SYLLABUS

B.B.A. V SEM

Subject – Research Methodology

UNIT – I	Business Research, Meaning and methods of research. Research Process, Identification and formulation of Research Problem, Sources of Data, Primary Data and Secondary Data.
UNIT – II	Research Design: Variables and types of variables, Hypothesis, Types and formulation of Hypothesis, Research Design and Types of research designs, Need for Research Design Features of a good research design and, Different research design--Exploratory, Descriptive. Experimental and Diagnostic and Survey Research.
UNIT – III	Measurement Methods: Interviews and Surveys. Observation, Content Analysis and Measurement Scales, Techniques of Developing Scales, Reliability and Validity of scales.
UNIT – IV	Data Analysis: Data analysis using statistical Packages, Hypothesis Testing, Parametric and Non-Parametric tests, Analysis of Differences between a Single Sample and a Population, Analysis of Differences between Two or More than Two Levels of an Independent Variable, Analysis of Designs with More than One Independent Variable, Analysis of relationships. statistical inferences for one or two samples.
UNIT – V	Chi-square tests, Analysis of Variance (ANOVA) and Use of Multivariate Analysis in Business Research.
UNIT – VI	Sharing the Results. Reporting Research, Types of reports and Characteristics of a research report.

Unit – 1
MEANING & TYPES OF RESEARCH

Meaning:

1) Gathering and analyzing a body of information or data and **extracting new meaning** from it or **developing unique solutions** to problems or cases.
2) A **report** or **review**, not designed to create new information or insight but to collate and synthesize existing information.
3) A search for **individual facts or data**. May be part of the search for a solution to a larger problem

Types :

There are two types of research which can be done to develop a thesis or dissertation:

1) **Practical Research:** The practical approach consists of the empirical study of the topic under research and chiefly consists of hands on approach. This involves first hand research in the form of questionnaires, surveys, interviews, observations and discussion groups.

2) **Theoretical Research:** A non empirical approach to research, this usually involves perusal of mostly published works like researching through archives of public libraries, court rooms and published academic journals.

3) **Descriptive/Qualitative**: This type of research methods involve describing in details specific situation using research tools like interviews, surveys, and Observations. It focuses on gathering of mainly verbal data rather than measurements.

4) **Descriptive/Quantitative**: This type of research methods requires quantifiable data involving numerical and statistical explanations. Quantitative analysis hinges on researchers understanding the assumptions inherent within different statistical models. It generates numerical data or information that can be converted into numbers. The presentation of data is through tables containing data in the form of numbers and statistics.

Advantages of Marketing Research

1. **Indicates current market trends** : Marketing research keeps business unit in touch with the latest market trends and offers guidance for facing market situation with confidence. It facilitates production as per consumer demand and preferences.
2. **Pinpoints deficiencies in marketing policies** : MR pinpoints the deficiencies as regards products, pricing, promotion, etc. It gives proper guidance regarding different aspects of marketing. They include product development, branding, packaging and advertising.
3. **Explains customer resistance** : MR is useful for finding out customer resistance to company's products. Suitable remedial measures are also suggested by the researcher to deal with the situation. This makes the products agreeable to the consumers.
4. **Suggests sales promotion techniques** : Marketing research enables a manufacturer to introduce appropriate sales promotion techniques, select most convenient channel of distribution, suitable pricing policy for the products and provision of discounts and concessions to dealers. It facilitates sales promotion.
5. **Guidance to marketing executives** : Marketing research offers information and guidance to marketing executives while framing marketing policies. Continuous research enables a company to face adverse marketing situation boldly. It acts as an insurance against possible changes in market environment.
6. **Selection and training of sales force** : Marketing research is useful for the selection and training of staff in the sales Organisation. It suggests the incentives which should be offered for motivation of employees concerned with marketing.
7. **Facilitates business expansion** : Marketing research enables a business unit to grow and expand its activities. It creates goodwill in the market and also enables a business unit to earn high profits through consumer-oriented marketing policies and programmes.

8. **Facilitates appraisal of marketing policies** : Research activities enable marketing executives to have an appraisal of the present marketing policies in the fight of research findings. Suitable adjustments in the policies are also possible as per the suggestions made.
9. **Suggests marketing opportunities** : Marketing research suggests new marketing opportunities and the manner in which they can be exploited fully. It identifies existing and emerging market opportunities.
10. **Facilitates inventory study** : Marketing research is useful for the evaluation of company's inventory policies and also for the introduction of more efficient ways of managing inventories including finished goods and raw materials.
11. **Provides marketing information** : MR provides information on various aspects of marketing. It suggests relative strengths and weaknesses of the company. On the basis of such information, marketing executives find it easy to frame policies for the future period. MR provides information, guidance and alternative solutions to marketing problems.
12. **Suggests distribution channels** : Marketing research can be used to study the effectiveness of existing channels of distribution and the need of making suitable changes in the distribution system.
13. **Creates progressive outlook** : Marketing research generates a progressive and dynamic outlook throughout the business Organisation. It promotes systematic thinking and a sense of professionalisation within the company. It also creates enthusiasm among executives concerned with marketing. This brings success and stability to the whole business unit.
14. **Social significance** : Marketing research is of paramount importance from the social angle. It acts as a means by which the ultimate consumer literally becomes king of the market place.

Topic 2- Research Process

The twelve stages or steps in a research process are:

1. Problem identification: The first step in a research process is to identify the problem or opportunity. The problem may be about decrease in sales, increase in competition, expansion of market, etc.

2. Problem definition: The second step in a research process is to define the problem. In this stage, the researcher must understand the problem correctly. He must find out the scope of the problem, the type of information needed, etc. If the problem is not defined properly, then it will result in waste of time, money and resources.

3. Research design: The third step in a research process is to prepare research design.

Research design is a plan for conducting a research. It guides the researcher in data collection. It gives proper direction to the research.

There are three types of research designs:

1. Exploratory research,
2. Descriptive Research and
3. Experimental Research.

All three types are used for marketing research.

4. Determining data needs: The fourth step in a research process is to determine the data needs. The researcher must consider the following issues:

1. Whether to use primary data or secondary data or both.
2. The accuracy and reliability of the data.
3. The availability of accurate and reliable data.
4. The cost and time required to collect the data.

5. Determining data sources: The fifth step in a research process is to determine the data sources. The researcher decides the sources of collecting data. The two main sources are secondary data and primary data. The researcher first collects secondary data. This is because it is easily available and less

costly. It is collected by Desk Research. Desk Research can be internal for e.g. collected from company's records or external i.e. acquired from libraries, trade journals, government sources, etc. If the secondary data is not sufficient to solve the marketing problem, then primary data is wheeled.
Collecting primary data is very costly and time consuming. It can be collected by using survey methods, i.e. by doing personal interviews, telephone interviews and mail surveys. It can also be collected by using observational method and experimentation method.
So in this step the researcher decides what source and what method to use for collecting data.

6. Sampling design: The sixth step in a research process is of sampling design. The Researchers has limited time and other resources. So he cannot contact the total population. That is, he cannot collect information from all the people in the market. Therefore, he selects few persons from the population. These handful persons are called sample respondent. They are considered to represent the total population. The researcher collects data from the sample respondents. Sampling helps to save time, efforts and cost. It is used to collect primary data. The researcher has to decide about method of sampling, the size-of-sample, etc.

7. Designing questionnaire: The seventh step in a research process is of designing a questionnaire. In this stage, primary data is collected with the help of a questionnaire. So the researcher has to prepare a questionnaire. A questionnaire is a list of questions. These questions are asked to the respondents for collecting data. The questionnaire must be suitable so that the require data is collected easily, quickly and correctly. It is used for conducting person interview, telephone interviews and mail survey. The researcher must decide about the type of the information required, the type of questioned to be asked, the wordings of the questionnaire, its order, etc.

8. Field staff selection: The eighth step in a research process is of selecting field staff. After preparing the questionnaire, the researcher selects field interviewers. The field interviewers collect information from the respondents. They must be property trained. Students of psychology and statistics are good for this job.

9. Collection and processing of data: The ninth step in a research process is of collection and processing of data. In this stage, the data is collected from the respondents. The questionnaire is used for collecting data. In case of mail surveys, the questionnaire is sent to the respondents by post. In case of telephone interviews, the data is collected through telephone. In case of personal interviews, the data is collected by the field interviewers. The researcher can also use observation method and experimentation method for collecting data. The data collected must be reliable and complete. It must also be collected quickly. Secondary data is also collected. The data collected is raw. It cannot be used directly. It has to be processed and organized neatly. That is, the data must be edited, coded, classified and tabulated. Editing helps to remove the unwanted data. Coding, classification and tabulation make the data ready for analysis and interpretation.

10. Analysis and interpretation of data: The tenth step in a research process is of analysis and interpretation of data. In this stage, the researcher analyzes and interprets the data. That is, he studies the data very careful and draws conclusions from it. These conclusions are then used to solve the marketing problem.

11. Project reporting: The eleventh step in a research process is to prepare a project report.
In this stage, the researcher prepares the final research report. This report contains a title of the report, method used, findings, conclusions and suggestions about how to solve the marketing problem. The language of the report must not be very difficult. The report must be submitted to the marketing executives for recommendations and implementation.

12. Follow up: Finally, the last step in a research process is to do a follow up.
In this stage, the marketing executive makes changes in the product, price, marketing policies, etc. as per the recommendations of the report. Here, the researcher should find out, whether his recommendations are implemented properly or not. He should also figure-out, whether the marketing problem is solved or not.

Topic 3- Identification & formulation of Research Problem
The main steps in identification & formulation of research problem are:
1. Specify the Research Objectives
A clear statement of objectives will help you develop **effective research.**
It will help the decision makers evaluate your project. **It's critical** that you have manageable objectives. (Two or three clear goals will help to keep your research project focused and relevant.)
2. Review the Environment or Context of the Research Problem
As a marketing researcher, you must work closely with your team. This will help you determine whether the findings of your project will produce enough information to be worth the cost.
In order to do this, you have to identify the environmental variables that will affect the research project.
3. Explore the Nature of the Problem
Research problems range from simple to complex, depending on the number of variables and the nature of their relationship.
If you understand the nature of the **problem as a researcher**, you will be able to better develop a solution for the problem.
To help you understand all dimensions, you might want to consider focus groups of consumers, sales people, managers, or professionals to provide what is sometimes much needed insight.
4. Define the Variable Relationships
Marketing plans often focus on creating a sequence of behaviors that occur over time, as in the adoption of a new package design, or the introduction of a new product.
Such programs create a commitment to follow some behavioral pattern in the future.
Studying such a process involves:
- Determining which variables affect the solution to the problem.
- Determining the degree to which each variable can be controlled.
- Determining the functional relationships between the variables and which variables are critical to the solution of the problem.

During the **problem formulation** stage, you will want to generate and consider as many courses of action and variable relationships as possible.
5. The Consequences of Alternative Courses of Action
There are always consequences to any course of action. Anticipating and communicating the possible outcomes of various courses of action is a primary responsibility in the research process.

Topic 4- Sources of data: primary & secondary data
Primary Data:
Raw data (also known as primary data) is a term for data collected from a *source*. Raw data has not been subjected to processing or any other manipulation, and are also referred to as *primary* data.
Sources of primary data:
Primary data is the data collected by the researcher themselves, i.e.
1. interview
2. observation
3. action research
4. case studies
5. life histories
6. questionnaires
7. ethnographic research
8. longitudinal studies

Advantages of Primary data:

1) **Targeted Issues are addressed.** The organization asking for the research has the complete control on the process and the research is streamlines as far as its objectives and scope is concerned. Researching company can be asked to concentrate their efforts to find data regarding specific market rather than concentration on mass market.

2) **Data interpretation is better.** The collected data can be examined and interpreted by the marketers depending on their needs rather than relying on the interpretation made by collectors of secondary data.

3) **Fresh/Recent Data.** Usually secondary data is not so recent and it may not be specific to the place or situation marketer is targeting. The researcher can use the irrelevant seeming information for knowing trends or may be able to find some relation with the current scenario. Thus primary data becomes a more accurate tool since we can use data which is useful for us.

4) **Proprietary Issues**. Collector of primary data is the owner of that information and he need not share it with other companies and competitors. This gives an edge over competitors replying on secondary data.

Disadvantages of Primary data:

1) **High Cost.** Collecting data using primary research is a costly proposition as marketer has to be involved throughout and has to design everything.

2) **Time Consuming.** Because of exhaustive nature of the exercise, the time required to do research accurately is very long as compared to secondary data, which can be collected in much lesser time duration.

3) **Inaccurate Feed-backs.** In case the research involves taking feedbacks from the targeted audience, there are high chances that feedback given is not correct. Feedbacks by their basic nature are usually biased or given just for the sake of it.

4) **More number of resources are required**. Leaving aside cost and time, other resources like human resources and materials too are needed in larger quantity to do surveys and data collection.

Secondary Data:

Secondary data, is data collected by someone other than the user. Common sources of secondary data for social science include censuses, organisational records and data collected through qualitative methodologies or qualitative research. Primary data, by contrast, are collected by the investigator conducting the research.

Sources of secondary data:

Secondary sources are data that already exists

1. Previous research
2. Official statistics
3. Mass media products
4. Diaries
5. Letters
6. Government reports
7. Web information
8. Historical data and information

Advantages of secondary data :

1) **Ease of Access:** There are many advantages to using secondary research. This includes the relative ease of access to many sources of secondary data. In the past secondary data accumulation required marketers to visit libraries, or wait for reports to be shipped by mail. Now with the availability of online access, secondary research is more openly accessed. This offers convenience and generally standardized usage methods for all sources of secondary research.
2) **Low Cost to Acquire**
   The use of secondary data has allowed researchers access to valuable information for little or no cost to acquire. Therefore, this information is much less expensive then if the researchers had to carry out the research themselves.
3) **Clarification of Research Question**
   The use of secondary research may help the researcher to clarify the research question. Secondary research is often used prior to primary research to help clarify the research focus.
4) **May Answer Research Question**
   The use of secondary data collection is often used to help align the focus of large scale primary research. When focusing on secondary research, the researcher may realize that the exact information they were looking to uncover is already available through secondary sources. This would effectively eliminate the need and expense to carry out there own primary research.
5) **May Show Difficulties in Conducting Primary Research**
   In many cases, the originators of secondary research include details of how the information was collected. This may include information detailing the procedures used in data collection and difficulties encountered in conducting the primary research. Therefore, the detailed difficulties may persuade the researcher to decide that the potential information obtained is not worth the potential difficulties in conducting the research.

Disadvantages of secondary data :

1) **Quality of Research**
   There are some disadvantages to using secondary research. The originators of the primary research are largely self-governed and controlled by the marketer. Therefore, the secondary research used must be scrutinized closely since the origins of the information may be questionable. Moreover, the researcher needs to take sufficient steps to critically evaluate the validity and reliability of the information provided.
2) **Not Specific to Researcher's Needs**
   In many cases, secondary data is not presented in a form that exactly meets the researcher's needs. Therefore, the researcher needs to rely on secondary data that is presented and classified in a way that is similar to their needs.
3) **Incomplete Information**
   In many cases, researchers find information that appears valuable and promising. The researcher may not get the full version of the research to gain the full value of the study. This is because many research suppliers offer free portions of their research and then charge expensive fees for their full reports.
4) **Not Timely**
   When using secondary research, one must exercise caution when using dated information from the past. With companies competing in fast changing industries, an out-of-date research reports many have little or no relevance to the current market situation.

Unit 2
RESEARCH DESIGN

Variables & Types of Variables

When it comes to experiments and data analysis, there are two main types of variables: **dependent variables** and **independent variables**. It's easy to get these mixed up, but the difference between dependent and independent variables is simple. Here is a quick and easy definition of each one, along with some examples.

1) Dependent Variable: This is the output variable you are really interested in monitoring to see if it was affected or not. It can also be called the "measured variable," the "responding variable," the "explained variable," etc. I think it is easy to remember this one because it is *dependent* on the other variables.

2) Independent Variables: These are the individual variables that you believe may have an effect on the dependent variable. They are sometimes called "explanatory variables," "manipulated variables," or "controlled variables."

Example #1: Golf Balls

Here's a simple situation: Suppose you want to test golf ball flight distances, so you set up a simple experiment in which various golf balls are placed into a mechanical chute and fired into the air. The variable you really care about, the "output" or ***dependent variable*** is golf ball distance. ***Independent variables*** are the variables you are going to test to see how they affect distance. In this case, they are going to be things like air temperature, golf ball brand, and color of the golf ball. In the end, if you do a fancy regression analysis on all your data, you are going to end up with a formula that looks something like this: golf ball distance = 50 feet + air temperature factor + golf ball brand factor + golf ball color factor. See how all the independent variables (air temp, brand, color) have an effect on the dependent variable (distance)?

Example #2: Ice Cubes

Here's another simple example: Imagine that you have a bunch of ice cubes and you want to test how long it takes them to melt in various situations. You have an experiment with 1,000 equally shaped ice cubes. Some of them are made of frozen cranberry juice and some of them are frozen lemonade. You are going to set some of them on a metal sheet and others are going to be placed on a wooden plank. Air temperature, wind, and every other condition you can think of will remain constant. So, in this case, your ***dependent variable*** is ice cube melting time. Your two ***independent variables*** are: juice type (cranberry or lemonade) and melting surface (metal or wood). I'm not sure why anyone would care to do such an experiment, but hopefully the difference between the dependent and independent variables are clear now.

Hypothesis, Types & Formulation of Hypothesis

Introduction and Definition

Hypothesis and the theories are generally responsible for the movement of knowledge from the unknown to the known. Hypotheses play a very important and a critical role in the assertion of a particular thing, as they are able to describe certain facts and are also able to explain the various relationships between these facts. As a result of this, hypotheses help a great deal in the investigation operations or activities.

On the institution of the problem to be answered in the process of the research, the researcher forms various tentative or possible solutions to these problems these proposed answers or the solutions are referred to as the hypothesis. But a very critical and essential point to be kept in mind here is that these propositions are not at all verified in nature.

So Hypothesis can be referred to as the interpretation of certain facts which is just a possible solution or a tentative answer to a problem and is completely or partly unverified in nature. Then afterwards on its establishment, it ceases to be a hypothesis and then finally becomes a theory or a principle. The word 'Hypothesis' has come from the Greek word hypo (means under)and tithenas (means to place) together

these words indicate towards the support they provide to each other on the placement of the hypothesis under the evidence, which acts as a foundation.
According to George A Luniberg, hypothesis can be defined as a 'tentative generalization, the validity of which remains to be tested. In this elementary stage, the hypothesis may be very hunch, guess, imaginative data, which becomes the basis for an action or an investigation.'
A very vital point that should be kept in mind about the hypotheses is that these are not theories these only have some linkage to the theory but hypothesis is not that much elaborated as the theory is. But it can be said that the hypothesis is derived from the theory.

Role and Functions of the hypothesis
1. Helps in the testing of the theories.
2. Serves as a great platform in the investigation activities.
3. Provides guidance to the research work or study.
4. Hypothesis sometimes suggests theories.
5. Helps in knowing the needs of the data.
6. Explains social phenomena.
7. Develops the theory.
8. Also acts as a bridge between the theory and the investigation.
9. Provides a relationship between phenomena in such a way that it leads to the empirical testing of the relationship.
10. Helps in knowing the most suitable technique of analysis.
11. Helps in the determination of the most suitable type of research.
12. Provides knowledge about the required sources of data.
13. Research becomes focused under the direction of the hypothesis.
14. Is very helpful in carrying out an enquiry of a certain activity.
15. Helps in reaching conclusions, if it is correctly drawn.

Sources of hypothesis
1. Observations made in routine activities.
2. Theories based on the scientific approach.
3. Analogies.
4. Knowledge obtained from the functional executives.
5. Results of the research and development department.
6. Experience of the investigator.

Characteristics of hypothesis
1. Should be very specific in nature.
2. Concept of the hypothesis should be clear.
3. Should be empirically testable.
4. Should be related to the devices and the techniques that are available.
5. Should relate to the body of the theory.
6. Should recognize the specific variables and their relation

Research Design & Types of Research Design
1. Explanatory or Descriptive hypothesis – This type of the hypothesis generally involves data about the cause of the process or about the law on which it is based. Hypothesis involving data about the cause is explanatory in approach and the hypothesis involving laws acts descriptive in the approach.
2. Tentative hypothesis – Such a hypothesis is made, when one does not possess complete information and understanding about a certain process or phenomenon. Such a situation, when one is not able to understand the process may occur due to the technical difficulties. It is also possible to test two or more hypothesis simultaneously the hypothesis about the propagation of light, namely, wave theory and the corpuscular theory of light both describe the light' s phenomenon but among both of these none of them is final hence these can be referred to as tentative in nature.

3. Representative fictions – Some hypothesis are based on the assumptions and depending on the nature of the case, it is not at all possible to prove these assumptions by the direct means such hypothesis is referred to as the representative fictions. The only positive point of these representative fictions is that they are very suitable in order to explain the whole phenomenon.

Problems faced during hypothesis formulation

Formulating a hypothesis is not at all an easy process and is faced with a large number of difficulties. According to Goode and Hatt, the various difficulties faced during the formulation of the hypothesis generally include the lack of the knowledge about the scientific approach of the method involved, as sometimes it becomes impossible to gather the complete information about a particular scientific method. One other major difficulty in the formulation of the hypothesis is the lack of clear theoretical background. Because of this problem of unclear and indefinite background of theory one is not able to arrive to a conclusion easily.

But with time answers to all such problems are available and these difficulties that arise during the hypothesis formulation can be easily removed by having complete and accurate information about the concepts of the subjects involved. Also the hypothesis should not be very long and should be timely in nature.

Research Design & Types of Research Design

A **research design** is a systematic plan to study a scientific problem. The design of a study defines the study type (descriptive, correlational, semi-experimental, experimental, review, meta-analytic) and sub-type (e.g., descriptive-longitudinal case study), research question, hypotheses, independent and dependent variables, experimental design, and, if applicable, data collection methods and a statistical analysis plan. Research design is the framework that has been created to seek answers to research questions.

Confirmatory versus exploratory research

Confirmatory research tests *a priori* hypotheses—outcome predictions that are made before the measurement phase begins. Such *a priori* hypotheses are usually derived from a theory or the results of previous studies. The advantage of confirmatory research is that the result is more meaningful, in the sense that it is much harder to claim that a certain result is statistically significant. The reason for this is that in confirmatory research, one ideally strives to reduce the probability of falsely reporting a non-significant result as significant. This probability is known as α-level or a type I error. Loosely speaking, if you know what you are looking for, you should be very confident when and where you will find it; accordingly, you only accept a result as significant if it is highly unlikely to have been observed by chance.

Exploratory research on the other hand seeks to generate *a posteriori* hypotheses by examining a data-set and looking for potential relations between variables. It is also possible to have an idea about a relation between variables but to lack knowledge of the direction and strength of the relation. If the researcher does not have any specific hypotheses beforehand, the study is exploratory with respect to the variables in question (although it might be confirmatory for others). The advantage of exploratory research is that it is easier to make new discoveries due to the less stringent methodological restrictions. Here, the researcher does not want to miss a potentially interesting relation and therefore aims to minimize the probability of rejecting a *real* effect or relation, this probability is sometimes referred to as β and the associated error is of type II. In other words, if you want to see whether some of your measured variables could be related, you would want to increase your chances of finding a significant result by lowering the threshold of what you deem to be *significant*.

Sometimes, a researcher may conduct exploratory research but report it as if it had been confirmatory this is a questionable research practice bordering fraud.

Need and Importance of Research Design

Research design carries an important influence on the reliability of the results attained. It therefore provides a solid base for the whole research. It is needed due to the fact that it allows for the smooth working of the many research operations. This makes the research as effective as possible by providing maximum information with minimum spending of effort, money and time. For building of a car, we must have a suitable blueprint made by an expert designer. In a similar fashion, we require a suitable design or plan just before data collection and analysis of the research project. Planning of design must be carried out cautiously as even a small mistake might mess up the purpose of the entire project. The design helps the investigator to organize his ideas, which helps to recognize and fix his faults, if any. In a **good research design**, all the components go together with each other in a coherent way. The theoretical and conceptual framework must with the research goals and purposes. In the same way, the data gathering method must fit with the research purposes, conceptual and theoretical framework and method of data analysis.

A research design is like a successful journey:

- Broadens your mind
- Provides fascinating & exciting experience
- Gives understanding of world around you
- Provides chance to meet people
- Gives fun and reward, but sometimes, very tedious & monotonous too.

The **importance of research design in research methodology** is due to the following:

- It may result in the preferred kind of study with helpful conclusion.
- It cuts down on inaccuracy.
- Allows you get optimum efficiency and reliability.
- Reduce wastage of time.
- Reduce uncertainty, confusion and practical haphazard related to any research problem.
- Of great help for collection of research material and testing of hypothesis.
- It is a guide for giving research the right path.
- Gets rid of bias and marginal errors.
- Provides an idea concerning the type of resources needed in terms of money, effort, time, and manpower.
- Smooth & efficient sailing (sets boundaries & helps prevent blind search)
- Maximizes reliability of results.
- Provides firm foundation to the endeavor.
- Averts misleading conclusions & thoughtless useless exercise.
- Provides opportunity to anticipate flaws & inadequacies (anticipates problems).
- Incorporates by learning from other people's critical comments & evaluations.

Features of a good Research Design

Research in simplified terms means searching for the facts searching for the replies to the various queries and also for the solutions to the various problems. Research is an inquiry or an investigation with a specific purpose to fulfill, it helps in clearing the various doubtful concepts and tries to solve or explain the various unexplained procedures or phenomenons.

The features that a good research procedure must possess are –

1. Should be systematic in nature.
2. Should be logical.
3. Should be empirical and replicable in nature.
4. Should be according to plans.
5. Should be according to the rules and the assumptions should not be based on the false bases or judgments.

6. Should be relevant to what is required.
7. Procedure should be reproducible in nature.
8. Controlled movement of the research procedure.

Different Research Designs

1) **Pure research**

a. Also called as the fundamental or the theoretical research.
b. Is basic and original.
c. Can lead to the discovery of a new theory.
d. Can result in the development or refinement of a theory that already exists.
e. Helps in getting knowledge without thinking formally of implementing it in practice based on the honesty, love and integrity of the researcher for discovering the truth.

2) **Applied research**

a. Based on the concept of the pure research.
b. Is problem oriented.
c. Helps in finding results or solutions for real life problems.
d. Provides evidence of usefulness to society.
e. Helps in testing empirical content of a theory.
f. Utilizes and helps in developing the techniques that can be used for basic research.
g. Helps in testing the validity of a theory but under some conditions.
h. Provides data that can lead to the acceleration of the process of generalization.

3) **Exploratory research**

a. Involves exploring a general aspect.
b. Includes studying of a problem, about which nothing or a very little is known.
c. Follows a very formal approach of research.
d. Helps in exploring new ideas.
e. Helps in gathering information to study a specific problem very minutely.
f. Helps in knowing the feasibility in attempting a study.

4) **Descriptive research**

a. Simplest form of research.
b. More specific in nature and working than exploratory research.
c. It involves a mutual effort.
d. Helps in identifying various features of a problem.
e. Restricted to the problems that are describable and not arguable and the problems in which valid standards can be developed for standards.
f. Existing theories can be easily put under test by empirical observations.
g. Underlines factors that may lead to experimental research.
h. It consumes a lot of time.
i. It is not directed by hypothesis.

5) **Diagnostic study**

a. Quite similar to the descriptive research.
b. Identifies the causes of the problems and then solutions for these problems.
c. Related to causal relations.
d. It is directed by hypothesis.
e. Can be done only where knowledge is advanced.

6) **Evaluation study**

a. Form of applied research.
b. Studies the development project.
c. Gives access to social or economical programmes.
d. Studies the quality and also the quantity of an activity.

7) **Action research**

a. Type of evaluation study.
b. Is a concurrent evaluation study.

UNIT 3
MEASUREMENT METHODS

Interview Research

1) The qualitative research interview seeks to describe and the meanings of central themes in the life world of the subjects. The main task in interviewing is to understand the meaning of what the interviewees say.
2) A qualitative research interview seeks to cover both a factual and a meaning level, though it is usually more difficult to interview on a meaning level.
3) Interviews are particularly useful for getting the story behind a participant's experiences. The interviewer can pursue in-depth information around the topic. Interviews may be useful as follow-up to certain respondents to questionnaires, e.g., to further investigate their responses.

Characteristics of Interview

1) Interviews are completed by the interviewer based on what the respondent says.
2) Interviews are a far more personal form of research than questionnaires.
3) In the personal interview, the interviewer works directly with the respondent
4) Unlike with mail surveys, the interviewer has the opportunity toprobe or ask follow up questions.
5) Interviews are generally easier for respondent, especially if what is sought is opinions or impressions.
6) Interviews are time consuming and they are resource intensive.
7) The interviewer is considered a part of the measurement instrument and interviewer has to well trained in how to respond to any contingency

Types of Interviews

1) **Informal, conversational interview** -no predetermined questions are asked, in order to remain as open and adaptable as possible to the interviewee's nature and priorities; during the interview the interviewer "goes with the flow".
2) **General interview guide approach** -the guide approach is intended to ensure that the same general areas of information are collected from each interviewee; this provides more focus than the conversational approach, but still allows a degree of freedom and adaptability in getting the information from the interviewee.
3) **Standardized, open-ended interview** -the same open-ended questions are asked to all interviewees; this approach facilitates faster interviews that can be more easily analyzed and compared.
4) **Closed, fixed-response interview** -where all interviewees are asked the same questions and asked to choose answers from among the same set of alternatives. This format is useful for those not practiced in interviewing

Survey Research & its Types

A survey is defined as a brief interview or discussion with individuals about a specific topic. The term survey is unfortunately a little vague, so we need to define it better. The term survey is often used to mean 'collect information.

Classification of Survey Design According to Instrumentation

In survey research, the instruments that are utilized can be either a questionnaire or an interview (either structured or unstructured).

1. Questionnaires

Typically, a questionnaire is a paper-and-pencil instrument that is administered to the respondents. The usual questions found in questionnaires are closed-ended questions, which are followed by response options. However, there are questionnaires that ask open-ended questions to explore the answers of the respondents.

Questionnaires have been developed over the years. Today, questionnaires are utilized in various survey methods, according to how they are given. These methods include the self-administered, the group-administered, and the household drop-off. Among the three, the self-administered survey method is often used by researchers nowadays. The self-administered questionnaires are widely known as the mail survey method. However, since the response rates related to mail surveys had gone low, questionnaires are now commonly administered online, as in the form of web surveys.

- **Advantages:** Ideal for asking closed-ended questions; effective for market or consumer research
- **Disadvantages:** Limit the researcher's understanding of the respondent's answers; requires budget for reproduction of survey questionnaires

2. Interviews

Between the two broad types of surveys, interviews are more personal and probing. Questionnaires do not provide the freedom to ask follow-up questions to explore the answers of the respondents, but interviews do.

An interview includes two persons - the researcher as the interviewer, and the respondent as the interviewee. There are several survey methods that utilize interviews. These are the personal or face-to-face interview, the phone interview, and more recently, the online interview.

- **Advantages:** Follow-up questions can be asked; provide better understanding of the answers of the respondents
- **Disadvantages:** Time-consuming; many target respondents have no public-listed phone numbers or no telephones at all

Classification of Survey Design According to the Span of Time Involved

The span of time needed to complete the survey brings us to the two different types of surveys: cross-sectional and longitudinal.

1. Cross-Sectional Surveys

Collecting information from the respondents at a single period in time uses the cross-sectional type of survey. Cross-sectional surveys usually utilize questionnaires to ask about a particular topic at one point in time. For instance, a researcher conducted a cross-sectional survey asking teenagers' views on cigarette smoking as of May 2010. Sometimes, cross-sectional surveys are used to identify the relationship between two variables, as in a comparative study. An example of this is administering a cross-sectional survey about the relationship of peer pressure and cigarette smoking among teenagers as of May 2010.

2. Longitudinal Surveys

When the researcher attempts to gather information over a period of time or from one point in time up to another, he is doing a longitudinal survey. The aim of longitudinal surveys is to collect data and examine the changes in the data gathered. Longitudinal surveys are used in cohort studies, panel studies and trend studies.

Measurement Scales

1) Dichotomous Scales

A dichotomous scale is a two-point scale which presents options that are absolutely opposite each other. This type of response scale does not give the respondent an opportunity to be neutral on his answer in a question.

Examples:

- Yes- No
- True - False
- Fair - Unfair
- Agree – Disagree

2) Rating Scales

Three-point, five-point, and seven-point scales are all included in the umbrella term "rating scale". A rating scale provides more than two options, in which the respondent can answer in neutrality over a question being asked.

Examples:

1. Three-point Scales

- Good - Fair – Poor
- Agree – Undecided - Disagree
- Extremely- Moderately - Not at all
- Too much - About right - Too little

2. Five-point Scales (e.g. Likert Scale)

- Strongly Agree – Agree – Undecided / Neutral - Disagree - Strongly Disagree
- Always – Often – Sometimes – Seldom – Never
- Extremely – Very - Moderately – Slightly - Not at all
- Excellent - Above Average – Average - Below Average - Very Poor

3. Seven-point Scales

- Exceptional – Excellent – Very Good – Good – Fair – Poor – Very Poor
- Very satisfied - Moderately satisfied - Slightly satisfied – Neutral - Slightly dissatisfied - Moderately Dissatisfied- Very dissatisfied

3) Semantic Differential Scales

A semantic differential scale is only used in specialist surveys in order to gather data and interpret based on the connotative meaning of the respondent's answer. It uses a pair of clearly opposite words, and can either be marked or unmarked.

Examples:

1. Marked Semantic Differential Scale

Please answer based on your opinion regarding the product:

	very	**slightly**	**neither**	**slightly**	**very**	
Inexpensive	[ ]	[ ]	[ ]	[ ]	[ ]	Expensive
Effective	[ ]	[ ]	[ ]	[ ]	[ ]	Ineffective
Useful	[ ]	[ ]	[ ]	[ ]	[ ]	Useless
Reliable	[ ]	[ ]	[ ]	[ ]	[ ]	Unreliable

2. Unmarked Semantic Differential Scale

The central line serves as the neutral point:

Inexpensive _____|_____ Expensive
Effective _____|_____ Ineffective
Useful _____|_____ Useless
Reliable _____|_____ Unreliable

Techniques of Developing Scales

1) Define the attitude

The first step in designing an attitude scale is to define the attitude you want to measure. What does the attitude mean? What does "desire to learn" mean? If students do not have a desire to learn, what do they have? Perhaps, "desire to get a degree." With these two end points we can begin to build a scale to differentiate between those who desire to learn, and those who merely want a credential. In defining

the attitude, we must choose which end of the scale will be positive, and which will be negative. The simplest way to do this is to assign the positive end of the scale to your attitude. For our example, we'll make "desire to learn" positive, and "desire to get a degree" negative.

2) **Determine related areas**
Having defined the end points of the scale, we next determine what attitudes, opinions, behaviors, or feelings might be related to each end of the scale. What kinds of things would reflect the positive side? The negative side? These related areas provide the raw material from which we'll develop attitudinal statements. In what areas would "learn" and "degree" students differ? Here's my suggested list: doing homework, using the library, extra reading, free time discussion, meetings with professors, opinions concerning the meaning of a degree, and views on grades.

3) Write statements
Next, we will write statements that reflect positive and negative aspects of these areas. We've defined "positive" to mean "that which agrees with my position," and "negative" means "that which disagrees with my position." The statements, even though reflecting subjective variables, should be objective. That is, statements must not be systematically biased toward one position or the other. Students who really want merely to get a degree should have no trouble scoring low on the scale. They should tend to agree with statements reflecting "degree" and tend to disagree with statements reflecting "learning." In the same way, students who really want to learn should tend to agree with "learning" statements, and tend to disagree with "degree" statements.

4) Create an item pool
Continue writing items, both positive and negative, until you have an item pool at least twice the size of your intended instrument. If you plan to have 20 statements in your final scale, then create an item pool of 40 items.

Validating the items
Enlist a validation panel of 6-8 persons to evaluate each item. It is suggested that you have persons on the panel who represent both extremes of the scale. Have the panel rate each item on its clarity and potency in defining the attitude in question.

Rank
Rank order the evaluated items on clarity and potency. Choose an equal number of positive and negative items from the best statements.

Formatting the Scale
Randomly order the selected statements. Use letters to indicate choices, such as "SD", "D", "A", and "SA" rather than numbers. I recommend that you use four or six levels of response. Using an even number of responses forces respondents to mark the direction of their attitudinal tendencies — positive or negative. Mean scores for groups filling out the scale have more meaning in this less stable construction. Many Likert scales have 5 levels, with a "no opinion" center. This neutral middle option allows subjects an easy way to avoid considering the statement.

Scoring the scale
The points given for each response depend on whether the statement is positive or negative. The person who "strongly agrees" with a "positive statement" gets the maximum points. One who "strongly disagrees" with a "positive statement" gets the minimum points. For a four-point scale, the scoring would be as follows for *positive statements*: SD=1, D=2, A=3, SA=4.

The person who "strongly agrees" with a negative statement gets the minimum number of points (1), while the one who "strongly disagrees" with a negative statement gets the maximum points (4). In our four-point example, the scoring for *negative statements* would be as follows: SD=4, D=3, A=2, and SA=1.

In this short 8-item example attitude scale subject attitude scores will range from a low of "**8**" (8 x 1 = 8) to a high of "**32**" (8 x 4 = 32). For a twenty-five item scale, this procedure yields scores ranging from 25 to 100. These scores can then be used to compare groups on the defined attitude

Reliability & Validity of Scales

Validity:

Validity is the extent to which an instrument measures what it is supposed to measure and performs as it is designed to perform. Does the measure employed really measure the theoretical concept (variable)? It is rare, if nearly impossible, that an instrument be 100% valid, so validity is generally measured in degrees. As a process, validation involves collecting and analyzing data to assess the accuracy of an instrument. There are numerous statistical tests and measures to assess the validity of quantitative instruments, which generally involves pilot testing. The remainder of this discussion focuses on external validity and content validity.

External validity is the extent to which the results of a study can be *generalized* from a sample to a population. Establishing eternal validity for an instrument, then, follows directly from sampling. Recall that a sample should be an accurate representation of a population, because the total population may not be available. An instrument that is externally valid helps obtain population generalizability, or the degree to which a sample represents the population.

Content validity refers to the appropriateness of the content of an instrument. In other words, do the measures (questions, observation logs, etc.) accurately assess what you want to know? This is particularly important with achievement tests. This would involve taking representative questions from each of the sections of the unit and evaluating them against the desired outcomes.

Reliability:

a. Will the measure employed repeatedly on the same individuals yield similar results? (stability)

b. Will the measure employed by different investigators yield similar results? (equivalence)

c. Will a set of different operational definitions of the same concept employed on the same individuals, using the same data-collecting technique, yield a highly correlated result? Or, will all items of the measure be internally consistent? (homogeneity) *Reliability* can be thought of as consistency. Does the instrument consistently measure what it is intended to measure? It is not possible to calculate reliability; however, there are four general estimators that you may encounter in reading research:

1. *Inter-Rater/Observer Reliability*: The degree to which different raters/observers give consistent answers or estimates.
2. *Test-Retest Reliability*: The consistency of a measure evaluated over time.
3. *Parallel-Forms Reliability:* The reliability of two tests constructed the same way, from the same content.
4. *Internal Consistency Reliability:* The consistency of results across items, often measured with Cronbach's Alpha.

Relating Reliability and Validity

Reliability is directly related to the validity of the measure. There are several important principles. First, a test can be considered reliable, but not valid. Consider the SAT, used as a predictor of success in college. It is a reliable test (high scores relate to high GPA), though only a moderately valid indicator of success (due to the lack of structured environment – class attendance, parent-regulated study, and sleeping habits – each holistically related to success).

Second, validity is more important than reliability. Using the above example, college admissions may consider the SAT a reliable test, but not necessarily a valid measure of other quantities colleges seek,

such as leadership capability, altruism, and civic involvement. The combination of these aspects, alongside the SAT, is a more valid measure of the applicant's potential for graduation, later social involvement, and generosity (alumni giving) toward the alma mater.

Finally, the most useful instrument is both valid and reliable. Proponents of the SAT argue that it is both. It is a moderately reliable predictor of future success and a moderately valid measure of a student's knowledge in Mathematics, Critical Reading, and Writing.

UNIT 4
DATA ANALYSIS

Hypothesis Testing

Hypothesis can be referred to as the interpretation of certain facts which is just a possible solution or a tentative answer to a problem and is completely or partly unverified in nature. Then afterwards on its establishment, it ceases to be a hypothesis and then finally becomes a theory or a principle. The word 'Hypothesis' has come from the Greek word hypo (means under)and tithenas (means to place) together these words indicate towards the support they provide to each other on the placement of the hypothesis under the evidence, which acts as a foundation.

Step 1: State the Null Hypothesis.

The null hypothesis can be thought of as the opposite of the "guess" the research made (in this example the biologist thinks the plant height will be different for the fertilizers). So the null would be that there will be no difference among the groups of plants. Specifically in more statistical language the null for an ANOVA is that the means are the same. We state the Null hypothesis as:

$H_0 : \mu_1 = \mu_2 = \cdots = \mu_k$

for *k* levels of an experimental treatment.

Step 2: State the Alternative Hypothesis.

H_1 : treatment level means not all equal

The reason we state the alternative hypothesis this way is that if the Null is rejected, there are many possibilities.For example, $\mu_1 \neq \mu_2 = \cdots = \mu_k$ is one possibility, as is $\mu 1 = \mu 2 \neq \mu 3 = \cdots = \mu k$. Many people make the mistake of stating the Alternative Hypothesis as: $\mu 1 \neq \mu 2 \neq \cdots \neq \mu k$ which says that every mean differs from every other mean. This is a possibility, but only one of many possibilities. To cover all alternative outcomes, we resort to a verbal statement of 'not all equal' and then follow up with mean comparisons to find out where differences among means exist. In our example, this means that fertilizer 1 may result in plants that are really tall, but fertilizers 2, 3 and the plants with no fertilizers don't differ from one another. A simpler way of thinking about this is that at least one mean is different from all others.

Step 3: Set α (Significance level)

If we look at what can happen in a hypothesis test, we can construct the following contingency table:

	In Reality	
Decision	H_0 is TRUE	H_0 is FALSE
Accept H_0	OK	Type II Error β = probability of Type II Error
Reject H_0	Type I Error α = probability of Type I Error	OK

You should be familiar with type I and type II errors from your introductory course. It is important to note that we want to set α before the experiment (*a-priori*) because the Type I error is the more 'grevious' error to make. The typical value of α is 0.05, establishing a 95% confidence level. **For this course we will assume α =0.05.**

Step 4: Collect Data
Remember the importance of recognizing whether data is collected through an experimental design or observational.

Step 5: Calculate a test statistic.
For categorical treatment level means, we use an *F* statistic, named after R.A. Fisher. We will explore the mechanics of computing the *F* statistic beginning in Lesson 2. The *F* value we get from the data is labeled $F_{calculated}$.

Step 6: Construct Acceptance / Rejection regions.
As with all other test statistics, a threshold (critical) value of *F* is established. This *F* value can be obtained from statistical tables, and is referred to as $F_{critical}$ or $F\ \alpha$. As a reminder, this critical value is the minimum value for the test statistic (in this case the *F* test) for us to be able to reject the null.
The *F* distribution, $F\ \alpha$, and the location of Acceptance / Rejection regions are shown in the graph below:

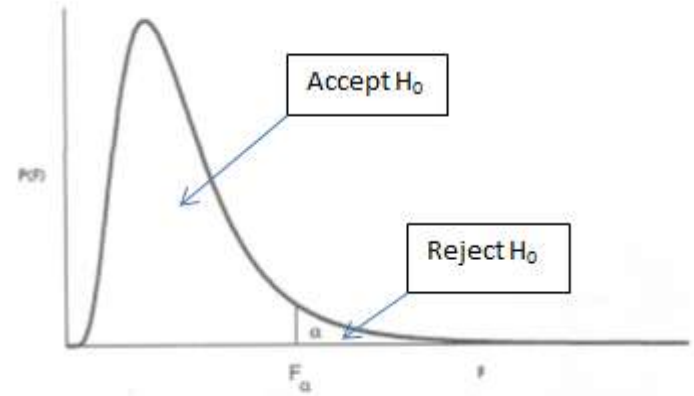

Figure K.1: The F distribution

Step 7: Based on steps 5 and 6, draw a conclusion about H_0.
If the $F_{calculated}$ from the data is larger than the Fα, then you are in the Rejection region and you can reject the Null Hypothesis with (1-α) level of confidence.
Note that modern statistical software condenses step 6 and 7 by providing a *p*-value. The *p*-value here is the probability of getting an $F_{calculated}$ even greater than what you observe. If by chance, the $F_{calculated}$ = $F\ \alpha$, then the *p*-value would exactly equal to α. With larger $F_{calculated}$ values, we move further into the rejection region and the *p*-value becomes less than α. So the decision rule is as follows:
If the *p*-value obtained from the ANOVA is less than α, then Reject H_0 and Accept H_A.

Errors In Hypothesis Testing
Type I Error (False Positive Error)
1) A type I error occurs when the null hypothesis is true, but is rejected. Let me say this again, a *type I error occurs when the null hypothesis is actually* ***true****, but was rejected as* ***false*** *by the testing*.
2) A type I error, or false positive, is asserting something as true when it is actually false. This false positive error is basically a "false alarm" – a result that indicates a given condition has been fulfilled when it actually has not been fulfilled (i.e., erroneously a positive result has been assumed).

Type II Error (False Negative)
1) A type II error occurs when the null hypothesis is false, but erroneously fails to be rejected. Let me say this again, a *type II error occurs when the null hypothesis is actually* ***false****, but was accepted as* ***true*** *by the testing.*
2) A type II error, or false negative, is where a test result indicates that a condition failed, while it actually was successful. A Type II error is committed when we fail to believe a true condition.

A tabular relationship between truthfulness/falseness of the null hypothesis and outcomes of the test can be seen in the table below:

	Null Hypothesis is true	**Null hypothesis is false**
Reject null hypothesis	Type I Error**False Positive**	**Correct Outcome**True Positive
Fail to reject null hypothesis	**Correct outcome**True Negative	Type II Error**False Negative**

Let's look at some business related examples. In these examples I have reworded the null hypothesis, so be careful on the cost assessment.

Null Hypothesis	**Type I Error / False Positive**	**Type II Error / False Negative**
Medicine A cures Disease B	(H_0 **true**, but rejected as **false**)Medicine A **cures** Disease B, but is **rejected as false**	(H_0 **false**, but accepted as **true**)Medicine A **does not cure** Disease B, but is **accepted as true**
Cost Assessment	Lost opportunity cost for rejecting an effective drug that could cure Disease B	Unexpected side effects (maybe even death) for using a drug that is not effective

Let's try one more.

Null Hypothesis	**Type I Error / False Positive**	**Type II Error / False Negative**
Display Ad A is effective in driving c onversions	(H_0 **true**, but rejected as **false**)Display Ad A **is effective** in driving conversions, but is **rejected as false**	(H_0 **false**, but accepted as **true**)Display Ad A is **not effective** in driving conversions, but is **accepted as true**
Cost Assessment	Lost opportunity cost for rejecting an effective Display Ad A	Lost sales for promoting an ineffective Display Ad A to your target visitors

The cost ramifications in the medicine example are quite substantial, so additional testing would likely be justified in order to minimize the impact of the type II error (using an ineffective drug) in our example. However, the cost ramifications in the Display Ad example are quite small, for both the type I and type II errors, so additional investment in addressing the type I and type II errors is probably not worthwhile

Parametric & Non Parametric Tests

1) **Parametric Test:** If the information about the population is completely known by means of its parameters then statistical test is called parametric test∗ Eg: t- test, f-test, z-test, ANOVA are Parametric Tests.

2) **Non parametric test:** If there is no knowledge about the population or parameters, but still it is required to test the hypothesis of the population. Then it is called non-parametric test∗ E.g.: Mann-Whitney, rank sum test, Kruskal-Wallis test

3) **Classification Of hypothesis :** Parametric test Non Parametric test ,t- test, f-test, z-test, ANOVA , Mann-Whitney, rank sum test, Kruskal-Wallis test

4) **Difference between parametric and Non parametric:** Non Parametric Information about population is completely known .No information about the population is available . Specific assumptions are made regarding the population .No assumptions are made regarding the population. Null hypothesis is made on parameters of the population distribution .The null hypothesis is free from parameters .

5) **Difference between parametric and Nonparametric Parametric** Non Parametric Test statistic is based on the distribution Test statistic is arbitrary .Parametric tests are applicable only for variable .It

is applied both variable and attributes No parametric test exist for Nominal scale data .Non parametric test do exist for nominal and ordinal scale data Parametric test is powerful, if it exist It is not so powerful like parametric test

6) **Advantages of non parametric test**: Non parametric test are simple and easy to understand∗ It will not involve complicated sampling theory∗ No assumption is made regarding the parent population∗ This method is only available for nominal scale data∗ This method are easy applicable for attribute dates.

7) **Disadvantages of non parametric test:** It can be applied only for nominal or ordinal scale∗ For any problem, if any parametric test exist it is highly powerful.∗ Non parametric methods are not so efficient as of parametric test∗ No nonparametric test available for testing the interactional analysis of variance model.

UNIT 5
CHI-SQUARE TEST

$$\chi^2 = \sum \frac{(\text{Observed Value} - \text{Expected Value})^2}{(\text{Expected Value})}$$

Degrees of freedom (df) =(n-1), where n is the number of classes

Analysis of Variance (ANOVA)

Purpose
1) The reason for doing an ANOVA is to see if there is any difference between groups on some variable.
2) For example, you might have data on student performance in non-assessed tutorial exercises as well as their final grading. You are interested in seeing if tutorial performance is related to final grade. ANOVA allows you to break up the group according to the grade and then see if performance is different across these grades.
ANOVA is available for both parametric (score data) and non-parametric (ranking/ordering) data.

Types of ANOVA
One-way between groups
The example given above is called a **one-way between groups model.**
You are looking at the differences between the groups.
There is only one grouping (final grade) which you are using to define the groups.
This is the simplest version of ANOVA.
This type of ANOVA can also be used to compare variables between different groups - tutorial performance from different intakes.

One-way repeated measures
A one way repeated measures ANOVA is used when you have a single group on which you have measured something a few times.
For example, you may have a test of understanding of Classes. You give this test at the beginning of the topic, at the end of the topic and then at the end of the subject.
You would use a one-way repeated measures ANOVA to see if student performance on the test changed over time.

Two-way between groups
A two-way between groups ANOVA is used to look at complex groupings.
For example, the grades by tutorial analysis could be extended to see if overseas students performed differently to local students. What you would have from this form of ANOVA is:
The effect of final grade
The effect of overseas versus local
The interaction between final grade and overseas/local
Each of the **main effects** are one-way tests. The **interaction effect** is simply asking "is there any significant difference in performance when you take final grade and overseas/local acting together".

Use of Multivariate Analysis in Research
1) Many statistical techniques focus on just one or two variables. Multivariate analysis (MVA) techniques allow more than two variables to be analysed at once. Multivariate statistical analysis refers to multiple advanced techniques for examining relationships among multiple variables at the same time. Researchers use multivariate procedures in studies that involve more than one dependent variable (also known as the outcome or phenomenon of interest), more than one independent variable (also known as a predictor) or both. Upper-level undergraduate courses and graduate courses in

statistics teach multivariate statistical analysis. This type of analysis is desirable because researchers often hypothesize that a given outcome of interest is effected or influenced by more than one thing.

2) Multiple regression is not typically included under this heading, but can be thought of as a multivariate analysis.

3) Commonly have many relevant variables in market research surveys

– E.g. one not atypical survey had ~2000 variables
– Typically researchers pore over many crosstabs
– However it can be difficult to make sense of these, and the crosstabs may be misleading

• MVA can help summarise the data
– E.g. factor analysis and segmentation based on agreement ratings on 20 attitude statements

• MVA can also reduce the chance of obtaining spurious results

Multivariate Analysis Methods

• Two general types of MVA technique
– Analysis of dependence
• Where one (or more) variables are dependent variables, to be explained or predicted by others
– E.g. Multiple regression, PLS, MDA
– Analysis of interdependence
• No variables thought of as "dependent"
• Look at the relationships among variables, objects or cases
– E.g. cluster analysis, factor analysis

UNIT 6
REPORTING RESEARCH

Characteristics of a Research Report:

1. Information collected in the report must be **relevant and focused** to derive desired results. Pictorial and graphical presentation of data and related information help to understand the details easily. There is a possibility that the collected data in the report needs to be represented at many places in different formats to fulfill the report goals. The ultimate goal is to determine all the issue and make suitable strategies to cope up with these issue or problems.
2. Report should follow the exact **predefined goals and objectives**. If there is any sort of divergence of related information which does not match the goals then the results are of no use. In fact there is a probability of landing up in making negative or out of focus strategies, which will be very dangerous.
3. The report should always contain the executive **summary of the work**. This is generally kept before the actual report starts as it shows the summary of the desired business plan.
4. Apart from the actual analysis the report should also depict the reasons of making this report and what advantages and profit it can provide after successful implementation of business plans described inside the report.
5. It should also contain the **methodology of the research** which shows the overall process adopted to create the report.
6. It is important that the report contains the possibility of errors in any of the module or process so that immediate measures could be taken to cope up with these errors.
7. The report should contain the **description of the questionnaires** used in analysis and the way it has been prepared.
8. The methodology used in the interviews should also be elaborated and what was achieved in this should also be described.
9. If the information show that some aspects needs to predict the future trends then the reports should depict that prediction. This prediction should have scale of success so that the accuracy could be judged efficaciously. The report should also define each and every variable and element used in creating these predictive analyses.
10. The report should be **flexible** enough to be changed accordingly. The analytical information described inside the report should be maintained in such a way that there is no extra effort labored if any strategy or process it to be changed in future. It should necessarily mould the changes without changing the structure of the report.

Types of Research Reports

1) Journal Articles

2) Peer review

3) Blind review

4) Primary vs. secondary source

5) Presentations at conferences

6) Theses and Dissertations

7) Books

Content of Research Journal Article

1) Abstract – 100 to 200 words max

2) Introduction

3) Variables under study

4) Purpose

5) Research questions/ or hypotheses

6) Literature review

7) Theoretical framework

8) Significance

9) Methodology

- Sample
- Research design
- Measurement tools
- Data collection
- Procedures

10) Results-findings

- Statistical tests
- Value of calculated statistic
- Significance (statistical) .05 or .01 usually