Probability:

The mathematical probability has its origin in the 17 th century. There are three different approaches of measuring probabilities. They are classical, relative frequency of occurrence and axiomatic probabilities.

Definition of probability: probability is a branch of mathematics that deals with analysis of uncertainty. Probability is also defined as the ratio between numbers of favorable outcomes to the total number of outcomes.

Explain the various terms involved in the probability:

Trial: Conducting an experiment for only one time then the experiment is called trial.
Outcome: the result of the trial is called as outcome.
Event: Favorable outcome of an experiment is called as event.
Experiment: repeating the trial under identical condition, then the trail becomes an experiment;

Deterministic Experiment: if the outcome of an experiment is able to predict, then the experiment is called as deterministic experiment.

Non deterministic Experiment: if the outcome of an experiment is not able to predict then the experiment is called as non deterministic experiment.

Sample space: the totality of all possible outcomes of an experiment is called as sample space.

Explain the different types of events with an example;

1. Mutually exclusive events: If the happening of one event which precludes (stops) the happening of another event, then the events are said to be mutually exclusive events.

2. Equally likely events: If the probability remains same for all the events then the events are said to be equally likely events.

3. Sure event or certain event: If the probability of an event is **equal to one (1),** then the event is said to be sure event.

4. Null or impossible or empty event: If the probability of an event is **equal to zero (0)** then the event is said to Null or impossible or empty event.

5. Simple and Composite event: If there exist only one sample points which favors for the happening of an event then the event is said to be simple event.
Composite event: If there exist more than one event which favors for the happening of an event then the events is said to be composite event.

6. Dependent and independent events: If the outcomes of an event which depends on the outcomes of another event then the events are said to be Dependent events.
Independent event: If the outcome of an event which does not depends on the outcomes of another event then the events are said to be Independent events.

Different types of probability:

1. Mathematical or Priori or Classical probability.
2. Empirical or Apriori or Statistical probability.

Classical probability definition:

In 'm' trials, an event A occurs 'n' times, then the probability of an event is given by

$$\text{Probability of an event (A)} = \frac{\text{No of favorable outcomes of an event A}}{\text{Total number of outcomes}}$$

i.e. $$\text{Probability of an event (A)} = \frac{m}{n}$$

Statistical probability definition:

In 'm' trials, an event A occurs 'n' times, then the probability of an event is given by

$$\text{Probability of an event (A)} = \lim_{n\to\infty} \frac{\text{No of favorable outcomes of an event A}}{\text{Total number of outcomes}}$$

i.e. $$\text{Probability of an event (A)} = \lim_{n\to\infty} \frac{m}{n}$$

Axiomatic approaches of probability:

1. Probability of any event will never take the negative values i.e.) probability of any event will always lies between 0 and 1.
2. Probability of sure event is always equal to 1.
3. Probability of null event is always equal to 0.
4. If A and B be any two events then the law of addition of probability is given by P(AUB) = P(A) + P (B) – P(AUB)

Addition and Multiplication theorem:

In the case of a set of mutually exclusive events, the probability (p) for the occurrence of one or other of these events is equal to the sum of their separate probabilities, p1, p2 ,p3……., pn
(i.e.,) p = p1+p2+p3+……+pn)

Multiplication theorem:

In the case of a set of independent events the probability (p) for the occurrence of all these events is equal to the product of their separate probabilities p1, p2, p3…..pn.

(i.e.,) p = p1.p2.p3……..pn.

Conditional probability:

Let A and B be any two events, then the condition probability is usually denoted by P (A/B) or P (B/A). P (A/B) denotes the probability for the occurrence of event A when B is already occurred. Similarly P (B/A) denotes the probability for the occurrence of event B when A is already occurred. The formula to find the condition probability is given by

Random variable: A random variable is a real valued function whose domain is S and whose range is R ($-\infty, \infty$). In other words the random variable is defined as assigning real numbers to the different outcomes of an experiment. Random variable is usually denoted by X, Y, Z. Basically random variable is divided into two types they are 1. Discrete random variable 2. Continuous random variable.

Discrete random variable:

If the random variable X takes the discrete values likes 0, 1, 2 etc then the random variable is called as discrete random variable.

Continuous random variable:

If the random variable takes the value within a limit say (a to b) then the random variable is called as continuous random variable.

Probability function: Let X be a discrete random variable which takes different values like x1,x2,x3,x4…… then for every values of xi there should be as corresponding pi, such that all pi must be greater than or equal to zero and summation of all pi is equal to one.

Probability mass function and probability density function:

Theoretical distributions

Binomial distribution:

It is a distribution associated with repetition of independent trials of an experiment. Each trial has two possible outcomes, generally called success and failure. Such a trial is known as Bernoulli trial. The sample space of Bernoulli trial is S= {s,f.} some of the example of Bernoulli trials are:

1. a toss of a single coin (head or tail)
2. the throw of a die (even or odd number)
3. Performance of a student in the examination (pass or fail).

Let us now define a random variable X on the sample space of Bernoulli trial as follows

X= 1, if the trial is a success.
= 0, if the result of the trial is failure.

The probability function of the random variable is given by $p(x) = \{p^x q^{1-x}; x=0, 1$
0, otherwise

The distribution defined by this probability function is called point binomial distribution.

An experiment consisting of a repeated number of Bernoulli trials is called Binomial experiment. A binomial experiment must possess the following properties.

1. There must be a fixed number of trials.(n is finite)
2. Each trial must always result in either success or failure.
3. The trials must be independent of each other.

Definition of binomial random variable:

Let X is the number of success in **n** repeated independent Bernoulli trials with probability **p** of success and probability **q** of failure for each trial. Then X is called the binomial random variable with the parameter n and p.

Definition of binomial distribution:

Let X be the discrete random variable is said to follow binomial distribution whose probability mass function is given by $p(x)=\{ {}^{n}c_x\ p^x\ q^{n-x}$; x=0,1,2…..n}

p+q=1

0 otherwise

The successive values of probability function are the successive terms in the binomial expansion of $(p+q)^n$. For this reason the distribution is called the binomial distribution.

Properties of binomial distribution:

1. The parameter s of the binomial; distribution are n and p.
2. The mean of the binomial distribution is np
3. The variance of the binomial distribution is npq.
4. The standard deviation of the binomial distribution is npq.
5. Additive property of binomial random variables:

If X_1 and X_2 are two independent binomial random variables with parameters (n_1, p) and (n_2, p) then X_1+X_2 is a binomial random variable with the parameters (n_1+n_2, p).

6. The expected frequency of the binomial distribution is given by

$E(x) = N\times P[X=x]$

$= N\times {}^{n}c_x\, p^x q^{n-x}$

Poison distribution:

If n is large, the evaluation of the binomial probabilities need more calculation. In such case, a simple approximation to the binomial probabilities could be of considerable use. The approximation of binomial when n is large and p is close to zero is called the Poisson distribution.

Definition of the Poisson distribution:

Let X be the discrete random variable is said to follow Poisson distribution whose probability mass function is given by $p(x)=(e^{-\lambda}.\lambda^x)/x^!;x=0,1,2...\infty\}$

Here $\lambda = np$.

The following are the some of the examples of the Poisson distribution:

1. The number of the defective items produced in a factory.
2. Number of deaths due to rare disease.
3. Number of mistakes committed by a typist per page.

]

Properties of Poisson distribution:

1. The binomial distribution is characterized by two parameters n.p, while the Poisson distribution is characterized by a single parameter λ.
2. The Poisson distribution was first discovered by a French mathematics S.D. Poisson in 1837.
3. The sample space for the binomial distribution {0,1,2…n} while the sample space for the Poisson distribution is {0,1.2…..n….)
4. the mean of the Poisson distribution is λ.
5. the variance of the Poisson distribution is λ.
6. the additive property of the Poisson random variables:

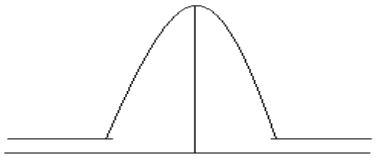
If X_1 and X_2 are two independent Poisson random variables with parameters ⋋1 and ⋋2 then X_1 + X_2 is a Poisson random variable with the parameter $⋋_1+⋋_2$.

7. the expected frequency of the Poisson distribution is given by
   $E(X) = N \times P[X=x]$

Normal distribution

Normal distribution is a limiting case of the binomial distribution under suitable statistical conditions namely (1) Sample size n is large (2) Neither p nor q is small. Several mathematicians were instrumental for the discovery of this distribution and among them the most prominent mathematician is Karl gauss and hence this distribution is called the Gaussian distribution. Normal distribution plays a vital role in sampling theory for drawing conclusions about point estimate of the parameters.
Characteristics of the normal distribution:

The diagram of a normal distribution is given below. It is called normal curve. It suggests several importance properties of the normal distribution.



1. The normal distribution is a symmetrical distribution and the graph of the normal distribution is bell shaped curve.
2. The curve has a single peak point therefore the distribution is called unimodal distribution.
3. The mean, median and mode of the normal distribution coincide.
4. As the value of x increases, the normal probability curve gets decreases.
5. The tails of the normal curve will never touches the x axis; therefore x axis acts as an asymptote to the normal curve.
6. Normal distribution is usually called as two parameter distribution since it consists of two parameters μ and σ.
7. The point of the inflection of the normal curve is given by x= u ±σ.
8. Since f(x) is the normal probability curve, the total area under the normal probability curve is equal to one (1).
9. Area property:

$$P[\mu - \sigma \leq X \leq \mu + \sigma] = 0.6545$$
$$P[\mu - 2\sigma \leq X \leq \mu + 2\sigma] = 0.9545$$
$$P[\mu - 3\sigma \leq X \leq \mu + 3\sigma] = 0.9973$$

Standard normal probability distribution:
Let X is a normally distributed random variable with mean μ and σ^2, then

$$Z = \frac{X-\mu}{\sigma}$$

is called standard normal variable. The value of z will always lies between -3.9 to 3. Since normal distribution is a symmetric distribution, the table value for negative values is as equal to positive value.

Chi Square Test

Fotr testing the significance of the difference between observed and expected frequencies under the null hypothesis that there is no significant difference, pearson has developed the statistic

$$X2 = \frac{\sum(Oi - Ei)^2}{Ei}$$

. Here Oi are the observed frequencies and Ei are the expected frequencies. The expected frequencies can be calculated on the assumption of H_0..

Uses of chi square test

The following are the uses if the x^2 statistic

1. it is used to test the goodness of fit of a distribution.
2. it is used to test the significant difference between the observed and expected frequencies in a sample.
3. it is also used to test the independence of attributes.
4. in the case of the small sample (where the population standard deviation is not known (X^2 statistic is used to test whether a specified value can be the population variance or not)

ANOVA

Analysis of variance is a technique used to test equality of means, when more than two populations are considered. In Z test and T test we considered only the equality of two population means. If there are more than two populations, for testing the equality of their means then analysis of variance (ANOVA) method is used. This technique introduced by R.A. Fisher was originally used in agriculture experiment in which different types of fertilizers were applied to plots of land, different types of feeding methods to animals and so on. This technique is widely used in different fields for example, to study the pattern of average sales by using different sales techniques, the types of drugs manufactured by different companies to cure a particular disease and so on.

Assumptions of ANOVA:

The samples are independently drawn from the populations.

The populations are normally distributed.

The variances of all the populations are equal.

Types of analysis of variance:

One way classification

Two way classification

In one way classification observations are classified according to one factor. That is either row or column.

In two way classification observations are classified according to two factors, one column wise and the other row wise.

MULTIPLE REGRESSION ANALYSIS

We have so far seen some of the multivariate statistical procedures for the analysis of dependence and independence. As we have seen there are several multivariate techniques available for the investigator to analyse his marketing associative data, which is more appropriate to use by him depends on the number of dependent and independent variables and the level of measurement of the variables.

In the analysis of associate data the marketing investigator is invariably interested in ***prediction*** problems such as,

● Can we predict how much microwave oven consumer may purchase per week from that person's sex, age, income and educational level?
● Can we predict the rupees sales achieved by our sales representatives as a function of our incentives offered, our bonus offer to dealers, our advertisement efforts, delivery schedules?
● Can we predict the outcome of our public offer of shares to the public in terms of our share price in the market, share promoters image, general economic situation, our Company's image?

The lists of such marketing problems are endless. One of the most popular statistical analytical tools in the hands of the market investigator is the linear regression model which can either be applied as bivariate or multivariate form.

MARKETING EXAMPLES OF MULTIPLE REGRESSION MODEL:

The regression model has been applied to problems ranging from measuring perception of quality by the consumers of a consumer durable product to predicting demand for a new software packages.

As a illustration of the application of regression model, one of the leading consumer durable company used a regression model to know the perception of '*quality'* of its consumer durable product '*washing machine',* based on such variables as:

♪ washing quality.

♪ Technology.

♪ After-sales service.

♪ Quantity of advertisement.

♪ Variety of products.

♪ Price.

♪ Range of models.

♪ Size of the company.

♪ Company image.

♪ Opinion of friends.

One firm used a regression model to predict doctors' prescription of its various range of formulations as related to the doctors' ratings of the following:

♪ Medical Representative's regularity.

♪ Quantity of samples given.

♪ Quality of promotional tools.

♪ Frequency of visit.

♪ Informativeness of products.

♪ Relevance to doctor needs.

♪ Quality of products.

♪ Company's reputation.

♪ Medical conferences hosted by the firm.

The model predicted the doctor's prescription habit in future time periods quite well. Moreover, it also provided diagnostic information as how to various factors that possibly contribute to increase the prescriptions from a doctor could be improved to achieve maximum sales.

In all the above problems, the investigator wishing to use multiple regressions is actually interested in four main questions:

(1). Can we find a linear composite of the predictor variables that will compactly express the relationship between a criterion variable and the set of predictors?

(2). If we can, how strong is the relationship; that is, how well can we predict values of the criterion variable from the values of the linear composite?

(3). Is the overall relationship statistically significant?

(4). Which predictors are most important in accounting for variation in the criterion variable; in particular, can the original model be reduced to fewer variables that still provide adequate prediction of the criterion?

The simple correlation and the regression models discussed in the preceding section were concerned with the relationship of two intervally scaled variables. In many marketing and business

problems, as we have seen in the examples earlier, the use of only one independent variable does not provide us the actual solution to a marketing problem. The use of only one independent variable, however, ignores the potential relationship of other variables in the analysis; it may become possible to develop an equation that allows a more accurate estimate of the dependent variable. Multiple regression analysis includes the influence of more than one dependent variable.

Hence, when two or more independent variables are used as predictor variable to estimate the value of the dependent variable, assuming a linear relationship between them, the analysis used is termed as Multiple Linear Regression.

It is quite tedious to compute a multiple regression equation manually and a readymade computer package is generally used to take care of the same. There are many regression programs available in the major mainframe software packages such as PSS, SAS and BMDP. Similarly, there are many such programs available for micro computers.

The *t*-test is applied to test the hypothesis R^2=0 and β=0. The variable having the highest *t*-value will explain the highest amount of variance in the dependent variable.

A common practice followed when a number of independent variables are large, is to use the technique of '***Stepwise Regression'***. The programme for stepwise regression is such that it first selects that independent variable xi out of the *k* variables, which explains the maximum variance. It then seeks to find out another variable, out of the remaining (*k*-1) independent variables the combination with which increases the amount of variation explained the most. This process is continued till the inclusion of more independent variables in the regression equation no longer results in any significant increase in R^2.

The independent variables x1, x2,…….x*k* are required not to be correlated amongst themselves, for the regression equation to be meaningful. Also, the relationship obtained between the dependent and independent variables is static and may change over time. This is the limitation of the ***Regression Analysis*****.**

USEFULNESS OF MULTIPLE REGRESSION ANALYSIS IN MARKETING PROBLEMS:

The multiple regression analysis is the most useful analytical models which can be used for marketing problem such as:

(1). The main variable which influence the dependent variable can be identified and this can be used by the marketing executive for positioning his products on the basis of it.

(2). The regression analysis can be used by the marketing executive to predict the possible consumer reactions over his products.

(3). It can also be used to predict the buying behaviours of consumers and the importance they attach to each factors contributing the quality of the products they wish to purchase.

(4). Multiple regression analysis can also be used to measure the effectiveness of advertisements over different advertisement contents.

(5). Multiple Regression Model can also be used to predict the sales of a particular product, whether new or existing, as a guide to production policy.

(6). Multiple Regression Model is extensively used to measure the effectiveness of the individual as well as team's sales performances and the most dominating factors responsible for the performance can be isolated among say salary package, bonus, incentives, travel assistance, retirement plan, etc.

(7). Multiple Regression Analysis is most widely used model to analytically estimate the sales of various dealers and the effect of advertisement, sales promotion schemes, publicity etc on their sales.

DISCRIMINANT ANALYSIS:

When the data for independent variables is continuous and at the same time used to predict the values of the dependent variables which is nominally scaled in nature, both correlation and regression techniques as well as cross tabulation techniques cannot be used. Correlation and Regression Analysis require both dependent and independent variables to be ***continuous***, whereas cross tabulation requires them both to be ***categorical***.

In marketing problem analysis, the investigator or the marketing researcher is required to classify respondents or people or objects into one group or more groups. For example, the investigator may be required to divide into two groups individuals who can be classified as buyers/ non-buyers, likers/ dislikers, owners/ non-owners, customers/non-customers, good/bad, loyalist/non-loyalist, etc or to classify a purchases individual demographic differences over purchase of MRF, DUNLOP,BRIDGESTONE and FALCON TYRES? Or how do Doctors, Lawyers, Auditors and Professors differ in terms of their preference ratings of six different luxury cars.

The problem faced by the researcher under such circumstances is need to be establish some formula with which he/she can predict the categories into which individuals would fall. That is, the analyst is seeking a method by which one can discriminate efficiently between the members of various groups, a process that is logically termed ***discriminant analysis***. Discriminant Analysis is a procedure that examined the relationship between a nominally scaled (categorical) dependent variable and one or more independent variables.

If only two categories are involved, the problem is a *two group discriminant case;* if three or more categories involved, we are dealing with multiple or group discriminant analysis.

The result of the discriminant analysis is that a discriminant equation can be used to predict which class a new observation will belong to. The analysis involves the transformation of scores on individuals from a set of independent predictor variables.

Given the linear discriminate equation, a classification boundary between two groups, Z_c(critical value, the boundary between the two groups), can be identified. To classify and individual, if Z_i(discriminant value of the *i*th element of the population) is greater than Zc, the individual belongs in one group. If $Z_i < Z_c$, the individual goes in the other group.

An instance where this would be useful would be a study to find what characterizes superior sales people in retail department stores and differentiates them from poor performers. This information would be helpful in considering superior performance for a promotion to department managers, or considering him for an incentive or one may want to know the characteristics of a good salesperson for hiring purposes. The categorical (dependent) variable, then, is performance, which can be broken into three levels: superior, average and poor. The independent (predictor) variables to be investigated include education level, age, sales experience, standard test scores, marital status and family size.

MARKETING APPLICATIONS OF DISCRIMINANT ANALYSIS:

(1). Discriminant analysis was employed to find out the sales performance of different salesmen employed in an organization on the basis of several levels like good, better, best, etc. in order to consider them for promotion or for an incentive programme.

(2). Discriminant analysis can be employed to study two different popular brands of any product in the same category(say "Ford" and "Chevrolet" Cars) in terms of their preference over personality characteristics of buyers.

(3). Another application is to find what characterizes a buyer who quickly adopt new styles in their choices of new innovative products and differentiate them from non-innovators. This will help a marketer to understand the diffusion of an innovation product.

(4). The multiple discriminant analysis was employed to examine what variables appeared to be the most important determination in adoption of a particular brand of product before and after certain event such as certifications, recognition, advertisement etc. on their brand.

(5). Some other application of discriminant analysis in marketing include an attempt to discriminate between those who save at commercial banks and those who choose to save at non-banking financial institutions, to determine the viewer characteristics of TV stations, an analysis of supermarket buyer decisions, to relate purchase behaviour to a particular promotional campaign and to predict possible buyers and non-buyers of new products.

(6). Discriminant analysis is useful in establishi9ng profiles of consumers belonging to various niches in the target market so essential for positioning the products and estimating the niche potentials.

(7). As it requires small sample sizes to arrive at the discriminant function, the discriminant analysis is widely used as an application tool in industrial marketing research.

LIMITATION:

-> The true relationship between predictor variable may not be linear.

➔ When the categories of the dependent are not measured objectively the linear discriminant function would be less meaningful.

FACTOR ANALYSIS:

The factor analysis and cluster analysis are the methods used for investigating the inter-relationships among all the relevant variables with none being dependent. It is a situation in which all the variables are treated an independent, and the interest is in analyzing their interdependence.

A general and frequently used independent analysis is that of factor analysis. The dependent and independent variables are at times difficult to identify or distinguish and we may have to consider all the variables at the same time. This is carried out without explicitly stating the variables or factors in the survey, but by using some indirect means to identify them. A set of statements to which the respondent can relate are developed. The extent of agreement or disagreement of the respondent on each statement is obtained on a rating scale. The ratings from all the respondents and all the statements are the subject to a factor analysis. It is a generic name given to a class of techniques whose purpose often consists of data reduction and summarization. In this way the objective is to represent a set of observed variables in terms of a smaller number of hypothetical, underlying and unknown dimensions which are called factors.

Out of different methods of factor analysis the popularly used one in marketing research application is called principle component analysis. The output is in the form of matrix with the statement as rows and factors identified as columns. The factors identified are such that the first factor explains the maximum amount of variance between the statements; a second factor explains

some more variance till a stage is reached when the inclusion of any other factor does not result in an increase in variance explained, or the increase is negligible. Under every factor column against each of the statement is a numerical value termed as the Factor Loading Statements which have a high factor loading compared to others are then isolated. There may be four or five such statements which are essentially pointing towards a single factor. For example, in the case of a instant coffee of premium quality, if the statements corresponding to the first factor are,

♥ Pleasant flavour.

♥ Mellow Taste.

♥ Comforting Taste.

♥ Pure clear taste.

Then, the above are grouped as 'Factor A' and it can be identified as the 'Comforting quality' of the product.

The statements corresponding to the second factor 'Factor B' are ,

♥ Sparkling taste

♥ Taste like real coffee

♥ Deep distinct flavour

♥ Alive taste

♥ Expensive taste

The 'Factor B' can be identified as the 'Genuineness' of the product. The statements corresponding to the third floor, 'Factor C' are,

♥ Taste just brewed

♥ Roasted taste

♥ Fresh taste

The 'Factor C' can be identified as the freshness of the product.

This has implications for 'Positioning' the product as well as in identifying advertising themes that the potential buyers would consider appealing. Factor Analysis can be very use4ful when faced with a mass of data that are defying analysis and guidance can be obtained from clearly written sources.

LIMITATIONS OF FACTOR ANALYSIS:

♦ The suitable statistical test to check the significance of the factor or factor loading are not available.

♦ The interpretation of factors is subjective in nature.

♦ The number of factors which should be included in the matrix is also debatable.

♦ Identification of four to five factors would require a minimum of 20-25 statements to be rated by the respondents. This may lead to misrepresentation of the true feelings or attitudes of the respondents.

♦ Complex factors which the respondent is not familiar with should be broken down onto more simple statements for him to understand.

CLUSTER ANALYSIS:

At times the investigator is interested in putting objects into groups on the basis of similarities among the objects based upon a set of common measures. This concept would seem to have wide spread application to marketing problems related to market segmentation. For example, a marketer would be interested in grouping potential customers into homogeneous groups in which the marketer could develop a specific marketing mix consists of product, price, place and promotion variables to reach that group successfully with compatible traits. In this way the marketers entire marketing efforts will not defuse but concentrate on that group. The basis upon which the group could be formed involve various segmentation variables like demographic (age, sex, income, occupation, education etc) geographic (region, city size etc) psychographic (lifestyle, personality etc), behavioural (usage, attitude etc). The data obtained on the above basis is then subjected to ***cluster analysis***. It identifies clusters of respondents who have given the same or similar responses to a certain combination of factors, constitutes the second cluster of respondents. This process is continued till all the respondents are exhausted. The total numbers of clusters so obtained constitute the distinct segments in the total market envisaged for the product. Then one or more out of these segments would be chosen as the target segment for the marketer, depending on the criteria like the size of the segment, growth prospects of the segment, reach of the segment and product range availability suitable for the segment.

Cluster analysis, for the most part, requires judgment on the part of the investigators as to the number and composition of the clusters to be formed. At times it is not an easy task to undertake. The application of the cluster analysis is used in the following marketing context.

- ❖ To group TV programmes into similar types.
- ❖ To develop homogeneous groups of census tracts.
- ❖ To determine spheres of opinion leadership.
- ❖ To assess the similarity of world markets.
- ❖ To find out the effect of price on brand switching.

COJOINT ANALYSIS:

In the real market, products are offered for consumption with multiple features, benefits, functional variations (attribute), etc. within certain price range. The consumers make trade of between or among attributes and their levels while choosing a particular option available in the

market place to suit his requirements as well as his paying ability.

It is a technique which seeks to determine the preferences of the consumer for the various combination levels of product attributes. It enables the investigator to get an insight of the extent to which a consumer is ready to trade a 10% increase in price, say for 1 year longer warranty period. It essentially computes the utility scores of the combinations to arrive at a score for each respondent. It is applicable to categorical data and not interval data is in the case of factor or cluster analysis. The categorical data is basically the different alternatives available for the product attribute.

In case of certain products particularly for consumer durables or industrial products like packaging machinery, textile machinery it is often found that many models and various functional variations are available for the same product within a certain price range. For example, a washing machine will be available with different capacity loading of clothes, optional attachments, different colors, different warranty periods etc. the customer finds it difficult to arrive at a trade-off i.e., whether to opt for a standard product with standard attachments or an upgraded version with an extra attachment at a slightly higher price.

The company marketing such product would be interested in finding out the type of combination most consumers prefer, so that they can estimate accordingly their fast moving, slow moving models. Ideally, when asked to rate the attributes that a consumer desires most in a washing machine the tendency would be to have a latest model with all the attachments at the most economical price, but this combination is practically not possible to offer. Thus when measured in absolute terms, the consumer would definitely ask for the most desirable level of the product attribute.

The cojoint analysis is a higher form of analysis which has been developed in the last ten years or so. The kind of analysis describe in the proceeding pages concerned with relationships between dependent and independent variables, or identifying factors which explained variances, or obtaining clusters of homogeneous groups and predictor variables to form discriminating groups. The focus for these kinds of analysis was a single product end the objective of research had been to point out their target segment, the features/ benefits/ attributes desired by the target market, the pricing, and distribution and promotion decision for the launch/ monitoring/ evaluation of the product performance.

USES OF COJOINT ANALYSIS:

- It is a higher form of analysis which is useful for products that are offered in different combinations for which the consumer has to make a trade-off.

- It is useful for products such as consumer products, industrial products etc, which requires a larger buying process for the purchaser who has to consider many alternatives and trade-offs.

- The attributes for which the different levels are to be tested might not be the ones that the consumer considers important while making a choice. In the case of the service considered for a star hotel the customer may consider restaurant facility, site seeing facility offered by the hotel, checking time, hospitality of the hotel staff etc. as being of more consequence. A factor analysis can be run prior to cojoint analysis to identify the factors which explain maximum variation.

UNIT 5

RESEARCH IN BUSINESS

"Research" is the process of a systematic and in-depth study or search of any particular topic, subject or area of investigation, backed by collection, compilation, presentation and interpretation of relevant details or data. It is a careful search of inquiry into any subject matter, which is an endeavour to discover or find out valuable facts which would be useful for further application or utilization. The research that involves scientific analysis would result in the formulation of new theories, the discovery of new techniques, a modification of old concepts or a knocking-off an existing theory concept or technique. It may develop a hypothesis and test it. It may also establish relationships between variables and identify the means for problem-solving.

"***Social Research"*** is the scientific analysis of the nature and trends of social phenomena of groups or in general, of human behaviour so as to formulate broad principles and scientific concepts. Social research is the systematic method of discovering new facts or of verifying old facts, through sequence, inter-relationship, casual explanations and the natural laws which cover them.

The scope of research in social science covers the disciplines of the following:

- Economics and Commerce
- Education
- Management
- Political Science and International Relations.
- Psychology
- Public Administration
- Sociology
- Anthropology
- Demography, etc.

An increasing amount of attention is being devoted to the decision-making process of business managers, customers and employers. Many of the advances in business management in recent years are the result of adopting research findings in the behavioural sciences to business situations. It is important to bear in mind that all the social sciences, law and many other disciplines may have aspects that relate to business.

RESEARCH AND BUSINESS DECISIONS:

Research, being a fact-finding process, profoundly influences business decisions. The business manager is interested in choosing that course of action which is most effective in attaining the goals of the organization. Research not only provides facts and figures in support of such business decisions, but enables one to choose a measuring rod to judge the effectiveness of each decision. This may be the reason why executives and business professionals consider research and research findings a boon in their problem-solving process. Model building has become an integral part of report writing now-a-days, which makes executive decisions more effective. The decision maker wants the simplest model that predicts outcomes reasonably well and in consistent with

effective action on his part. Research has a tremendous potentially to assist him in this respect substantially. In management, it can, therefore, be defined as the process of systematic investigation of any management problem.

A considerable number of business problems are now given a quantitative treatment with some degree of success with the help of operations research. Quantitative analysis has now been extended to many other areas of business. In fact business decisions are now more quantitatively dealt with than ever before, irrespective of functional distinctions. There may not be any reason now to believe that business is more dependent on research than ever before. Research and development, however, have become an essential part of any business firms now. Research in business is, broadly, a systematic activity directed towards investigating managerial or business problems and results in an invention or a discovery of management tools for problem-solving and decision-making. It can be a detailed investigation of the existing problems, practices or processes.

Management which starting off as a scientific approach to the organization of things, it borrowed heavily from disciplines like sociology, psychology, mathematics and statistics. Now it is a distinct body of knowledge having the potential for theory and practice. Though management in general is said to encompass the aspects like planning, organizing, staffing, directing and controlling, the discipline has spread itself to the specialized areas now. Thus we have management concepts as applied finance, production, personnel and marketing. These areas can effectively contribute to the achievement of organizational goals with the help of research and analysis.

1. **CONDUCTING INVESTIGATION:**

Research Design:

A ***"Research Design"*** is the specification of methods and procedures for acquiring the information needed to structure or to solve problems. It is the overall operational pattern or framework of the project that stipulates what information is to be collected, from which sources, and by what procedures. If it is good design, it will ensure that the information obtained is relevant to the research problem and that it was collected by objective and economical procedures. A research design might be described as a series of advance decision that, taken together, form a specific master plan or model for the conduct of the investigation.

Research Design is needed because it facilitate the smooth sailing of the various research operations, thereby making research as efficient as possible, yielding maximum information with minimum effort, time and cost. Research design, in fact, stands for advanced planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objective of the research and the availability of staff, time and money. It has a great bearing on the reliability of the results arrived at and as such constitutes the firm foundation of the entire edifice of the research work. Thoughtlessness in designing the research exercise futile. It is, therefore, imperative that an efficient and appropriate design must be prepared before starting research operations. The design helps the researcher to organize his ideas in a form whereby it will be possible for him to look for flaws and inadequacies.

Types of Research Design:

As indicated earlier, a research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. The arrangement of conditions suitable for collection and analysis of

data varies depending upon the type of research study. One has to prepare his research design, depending on the specific nature of the study. Let us discuss in some detail the types of various researches.

The following are the different types of research design:

1) . Exploratory or formulative study
2) . Descriptive study
3) . Diagnostic study
4) . Experimental study

Exploratory or Formulative Study:

Exploratory or formulative studies are those which aim at gaining familiarity with a phenomenon or which aim at achieving insights into the phenomenon or studies which deal with formulation of a more precise research problem or developing a hypothesis. It is from the findings of these studies that a new research problem may be formulated or a new hypothesis developed. It is the initial step of problem finding and in fact much of social research is of an exploratory nature. Hence, it is said to be the primary stage of research.

Usually, exploratory research result when one is confronted with a problem and he wants to know why. For instance, the sales of a company are stagnant or coming down; the sales of a company are stagnant or coming down; the sales manager would be interested in knowing why this is happening. This would be the starting point for research. The sales manager would be anxious to find a solution for this business problem.

Exploratory research may also be involved when perceived problem is much less general. For instance, the research department may be requested to find why one group of sales representatives is particularly unproductive or why certain market segments are buying less than others. Exploratory research is, therefore, much useful to develop the most promising hypothesis.

Because the objective of an exploratory study is to find new hypotheses, flexibility and ingenuity characterize the investigation. As they proceed with the investigation, researcher must be on the alert to recognize new ideas. As such, formal design is absent in exploratory studies, we can distinguish three separate stages that are usually included in exploratory studies and conducted in the sequence listed as follows:

- Study of secondary sources of information.
- Interviews with persons who are knowledgeable about the subject areas being explored, and
- Analysis of selected cases (case study method of research)

Descriptive Study:

A study which wants to portray the characteristics of a group or individuals or situation is known as descriptive study. For instance, the degree to which product use varies with income, age, sex, occupation, or other characteristics is a descriptive study. The many objective of descriptive

study is to acquire knowledge. There are certain areas where knowledge has not yet properly developed. For instance, the management practice in the Indian corporate sector and the behaviour of Indian consumers are little known. In such cases, the investigator has to confine him to descriptive design.

Unfortunately, it is relatively easy to start a descriptive study with the vague thought that the data collected will be interesting. As a result many descriptive studies are made with only hazy objectives and with inadequate planning. Much of the data collected in such studies turns out to be useless. Descriptive studies of this type, in which there is no clear hypothesis, are actually more explanatory than they are conclusive. To be of maximum value, a descriptive study must collect data for a definite purpose.

Diagnostic Study:

A study which wants to determine the frequency of occurrence of an event of its association with something else is known as diagnostic study. It is concerned with an existing problem and its basic nature and cause. It is interested in identification as well as treatment.

Experimental Study:

Experimentation is the highest stage in social research. This is the chief method of research in physical or natural science. But the utility of experimental method of research is now tried in different subjects like marketing and management. Experimental studies are mainly designed to find out the cause and effect relationship of the phenomenon under study. In fact, when observation is arranged and controlled it becomes experiment. As such, controlled observation is nothing but an experiment.

The definition part of experimental study defines "***Experimentation"*** as that process in which one or more variables are manipulated under conditions that permit the collection of data that show the effects if any of such variables in a unconfused fashion.

2. ACADEMIC AND BUSINESS RESEARCH:

Academic Research is basically pure or more basic research which is a search for broad principles and synthesis without any immediate utilization objective, for example Franklin's discovery of electricity and Einstein's theory of relativity. This is moving an intellectual exploration arising from insatiable intellectual curiosity. It is not concerned with solving any practical problems of policy but with discovering and fashioning tools of analysis and with discovering underlying, and if possible universal laws and theories. For example, Joan Robinson's "***Imperfect Competition"*** and Chamberlin's "***Monopolistic Competition"*** are basic academic research. Fundamental research is original or basic in character. It is also known as theoretical research, because its objective is to discover or enunciate new but broad principles and synthesis without aiming at any immediate application.

Business Research, on the other hand, is applied research, also known as, action research is associated with particular project and problem. Such research, being of practical value, may relate to current activity or immediate practical situations. It aims at finding a solution for an immediate problem facing a society. Practically all social science research, including business research, undertaken in India is of the applied variety and more particularly of the type which helps formulation of policy. Applied research is thus concerned with actual life. It discovers the what, how and why of actual life.

Much of the research in business in India is exploratory in character. Researchers in these disciplines are now trying to have better insights into the problem areas and are in the process of testing vague hypotheses for the clear conclusion. In this sense, we can say that the stage of research in these disciplines in India is primary. Because of the problem of collecting data from primary sources, many researchers are depending on the secondary data. Surveying the individuals with idea is also common. Studies in the area like financial management, personnel management, banking, industry are generally based on the secondary type of data and hence are mainly exploratory in nature. Further case study type of research is also quite common to business disciplines. Descriptive and diagnostic studies occupy the next important place in research in business. Experimentation is considered the highest stage in business research including to some course, the utility of experimental method in business is adequately highlighted by the Hawthorne studies conducted by Mayo and his colleagues.

3. **RESEARCH FORMAT:**

The research process is an orderly step taken by the researcher or investigator in order to gather information necessary for making business decisions. In the research process, each step must be carefully planned and that the relationship between the steps must be formally recognized. What this means is that a "***Research Format"***, which is a general style or shape of research project, must be developed and put in writing. As such, the research format becomes the "***mater"*** guide for implementing and controlling the research project. Although the research format will differ from investigator to investigator, the following are said to be the important components as there is no uniform guidelines.

- Title of the problem
- Nature of the study
- Objectives of the study
- Scope of the study
- Survey of Literature
- Conceptualization of Terms used
- Formulation of Hypotheses
- Selection of sample
- Data Collection
- Data Analysis
- Report Writing
- Bibliography

RESEARCH FORMAT-ILLUSTRATION

A medium-sized company, operating in the western market in the business of refined oil, which is sold in loose form in the local market, wanted to launch refined groundnut oil (***GNO)*** in Ahmedabad in the packaged cooking oil market. (***Title of the Problem)***

A preliminary study indicated (Nature ***of the study*** –in this case Exploratory Survey) that the need satisfied by GNO is that of a cooking medium. The decision making unit in the household is the housewife. The entire year's consumption was usually bought in bulk in packaged tin during the season which lasts from November to February. The more popular brands were found to be Pankaj, Dharti, Laxmi, Postman and Goldnut. The market shares were estimated roughly as Pankaj (50%), Dharti (35%) and other (15%).

The distribution of GNO is thorough retailers (margin 2%) and wholesalers/dealers (1%). The benefits which a housewife sought is groundnut oil as a cooking medium were taste, odour, natural cooking flavour, non-smoking property, unadulterated fresh after storage, non-solidifying and economical.

The research objectives of the survey (*objectives* ***of the study)*** were the identify:

(1). The desired critical benefits and estimate their deficiencies in the current brands.

(2). A position for the product in the segment choosen.

(3). The critical product attributes which go into the making of the chosen benefit pack.

The ***scope of the study*** of this particular illustration may be defined as the acceptability of GNO as cooking oil in terms of quality and availability by the housewife.

The ***survey of literature*** in this case is not warranted as the study is to collect data form primary source. I.e. conducting survey among households.

The ***Hypothesis*** may be formulated as followed as far as this illustration is concerned:

(1). The desired position of the product in the minds of housewife in terms of quality is high.

(2). The product should be readily available.

A sample of 80 household (***selection of sample)*** was proportionally distributed across the three strata generated on the basis of income. The questionnaire was designed(***Data Collection)*** to seek responses in terms of product usage characteristics, brand used, frequency of purchase, quantity used, brand switch behaviour, Benefits received, degree of importance of attributes on a rating scale.

The criticality of the benefits was first obtained (***Data Analysis***) based on the aggregate benefit desired ratings. The coefficient of associations and the degree to which they are significant are analyzed.

After data analysis using appropriate statistical methods, the desired position of the product (***Report Writing***) as identified by the benefit structure analysis is that it is a product which is of a high quality, nutrition, pure, having a strong groundnut flavour and is readily available with free home delivery during the season. Quality would be emphasized also through a higher price on competitively higher terms.

REPORT WRITING:

Report Writing is the final stage of the research. It is the final outcome of the efforts of the investigator or researcher and it should reflect the same. The successful report gives meaning to the

statistical and logical findings and wins the acceptance of those who will translate the findings into action.

The report serves three chief functions.

(1). It is the means where by the data, analyses, and findings are placed in an organized and permanent form as a future reference material.

(2). The quality of the research work is likely to be judged mainly by the report.

(3). The effectiveness of the report lies only on the actions or policies taken which is the goal of all business research.

Essentials of a Good Report:

The researcher's ability is revealed through the quality of his study. It depends on how well he could make his presentation valid, reliable, clear and acceptable where the utility of the report is increased. The following are said to be the essentials of a good report.

- Clarity and Coherence
- Writing Correctly
- Styled to the Reader's taste
- Readability
- Effective Arrangement
- Using non-technical language
- Making it Brief
- Stressing practical action
- Using visual devices in the report

Content of the Report:

The following outline shows the conventional and logical arrangement of the steps in report writing.

- Title Page
- Table of Contents
- Synopsis of the report
- Introduction
- Methodology
- Findings
- Limitations of the study
- Conclusions(drawn from data)
- Recommendations (stemming from the conclusions)
- Appendix
- Bibliography