{Proportionate change in the quantity demanded for product X}}{\text{Proportionate change in the price of X}}$$

The same is expressed as

$$E_{dp} = \frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1}$$

Where  $Q_1$  is the quantity demanded before price change,  $Q_2$  is quantity demanded after price change,  $P_1$  is the price before change and  $P_2$  is the price after change.

The price is said to be elastic, when the proportionate change in quantity demanded is more than the proportionate change in price. For instance, a 5 percent fall in the price results in an increase of 20 percent in the quantity demanded, the price is said to be elastic, which implies that the elasticity is more than one ( $e > 1$ ).

#### Box 3.1 Concept of Price Elasticity and Impact on Revenue Summarised

Price elasticity of demand What this means Impact on Price

$ED > 1$  (elastic demand) Percentage change in quantity demanded greater than percentage change in Price Revenue increases with every fall in price

$ED = 1$  (Unity elasticity) Percentage change in quantity demanded is equal to percentage change in Price Revenue remains unchanged even though there is fall in the price

$ED < 1$  (Inelastic demand) Percentage change in quantity demanded less than percentage change in Price Revenue decreases when price is lowered



On the other hand, if the price is said to be inelastic then it means that the proportionate change in the quantity demanded is less than the proportionate change in the price. A 10 percent increase in price resulting in a 2 percent drop in the quantity demanded of the product implies a product where the demand is said to be price inelastic, which means the elasticity is less than one ( $e < 1$ ).

### Example 1 Elastic price demand ( $e > 1$ ):

Determine the price elasticity of demand given that

- the quantity demanded for product M is 1000 units at a price of Rs. 100.
- the price declines to Rs. 90 and the quantity demanded increases to 1500 units.

**Solution**

$$Edp = \frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1}$$

Let us define these variables here.

$$Q_1 = 1000 \text{ units (quantity before change)}$$

$$Q_2 = 1500 \text{ units (quantity after change)}$$

$$P_1 = \text{Rs. } 100 \text{ (price before change)}$$

$$P_2 = \text{Rs. } 90 \text{ (price after change)}$$

$$Edp = \frac{(1500 - 1000)/1000}{(90 - 100)/100} = -5$$

Since  $Edp$  is  $-5$ , it means that for a 10 percent change in price, there is a change in demand by 50 percent. Where the numerical value of elasticity is more than one, the demand is *elastic*. In other words, the percentage of increase in quantity demanded is more than the percentage of decrease in price.

### Example 2 Inelastic price demand ( $e < 1$ ):

Determine the price elasticity of demand given that

- the quantity demanded for product M is 1000 units at a price of Rs. 100.
- the price declines to Rs. 70 and the quantity demanded increases to 1100 units.

**Solution**

$$Edp = \frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1}$$

Let us define these variables here.

$$Q_1 = 1000 \text{ units (quantity before change)}$$

$$Q_2 = 1100 \text{ units (quantity after change)}$$

$$P_1 = \text{Rs. } 100 \text{ (price before change)}$$

$$P_2 = \text{Rs. } 70 \text{ (price after change)}$$

$$Edp = \frac{(1100 - 1000)/1000}{(70 - 100)/100} = -0.33$$



### Box 3.2 Price Elasticity for Goods and Services

Price elasticity for various goods and services varies based on number of factors such as number of substitutes available, urgency in use etc. For instance, where there are more number of substitutes (as in case of brinjals or cabbage), a product may have higher price elasticity and vice versa. Price elasticity is low for public utility services such as transport and electricity used for domestic purposes). Observe the following table.

Goods/services	Price elasticity
Brinjals	3.5
Cabbage	2.8
Health insurance	1.9
Public transport	1.0
Electricity for domestic purpose	0.5

Since  $E_{dp}$  is  $-0.33$ , it means that for a 10 percent fall in price, there is an increase in demand by 3.3 percent. Where the numerical value of elasticity is less than one, the price demand is *inelastic*. In other words, the percentage of increase in quantity demanded is less than the percentage of decrease in price.

#### Example 3 Unity price elasticity ( $e=1$ ):

Determine the price elasticity of demand given that

- the quantity demanded for product M is 1000 units at a price of Rs. 100.
- the price declines to Rs. 50 and the quantity demanded increases to 1500 units.

*Solution*

$$E_{dp} = \frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1}$$

Let us define these variables here.

$Q_1 = 1000$  units (quantity before change)

$Q_2 = 1500$  units (quantity after change)

$P_1 = \text{Rs. } 100$  (price before change)

$P_2 = \text{Rs. } 50$  (price after change)

$$E_{dp} = \frac{(1500 - 1000)/1000}{(50 - 100)/100} = 1.0$$

Since  $E_{dp}$  is 1, it means that for a 50 percent fall in price, there is an increase in demand by 50 percent. Where the numerical value of elasticity is equal to one, the price demand is *unity elasticity*. In other words, the percentage of increase in quantity demanded is equal to the percentage of decrease in price.





**Significance of price elasticity of demand** It is necessary that the trader should be aware of the impact of changes in the quantity demanded for a given change in price. He can take a decision as to how much he can supply if he is aware of the likely change in quantity demanded as a result of change in price.

### Box 3.3 Situation Analysis: Price Elasticity

In each situation, state whether demand is price elastic, price inelastic or unity elasticity.

- A 10% rise in the price of refrigerators leads to a 10% fall in quantity demanded.
- The quantity of cars demanded rises by 14% following a 5% fall in car prices.
- A 10% rise in the cinema ticket rate leads to a 5% fall in their quantity demanded.
- A 3% change in price of petrol leads to a 0.05% change in quantity demanded
- A 10% increase in the wages of construction workers
- A 20% increase in the deluxe interior fittings

**(b) Income Elasticity of Demand** Income elasticity of demand refers to the quantity demanded of a commodity in response to a given change in income of the consumer.

Income elasticity is normally positive, which indicates that the consumer tends to buy more and more with every increase in income.

It is measured as follows:

$$\text{Income elasticity of demand} = \frac{\text{Proportionate change in quantity demanded for product X}}{\text{Proportionate change in income}}$$

The same is expressed as

$$Ed_i = \frac{(Q_2 - Q_1)/Q_1}{(I_2 - I_1)/I_1}$$

Where  $Q_1$  is the quantity demanded before change,  $Q_2$  is quantity demanded after change  
 $I_1$  is income before change and  $I_2$  is the income after change.

A positive income elasticity indicates that the demand for the product rises more quickly than the rise in disposable income. In other words, the demand is more responsive to a change in income.

**Example 4 Elastic income demand ( $e > 1$ ):**

Determine the Income elasticity of demand given that

- the quantity demanded for product M is 1000 units at a daily income of Rs. 100.
- the daily income declines to Rs. 80 and the quantity demanded decreases to 700 units.

**Solution**

$$Ed_i = \frac{(Q_2 - Q_1)/Q_1}{(I_2 - I_1)/I_1}$$



Let us define these variables here.

$Q_1 = 1000$  units (quantity before change)

$Q_2 = 700$  units (quantity after change)

$I_1 = \text{Rs. } 100$  (daily income before change)

$I_2 = \text{Rs. } 80$  (daily income after change)

$$\begin{aligned} \text{Edi} &= \frac{(700 - 1000)/1000}{(80 - 100)/100} \\ &= 1.5 \end{aligned}$$

Edi is 1.5, which means that for a 10 percent fall in income, there is a decrease in demand by 15 percent. Where the numerical value of elasticity is more than one, the price demand is *relatively elastic*. In other words, the percentage of decrease in quantity demanded is more than the percentage of fall in income. In times of depression, the incomes fall and consequently the demand for the goods and services also decrease.

Similarly the inelastic income demand and unity income demand can be determined.

**Significance of income elasticity** In determining the effects of changes in business activity, it is necessary for the trader to be aware of the income elasticity of demand for given commodities. With the help of income elasticity of demand, he can estimate the likely changes in the demand for his product as a result of changes in the national income. Income elasticity will help us in knowing whether a commodity is a superior good, normal good or an inferior good. If the income elasticity is positive and greater than one, it is a *superior good*. The superior goods such as automobiles and refrigerators can be advertised in business magazines for better attention from the consumers. Retail show rooms also can be located where high income group customers find it convenient to shop. If the income elasticity is positive and less than or equal to one, it is a *normal good*. If the income elasticity is negative, it is an *inferior good*. Knowledge of the nature of goods helps in allocating advertisement budget.

#### Box 3.4 Situation Analysis: Income Elasticity

In each situation, state whether income elasticity of demand is positive or negative. Explain the reason in each case.

- Salt
- Electricity
- Holidays in Singapore
- Colour Television
- Tubeless tyres (used in imported cars)

**(c) Cross Elasticity of Demand** Cross elasticity of demand refers to the quantity demanded of a commodity in response to a change in the price of a related good, which may be substitute or complement.

It is measured as follows:

$$\text{Cross elasticity of demand} = \frac{\text{Proportionate change in quantity demanded for product X}}{\text{Proportionate change in price of product Y}}$$



The same is expressed as

$$E_{dc} = \frac{(Q_2 - Q_1)/Q_1}{(P_{2y} - P_{1y})/P_{1y}}$$

Where  $Q_1$  is the quantity demanded before change,  $Q_2$  is quantity demanded after change,  $P_{1y}$  is the price before change and  $P_{2y}$  is the price after change in the case of product  $Y$ .

Cross elasticity is always positive for substitutes (which means that the demand for tea goes up if there is an increase in the price of coffee) and negative for complements (which means that if there is an increase in the price of sugar, the demand for coffee tends to fall).

**Example 5 Inelastic cross demand ( $e < 1$ ):**

Determine the cross elasticity of demand given that

- the quantity demanded for product  $M$  is 1000 units at a daily income of Rs. 100.
- the daily income declines to Rs. 80 and the quantity demanded decreases to 700 units.

*Solution*

$$E_{dc} = \frac{(Q_2 - Q_1)/Q_1}{(P_{2y} - P_{1y})/P_{1y}}$$

Let us define these variables here.

$Q_1 = 1000$  kg (quantity of coffee demanded before change)

$Q_2 = 1200$  kg (quantity of coffee demanded after change)

$P_{1y} = \text{Rs. } 20$  (price of sugar per kg. before change)

$P_{2y} = \text{Rs. } 30$  (price of sugar per kg after change)

$$\begin{aligned} E_{dp} &= \frac{(1200 - 1000)/1000}{(30 - 20)/20} \\ &= 0.4 \end{aligned}$$

Since  $E_{dp}$  is 0.4 it means that for a 10 percent increase in the price of sugar, there is an increase in demand by 4 percent. Where the numerical value of elasticity is less than one, the cross demand is *relatively inelastic*. In other words, the percentage increase in quantity demanded of coffee is less than the percentage increase in price of a related good say sugar. Sugar and coffee are complements. The increase in price of sugar has shown its impact on the demand for coffee by marginalising the percentage of increase.

Similarly, the elastic cross demand (where  $e > 1$ ) and unity cross demand (where  $e = 1$ ) can be determined.

### Box 3.5 Situation Analysis: Cross Elasticity

In each situation, state whether the cross elasticity of demand is positive or negative:

- Rice and vegetables
- Car and scooters
- Computers and related software
- Bank loans and Number of industries



**Significance of cross elasticity of demand** Knowledge of cross elasticity of demand helps a firm to estimate the likely effect of pricing decisions of its traders dealing in related products on sales. It also helps in defining industry.

**(d) Advertising Elasticity** It refers to increase in the sales revenue because of change in the advertising expenditure. In other words, there is a direct relationship between the amount of money spent on advertising and its impact on sales. Advertising elasticity is always positive.

$$\text{Advertising elasticity} = \frac{\text{Proportionate change in quantity demanded for product X}}{\text{Proportionate change in advertisement costs}}$$

The same is expressed as

$$E_{da} = \frac{(Q_2 - Q_1)/Q_1}{(A_2 - A_1)/A_1}$$

Where  $Q_1$  is the quantity demanded before change,  $Q_2$  is quantity demanded after change  $A_1$  is the amount spent on advertisement before change and  $A_2$  is the amount spent on advertisement after change.

### Box 3.6 Elasticity Concept: How Airlines Industry Benefits

The concept of elasticity of demand is useful to every businessman equality. The stakes in airlines industry are huge and hence this example highlights how risk is minimised by following elasticity concept.

Basic service remains the same, by providing some other related facilities, Airlines charges its customers differently.

For instance, it has two classes: Business class and Economy class.

Business Class passengers are assumed to have low elasticity and hence are charged relatively higher. Because of their tight schedule, they have a compulsion to travel at the earliest through for a higher fare.

Economy class passengers normally have high elasticity and hence are charged lower. They respond very sharply to price increases. They may even postpone to take advantages in the fare, if any. However, if the travel is urgent, one may even travel by Business class also.

It is common to find airlines offering special incentives to the frequent flyers such as special discounts for early bookings, group bookings, allowing more luggage, etc.

The advertising elasticity is said to be high when even a small percentage change in the advertising expenditure results in a large percentage of change in the level of quantity demanded or sales.

#### Example 6 Elastic advertising demand ( $e > 1$ ):

Determine the advertising elasticity of demand given that

- the quantity demanded for product M is 1,00,000 units per day at a monthly advertising budget of Rs. 10,000
- the monthly advertising budget is slashed to Rs. 5,000; the quantity demanded will fall down to 30,000 units per day.



**Solution**

$$Eda = \frac{(Q_2 - Q_1)/Q_1}{(A_2 - A_1)/A_1}$$

Let us define these variables here.

$Q_1 = 100000$  units (quantity demanded before change)

$Q_2 = 30,000$  units (quantity demanded after change)

$A_1 = \text{Rs.}10,000$  (advertising budget before change)

$A_2 = \text{Rs.}5,000$  (advertising budget after change)

$$\begin{aligned} Eda &= \frac{(Q_2 - Q_1)/Q_1}{(A_2 - A_1)/A_1} \\ &= +1.4 \end{aligned}$$

Since  $Eda$  is  $+1.4$  it means that for a 10 percent decrease in the advertising budget, there is a decrease in demand by 14 percent. Where the numerical value of elasticity is more than one, the advertising elasticity is *relatively elastic*. In other words, the percentage of decrease in advertising budget is less than the percentage of decrease in the quantity demanded.

Similarly the inelastic advertising demand (where  $e < 1$ ) and unity elasticity of advertising (where  $e = 1$ ) can be determined.

**Significance of advertising elasticity of demand** The advertising agencies richly depend on this concept to provide consultancy for their clients about the advertisement budgets for a given level of sales activity.

## FACTORS GOVERNING ELASTICITY OF DEMAND

Elasticity is governed by a number of factors. Change in any one of these factors is likely to affect the elasticity of demand. The factors are:

**(a) Nature of product** Based on their nature, the products and services are classified into necessities, comforts and luxuries. Necessaries imply the absolute or basic necessities such as food, clothing, housing. Comforts refer to TV, refrigerator and so on. By luxuries, we mean sofa sets, marble flooring in a house and such others. The meaning and definition of these necessaries, luxuries and comforts change from person to person, time to time and place to place. For example, a scooter may be a comfort or luxury for a student but when he does a part-time job, it may be a necessity for him.

The nature of product has a significant impact on the elasticity of demand. For instance, if there is an increase in the price of rice, we still buy it because it is a necessity for us. This means that the demand is inelastic to price. Though there is an increase in price, we tend to buy the necessities such as petrol, diesel and so on. In other words, the demand does not fall because of increase in price. From this, we can say that the necessities have inelastic demand. For comforts and luxuries, the demand is relatively elastic. It means that any increase in the price of comforts or luxuries will lead to moderate to significant fall in their demand.

**(b) Time frame** The more the time available for the customer, the demand for a particular product may be elastic and vice versa. Take the case of vegetables. When you do not have time, you go to a nearby shop and buy whatever you want at the given price. Had you had little free time, you would have preferred to get the same from a vegetable market at lesser price.



- (c) **Degree of postponement** Where the product consumption can be postponed, the product is said to have elastic demand and where it cannot be postponed, it is said to have inelastic demand. The consumption of necessities cannot be postponed and hence they have inelastic demand.
- (d) **Number of alternative uses** If the number of alternative uses are more, the demand is said to be highly inelastic and vice versa. Take the case of power or electricity. It is used for a number of alternative uses such as running of machines in industries, offices, households, trains, and so on.
- (e) **Tastes and preferences of the consumer** Where the customer is particular about his taste and preferences, the product is said to be inelastic. For the customers who are particular or loyal to certain brands such as Colgate, Tata Tea, Annapurna Atta, and so on, price increases do not matter. They tend to buy that brand in spite of the price changes.
- (f) **Availability of close substitutes** Where there are a good number of close substitutes, the demand is said to be elastic and vice versa. For gold, there is no close and literal substitute and hence the demand for gold is inelastic. If coffee and tea are equally good for me, if there is an increase in price of coffee, I may tend to switch over to tea. But this may not hold good when I am particular about coffee only. I may be prepared to pay higher price for coffee.
- (g) **In case of complementaries or joint goods** In case of complementaries or goods having joint demand, the elasticity is comparatively low.
- (h) **Level of prices** If the price is very expensive (such as diamonds) or very cheap (such as salt), then the product is likely to have an inelastic demand. If the price is too high, a fall in it will not increase the demand much. Similarly, if the price is too low, a further fall in its price is not likely to result in more demand. The demand of the relatively poor people is more sensitive to price changes. In order to derive maximum satisfaction from their limited income, they try to plan their purchases in response to changes in prices. The rich may not bother about price changes.
- (i) **Availability of subsidies** Subsidy refers to money paid by a government or other public authority in order to help a company financially or to make something cheaper for the public. There is need for subsidies in case of goods with inelastic demand such as LPG, sugar, wheat and so on.
- (j) **Expectation of prices** Where people expect a fall in the price, the demand for the product is likely to be inelastic.
- (k) **Durability of the product** Where the product is durable in case of consumer durables such as TV, the demand is elastic. In the case of perishable goods such as milk, the demand is inelastic.
- (l) **Government policy** Where the government policy is liberal, the product is likely to have elastic demand and vice versa. Government, in the interest of the lower income group consumers, closely monitors the prices of certain products (such as, ration goods as sold in fair price shops are likely to have inelastic demand). Also, another example could be taxes. Government can raise tax collections with a little reduction in the tax rates.

### Significance of Elasticity of Demand

The concept of elasticity is very useful to the producers and policy-makers alike. It is a very valuable tool to decide the extent of increase or decrease in price for a desired change in the quantity demanded for the products and services in the firm or the economy. The following are its applications:

- (a) to fix the prices of factors of production



- (b) to fix the prices of goods and services provided rendered
- (c) to formulate or revise government policies
- (d) to forecast demand
- (e) to plan the level of output and price

These are explained below:

**(a) Prices of factors of production** The factors of production are land, labour, capital organisation and technology. These have a cost. We have to pay rent, wages, interest, profits and price for these factors of production. Now, the question is how much do we have to pay for each of these factors. The elasticity here depends on the supply of each of the factors vis-a-vis the demand for each of them respectively. For instance, where the labour is organised and unionised, the labour is said to be inelastic. Similarly, in a village, demand for land may be elastic, whereas in the case of an industrial township, it is inelastic. A higher rent has to be paid for the facilities available there.

**(b) Price fixation** The manufacturer can decide the amount of price that can be fixed for his product based on the concept of elasticity. If there is no competition, in other words, in the case of a monopoly, the manufacturer is free to fix his price as long as it does not attract the attention of the government. Where there are close substitutes, the product is such that its consumption can be postponed, it cannot be put to alternative uses and so on, then the price of the product cannot be fixed very high.

**(c) Government policies**

- (i) *Tax policies* Government extensively depends on this concept to finalise its policies relating to taxes and revenues. Where the product is such that the people cannot postpone its consumption, the government tends to increase its price, such as petrol and diesel, cigarettes, and so on. The finance minister uses elasticity concept to identify the various products and services where the taxes can be levied, and where relief can be extended to bring about the desired changes in the production, consumption, savings or investments.
- (ii) *Raising bank deposits* If the government wants to mobilise larger deposits from the customers, it proposes to raise the rates of fixed deposits marginally and vice versa.
- (iii) *Public utilities* Government uses the concept of elasticity in fixing charges for the public utilities such as electricity tariff, water charges, ticket fare in case of road or rail transport and so on.
- (iv) *Revaluation or devaluation of currencies* The government has to study the impact of revaluation or devaluation on the interests of the exporters and importers.
- (v) *Formulate government policy* If the product is such that the demand is inelastic, the government would like to exercise close control over the matters relating to its supply and demand.

**(d) Forecasting demand** Income elasticity is used to forecast demand for a particular product or service. The demand for the products can be forecast at a given income level. The trader can estimate the quantity of goods to be sold at different income levels to realise the targeted revenue. In other words, the impact of changing income levels on the demand of the product can be assessed with the help of income elasticity.

**(e) Planning the levels of output and price** The knowledge of price elasticity is very useful to producers. The producer can evaluate whether a change in price will bring in adequate revenue or not. In general, for items whose demand is elastic, it would benefit him to charge relatively low prices. On the other hand,



if the demand for the product is inelastic, a little higher price may be helpful to him to get huge profits without losing sales.

To sum up, elasticity is an equally valuable tool for the producer, trader and policy-makers.

### Point Elasticity and Arc Elasticity

A demand curve does not have the same elasticity throughout its entire length. In general, elasticity differs at different points on a given demand curve. However, this does not hold good in the following three cases: a) perfectly elastic b) perfectly inelastic and c) unity elasticity. The demand curves in each of these cases possess a single elasticity throughout its entire length. Figure 3.2 shows the changing elasticity at different points of a demand curve.

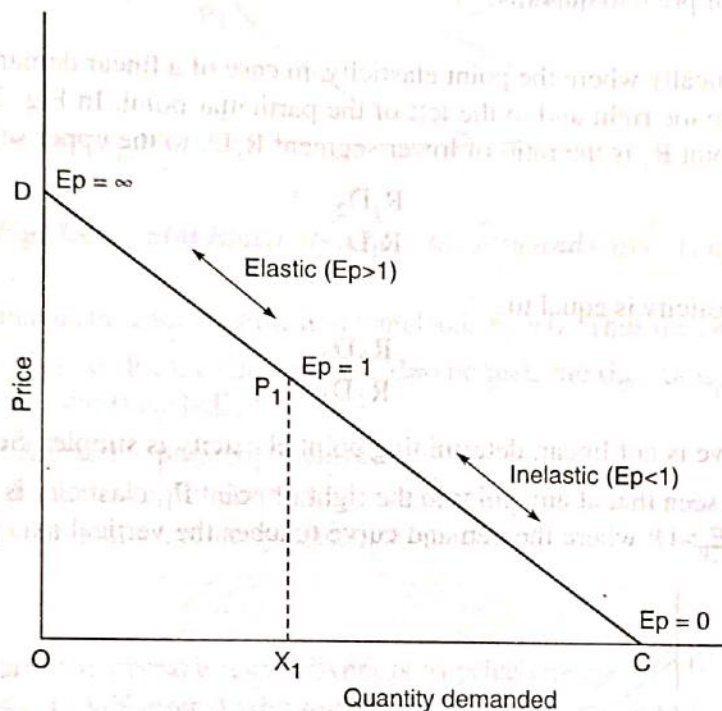


Fig. 3.2 Elasticity Changing at Different Points of the Demand Curve

From Fig. 3.2, it can be seen that elasticity at Point C where the demand curve meets the quantity axis is equal to zero, and elasticity at point D where the demand curve meets the price axis is equal to infinity. If  $P_1$  is the mid-point of DC, elasticity at  $P_1$  is equal to 1. At all the points between  $P_1$  and C, the elasticity is greater than zero but less than unity and at the points between  $P_1$  and D elasticity is greater than unity but less than infinity. At point D, elasticity is equal to  $\infty$ . Thus the range of values of elasticity is between zero and infinity which means:

$$0 \geq e \leq \infty$$

The elasticity computed at a single point on the demand curve for an infinitesimal change in price is called 'point' elasticity. The elasticity between two separate points of demand curve is called 'arc' elasticity. Point elasticity is more precise than arc elasticity concept.



The point elasticity is defined as the proportionate change in quantity demanded resulting from a very small change in price of that commodity. It is expressed as

$$\text{Point } E_p = - \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

Point elasticity can be calculated with the help of Differential Calculus.

$$E_{d_p} = \frac{dQ}{dP} \cdot \frac{P}{Q} \text{ where } E_{d_p} \text{ is point price elasticity of demand, } \frac{dQ}{dP} \text{ is first order derivative of demand}$$

equation,  $\frac{P}{Q}$  is the ratio of price to quantity.

Figure 3.3 shows graphically where the point elasticity, in case of a linear demand curve, is the ratio of the segments of the line to the right and to the left of the particular point. In Fig. 3.3 the elasticity of the linear demand curve at point  $R_1$  is the ratio of lower segment  $R_1D_2$  to the upper segment  $R_1D_1$  that is,

$$\frac{R_1D_2}{R_1D_1}$$

And at point  $R_2$ , the elasticity is equal to

$$= \frac{R_2D_2}{R_2D_1}$$

Where the demand curve is not linear, determining point elasticity is simpler. See Fig. 3.4.

From Fig.3.4 it can be seen that at any point to the right of point  $P_1$ , elasticity is less than unity ( $E_p < 1$ ), and any point to its left ( $E_p > 1$ ); where the demand curve touches the vertical axis  $E_p \rightarrow \infty$

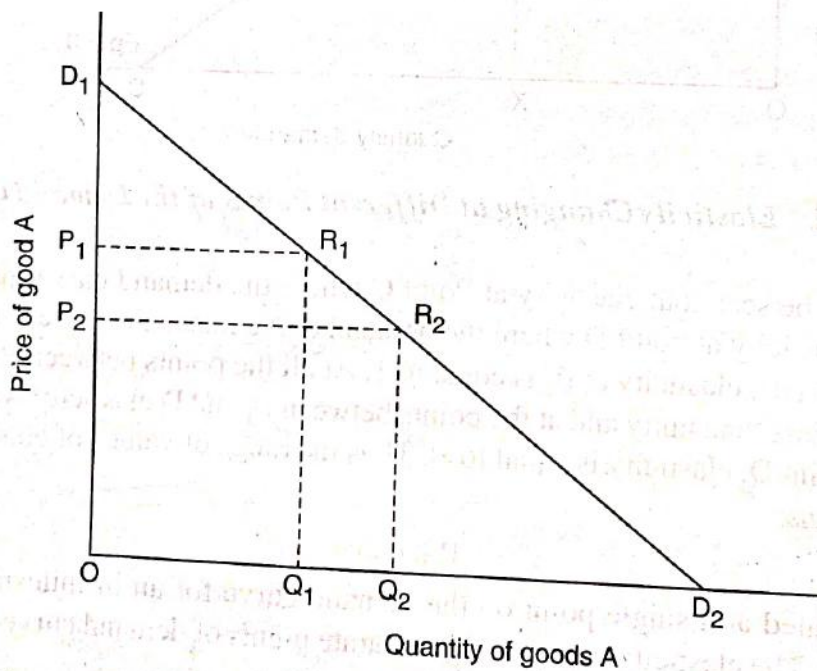


Fig. 3.3 Point Elasticity where the Demand Curve is Linear



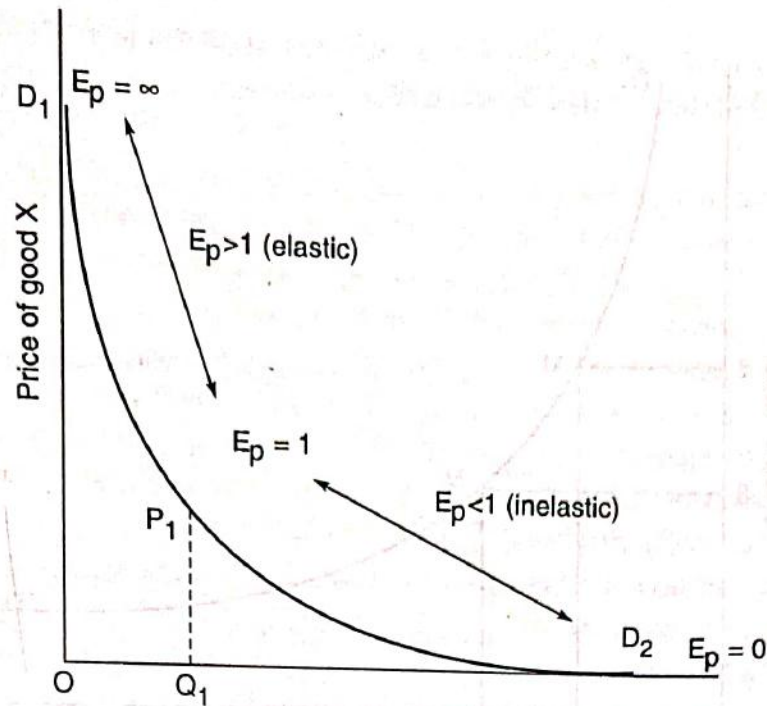


Fig. 3.4 Point Elasticity where the Demand Curve is not Linear

And where the demand curve touches the horizontal axis  $E_p = 0$ . Thus the range of values of elasticity are  $0 \leq E_p \leq \infty$ . To the right of  $P_1$ , the demand is said to be inelastic (i.e.,  $0 < E_p < 1$ ) and to the left of  $P_1$ , the demand is said to be elastic (i.e.,  $1 < E_p < \infty$ )

Where  $E_p = 0$ , the demand is perfectly inelastic

Where  $E_p = 1$  the demand is unity elasticity

Where  $E_p = \infty$ , the demand is perfectly elastic.

### Arc Elasticity

Arc elasticity measures the average responsiveness to price change over a finite stretch on the demand curve. See Fig. 3.5 where MN refers to the stretch on the demand curve  $D_1D_2$ , it is not clear whether Point M or Point N should be considered to determine elasticity. It makes a difference from which point we start. Moving from point M to N is different from N to M. It is because the percentage changes in quantity and price is different, depending upon the price and quantity from which it is taken. The difference in the starting point reveals the different values of elasticity coefficients.

If we move from M to N, we get

$$E_p = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} = \left(\frac{100}{3}\right) \cdot \left(\frac{6}{400}\right) = 0.5$$

If we move from N to M, we get

$$E_p = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} = \left(\frac{100}{3}\right) \cdot \left(\frac{3}{500}\right) = 0.2$$

Now take the average of the two end values  $(0.5 + 0.2)/2 = 0.35$



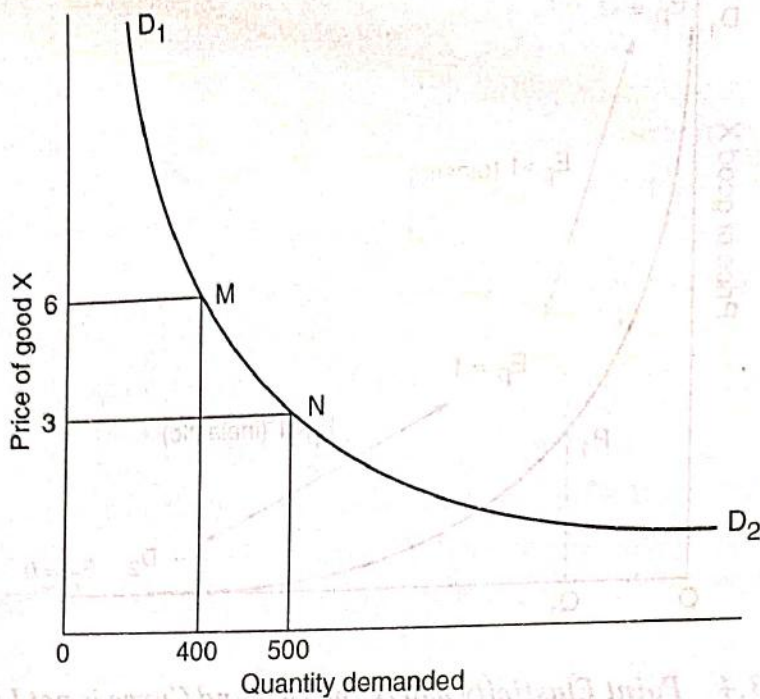


Fig. 3.5 Arc Elasticity

Which means it is the price demand that is inelastic

The arc elasticity is defined as below:

$$\text{ArcEp} = \frac{\Delta Q}{\Delta P} \frac{(P_1 + P_2)/2}{(Q_1 + Q_2)/2} = \frac{\Delta Q}{\Delta P} \frac{(P_1 + P_2)}{(Q_1 + Q_2)}$$

Where  $P_1$  and  $P_2$  are prices before and after changes,  $Q_1$  and  $Q_2$  are quantities demanded before and after changes respectively.  $\Delta Q$  and  $\Delta P$  refer to change in the quantity demanded and change in the price respectively. To make the arc elasticity more meaningful, compute between the points on the demand curve that are close enough.

To conclude, elasticity of demand is a very important concept for decision makers whether it is a finance minister or a monopolist. The concept of elasticity of demand helps to measure the changes in the quantity demanded in relation to changes in income or price and analyse how price or income can be a decisive factor to bring desired change in the quantity demanded.

### CHAPTER SUMMARY

- Elasticity of demand refers to the rate of responsiveness in the demand of a commodity for a given change in price or any other determinants of demand.
- Elasticity of demand may be of four types: (a) price elasticity of demand, (b) income elasticity of demand, (c) cross elasticity of demand, (d) advertising elasticity of demand.
- Elasticity of demand can be measured as (a) Perfectly elastic demand, (b) Perfectly inelastic demand, (c) Unity elasticity, (d) Relatively elastic demand and, (e) Relatively inelastic demand.





# DEMAND FORECASTING

## Learning Objectives

**After completing this chapter, you should be able to understand**

- the need for forecasting demand
- factors affecting demand forecasting
- demand forecasting methods
- evaluation of each of these methods

## INTRODUCTION

It is necessary to measure demand accurately in terms of quantity and its value for several purposes. Forecasting helps to assess the likely demand for products and services and to plan production accordingly. Demand forecasting is helpful not only at the firm level but also at the national level. There have been instances where the government had to spend excessively on imports just because the demand for certain goods had not been forecast in a scientific manner.

## THE NEED FOR DEMAND FORECASTING

It is customary in all advanced countries to estimate demand for goods and services in a realistic manner so as to carry out the production plans. The importance of demand forecasting is paramount when either production or demand is uncertain. Where the supply is not in accordance with the demand, it results in the development of a black market or excessive prices. In populous countries such as India, in addition to demand forecasting, supply management is also critical. The results of demand forecasting guide the entrepreneurs to set up their business/industrial activities accordingly. The macro policies such as export/import and fiscal policies can be designed based on the results of demand forecasting.

Where there is a lot of competition, the entrepreneur has to estimate the demand for his products and services so that he can plan his material inputs, such as manpower, finances, advertising and other overheads. In India, the services of the National Council of Applied Economic Research (NCAER) are



very valuable in terms of demand estimates. NCAER estimates the probable demand for both industrial and consumer goods at the national and the regional levels. These estimates guide the entrepreneurs to plan their production.

## FACTORS GOVERNING DEMAND FORECASTING

There are several factors which govern the forecasting process. These are:

### Functional Nature of Demand

Market demand for a particular product or service is not a single number but it is a function of a number of factors. For instance, higher volumes of sales can be realised with higher levels of advertising or promotion efforts. However, there could be some minimum volume of sales even when there is no advertising on a large scale.

### Types of Forecasts

Based on the period under forecast, the demand forecast can be of two types: (a) short-run forecasts and (b) long-run forecasts. Short-run forecasts cover a period of one year whereas long-run forecasts cover any period ranging from one year to 20 years. Short-run forecasts help to foresee the fluctuations in the demand based on seasonal and cultural factors such as festivals and so on, and plan the schedules of production or supply accordingly. In other words, short-run forecasts facilitate decisions by which the utilisation of resources can be optimised. The annual requirements of inventory can be procured at competitive prices. In the light of the short-run forecasts, the trader can formulate an appropriate pricing policy in tune with the seasonal fluctuations. The performance of the sales force can be monitored with necessary incentives very closely if short-run forecasts are available.

A short-range forecast of the total demand for a particular product helps to provide a basis for ordering raw materials, to plan and schedule production activities, to seek short-term finances, and so on.

A long-run forecast provides information for major strategic decisions that result in extension or reduction of limiting resources. A long-run forecast can be an effective basis to make an application for necessary long-term finance. It provides an appropriate basis to recruit human resources with a required specialisation. A long range forecast of regional demand for its major product line helps to provide a basis for considering market expansion.

### Forecasting Level

The forecasting may be at the *firm level*, *industry level*, *national level* or at the *global level*. Forecasting at the firm level means estimating the demand for the products and services offered by a single firm. The aggregate demand estimated for the goods and services of all the firms constitutes the industry level forecast. The total estimate of different trade associations can also be viewed as industry level forecast. National level forecast is for the whole economy. National level forecasts are worked out based on the levels of income, savings of the consumers. It is essential to consider the appropriate indices of industrial production to work out national forecasts. With globalisation and deregulation, the entrepreneurs have started exploring the foreign markets for which the global level forecasts are utilised.



## Degree of Orientation

Demand forecasts can be worked out based on total sales or product/service-wise sales for a given time period. Forecasts in terms of total sales can be viewed as *general forecast* whereas product/service-wise or region or customer segment-wise forecast is referred to as *specific forecast*.

## Established or New Products

It is relatively easy to forecast demand for established products or products which are currently in use. If a firm wants to deal in detergents, it can find access to the industry demand for the detergents and market share of each competitor. It is upto this individual new firm and its ingenuity to create its own customer base by pulling customers of the other competitors through strategy. This type of database is not readily available in case of new products. Every product, till it is introduced in a given market, is a new product. Internet, WAP-enabled mobile phones and so on are relatively new products into the market at least in some of the developing countries. Even today, there are a number of villages where there is no power supply, and hence, facilities like TV for instance, are not available.

Technological development in certain countries is relatively advanced and this facilitates forecasting. If the product is introduced in any part of the world, there is some basis to gauge how customers react to such products. But, how to estimate demand for a new or innovative product? Providing sight-seeing trip into cosmos on a commercial basis could be cited as one example for a new product or service. In this case, the market segment would consist of only such customers who are substantially rich and passionate for such travel. However, it is relatively very difficult to forecast demand for new products. It is because there is paucity of information about the customer base. The firm has to spend a lot of research on its likely clientele to know the consumption pattern. The utility of the new products, more often, could throw light on its likely demand.

Joel Dean suggested a number of possible approaches to forecasting demand for new products. These are outlined below:

- (a) find out the demand for a related existing product and project the demand for the new product as its outgrowth
- (b) the new product in consideration can be analysed as a substitute for some existing product
- (c) assess the pattern of growth of established products and estimate, on this basis, the rate of growth and the likely level of demand for the new product over a given period.
- (d) assess the demand through a sampled or total survey of consumers' intentions over the new product features and price
- (e) offer the product for sale in a limited market and test the results. If the results are good, offer the same in wider market. Where the results are not satisfactory, find out the reasons for the poor sales and work on the product again to ensure wider acceptance.
- (f) contact the dealers to know the customers' reactions to the new product.

It is not necessary that all the above alternatives should be tried independently. More than one alternative can be pursued simultaneously. For instance, the product can be tried in the limited market and the reactions of the sales force can be simultaneously studied.



## Nature of Goods

The goods are classified into producer goods, consumer goods, consumer durables and services. The patterns of forecasting in each of these differ.

## Degree of Competition

There may be a single trader or a few traders depending upon the nature of goods and services.

### Box 4.1 How New Products are Planned and their Turnover Estimated

Amul is the brand name owned by Gujarat Cooperative Milk Marketing Federation, the cooperative of 21 lakh farmers.

**Present product range:** Ice creams, cheese, butter, packed milk, chocolates, gulab jamun mix, yoghurt and shrikhand.

**Just Launched:** Pizza, soft cone ice cream, chocolate eclairs

**Ready to launch:** Frozen foods, stuffed parathas, paneer pakoras, tea and coffee (both filter and instant), matar paneer and pizzas.

**Present turnover** (2000-1) Rs 2,258 crore

**Targeted turnover** (2003-4) Rs 4,400 crore

(2006-7) Rs 10,000 crore

The new products will contribute 25 percent of the targeted turnover.

## Other Factors

Every forecast of demand should clearly list the assumptions made about the demographic, economic, technological, political and cultural environment. In other words, there are certain other factors such as political developments, changing fashions and customer preferences, changes in technology, changes in the price level or inflation and so on, and these are critical factors which govern demand forecasting. For instance, if a government is committed to information technology, the demand for PCs can be foreseen. This demand pattern undergoes a drastic change in case there is change in the government. The philosophy and priorities of the new government may be totally different.

## Market Demand

Market demand for a particular product is the total volume that would be bought by a defined customer group in a marked geographical area in a certain marketing programme.

Market demand is affected by a host of controllable factors such as the demographic, economic, technological, political and cultural environment, as well as elasticity with respect to industry price, promotion, product improvements and distribution efforts at given industry prices and marketing outlays.

## Functional Nature of Market Demand

Market demand is a function of many variables out of which marketing effort is prominent. Figure 4.1 explains the functional nature of market demand. The curve shown market forecast here refers to the



market demand function that rises with higher levels of industry marketing effort. In other words, a change in industry marketing effort will bring forth a change in the curve also. There could be a minimum amount of sales even when there is no significant marketing expenditure by the industry.

Figure 4.1 reveals that the returns increase initially for every increase in the market expenditure. But this is not eternal. This is only up to a particular level. Beyond this level, the returns decrease. In other words, higher marketing expenditure would not necessarily stimulate further demand. This implies an upper limit to market demand called the market potential or maximum possible level of demand.

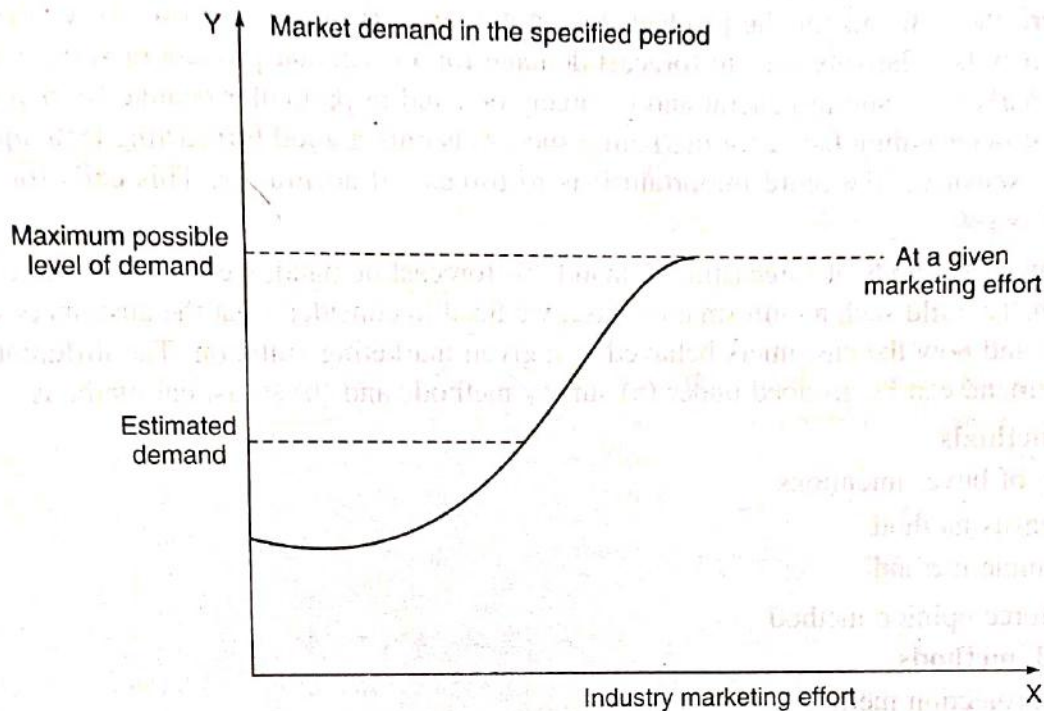


Fig. 4.1 Market Demand as a Function of Industry Marketing Effort

The curve also reflects alternative forecasts of market demand associated with alternative levels of industry marketing effort. What is shown in the curve is only one of the many possible levels of industry marketing effort that will actually occur. The market demand for a given marketing effort is called the *estimated demand*. It is the expected level of market demand for an expected level of industry marketing effort in a given environment.

### What Constitutes a Scientific Approach to Forecasting?

The following steps constitute a scientific approach to demand forecasting:

- (a) Identify and state the objectives of forecasting clearly
- (b) Select appropriate method of forecasting, in the light of (a)
- (c) Identify the variables affecting the demand for the given product or service
- (d) Express these variables in appropriate forms
- (e) Collect the relevant data to represent the variables
- (f) Determine the most probable relationship between the dependent variable and independent variable, using the appropriate statistical techniques.



- (g) Make appropriate assumptions to forecast and interpret results in terms of market share, turnover in terms of value and volume, product groups, individual products, sizes and brands of each individual products and so on.
- (h) Let there be alternative forecasts to make the forecasting exercise more meaningful.

## METHODS OF DEMAND FORECASTING

Forecasting demand is not an easy exercise. It may be easy only in the case of a very few products or services. where the demand for the product does not change from time to time or competition is not significant, it may be relatively easy to forecast demand for a particular product or service. In a majority of the cases, market demand in general and company demand in particular change from year to year. In such a case, the determining factor for marketing success is only a good forecasting technique. The more the demand is sensitive, the more important it is to forecast it accurately. This calls for an elaborate forecasting process.

There are many methods of forecasting demand. To forecast demand, we need to build a certain base of information. To build such an information base, we need to consider what the customers say, what the customers do, and how the customers behaved in a given marketing situation. The different methods of forecasting demand can be grouped under (a) survey methods and (b) statistical methods.

### 1. Survey methods

#### (a) Survey of buyer intentions

- Census method
- Sample method

#### (b) Sales force opinion method

### 2. Statistical methods

#### (a) Trend projection method

- Trend line by observation
- Least square method
- Time series analysis
- Moving averages method
- Exponential smoothing

#### (b) Barometric techniques

#### (c) Simultaneous equations method

#### (d) Correlation and regression methods

### 3. Other methods

#### (a) Expert opinion method

#### (b) Test marketing

#### (c) Controlled experiments

#### (d) Judgemental approach

## 1. Survey Methods

**(a) Survey of Buyers' Intentions** To anticipate what buyers are likely to do under a given set of circumstances, a most useful source of information would be the buyers themselves. It is better to



draw a list of all potential buyers, approach each buyer to ask how much does he plans to buy of the given product at a given point of time under particular conditions. This is the most effective method because the buyer is the ultimate decision-maker and we are collecting the information directly from him.

The survey of buyers can be conducted either by covering the whole population\* or by selecting a sample group of buyers. Suppose there are 10,000 buyers for a particular product. If the company wishes to elicit the opinion of all the buyers, this method is called *census method* or *total enumeration method*. This method is not only time-consuming, but also costly. On the other hand, the firm can select a group of buyers who can represent the whole population. This method is called the *sample method*. A survey of buyers based on sample basis can be completed faster with relatively lower costs.

There are professional organisations specialised in market research on behalf of the firms who wish to forecast the demand for their products and/or services. Normally, a questionnaire is designed to elicit the information. The data thus collected forms the information base to design the consumer profiles. These consumer profiles guide the firms to identify the factors that influence demand. Also they may enable the firms to strengthen their weak areas of operation and to refocus their marketing strategy. Specialised organisation such as the ORG-Marg, and others conduct consumer surveys on large scale and offer necessary market intelligence.

Surveys of this nature focus directly on the consumer requirements and their behaviour. They look more simple and easy to be administered when compared to other statistical techniques such as trend analysis and econometric methods such as regression analysis.

The survey method is considered more *advantageous* in the following situations.

- (i) where the product is new on the market for which no data previously exists
- (ii) when the buyers are few and they are accessible
- (iii) when the cost of reaching them is not significant
- (iv) when the consumers stick to their intentions
- (v) when they are willing to disclose what they intend to do.

This method has certain *disadvantages* also. They are:

- (i) *Surveys may be expensive* Quite often the value of information supplied by the customer is not worth the cost of gathering it.
- (ii) *Sample size and timing of survey* Sample size should be large enough to yield meaningful results on the desired aspects of study. Also the sample should be selected in such a way that it represent the whole population under the study. This increases the cost and also the time needed to undertake the analysis. The forecast results can deeply be influenced by the timing of the survey. For example, the number of residents preferring to stay in multi-storied apartments soon after the news about an earthquake may drastically come down when compared to the normal times.

Where the surveys are conducted by a group of firms, these costs can be shared.

- (iii) *Methods of sampling* The survey should be based on appropriate method of sampling. The method so selected should be capable of providing results with no bias. For instance, the surveys conducted on the internet will have an built-in bias towards those in the higher socio-economic groups who have access to internet.
- (iv) *Inconsistent buying behaviour* The buyers also may not express their intentions freely. Even the buyers do not act upon the way they express. Most of the buyers are susceptible to the advertise-

\* Population here refers to the total number of buyers for a product or service. It does not refer to the country's population.



ment strategies and are emotional when it really comes to the question of buying the product or service.

**(b) Sales Force Opinions** Another source of getting reliable information about the possible level of sales or demand for a given product or service is the group of people who sell the same. Thus, we can control the limitations of cost and delays in contacting the customers.

The sales people are those who are in constant touch with the main and large buyers of a particular market, and hence they constitute another valid source of information about the likely sales of a product. The sales force is capable of assessing the likely reactions of the customers of their territories quickly, given the company's marketing strategy. It is less costly as the survey can be conducted instantaneously through telephone, fax or video-conferencing, and so on. The data, thus collected, forms another valid source of reliable information.

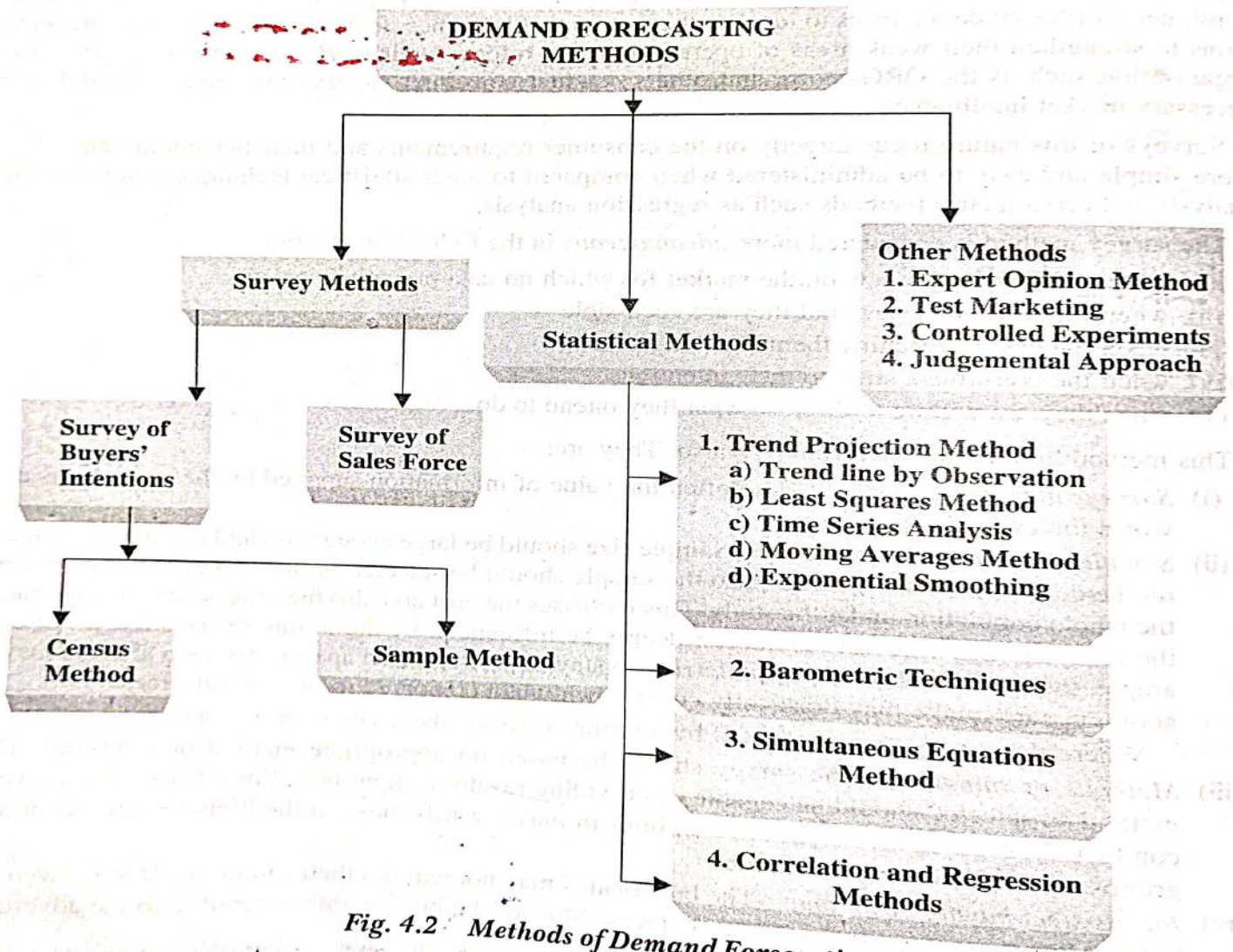


Fig. 4.2 Methods of Demand Forecasting



Here also, there is a danger that salesmen may sometimes become biased in their views. The sales people are paid based on their results. Where the targets are set based on the results of the survey of the sales force, and the payment is linked to achievement of these targets, incentive is paid to those who achieve more than their targets. To prevent the company from fixing higher targets, it is quite likely that they understate or overstate the demand to eventually get low or high sales quota set for them.

This method is appropriate when

- sales persons are likely to be most knowledgeable sources of information
- the salesmen are cooperative
- bias factor can be corrected by means of growth factor. Where the company finds that the sales position is forecast lower, it may correct it by adding to it the estimated difference.

In all, the results obtained through this method are questionable in terms of reliability. Hence the advantages of speed and cost associated with this method are not really very significant.

## 2. Statistical Methods

For forecasting the demand for goods and services in the long-run, statistical and mathematical methods are used considering the past data.

**(a) Trend Projection Methods** These are generally based on analysis of past sales patterns. These methods dispense with the need for costly market research because the necessary information is often already available in company files in terms of different time periods, that is, a time series data. There are five main techniques of mechanical extrapolation. In extrapolation, it is assumed that existing trend will maintain all through.

**(i) Trend line by observation** This method of forecasting trend is elementary, easy and quick as it involves merely the plotting the actual sales data on a chart and then estimating just by observation where the trend line lies. The line can be extended towards a future period and corresponding sales forecast read from the graph.

**(ii) Least Squares Method** Certain statistical formulae are used here to find the trend line which 'best fits' the available data. The trend line is the basis to extrapolate the line for future demand for the given product or service on graph. Here it is assumed that there is a proportional (linear) change in sales over a period of time. In such a case, the trend line equation is in linear form. Where this assumption does not hold good, the equation can be in non-linear form.

The estimating linear trend equation of sales is written as:

or

$$S = x + y(T)$$

Where  $x$  and  $y$  have been calculated from past data  $S$  is sales and  $T$  is the year number for which the forecast is made. To find the values of  $x$  and  $y$ , the following normal equations have to be stated and solved:

$$\sum S = Nx + y \sum T$$

$$\sum ST = x \sum T + y \sum T^2$$

Where  $S$  is the sales;  $T$  is the year number,  $n$  = number of years





**Example 1**

Year	1996	1998	2000	2002	2004
Sales (Rs. in lakhs)	75	84	92	98	88

Estimate the sales for the years 2004 and 2006.

**Solution**

State and solve the normal equations to determine the values of  $x$  and  $y$  in the trend equation.

$$\sum S = Nx + y \sum T$$

$$\sum ST = x \sum T + y \sum T^2$$

Let us now determine the following:

$$\sum S, \sum ST, \sum T \text{ and } \sum T^2$$

Year	Year no. (T)	Sales (S) (Rs. in lakhs)	ST	T <sup>2</sup>
1992	1	75	75	1
1994	3	84	252	9
1996	5	92	460	25
1998	7	98	686	49
2000	9	88	792	81
$\sum T = 25$		$\sum S = 437$	$\sum ST = 2265$	$\sum T^2 = 165$

By substituting the above values in the normal equations, we get

$$437 = 5x + 25y$$

$$2265 = 25x + 165y$$

By solving these equations, we get  $x = 77.4$  and  $y = 2$ . Years 2004 and 2006 take on the year numbers 11 and 13 respectively.

By substituting these values in the trend equation  $x + y(T)$

$$S_{2002} = 77.4 + 2(11)$$

$$= 99.4 \text{ lakh units.}$$

$$S_{2004} = 77.4 + 2(13)$$

$$= 103.4 \text{ lakh units.}$$

Thus the forecast sales for year 2004 and 2006 are 99.4 and 103.4 lakh units.

**(iii) Time series analysis** Where the surveys or market tests are costly and time-consuming, statistical and mathematical analysis of past sales data offers another method to prepare the forecasts, that is, time series analysis. One major requirement to administer this technique is that the product should have actively been traded in the market for quite sometime in the past. In other words, considerable data on the performance of the product or service over significantly large period should be available for better results under this method. Time series emerge from such a data when arranged chronologically. Given significantly large data, the cause and effect relationships can be discovered through quantitative analysis.



The following are the four major components analysed from time series while forecasting the demand:

*Trend (T)*, also called the long-term trend, is the result of basic developments in the population, capital formation and technology. These developments relate to over a period of long time say five to ten years, not definitely overnight. The trend is considered statistically significant when it has reasonable degree of consistency. A significant trend is central and decisive factor considered while preparing a long-range forecast.

*Cyclic Trend (C)* is seen in the wave like movement of sales. The sales data is quite often affected by swings in the levels of general economic activity, which tend to be somewhat periodic. These could be related to the business cycles in the economy such as inflation or recession. For instance, during the period of inflation, prices of the products go up and hence the demand slows down.

*Seasonal Trend (S)* refers to a consistent pattern of sales movements within the year. More goods are sold during the festival seasons. The seasonal component may be related to weather factors, holidays, and so on.

*Erratic Trend (E)* results from the sporadic occurrence of strikes, riots, and so on. These erratic components can even damage the impact of more systematic components, and thus make the forecasting process much more complex.

Classical time series analysis involves procedures for decomposing the original sales series ( $Y$ ) into the components  $T, C, S, I$ . There are different models in the time series analysis. While one model states that these components interact linearly, that is,  $Y = T + C + S + E$ , another model states that  $Y$  is the product of all these components that is,  $Y = T \times C \times S \times E$ .

A trend line is fitted by projecting the trend of the time series, through a series either by observation or by means of statistical techniques such as the method of least squares. Identify an algebraic relation (maybe in the form of linear, quadratic or logarithmic) depending upon the relationship between the dependent and independent variables to project the trend line into the future by extrapolation.

Compute the trend values from the original data and then eliminate them from the observed data ( $TSCI/T$ ). After this, calculate the seasonal index to remove the seasonal effect ( $SCI/S$ ). Thus, a cycle is fitted to the remainder which also contains an irregular effect.

This method yields significantly good results

- because it is simple and inexpensive
- because it considers the significantly large data which reflects a continuing growth trend
- where the underlying demand factors remain stable over time. Even if the demand factors might have changed, past data reflects the compounding effect of such changes
- decomposition of time series data is a useful technique for understanding the nature of business fluctuations.

The method fails to be relevant

- when there is a break-down in the trend projection as a result of a turning point or significant change in policies or procedures.
- when it is difficult to identify the turning points causing the changes in the trend. As long as there are no major changes in the policies and procedures, the management does not face significant challenge in its forecasting exercise. But in the event of a turning point, it is necessary to assess the



changes resulting as a result of changes in the policies. For instance, the Government of India continued its patronage in terms of financial assistance to the sick public sector units till 1999. In the year 2000, a decision has been taken by the government to disinvest the public enterprises. Such type of major and significant decision is going to affect the future of the public enterprises. Any attempt to project the trend in the flow of funds based on the past data, from Government to the sick public sector unit, is ridiculous.

- as this method calls for expert knowledge in the use of mathematics and statistics to forecast a demand for a given product or service. In this method, past and future sales are treated as a function of time rather than of any real demand factors.
- the long-term trend and seasonal trends can be forecast but not the cyclical and irregular trends, and hence, it has limited utility in business forecasting.

(iv) **Moving average method** This method considers that the average of past events determine the future events. In other words, this method provides consistent results when the past events are consistent and unaffected by wide changes. As the name itself suggests, under this method, the average keeps on moving depending up on the number of years selected. Selection of the number of years is the decisive factor in this method. Moving averages get updated as new information flows in.

This method is easy to compute. One major advantage with this method is that the old data can be dispensed with, once the averages are computed. These averages, not the original data, are further used as the forecast for next period.

The main shortcoming of this method is that it gives equal weightage to data both in the recent past and the earlier one.

The following example illustrates the concept of moving averages method.

### Example 2

Compute 3-day moving average from the following daily sales data.

Date and month	Daily sales (Lakhs of tonnes)	3-day Moving average
Jan.1	40	
2	44	
3	48	
4	45	44
5	53	45.7

### Solution

To calculate 3-day moving average,

$$S_4 = \frac{40 + 44 + 48}{3} = 44$$

$$S_5 = \frac{44 + 48 + 45}{3} = 45.7$$

(v) **Exponential smoothing** This is a more popular technique used for short run forecasts. This method is an improvement over moving averages method. Unlike in moving averages method, all time periods



Similarly, predicted sales for year 7 can be worked out.

$$\begin{aligned}
 S_7 &= cS_6 + (1 - c) Sm_t \\
 &= 0.1 (5.1) + (1 - 0.1) 5.8875 \\
 &= 0.51 + (0.9) 5.8875 \\
 &= 0.51 + 5.298 \\
 &= 5.808
 \end{aligned}$$

Since this method involves more mathematical computation, computers can be advantageously used for better accuracy and quick results.

**(b) Barometric Techniques** Where forecasting based on time series analysis or extrapolation may not yield significant results, barometric techniques can be made use of. Under the barometric technique, one set of data is used to predict another set. In other words, to forecast demand for a particular product or service, use some other relevant indicator (which is known as a barometer) of future demand. How the statistical data relating to the economy comes handy for this purpose is explained in the following examples:

- To assess the demand for services in India and abroad, we can see the percentage of population in each occupation. In the US, 78-percent of the labour force is employed in services and 15 percent in manufacturing; in India, according to 1991 census, 21 percent of the workforce is engaged in services, 13 percent in manufacturing and 67 percent in agriculture. The world over, an increase in prosperity has been accompanied by an increase in demand for services.
- We can know how many jobs in a particular sector can be created, based on the estimated revenues from it over a period of time. A study conducted by the National Association of Software and Service Companies (NASSCOM) indicates that about 23,000 Indians are already generating \$225 million in revenues from such services. The NASSCOM estimates that these services could generate 1.1 million jobs and \$19 billion in revenues by 2008. These estimates may guide the policy-makers to initiate necessary measures to offer necessary courses in the universities, to change the course syllabus, and so on.
- What kind of occupations will continue to be relevant in the years to come? This can be assessed by looking into the percentage of the demand in the global market for each of the occupations. McKinsey & Co, one of the globally leading management consulting company, identified 11 white-collar services that can be performed off-shore with relative ease. The firm projects, by 2010, a global market of \$180 billion of such services including finance and accounting (\$20 billion); engineering and design (\$6 billion); data-search, integration and management (\$20 billion); distance education (\$19 billion); website services (\$7 billion); and customer interaction services (\$42 billion). These figures guide many entrepreneurs to plan their ventures accordingly.
- The demand for soft furnishings may also be linked to the number of new houses completed and sold.
- The demand for cable TV may be linked to the number of new houses occupied in a given area.

This technique has certain drawbacks also.

- It may be difficult to determine the time lag between the change in one variable and the change in the forecast variable. It can be expected that the consumer will buy a scooter when there is increase in income level. But how long it will take for him, to pick up scooter after the increase in income? Is it a year or longer?



- Although it is possible to determine the direction of change, it is often difficult to predict the magnitude of the change in the forecast variable. For a given change in income level, what could be the increase in the number of scooters sold?

**(c) Simultaneous Equation Method** In this method, all variables are simultaneously considered, with the conviction that every variable influences the other variables in an economic environment. Hence, the set of equations equal the number of dependent (controllable) variable which is also called endogenous variables. In other words, it is a system of 'n' equations with 'n' unknowns. It can be solved, the moment the model is specified because it covers all the unknown variables, it is also called complete systems approach to demand forecasting.

Like two least squares, where regression of investment (I) is found on all the pre-determined variables such as government policy, competition, level of technology and so on, which are beyond the control of the management. These include the exogenous variables such as government policy and lagged endogenous variables such as  $S_{t-1}$ .

This method is more practical in the sense that it requires to estimate the future values of only predetermined variables. It is an improvement over regression method whereas in regression equation, the value of both exogenous and endogenous variables have to be predicted. It is no better than regression method. It inherits all the limitations of regression method.

It is difficult to compute where the number of equations is larger.

**(d) Correlation and Regression Methods** Correlation and regression methods are statistical techniques. Correlation describes the degree of association between two variables such as sales and advertisement expenditure. When the two variables tend to change together, then they are said to be correlated. The extent to which they are correlated is measured by correlation coefficient. Of these two variables, one is a dependent variable and the other is an independent. If the high values of one variable are associated with the high values of another, they are said to be positively correlated. For example, if the sales have gone up as a result of increase in advertisement expenditure, we can say that the sales and advertisement are positively correlated. Similarly, if the high values of one variable are associated with the low values of another, then they are said to be negatively correlated. For example, if the price of a product has come down; and as a result, there is increase in its demand, the demand and the price are negatively correlated. In other words, where the functional relationship is analysed with the independent variable, it is simple correlation. It is likely that there could be several independent variables, and in such a case, it is called multiple correlation. Correlation coefficient ranges between +1 and -1. It does not exceed this range. Where the correlation coefficient is zero, it indicates that the variables under study are not related at all.

In regression analysis, an equation is estimated which best fits in the sets of observations of dependent variables and independent variables. The best estimate of the true underlying relationship between these variables is thus generated. The dependent (unknown) variable is then forecast based on this estimated equation, for a given value of the independent (known) variable. The method of least squares is applied in most regressions. As the regression coefficients estimated from the sample observations are merely the best estimate of true population parameters, the regression equation cannot exactly predict the dependent variable for a given value of the independent variable. In cases of more than one independent variable having significant effect upon the dependent variable, multiple linear regression is employed.

The main advantage of this method is that it provides the values of independent variable from within the model itself. Thus it frees the forecaster from the difficulty of estimating them exogenously.



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## Other Methods

**(a) Expert Opinion** Well-informed persons are called experts. Experts constitute yet another source of information. These persons are generally the outside experts and they do not have any vested interests in the results of a particular survey.

An expert is good at forecasting and analysing the future trends in a given product or service at a given level of technology. The services of an expert could be advantageously used when a firm uses general economic forecasts or special industry forecasts prepared outside the firm. It may be easy to administer this method where there are parameters clearly defined to make forecasts. These act as guidelines.

This method also has certain advantages and disadvantages.

The main advantages of this method are:

- results of this method would be more reliable as the expert is unbiased, has no direct commercial involvement in its primary activities
- independent demand forecasts can be made relatively quickly and cheaply
- where there are different points of view among different experts, consensus can be arrived through an objective analysis. The experts can be asked to explain the reasons why the forecasts are out of line with the consensus. These can be taken into account before taking the final decisions. Sorting out the differences in the estimates in this way is called *Delphi Technique*.
- this method constitutes a valid strategy particularly in the case of new products, in respect of which there is no other alternative or source of information.

The main disadvantage is that an expert cannot be held accountable if his estimates are found incorrect.

**(b) Test Marketing** It is likely that opinions given by buyers, salesmen or other experts may be, at times, misleading. This is the reason why most of the manufacturers favour to test their product or service in a limited market as test-run before they launch their products nationwide. Based on the results of test marketing, valuable lessons can be learnt on how consumers react to the given product and necessary changes can be introduced to gain wider acceptability. To forecast the sales of a new product or the likely sales of an established product in a new channel of distribution or territory, it is customary to find test marketing in practice.

Automobile companies maintain a panel of consumers who give feedback on the style and design and specifications of the new models. Accordingly these companies make necessary changes, if any, and launch the product in the wider markets.

(In test marketing, the entire product and marketing programme is tried out for the first time in a small number of well-chosen and authentic sales environment. The primary objective, here, is to know whether the customer will accept the product in the present form or not.

If sales are not encouraging in the markets so tested, it is clear that the product has certain defects, which are to be looked into seriously. The company can work further to identify these defects, correct them and then test the product again, if necessary.)

One of the factors determining the success of the test marketing is the relevance of small market chosen. (A small market representing all the features of the wide market constitutes an ideal place to conduct test marketing for a given product or service.) In other words, it should be representative.



(Of late, test marketing is applied not only to marketing products and services, but also to film production. There are cases of reshooting certain parts of a major film based on the feedback from test marketing audience. This practice, though originating in Hollywood, has now spread to India also. For instance, where the ending of the film was not in line with the public opinion of selected audience, or the sense of humour was difficult to understand as evidenced by people laughing at wrong places, the producers chose to reshoot.)

The *advantages* of test marketing are:

- (a) the acceptability of the product can be judged in a limited market
- (b) before it is too late, the corrections can be made to the product design, if necessary. Thus, major catastrophe, in terms of failure, can be avoided.
- (c) the customer psychology is more focussed in this method and the product and services are aligned or redesigned accordingly to gain more customer acceptance.

The following are the *disadvantages* of this method:

- It reveals the quality of the product to the competitors before it is launched in the wider market. The competitors may bring about a similar product or often misuse the results of the test marketing against the given company.
- It is not always easy to select a representative audience or market.
- It may also be difficult to extrapolate the feedback received from such a test market, particularly where the chosen market is not fully representative.

**(c) Controlled Experiments** Controlled experiments refer to such exercises where some of the major determinants of demand are manipulated to suit to the customers with different tastes and preferences, income groups, and such others. It is further assumed that all other factors remain the same. In this method, the product is introduced with different packages, different prices in different markets or same markets to assess which combination appeals to the customer most. Regression equation can be built upon these price-quantity relationships of different markets. This method can not provide better results, unless these markets are homogeneous in terms of, tastes and preferences of the customers, their income and so on.

This method is used to gauge the effect of a change in some demand determinant like price, product design, advertisement, packaging, and so on.

This method is still in the infancy stage and not much tried because of the following reasons:

- It is costly and time consuming
- It involves elaborate process of studying different markets and different permutations and combinations that can push the product aggressively
- If it fails in one market, it may affect other markets also

**(d) Judgemental Approach** When none of the above methods are directly related to the given product or service, the management has no alternative other than using its own judgement. Even when the above methods are used, the forecasting process is supplemented with the factor of judgement for the following reasons:

- Historical data for significantly long period is not available
- Turning points in terms of policies or procedures or causal factors cannot be precisely determined