BUSINESS RESEARCH METHODS **Semester – IV**

18BAU401 **6H – 5C**

Instruction Hours / week: L: 6 T: 0 P : 0 **Marks: Internal: 40 External: 60 Total: 100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the students

1. To understand the concept of research, Research Process, research design, sampling techniques, hypothesis writing and report writing.
2. To analyse the research problem and design the blue print to capture data and analyse the same using appropriate statistical techniques and apply the learning lifelong.
3. To Critically formulate the research design and sampling design suitable for the problem.
4. To communicate orally and written form the research problem, research design, sampling techniques.
5. To design a report to communicate the findings and suggestion to make business decision.

COURSE OUTCOMES:

Learners should be able to

1. Comprehend the meaning of research, theory of induction, deduction, research process, research design, sampling techniques, hypothesis writing and report writing
2. Analyse the research problem and design the blue print to capture data and analyse the same using appropriate statistical techniques and apply the learning lifelong.
3. Critically formulate the research design and sampling design suitable for the problem.
4. Communicate orally and written for the research problem, research design, sampling techniques.
5. Design a report to communicate the findings and suggestion to make business decision

UNIT I RESEARCH AND RESEARCH PROCESS

Meaning of research; Scope of Research in Business; Purpose of Research; Types of Research, Problem identification, Review of Literature, Concept of theory - deductive and inductive theory - Concept, Construct, Definition, Variables - Research Process

UNIT II RESEARCH DESIGN AND SAMPLING DESIGN

Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design.

Data Sources – Primary and Secondary Data.

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response, Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Non Probability Sampling – Convenience, Quota, Judgmental, snowball sampling.

UNIT III MEASUREMENT AND SCALING

Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Concept of Scaling, Ratings and Ranking Scale, Thurstone, Likert and Semantic Differential scaling, Paired Comparison.

Preparing questionnaire – Quality of a good questionnaire.

UNIT IV HYPOTHESIS TESTING

Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing –Tests concerning means and proportions; ANOVA, Chi-square test and other Nonparametric tests, correlation and Regression

UNIT V REPORT PREPARATION

Meaning, types and layout of research report; Steps in report writing; Citations, Bibliography and Annexure in report.

Note: Distribution of marks - 90% theory and 10% problems

SUGGESTED READINGS:

1. C.R. Kothari , Gaurav Garg (2018), Research Methodology, Fourth Edition, New Age International Publishers, New Delhi.
2. Uma Sekaran, Roger Bougie (2018), Research Methods for Business: A Skill-Building Approach, 7th edition, Wiley, New Delhi.
3. Donald Cooper and Pamela Schindler (2017), Business Research Methods, 11th edition, McGraw Hill education, New Delhi.
4. Zikmund William G. et.al (2016), Business Research Methods, Cengage India, New Delhi.
5. Mark N.K. Saunders, Philip Lewis, Adrian Thornhill (2015), Research Methods for Business Students, 7th edition, Pearson Education, New Delhi.

UNIT I RESEARCH AND RESEARCH PROCESS

Meaning of research; Scope of Research in Business; Purpose of Research; Types of Research, Problem identification, Review of Literature, Concept of theory - deductive and inductive theory - Concept, Construct, Definition, Variables - Research Process

MEANING OF RESEARCH

Research is an endeavour to discover, develop and verify knowledge. It is an intellectual act that begins with the asking of questions and progressiveness through the critical examination of evidence that is both relevant and reliable to the revelation of truth. Research can be defined as the search for knowledge, or as any systematic investigation, with an open mind, to establish novel facts, solve new or existing problems, prove new ideas, or develop new theories, usually using a scientific method. The primary purpose of research is discovering, interpreting, and the development of methods and systems for the advancement of human knowledge on a wide variety of scientific matters of our world and the universe.

DEFINITIONS OF RESEARCH

Webster's New International Dictionary: "Research is careful critical enquiry or examination in seeking facts or principles, diligent investigation in order to ascertain something.

John W. Best: Research may be defined as the systematic and objective analysis and recording to controlled observations that may lead to the development of generalization, principles of theories resulting in prediction and possible ultimate control of events

Robert Ross: Research is essentially an investigation, a recording and an analysis of evidence too the purpose of gaining knowledge

Clifford Woody: Research comprises of defining and redefining problems, formulating hypothesis or suggested solutions, collecting, organizing and evaluating data making deduction and reaching conclusion and at last carefully testing conclusions to determine whether they fit in formulating hypothesis.

John Dewey: Research is considered to be the formal, systematic, intensive process of carrying on the scientific method of analysis. It involves a more systematic structure of investigation, usually in some sort of formal record of procedures and a report of result or conclusions.

Fred Kerlinger: Research is an organized enquiry designed and carried out to provide information for solving a problem.

Redman and Mory: Systematized effort to gain new knowledge

OBJECTIVES OF RESEARCH

- The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet.
- To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formulative research studies);
- To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies);

- To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies);
- To test a hypothesis of a causal relationship between variables (such studies are known as hypothesis-testing research studies).

SIGNIFICANCE OF RESEARCH

- "All progress is born of inquiry. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention" is a famous Hudson Maxim in context of which the significance of research can well be understood. Increased amounts of research make progress possible. Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organisation.
- The role of research in several fields of applied economics, whether related to business or to the economy as a whole, has greatly increased in modern times. The increasingly complex nature of business and government has focused attention on the use of research in solving operational problems. Research, as an aid to economic policy, has gained added importance, both for government and business.
- **1) Research provides the basis for nearly all Government Policies in our Economic System**

  For instance, government's budgets rest in part on an analysis of the needs and desires of the people and on the availability of revenues to meet these needs. The cost of needs has to be equated to probable revenues and this is a field where research is most needed. Through research we can devise alternative policies and can as well examine the consequences of each of these alternatives. Decision-making may not be a part of research, but research certainly facilitates the decisions of the policy maker. Government has also to chalk out programmes for

dealing with all facets of the country's existence and most of these will be related directly or indirectly to economic conditions. The plight of cultivators, the problems of big and small business and industry, working conditions, trade union activities, the problems of distribution, even the size and nature of defense services are matters requiring research. Thus, research is considered necessary with regard to the allocation of nation's resources. Another area in government, where research is necessary, is collecting information on the economic and social structure of the nation. Such information indicates what is happening in the economy and what changes are taking place. Collecting such statistical information is by no means a routine task, but it involves a variety of research problems. These days nearly all governments maintain large staff of research technicians or experts to carry on this work. Thus, in the context of government, research as a tool to economic policy has three distinct phases of operation, viz., (i) investigation of economic structure through continual compilation of facts; (ii) diagnosis of events that are taking place and the analysis of the forces underlying them; and (iii) the prognosis, i.e., the prediction of future developments.

- **2) Research has its Special Significance in Solving various Operational and Planning Problems of Business and Industry**

Operations research and market research, along with motivational research, are considered crucial and their results assist, in more than one way, in taking business decisions. Market research is the investigation of the structure and development of a market for the purpose of formulating efficient policies for purchasing, production and sales. Operations research refers to the application of mathematical, logical and analytical techniques to the solution of business problems of cost minimization or of profit maximization or what can be termed as optimization

problems. Motivational research of determining why people behave as they do is mainly concerned with market characteristics. In other words, it is concerned with the determination of motivations underlying the consumer (market) behaviour. All these are of great help to people in business and industry who are responsible for taking business decisions. Research with regard to demand and market factors has great utility in business. Given knowledge of future demand, it is generally not difficult for a firm, or for an industry to adjust its supply schedule within the limits of its projected capacity. Market analysis has become an integral tool of business policy these days. Business budgeting, which ultimately results in a projected profit and loss account, is based mainly on sales estimates which in turn depend on business research. Once sales forecasting is done, efficient production and investment programmes can be set up around which are grouped the purchasing and financing plans. Research, thus, replaces intuitive business decisions by more logical and scientific decisions.

- **3) Research is equally important for social scientists in studying social relationships and in seeking answers to various social problems.**

It provides the intellectual satisfaction of knowing a few things just for the sake of knowledge and also has practical utility for the social scientist to know for the sake of being able to do something better or in a more efficient manner. Research in social sciences is concerned both with knowledge for its own sake and with knowledge for what it can contribute to practical concerns. "This double emphasis is perhaps especially appropriate in the case of social science. On the one hand, its responsibility as a science is to develop a body of principles that make possible the understanding and prediction of the whole range of human interactions.

On the other hand, because of its social orientation, it is increasingly being looked to for practical guidance

- In addition to what has been stated above, the significance of research can also be understood keeping in view the following points:
- To those students who are to write a master's or Ph.D. thesis, research may mean careerism or a way to attain a high position in the social structure;
- To professionals in research methodology, research may mean a source of livelihood;
- To philosophers and thinkers, research may mean the outlet for new ideas and insights;
- To literary men and women, research may mean the development of new styles and creative work;
- To analysts and intellectuals, research may mean the generalizations of new theories.
- Thus, research is the fountain of knowledge for the sake of knowledge and an important source of providing guidelines for solving different business, governmental and social problems. It is a sort of formal training which enables one to understand the new developments in one's field in a better way.

TYPES OF RESEARCH

1) Descriptive Research

A descriptive study may be simple or complex. It determines who, what, where and how of a topic. It is concerned with describing the characteristics (e.g., the extent to which libraries are used) estimating the proportion of the people in a specified population who hold certain views or attitudes (e.g., how many favour the abolition of capital punishment?) predicting specifically (e.g., how may will cash their government bonds during a given period?) and discovering or testing whether certain

variables are associated (e.g., people who spend a good deal of time for reading, go to movies often with each other)

Descriptive study may employ any of or all the methods of data collection such as interview, questionnaire, observation, tests and cumulative record cards. In the descriptive study the researcher must be careful to make a note of the bias and extravagance that may creep in at every stage of the study – formulating the objectives of the study; designing the methods of data collection; selecting the sample; collecting, processing and analyzing the data; and reporting the findings.

2) Analytical Research

Analytical study makes use of available information by analyzing and doing critical evaluation. Analytical study makes use of higher level statistical tools which are not commonly used.

3) Applied Research

Applied research aims at finding a solution for an immediate problem faced by any business organization. This research deals with real life situations. Example: "Why have sales decreased during the last quarter"? Market research is an example of applied research. Applied research has a practical problem-solving emphasis. It brings out many new facts.

Examples:

1. Use of fibre glass body for cars instead of metal.

2. To develop a new market for the product.

4) Fundamental Research

This is otherwise known as basic research or fundamental research. Gathering knowledge for knowledge's sake is known as fundamental research. It does not have any commercial potential. It is

not connected to any practical problem. e.g. Theory of Relativity. It is only for the enrichment of the knowledge.

5) Quantitative Research

Quantitative researches are based on the measurements of quantity or amounts. It means that these type of researches deals with items which are expressed in numbers.

6) Qualitative Research

Qualitative researches deals with the qualitative phenomena. i.e. anything which cannot be expressed in numerical terms. Motivation research is an example of qualitative research.

7) Conceptual Research

Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.

8) Empirical Research

Empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research. In such a research it is necessary to get at facts firsthand, at their source, and actively to go about doing certain things to stimulate the production of desired information. In such a research, the researcher must first provide himself with a working hypothesis or guess as to the probable results. He then works to get enough facts (data) to prove or disprove his hypothesis. He then sets up experimental designs which he thinks will manipulate the persons or the materials concerned so as to bring forth the desired information. Such research is thus characterized by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects. Empirical research is

appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

9) One-time research or Longitudinal Research

the former case the research is confined to a single time-period, whereas in the latter case the research is carried on over several time-periods.

10) Field Method

Field study is a scientific enquiry aimed at discovering the relations and interactions among sociological, physiological and educational variables in real social structures and life situations like communities, schools, factories, organizations and institutions. Hence, it is called field study.

11) Exploratory Research

Explanatory research is carried, when the reason for a problem is not clear. In exploratory research, all possible reasons which are very obvious are eliminated, thereby directing the research to proceed further with limited options.

Example for Exploratory Research

Sales decline in a company may be due to:

- Inefficient service
- Improper price
- Inefficient sales force
- Ineffective promotion
- Improper quality

12) Formalized Research

Formalized research studies are those with substantial structure and with specific hypotheses to be tested.

13) Historical Research

This research is the induction of principles through research into the past and social forces which have shaped the present. Its aim is to apply reflective thinking to unsolved social problems by discovering past trends of events, facts and attitudes, and by tracing lines of development in human thought and action.

14) Decision Oriented Research

Decision-oriented research is always for the need of a decision maker and the researcher in this case is not free to embark upon research according to his own inclination.

15) Individual and Group Research

The research undertaken by an individual is called individual research. The bulk of research activities in universities, and colleges are made by the individual. The individual research is done on the basis of one's own judgement, interest and capacity.

Group research is undertaken by several researchers. Their activities are coordinated by a director, Research conducted by a firm, trade association and government agency is performed by a team of researchers under a project director. Research in colleges and universities financed by grants is done on a group basis.

16) Operations Research

This method of research has been done for solving problems by using scientific methods and quantitative techniques. While the researchers care to study the development of methods, the industrial

operations researcher evinces interest in the applications of methods to solve the pressing or critical problems of their firm.

Research can also be classified as conclusion-oriented and decision-oriented. While doing conclusion-oriented research a researcher is free to pick up a problem, redesign the enquiry and is free to conceptualize as he wishes. Decision-oriented research always implies taking a rational decision. Operational research is an example of decision-oriented research.

CRITERIA OF GOOD RESEARCH

- Whatever may be the types of research works and studies, one thing that is important is that they all meet on the common ground of scientific method employed by them. One expects scientific research to satisfy the following criteria:
- The purpose of the research should be clearly defined and common concepts be used.
- The research procedure used should be described in sufficient detail to permit another researcher to repeat the research for further advancement, keeping the continuity of what has already been attained.
- The procedural design of the research should be carefully planned to yield results that are as objective as possible.
- The researcher should report with complete frankness, flaws in procedural design and estimate their effects upon the findings.
- The analysis of data should be sufficiently adequate to reveal its significance and the methods of analysis used should be appropriate. The validity and reliability of the data should be checked carefully.

- Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.
- Greater confidence in research is warranted if the researcher is experienced, has a good reputation in research and is a person of integrity.

QUALITIES OF GOOD RESEARCH

1) Good research is Systematic

It means that research is structured with specified steps to be taken in a specified sequence in accordance with the well defined set of rules. Systematic characteristic of the research does not rule out creative thinking but it certainly does reject the use of guessing and intuition in arriving at conclusions.

2) Good research is Logical

This implies that research is guided by the rules of logical reasoning and the logical process of induction and deduction are of great value in carrying out research. Induction is the process of reasoning from a part to the whole whereas deduction is the process of reasoning from some premise to a conclusion which follows from that very premise.

3) Good research is Empirical

It implies that research is related basically to one or more aspects of a real situation and deals with concrete data that provides a basis for external validity to research results.

4) Good research is Replicable

This characteristic allows research results to be verified by replicating the study and thereby building a sound basis for decisions.

QUALITIES OF A GOOD RESEARCHER

A) General Qualities

1) Scientific Attitude

The first essential Quality of a successful research worker is that he must possess a scientific (systematic) frame (structure) of mind. He must have the determination (willpower / strength of mind) and ability to get the naked (hidden) facts and not to be influenced by one's own wishes.

As human beings he has certain praises (admiration) and prejudices (bias). He has also certain precarceived notions (ideas) about the problems being researched. He should keep all these things with him.

2) Imagination and Insight

Researcher must possess high degree of imagination. He should be able to go deeper and deeper into the realm (area) of abstract social phenomena (fact / event) and visualize the intangible aspects (features) of the society

3) Perseverance

Work of scientific research requires steady of mind. Researcher should not get easily discouraged. It is equally possible that he might subsequently feel that the choice of the problem was wrong. Inspite of all this he must have more courage to face the difficulties and work patiently and continuously over long periods

4) Quick Grasping Power

The researcher should possess the power to grasp the significance of things quickly

5) Clarity of Thinking

A good researcher should have clear idea about the terminology that he is going to use.

B) Specific Qualities

1) Knowledge of the Subject

The researcher should be enough knowledge in his area of research. Such knowledge helps him in preparing questionnaire and schedule to get proper information. He can enter into face to face discussion and remove any doubts arising the minds of the people regarding the study

2) Knowledge of the technique of Research

Researcher should have basic idea on tools used in his research

3) Personal Taste in the Study

A personal taste in the study will inspire him and keep his morale (confidence) in times of difficulties. A forced work is often monotonous and very tiresome

4) Familiarity about the Information

The researcher should be familiar with the people whom he is studying. Familiarity will help him to get intimate (close) information

5) Unbiased Attitude

The researcher should have no preconceptions (idea / bias) about the subject under study. He should go to his research with absolutely a clean state. He should maintain an open mind and look for data which would substantiate (validate / verify) and give his theory a new meaning.

RESEARCH PROBLEM

SELECTING THE PROBLEM

The research problem undertaken for study must be carefully selected. The task is a difficult one, although it may not appear to be so. Help may be taken from a research guide in this connection. A problem must spring from the researcher's mind like a plant springing from its own seed. If our eyes

need glasses, it is not the optician alone who decides about the number of the lens we require. We have to see ourselves and enable him to prescribe for us the right number by cooperating with him. Thus, a research guide can at the most only help a researcher choose a subject. However, the following points may be observed by a researcher in selecting a research problem or a subject for research:

(i) Subject which is overdone should not be normally chosen, for it will be a difficult task to throw any new light in such a case.

(ii) Controversial subject should not become the choice of an average researcher.

(iii) Too narrow or too vague problems should be avoided.

(iv) The subject selected for research should be familiar and feasible so that the related research material or sources of research are within one's reach. Even then it is quite difficult to supply definitive ideas concerning how a researcher should obtain ideas for his research.

For this purpose, a researcher should contact an expert or a professor in the University who is already engaged in research. He may as well read articles published in current literature available on the subject and may think how the techniques and ideas discussed therein might be applied to the solution of other problems. He may discuss with others what he has in mind concerning a problem. In this way he should make all possible efforts in selecting a problem.

(v) The importance of the subject, the qualifications and the training of a researcher, the costs involved, the time factor are few other criteria that must also be considered in selecting a problem. In other words, before the final selection of a problem is done, a researcher must ask himself the following questions:

(a) Whether he is well equipped in terms of his background to carry out the research?

(b) Whether the study falls within the budget he can afford?

(c) Whether the necessary cooperation can be obtained from those who must participate in research as subjects?

If the answers to all these questions are in the affirmative, one may become sure so far as the practicability of the study is concerned.

(vi) The selection of a problem must be preceded by a preliminary study. This may not be necessary when the problem requires the conduct of a research closely similar to one that has already been done. But when the field of inquiry is relatively new and does not have available a set of well developed techniques, a brief feasibility study must always be undertaken.

Technique involved in Defining a Problem

(i) Statement of the problem in a general way: First of all the problem should be stated in a broad general way, keeping in view either some practical concern or some scientific or intellectual interest. For this purpose, the researcher must immerse himself thoroughly in the subject matter concerning which he wishes to pose a problem. In case of social research, it is considered advisable to do some field observation and as such the researcher may undertake some sort of preliminary survey or what is often called *pilot survey*. Then the researcher can himself state the problem or he can seek the guidance of the guide or the subject expert in accomplishing this task. Often, the guide puts forth the problem in general terms, and it is then up to the researcher to narrow it down and phrase the problem in operational terms. In case there is some directive from an organizational authority, the problem then can be stated accordingly. The problem stated in a broad general way may contain various ambiguities which must be resolved by cool thinking and rethinking over the problem. At the same time the feasibility of a particular solution has to be considered and the same should be kept in view while stating the problem.

(ii) Understanding the nature of the problem: The next step in defining the problem is to understand its origin and nature clearly. The best way of understanding the problem is to discuss it with those who first raised it in order to find out how the problem originally came about and with what objectives in view. If the researcher has stated the problem himself, he should consider once again all those points that induced him to make a general statement concerning the problem. For better understanding of the nature of the problem involved, he can enter into discussion with those who have a good knowledge of the problem concerned or similar other problems. The researcher should also keep in view the environment within which the problem is to be studied and understood.

(iii) Surveying the available literature: All available literature concerning the problem at hand must necessarily be surveyed and examined before a definition of the research problem is given. This means that the researcher must be well-conversant with relevant theories in the field, reports and records as also all other relevant literature. He must devote sufficient time in reviewing of research already undertaken on related problems. This is done to find out what data and other materials, if any, are available for operational purposes.

(v) Rephrasing the research problem: Finally, the researcher must sit to rephrase the research problem into a working proposition. Once the nature of the problem has been clearly understood, the environment (within which the problem has got to be studied) has been defined, discussions over the problem have taken place and the available literature has been surveyed and examined, rephrasing the problem into analytical or operational terms is not a difficult task. Through rephrasing, the researcher puts the research problem in as specific terms as possible so that it may become operationally viable and may help in the development of working hypotheses.

(a) Technical terms and words or phrases, with special meanings used in the statement of the problem, should be clearly defined.

(b) Basic assumptions or postulates (if any) relating to the research problem should be clearly stated.

(c) A straight forward statement of the value of the investigation (i.e., the criteria for the selection of the problem) should be provided.

(d) The suitability of the time-period and the sources of data available must also be considered by the researcher in defining the problem.

(e) The scope of the investigation or the limits within which the problem is to be studied must mentioned explicitly in defining a research problem

REVIEW OF LITERATURE

`literature review is a comprehensive summary of previous research on a topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research. The review should enumerate, describe, summarize, objectively evaluate and clarify this previous research. It should give a theoretical base for the research and help you (the author) determine the nature of your research. The literature review acknowledges the work of previous researchers, and in so doing, assures the reader that your work has been well conceived. It is assumed that by mentioning a previous work in the field of study, that the author has read, evaluated, and assimiliated that work into the work at hand.

A literature review creates a "landscape" for the reader, giving her or him a full understanding of the developments in the field. This landscape informs the reader that the author has indeed assimilated all (or the vast majority of) previous, significant works in the field into her or his research.

"In writing the literature review, the purpose is to convey to the reader what knowledge and ideas have been established on a topic, and what their strengths and weaknesses are. The literature review must be defined by a guiding concept (eg. your research objective, the problem or issue you are discussing, or your argumentative thesis). It is not just a descriptive list of the material available, or a set of summaries

THEORY

A theory is a contemplative and rational type of abstract or generalizing thinking about a phenomenon, or the results of such thinking.

In an inductive approach to research, a researcher begins by collecting data that is relevant to his or her topic of interest. Once a substantial amount of data have been collected, the researcher will then take a breather from data collection, stepping back to get a bird's eye view of her data. At this stage, the researcher looks for patterns in the data, working to develop a theory that could explain those patterns. Thus when researchers take an inductive approach, they start with a set of observations and then they move from those particular experiences to a more general set of propositions about those experiences. In other words, they move from data to theory, or from the specific to the general.

Deductive Approaches and Some Examples

Researchers taking a deductive approach take the steps described earlier for inductive research and reverse their order. They start with a social theory that they find compelling and then test its implications with data. That is, they move from a more general level to a more specific one. A deductive approach to research is the one that people typically associate with scientific investigation. The researcher studies what others have done, reads existing theories of whatever phenomenon he or she is studying, and then tests hypotheses that emerge from those theories.

- The inductive approach involves beginning with a set of empirical observations, seeking patterns in those observations, and then theorizing about those patterns.
- The deductive approach involves beginning with a theory, developing hypotheses from that theory, and then collecting and analyzing data to test those hypotheses.
- Inductive and deductive approaches to research can be employed together for a more complete understanding of the topic that a researcher is studying.

Inductive research approach

When there is little to no existing literature on a topic, it is common to perform inductive research because there is no theory to test. The inductive approach consists of three stages:

1. Observation
    - A low-cost airline flight is delayed
    - Dogs A and B have fleas
    - Elephants depend on water to exist
2. Observe a pattern
    - Another 20 flights from low-cost airlines are delayed
    - All observed dogs have fleas
    - All observed animals depend on water to exist
3. Develop a theory
    - Low cost airlines always have delays
    - All dogs have fleas
    - All biological life depends on water to exist

Limitations of an inductive approach

A conclusion drawn on the basis of an inductive method can never be proven, but it can be invalidated.

Example

You observe 1000 flights from low-cost airlines. All of them experience a delay, which is in line with your theory. However, you can never prove that flight 1001 will also be delayed. Still, the larger your dataset, the more reliable the conclusion.

Deductive research approach

When conducting deductive research, you always start with a theory (the result of inductive research). Reasoning deductively means testing these theories. If there is no theory yet, you cannot conduct deductive research.

The deductive research approach consists of four stages:

1. Start with an existing theory
    - Low cost airlines always have delays
    - All dogs have fleas
    - All biological life depends on water to exist
2. Formulate a hypothesis based on existing theory
    - If passengers fly with a low cost airline, then they will always experience delays
    - All pet dogs in my apartment building have fleas
    - All land mammals depend on water to exist
3. Collect data to test the hypothesis
    - Collect flight data of low-cost airlines

- Test all dogs in the building for fleas
- Study all land mammal species to see if they depend on water

4. Analyse the results: does the data reject or support the hypothesis?
    - 5 out of 100 flights of low-cost airlines are not delayed = reject hypothesis
    - 10 out of 20 dogs didn't have fleas = reject hypothesis
    - All land mammal species depend on water = support hypothesis

Limitations of a deductive approach

The conclusions of deductive reasoning can only be true if all the premises set in the inductive study are true and the terms are clear.

Example

- All dogs have fleas (premise)
- Benno is a dog (premise)
- Benno has fleas (conclusion)

CONCEPT OF CONSTRUCT AND VARIABLES

Based on the premises we have, the conclusion must be true. However, if the first premise turns out to be false, the conclusion that Benno has fleas cannot be relied upon.

A **construct** is an indicator variable that measures a characteristics, or trait. For example, college admission scores are **constructs** that measure how well a student is likely to do in their first year.

Construct validity measures how well the observed **construct** predicts the outcome expected.

Constructs are broad concepts or topics for a study. Constructs can be conceptually defined in that they have meaning in theoretical terms. They can be abstract and do not necessarily need to be directly observable. Examples of constructs include intelligence or life satisfaction.

Variables are created by developing the construct into a measurable form. Variables, by definition, correspond to any characteristic that varies (meaning they have at least two possible values). Examples of variables include height in inches, scores on a depression inventory, and ages of employees.

Variables and operational definitions go hand in hand. Operational definitions specifically identify how the variables are measured for the purposes of the research. An operational definition should identify how the variable is calculated or recorded as a numeric value. In addition, the operational definition should specify the range of possible values and the variable's level of measurement (nominal, ordinal, or interval).

RESEARCH PROCESS

Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps.

1. Formulating the Research Problem;
2. Extensive literature survey;
3. Developing the Hypothesis;
4. Preparing the Research Design;
5. Determining Sample Design;
6. Collecting the Data;
7. Execution of the Project;
8. Analysis of Data;

9. Hypothesis testing;

10. Generalizations and Interpretation, and

11. Preparation of the Report or Presentation of the Results

1) Formulating the Research Problem

There are two types of research problems, viz., those which relate to states of nature and those which relate to relationships between variables. At the very outset the researcher must single out the problem he wants to study, i.e., he must decide the general area of interest or aspect of a subject-matter that he would like to inquire into. Initially the problem may be stated in a broad general way and then the ambiguities, if any, relating to the problem be resolved. Then, the feasibility of a particular solution has to be considered before a working formulation of the problem can be set up. The formulation of a general topic into a specific research problem, thus, constitutes the first step in a scientific enquiry. Essentially two steps are involved in formulating the research problem, viz., understanding the problem thoroughly, and rephrasing the same into meaningful terms from an analytical point of view.

The best way of understanding the problem is to discuss it with one's own colleagues or with those having some expertise in the matter. In an academic institution the researcher can seek the help from a guide who is usually an experienced man and has several research problems in mind. Often, the guide puts forth the problem in general terms and it is up to the researcher to narrow it down and phrase the problem in operational terms. In private business units or in governmental organisations, the problem is usually earmarked by the administrative agencies with whom the researcher can discuss as to how the problem originally came about and what considerations are involved in its possible solutions.

The researcher must at the same time examine all available literature to get himself acquainted with the selected problem. He may review two types of literature the conceptual literature concerning

the concepts and theories, and the empirical literature consisting of studies made earlier which are similar to the one proposed. The basic outcome of this review will be the knowledge as to what data and other materials are available for operational purposes which will enable the researcher to specify his own research problem in a meaningful context. After this the researcher rephrases the problem into analytical or operational terms i.e., to put the problem in as specific terms as possible. This task of formulating, or defining, a research problem is a step of greatest importance in the entire research process. The problem to be investigated must be defined unambiguously for that will help discriminating relevant data from irrelevant ones. Care must, however, be taken to verify the objectivity and validity of the background facts concerning the problem.

2) Extensive Literature Survey

Once the problem is formulated, a brief summary of it should be written down. It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or the Research Board for approval. At this juncture the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go to. Academic journals, conference proceedings, government reports, books etc., must be tapped depending on the nature of the problem. In this process, it should be remembered that one source will lead to another. The earlier studies, if any, which are similar to the study in hand should be carefully studied. A good library will be a great help to the researcher at this stage.

3) Developing the Hypothesis

After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical

or empirical consequences. As such the manner in which research hypotheses are developed is particularly important since they provide the focal point for research. They also affect the manner in which tests must be conducted in the analysis of data and indirectly the quality of data which is required for the analysis. In most types of research, the development of working hypothesis plays an important role. Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested. The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track. It sharpens his thinking and focuses attention on the more important facets of the problem. It also indicates the type of data required and the type of methods of data analysis to be used.

How does one go about developing working hypotheses? The answer is by using the following approach:

- Discussions with colleagues and experts about the problem, its origin and the objectives in seeking a solution;
- Examination of data and records, if available, concerning the problem for possible trends, peculiarities and other clues;
- Review of similar studies in the area or of the studies on similar problems; and
- Exploratory personal investigation which involves original field interviews on a limited scale with interested parties and individuals with a view to secure greater insight into the practical aspects of the problem.

Thus, working hypotheses arise as a result of a-priori thinking about the subject, examination of the available data and material including related studies and the counsel of experts and interested parties. Working hypotheses are more useful when stated in precise and clearly defined terms. It may as well

be remembered that occasionally we may encounter a problem where we do not need working hypotheses, especially in the case of exploratory or formulative researches which do not aim at testing the hypothesis. But as a general rule, specification of working hypotheses in another basic step of the research process in most research problems.

4) Preparing the Research Design

The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design, i.e., he will have to state the conceptual structure within which research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximal information. In other words, the function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money. But how all these can be achieved depends mainly on the research purpose. Research purposes may be grouped into four categories, viz., (i) Exploration, (ii) Description, (iii) Diagnosis, and (iv) Experimentation. A flexible research design which provides opportunity for considering many different aspects of a problem is considered appropriate if the purpose of the research study is that of exploration. But when the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimises bias and maximises the reliability of the data collected and analysed.

There are several research designs, such as, experimental and non-experimental hypothesis testing. Experimental designs can be either informal designs (such as before-and-after without control, after-only with control, before-and-after with control) or formal designs (such as completely randomized design, randomized block design, Latin square design, simple and complex factorial designs), out of which the researcher must select one for his own project.

The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

a) The means of obtaining the information;

b) The availability and skills of the researcher and his staff (if any);

c) Explanation of the way in which selected means of obtaining information will be organized and the reasoning leading to the selection;

d) The time available for research; and

e) The cost factor relating to research, i.e., the finance available for the purpose.

5) Determining Sample Design

All the items under consideration in any field of inquiry constitute a 'universe' or 'population'. A complete enumeration of all the items in the 'population' is known as a census inquiry. It can be presumed that in such an inquiry when all the items are covered no element of chance is left and highest accuracy is obtained. But in practice this may not be true. Even the slightest element of bias in such an inquiry will get larger and larger as the number of observations increases. Moreover, there is no way of checking the element of bias or its extent except through a resurvey or use of sample checks. Besides, this type of inquiry involves a great deal of time, money and energy. Not only this, census inquiry is not possible in practice under many circumstances. For instance, blood testing is done only on sample basis. Hence, quite often we select only a few items from the universe for our study purposes. The items so selected constitute what is technically called a sample.

The researcher must decide the way of selecting a sample or what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually

collected for obtaining a sample from a given population. Thus, the plan to select 12 of a city's 200 drugstores in a certain way constitutes a sample design. Samples can be either probability samples or non-probability samples. With probability samples each element has a known probability of being included in the sample but the non-probability samples do not allow the researcher to determine this probability. Probability samples are those based on simple random sampling, systematic sampling, stratified sampling, cluster/area sampling whereas non-probability samples are those based on convenience sampling, judgement sampling and quota sampling techniques. A brief mention of the important sample designs is as follows:

a) Deliberate Sampling

b) Simple Random Sampling

c) Systematic Sampling

d) Stratified Sampling

e) Quota Sampling

f) Cluster Sampling and Area Sampling

g) Multi-stage Sampling

h) Sequential Sampling

6) Collecting the Data

a) By Observation

This method implies the collection of information by way of investigator's own observation, without interviewing the respondents. The information obtained relates to what is currently happening and is not complicated by either the past behaviour or future intentions or attitudes of respondents. This

method is no doubt an expensive method and the information provided by this method is also very limited. As such this method is not suitable in inquiries where large samples are concerned.

b) Through Personal Interview

The investigator follows a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews. This method of collecting data is usually carried out in a structured way where output depends upon the ability of the interviewer to a large extent.

c) Through Telephone Interview

This method of collecting information involves contacting the respondents on telephone itself. This is not a very widely used method but it plays an important role in industrial surveys in developed regions, particularly, when the survey has to be accomplished in a very limited time.

d) By Mailing of Questionnaire

The researcher and the respondents do come in contact with each other if this method of survey is adopted. Questionnaires are mailed to the respondents with a request to return after completing the same. It is the most extensively used method in various economic and business surveys. Before applying this method, usually a Pilot Study for testing the questionnaire is conduced which reveals the weaknesses, if any, of the questionnaire. Questionnaire to be used must be prepared very carefully so that it may prove to be effective in collecting the relevant information.

e) Through Schedules

Under this method the enumerators are appointed and given training. They are provided with schedules containing relevant questions. These enumerators go to respondents with these schedules. Data are collected by filling up the schedules by enumerators on the basis of replies given by

respondents. Much depends upon the capability of enumerators so far as this method is concerned. Some occasional field checks on the work of the enumerators may ensure sincere work.

The researcher should select one of these methods of collecting the data taking into consideration the nature of investigation, objective and scope of the inquiry, finanical resources, available time and the desired degree of accuracy. Though he should pay attention to all these factors but much depends upon the ability and experience of the researcher. In this context Dr A.L Bowley very aptly remarks that in collection of statistical data commonsense is the chief requisite and experience the chief teacher.

7) Execution of the Project

Execution of the project is a very important step in the research process. If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable. The researcher should see that the project is executed in a systematic manner and in time. If the survey is to be conducted by means of structured questionnaires, data can be readily machine-processed. In such a situation, questions as well as the possible answers may be coded. If the data are to be collected through interviewers, arrangements should be made for proper selection and training of the interviewers. The training may be given with the help of instruction manuals which explain clearly the job of the interviewers at each step. Occasional field checks should be made to ensure that the interviewers are doing their assigned job sincerely and efficiently. A careful watch should be kept for unanticipated factors in order to keep the survey as much realistic as possible. This, in other words, means that steps should be taken to ensure that the survey is under statistical control so that the collected information is in accordance with the pre-defined standard of accuracy. If some of the respondents do not cooperate, some suitable methods should be designed to tackle this problem. One method of dealing with the non-

response problem is to make a list of the non-respondents and take a small sub-sample of them, and then with the help of experts vigorous efforts can be made for securing response.

8) Analysis of Data

After the data have been collected, the researcher turns to the task of analysing them. The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences. The unwieldy data should necessarily be condensed into a few manageable groups and tables for further analysis. Thus, researcher should classify the raw data into some purposeful and usable categories. Coding operation is usually done at this stage through which the categories of data are transformed into symbols that may be tabulated and counted. Editing is the procedure that improves the quality of the data for coding. With coding the stage is ready for tabulation. Tabulation is a part of the technical procedure wherein the classified data are put in the form of tables. The mechanical devices can be made use of at this juncture. A great deal of data, specially in large inquiries, is tabulated by computers. Computers not only save time but also make it possible to study large number of variables affecting a problem simultaneously.

Analysis work after tabulation is generally based on the computation of various percentages, coefficients, etc., by applying various well defined statistical formulae. In the process of analysis, relationships or differences supporting or conflicting with original or new hypotheses should be subjected to tests of significance to determine with what validity data can be said to indicate any conclusion(s). For instance, if there are two samples of weekly wages, each sample being drawn from factories in different parts of the same city, giving two different mean values, then our problem may be whether the two mean values are significantly different or the difference is just a matter of chance.

Through the use of statistical tests we can establish whether such a difference is a real one or is the result of random fluctuations. If the difference happens to be real, the inference will be that the two samples come from different universes and if the difference is due to chance, the conclusion would be that the two samples belong to the same universe. Similarly, the technique of analysis of variance can help us in analysing whether three or more varieties of seeds grown on certain fields yield significantly different results or not. In brief, the researcher can analyse the collected data with the help of various statistical measures.

9) Hypothesis Testing

After analysing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier. Do the facts support the hypotheses or they happen to be contrary? This is the usual question which should be answered while testing hypotheses. Various tests, such as Chi square test, t-test, F-test, have been developed by statisticians for the purpose. The hypotheses may be tested through the use of one or more of such tests, depending upon the nature and object of research inquiry. Hypothesis-testing will result in either accepting the hypothesis or in rejecting it. If the researcher had no hypotheses to start with, generalisations established on the basis of data may be stated as hypotheses to be tested by subsequent researches in times to come.

10) Generalizations and Interpretation

If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalisation, i.e., to build a theory. As a matter of fact, the real value of research lies in its ability to arrive at certain generalisations. If the researcher had no hypothesis to start with, he might seek to explain his findings on the basis of some theory. It is known as interpretation. The process of interpretation may quite often trigger off new questions which in turn may lead to further researches.

11) Preparation of the Report or Presentation of the Results

Finally, the researcher has to prepare the report of what has been done by him. Writing of report must be done with great care keeping in view the following:

1) The layout of the report should be as follows: (i) the preliminary pages; (ii) the main text, and (iii) the end matter.

In its preliminary pages the report should carry title and date followed by acknowledgements and foreword. Then there should be a table of contents followed by a list of tables and list of graphs and charts, if any, given in the report.

The main text of the report should have the following parts:

a) Introduction: It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.

b) Summary of Findings: After introduction there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarised.

c) Main Report: The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections.

d) Conclusion: Towards the end of the main text, researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up.

At the end of the report, appendices should be enlisted in respect of all technical data. Bibliography, i.e., list of books, journals, reports, etc., consulted, should also be given in the end. Index should also be given specially in a published research report.

2) Report should be written in a concise and objective style in simple language avoiding vague expressions such as 'it seems,' 'there may be', and the like.

3) Charts and illustrations in the main report should be used only if they present the information more clearly and forcibly.

4) Calculated 'confidence limits' must be mentioned and the various constraints experienced in conducting research operations may as well be stated.

PROBLEMS ENCOUNTERED BY RESEARCHERS IN INDIA

Researchers in India, particularly those engaged in empirical research, are facing several problems.Some of the important problems are as follows:

1. The lack of a scientific training in the methodology of research is a great impediment for researchers in our country. There is paucity of competent researchers. Many researchers take a leap in the dark without knowing research methods. Most of the work, which goes in the name of research is not methodologically sound. Research to many researchers and even to their guides, is mostly a scissor and paste job without any insight shed on the collated materials. The consequence is obvious, viz., the research results, quite often, do not reflect the reality or realities. Thus, a systematic study of research methodology is an urgent necessity. Before undertaking research projects, researchers should be well equipped with all the methodological aspects. As such, efforts should be made to provide short duration intensive courses for meeting this requirement.

2. There is insufficient interaction between the university research departments on one side and business establishments, government departments and research institutions on the other side. A great deal of primary data of non-confidential nature remains untouched/untreated by the researchers for want of proper contacts. Efforts should be made to develop satisfactory liaison among all concerned for better

and realistic researches. There is need for developing some mechanisms of a university—industry interaction programme so that academics can get ideas from practitioners on what needs to be researched and practitioners can apply the research done by the academics.

3. Most of the business units in our country do not have the confidence that the material supplied by them to researchers will not be misused and as such they are often reluctant in supplying the needed information to researchers. The concept of secrecy seems to be sacrosanct to business organisations in the country so much so that it proves an impermeable barrier to researchers. Thus, there is the need for generating the confidence that the information/data obtained from a business unit will not be misused.

4. Research studies overlapping one another are undertaken quite often for want of adequate information. This results in duplication and fritters away resources. This problem can be solved by proper compilation and revision, at regular intervals, of a list of subjects on which and the places where the research is going on. Due attention should be given toward identification of research problems in various disciplines of applied science which are of immediate concern to the industries.

5. There does not exist a code of conduct for researchers and inter-university and interdepartmental rivalries are also quite common. Hence, there is need for developing a code of conduct for researchers which, if adhered sincerely, can win over this problem.

6. Many researchers in our country also face the difficulty of adequate and timely secretarial assistance, including computerial assistance. This causes unnecessary delays in the completion of research studies. All possible efforts be made in this direction so that efficient secretarial assistance is made available to researchers and that too well in time. University Grants Commission must play a dynamic role in solving this difficulty.

7. Library management and functioning is not satisfactory at many places and much of the time and energy of researchers are spent in tracing out the books, journals, reports, etc., rather than in tracing out relevant material from them.

8. There is also the problem that many of our libraries are not able to get copies of old and new Acts/Rules, reports and other government publications in time. This problem is felt more in libraries which are away in places from Delhi and/or the state capitals. Thus, efforts should be made for the regular and speedy supply of all governmental publications to reach our libraries.

9. There is also the difficulty of timely availability of published data from various government and other agencies doing this job in our country. Researcher also faces the problem on account of the fact that the published data vary quite significantly because of differences in coverage by the concerning agencies.

10. There may, at times, take place the problem of conceptualization and also problems relating to the process of data collection and related things.

POSSIBLE QUESTIONS

PART B

1. Define research
2. What is meant by research problem?
3. State the characteristics of research
4. List out the qualities of good research?
5. Give the meaning of variable
6. What is meant by construct?
7. State the difference between inductive and deductive theory

PART C

1. Explain the scope of business research in detail
2. Discuss the types of research in detail
3. Describe the process of research with suitable diagram.
4. Define theory and explain the types of theories in detail
5. Define research problem and explain the techniques of developing research problem

KARPAGAM ACADEMY OF HIGHER EDUCATION

BUSINESS RESEARCH METHODS (18BAU401)

MULTIPLE CHOICE QUESTIONS

UNIT I

S.No	Questions	Option 1	Option 2	Option 3	Option 4	Answer
1	A study to gain familiarity with a phenomenon to achieve new insights is :	Exploratory research	Descriptive Research	Diagnostic Research	Hypothesis testing Research	Exploratory research
2	Study to determine the frequency with which something occurs uis called	Diagnostic Research	Descriptive Research	Exploratory research	Hypothesis testing Research	Diagnostic Research
3	Study to portray accurately characteristics of a particular individual , situation or a	Exploratory research	Descriptive Research	Diagnostic Research	Hypothesis testing Research	Descriptive Research
4	In social science and business research we often use:	Ex post facto research	Hypothesis testing Research	Diagnostic Research	Exploratory research	Ex post facto research
5	If the researcher has no control over the variables it is termed as :	Exploratory research	Ex post facto research	Diagnostic Research	Hypothesis testing Research	Ex post facto research
6	Critical evaluation made by the researcher with the facts and information already	Exploratory research	Analytical Research	Diagnostic Research	Hypothesis testing Research	Analytical Research
7	Gathering knowledge for knowledge sake is termed as :	Exploratory research	Pure Research	Diagnostic Research	Hypothesis testing Research	Pure Research

8	Research aiming to find an solutions for an immediate problem is called:	Applied Research	Exploratory research	Diagnostic Research	other research	Applied Research
9	Research to find reason , why people think or do certain things is an example	Qualitative research	Quantitative Research	Applied Research	Fundamental research	Qualitative research
10	Data based research coming up with conclusions which are capable of being verified	Empirical Research	Pure Research	Conceptual Research	Basic Research	Empirical Research
11	To develop new concepts or to reinterpret existing ones, philosophers and thinkers	Empirical Research	Conceptual Research	Pure Research	Basic Research	Conceptual Research
12	A researcher is free to pick up a problem in	Conclusion-oriented Research	Decision-oriented Research	Historical Research	Diagnostic Research	Conclusion-oriented Research
13	A researcher will not be free to embark upon research according to his own	Historical Research	Decision-oriented Research	Conclusion-oriented Research	Diagnostic Research	Decision-oriented Research
14	Decision-oriented Research is always for the need of the	Researcher	Society	Decision maker	Others	Decision maker
15	Research carried out on over several time periods are called	One-time Research	Longitudinal Research	Field setting Research	Clinical Research	Longitudinal Research
16	Research studies with substantial structure and specific hypothesis to be	Formalized Research	Empirical Research	Historical Research	One-time Research	Formalized Research

17	Characteristics of research that allows research results to be verified by replicating	Logical	Empirical	Historical	Replicable	Replicable
18	The methods or techniques used by researchers in performing research	Research Methods	Research techniques	Research Methodology	Research process	Research Methods
19	The way to systematically solve the research problem is called:	Research Methods	Research techniques	Research process	Research Methodology	Research Methodology
20	Conceptual Literature comprises of :	Concepts and Theories	Earlier studies	Scientific enquiry	Specific Details	Concepts and Theories
21	Empirical literature comprises of :	Concepts and Theories	Earlier studies	Scientific enquiry	Specific Details	Earlier studies
22	if we want to identify the reasons for human behavior we can best apply	Qualitative research	Quantitative research	Fundamental research	Analytical research.	Qualitative research
23	Attitude or opinion research is	qualitative research	quantitative research	conceptual research	fundamental research.	qualitative research
24	To determine the frequency with which something occurs or associated with	descriptive research	formulative research	diagnostic research	hypothesis research	diagnostic research
25	Research means _____	find out new things	find out old things	find out methods	find out techniques	find out new things

26	. Depth interview defined as	Medge Jhon	Dr. Fay. B. Karpf	P.V. Young	Morton.	P.V. Young
27	Primary data is _____ source of collection	Second	Indirect	non direct	Direct	Direct
28	Over Rapporting _____	to collect the data	for good interaction	should be avoided	should be used	should be avoided
29	Sample size should be possible with the help of	Society	Available resources	Person	hypothesis	Available resources
30	Good research is	Progressive	Systematic	Informative	non informative	Systematic
31	Failure to set out clearly the objectives of research are bound to lead to confusion	Partly true	partly false	false	true	true
32	Which one if the following is not the essentials of sampling?	Representative	Adequacy	Homogeneity	Reliability	Homogeneity
33	The main objective of research design is	Budgeting on time	Budgeting on money	Number of respondents to be selected	prepare a structure	prepare a structure
34	The concept which can take on different quantitative values is called as _____	variable	information	sources	data	variable

35	The pre determined plots or the blocks and different treatment are used as	units	experimental units	tratments	control groups	experimental units
36	Which one of the following is not the source of research problem?	Specialization	Observation	Consultations	Resource development	Resource development
37	The formal, systematic and intensive process of carrying on a scientific method of	Research Design	Research	Interpretation	Research analysis	Research
38	The research, which has the purpose of improving a product or a process testing	Statistical research	Applied research	Domestic research	Biological researc	Applied research
39	The research that describes what was in the past is	Schedule	Research	Historical research	Ancient research	Historical research
40	According to the nature of the sample chosen for the study what varies	Data Collection	Sampling	Methodology	Research Problem	Data Collection
41	The device which would retain the actual wording of the respondents is	Recording	)Writing	Copying	Editing	Recording
42	It refers to the relationship between facts or to the of them in some meaningful	Science	Fact	Theory	Economics	Theory
43	What is regarded as an empirically verifiable observation?	Science	Research	Theory	Social Sciences	Research

44	It is a tentative statement about something validity of which is usually unknown	Null hypothesis	Hypothesis	Research hypothesis	Statistical hypothesis	Hypothesis
45	Formulative research studies emphasise on	Bibliographical survey	Discovery of insights	Sample representatives	Specific prediction.	Discovery of insights
46	Research depends upon	random method	systematic method	horizontal method	vertical method	systematic method
47	Which of the following method of sampling belongs to the category of probability	Judgement sampling	Quota sampling	Convenience sampling	Stratified sampling	Convenience sampling
48	Basic principle of an experimental design is	Duplication	Replication	Simplification	Multiplication	Replication
49	The content of a structured interview is	Statement based on experience	Controlled observation	Predetermined questions	Feelings and beliefs	Predetermined questions
50	Social microscope is	Statistical data	Interview	Observation	Case study method	Case study method
51	In an experimental research a group is exposed to usual conditions is termes	experimental group	cntrol group	confounded relationship	non experimental group	cntrol group
52	A Standard test must have the following quality	) Objectivity	Length	Interest	Nonverbal content	Objectivity

53	---------- constitutes the blue print collection measurement and analysis of data	Applied thinking	Operational research	Subjective assessment	Research design	Research design
54	Phenomena, which can take on qualitatively different values even in decimal	Non-continuous	Continuous variable	Independent variables	dependent variables	Continuous variable
55	_____ research is based on the measurement of quantity or amount	Quantitiative	Qualititative	experimental	non experimental	Quantitiative
56	_____ research is concerned with qualitative phenomena	Quantitative	Qualitative	non experimental	experimental	Qualitative
57	_____ research is related to some abstract idea or theory	Conceptual	Empirical	Conceptual & Empirical	applied	Conceptual
58	_____ research relies on experience or observation alone	Conceptual	Empirical	Field setting	Historical	Empirical
59	_____ research, which utilizes historical sources like documents,	Field setting	Conceptual	Empirical	Historical	Historical
60	_____ scale is simply a system of assigning number	Ordinal	Interval	Nominal	ratio	Nominal

UNIT II RESEARCH DESIGN AND SAMPLING DESIGN

Research Design: Concept and Importance in Research Features of a good research design Exploratory Research Design concept, types and uses, Descriptive Research Designs concept, types and uses. Experimental Design.

Data Sources Primary and Secondary Data.

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response, Characteristics of a good sample. Probability Sample Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Non Probability Sampling Convenience, Quota, Judgmental, snowball sampling.

RESEARCH DESIGN

The formidable problem that follows the task of defining the research problem is the preparation of the design of the research project, popularly known as the "research design". Decisions regarding what, where, when, how much, by what means concerning an inquiry or a research study constitute a research design.

"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."1 In fact, the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data. More explicitly, the desing decisions happen to be in respect of:

(i) What is the study about?

(ii) Why is the study being made?

(iii) Where will the study be carried out?

(iv) What type of data is required?

(iv) Where can the required data be found?

(v) What periods of time will the study include?

(vi) What will be the sample design?

(vii) What techniques of data collection will be used?

(viii) How will the data be analysed?

(ix) In what style will the report be prepared?

Keeping in view the above stated design decisions, one may split the overall research design into the following parts:

(a) the sampling design which deals with the method of selecting items to be observed for the given study;

(b) the observational design which relates to the conditions under which the observations are to be made;

(c) the statistical design which concerns with the question of how many items are to be observed and how the information and data gathered are to be analysed;

(d) the operational design which deals with the techniques by which the procedures specified in the sampling, statistical and observational designs can be carried out.

From what has been stated above, we can state the important features of a research design as under:

(i) It is a plan that specifies the sources and types of information relevant to the research problem.

(ii) It is a strategy specifying which approach will be used for gathering and analysing the data. (iii) It also includes the time and cost budgets since most studies are done under these two constraints.

FEATURES OF A GOOD DESIGN

A good design is often characterized by adjectives like flexible, appropriate, efficient, economical and so on. Generally, the design which minimizes bias and maximizes the reliability of the data collected and analysed is considered a good design. The design which gives the smallest experimental error is supposed to be the best design in many investigations. Similarly, a design which yields maximal information and provides an opportunity for considering many different aspects of a problem is considered most appropriate and efficient design in respect of many research problems. Thus, the question of good design is related to the purpose or objective of the research problem and also with the nature of the problem to be studied. A design may be quite suitable in one case, but may

be found wanting in one respect or the other in the context of some other research problem. One single design cannot serve the purpose of all types of research problems. A research design appropriate for a particular research problem, usually involves the consideration of the following factors:

(i) the means of obtaining information;

(ii) the availability and skills of the researcher and his staff, if any;

(iii) the objective of the problem to be studied;

(iv) the nature of the problem to be studied; and

(v) the availability of time and money for the research work.

IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

Before describing the different research designs, it will be appropriate to explain the various concepts relating to designs so that these may be better and easily understood.

1. Dependent and independent variables:

A concept which can take on different quantitative values is called a variable. As such the concepts like weight, height, income are all examples of variables. Qualitative phenomena (or the attributes) are also quantified on the basis of the presence or absence of the concerning attribute(s). Phenomena which can take on quantitatively different values even in decimal points are called 'continuous variables'.* But all variables are not continuous. If they can only be expressed in integer values, they are non-continuous variables or in statistical language 'discrete variables'.** Age is an example of continuous variable, but the number of children is an example of non-continuous variable. If one variable depends upon or is a consequence of the other variable, it is termed as a dependent variable, and the variable that is antecedent to the dependent variable is termed as an independent variable. For instance, if we say that height depends upon age, then height is a dependent variable and age is an independent variable. Further, if in addition to being dependent upon age, height also depends upon the individual's sex, then height is a dependent variable and age and sex are independent variables.

2. Extraneous variable:

Independent variables that are not related to the purpose of the study, but may affect the dependent variable are termed as extraneous variables. Suppose the researcher wants to test the hypothesis that there is a relationship between children's gains in social studies achievement and their

self-concepts. In this case self-concept is an independent variable and social studies achievement is a dependent variable. Intelligence may as well affect the social studies achievement, but since it is not related to the purpose of the study undertaken by the researcher, it will be termed as an extraneous variable. Whatever effect is noticed on dependent variable as a result of extraneous variable(s) is technically described as an 'experimental error'. A study must always be so designed that the effect upon the dependent variable is attributed entirely to the independent variable(s), and not to some extraneous variable or variables.

3. Control:

One important characteristic of a good research design is to minimise the influence or effect of extraneous variable(s). The technical term 'control' is used when we design the study minimising the effects of extraneous independent variables. In experimental researches, the term 'control' is used to refer to restrain experimental conditions.

4. Confounded relationship:

When the dependent variable is not free from the influence of extraneous variable(s), the relationship between the dependent and independent variables is said to be confounded by an extraneous variable(s).

5. Research hypothesis:

When a prediction or a hypothesised relationship is to be tested by scientific methods, it is termed as research hypothesis. The research hypothesis is a predictive statement that relates an independent variable to a dependent variable. Usually a research hypothesis must contain, at least, one independent and one dependent variable. Predictive statements which are not to be objectively verified or the relationships that are assumed but not to be tested, are not termed research hypotheses.

6. Experimental and non-experimental hypothesis-testing research:

When the purpose of research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of the experimental design or of the non-experimental design. Research in which the independent variable is manipulated is termed 'experimental hypothesis-testing research' and a research in which an independent variable is not manipulated is called 'non-experimental hypothesis-testing research'. For instance, suppose a researcher wants to study whether intelligence affects reading ability for a group of students and for this purpose he randomly selects 50 students

and tests their intelligence and reading ability by calculating the coefficient of correlation between the two sets of scores.

7. Experimental and control groups:

In an experimental hypothesis-testing research when a group is exposed to usual conditions, it is termed a 'control group', but when the group is exposed to some novel or special condition, it is termed an 'experimental group'. In the above illustration, the Group A can be called a control group and the Group B an experimental group. If both groups A and B are exposed to special studies programmes, then both groups would be termed 'experimental groups.' It is possible to design studies which include only experimental groups or studies which include both experimental and control groups.

8. Treatments:

The different conditions under which experimental and control groups are put are usually referred to as 'treatments'. In the illustration taken above, the two treatments are the usual studies programme and the special studies programme. Similarly, if we want to determine through an experiment the comparative impact of three varieties of fertilizers on the yield of wheat, in that case the three varieties of fertilizers will be treated as three treatments.

9. Experiment:

The process of examining the truth of a statistical hypothesis, relating to some research problem, is known as an experiment. For example, we can conduct an experiment to examine the usefulness of a certain newly developed drug. Experiments can be of two types viz., absolute experiment and comparative experiment. If we want to determine the impact of a fertilizer on the yield of a crop, it is a case of absolute experiment; but if we want to determine the impact of one fertilizer as compared to the impact of some other fertilizer, our experiment then will be termed as a comparative experiment. Often, we undertake comparative experiments when we talk of designs of experiments.

10. Experimental unit(s):

The pre-determined plots or the blocks, where different treatments are used, are known as experimental units. Such experimental units must be selected (defined) very carefully.

METHODS OF RESEARCH DESIGN

Different research designs can be conveniently described if we categorize them as: (1) research design in case of exploratory research studies; (2) research design in case of descriptive and diagnostic research studies, and (3) research design in case of hypothesis-testing research studies.

1) Research design in case of exploratory research studies

Exploratory research studies are also termed as formulative research studies. The main purpose of such studies is that of formulating a problem for more precise (accurate) investigation or of developing the working hypotheses from an operational point of view. The major emphasis in such studies is on the discovery of ideas and insights. As such the research design appropriate for such studies must be flexible enough to provide opportunity for considering different aspects of a problem under study. Inbuilt flexibility in research design is needed because the research problem, broadly defined initially, is transformed into one with more precise meaning in exploratory studies, which fact may necessitate changes in the research procedure for gathering relevant data. Generally, the following three methods in the context of research design for such studies are talked about:

(a) the survey of concerning literature

(b) the experience survey and

(c) the analysis of 'insight-stimulating' examples.

The survey of concerning literature happens to be the most simple and fruitful method of formulating precisely the research problem or developing hypothesis. Hypotheses stated by earlier workers may be reviewed and their usefulness be evaluated as a basis for further research. It may also be considered whether the already stated hypotheses suggest new hypothesis. In this way the researcher should review and build upon the work already done by others, but in cases where hypotheses have not yet been formulated, his task is to review the available material for deriving the relevant hypotheses from it.

Besides, the bibliographical survey of studies, already made in one's area of interest may as well as made by the researcher for precisely formulating the problem. He should also make an attempt to apply concepts and theories developed in different research contexts to the area in which he is himself working. Sometimes the works of creative writers also provide a fertile ground for hypothesis-formulation and as such may be looked into by the researcher.

Experience survey means the survey of people who have had practical experience with the problem to be studied. The object of such a survey is to obtain insight into the relationships between variables and new ideas relating to the research problem. For such a survey people who are competent and can contribute new ideas may be carefully selected as respondents to ensure a representation of different types of experience. The respondents so selected may then be interviewed by the investigator. The researcher must prepare an interview schedule for the systematic questioning of informants. But the interview must ensure flexibility in the sense that the respondents should be allowed to raise issues and questions which the investigator has not previously considered. Generally, the experience-collecting interview is likely to be long and may last for few hours. Hence, it is often considered desirable to send a copy of the questions to be discussed to the respondents well in advance. This will also give an opportunity to the respondents for doing some advance thinking over the various issues involved so that, at the time of interview, they may be able to contribute effectively. Thus, an experience survey may enable the researcher to define the problem more concisely (briefly) and help in the formulation of the research hypothesis. This survey may as well provide information about the practical possibilities for doing different types of research.

Analysis of 'insight-stimulating' examples is also a fruitful method for suggesting hypotheses for research. It is particularly suitable in areas where there is little experience to serve as a guide. This method consists of the intensive study of selected instances of the phenomenon in which one is interested. For this purpose the existing records, if any, may be examined, the unstructured interviewing may take place, or some other approach may be adopted. Attitude of the investigator, the intensity of the study and the ability of the researcher to draw together diverse information into a unified interpretation are the main features which make this method an appropriate procedure for evoking insights.

Now, what sort of examples is to be selected and studied? There is no clear cut answer to it. Experience indicates that for particular problems certain types of instances are more appropriate than others. One can mention few examples of 'insight-stimulating' cases such as the reactions of strangers, the reactions of marginal individuals, the study of individuals who are in transition from one stage to another, the reactions of individuals from different social strata and the like. In general, cases that provide sharp contrasts or have striking features are considered relatively more useful while adopting this method of hypotheses formulation.

Thus, in an exploratory of formulative research study which merely leads to insights or hypotheses, whatever method or research design outlined above is adopted, the only thing essential is that it must continue to remain flexible so that many different facets of a problem may be considered as and when they arise and come to the notice of the researcher.

2) Research design in case of descriptive and diagnostic research studies

Descriptive research studies are those studies, which are concerned with describing the characteristics of a particular individual, or of a group, whereas diagnostic research studies determine the frequency with which something occurs or its association with something else. The studies concerning whether certain variables are associated are examples of diagnostic research studies. As against this, studies concerned with specific predictions, with narration of facts and characteristics concerning individual, group or situation are all examples of descriptive research studies. Most of the social research comes under this category. From the point of view of the research design, the descriptive as well as diagnostic studies share common requirements and as such we may group together these two types of research studies. In descriptive as well as in diagnostic studies, the researcher must be able to define clearly, what he wants to measure and must find adequate methods for measuring it along with a clear cut definition of 'population' he wants to study. Since the aim is to obtain complete and accurate information in the said studies, the procedure to be used must be carefully planned. The research design must make enough provision for protection against bias and must maximize reliability, with due concern for the economical completion of the research study. The design in such studies must be rigid and not flexible and must focus attention on the following:

- Formulating the objective of the study (what the study is about and why is it being made?)
- Designing the methods of data collection (what techniques of gathering data will be adopted?)
- Selecting the sample (how much material will be needed?)
- Collecting the data (where can the required data be found and with what time period should the data be related?)
- Processing and analyzing the data.
- Reporting the findings.

In a descriptive/diagnostic study the first step is to specify the objectives with sufficient precision (accuracy) to ensure that the data collected are relevant. If this is not done carefully, the study may not provide the desired information.

Then comes the question of selecting the methods by which the data are to be obtained. In other words, techniques for collecting the information must be devised. Several methods (viz., observation, questionnaires, interviewing, examination of records, etc.), with their merits and limitations, are available for the purpose and the researcher may user one or more of these methods which have been discussed in detail in later chapters. While designing data-collection procedure, adequate safeguards against bias and unreliability must be ensured. Whichever method is selected, questions must be well examined and be made unambiguous; interviewers must be instructed not to express their own opinion; observers must be trained so that they uniformly record a given item of behaviour. It is always desirable to pretest the data collection instruments before they are finally used for the study purposes. In other words, we can say that "structured instruments" are used in such studies.

In most of the descriptive/diagnostic studies the researcher takes out sample(s) and then wishes to make statements about the population on the basis of the sample analysis or analyses. More often than not, sample has to be designed. Here we may only mention that the problem of designing samples should be tackled in such a fashion that the samples may yield accurate information with a minimum amount of research effort. Usually one or more forms of probability sampling, or what is often described as random sampling, are used.

To obtain data free from errors introduced by those responsible for collecting them, it is necessary to supervise closely the staff of field workers as they collect and record information. Checks may be set up to ensure that the data collecting staff perform their duty honestly and without prejudice. "As data are collected, they should be examined for completeness, comprehensibility, consistency and reliability."

The data collected must be processed and analysed. This includes steps like coding the interview replies, observations, etc.; tabulating the data; and performing several statistical computations. To the extent possible, the processing and analysing procedure should be planned in detail before actual work is started. This will prove economical in the sense that the researcher may avoid unnecessary labour such as preparing tables for which he later finds he has no use or on the other hand, re-doing some tables because he failed to include relevant data. Coding should be done carefully to avoid error in coding and for this purpose the reliability of coders needs to be checked. Similarly, the accuracy of tabulation may be checked by having a sample of the tables re-done. In case of mechanical tabulation the material (i.e., the collected data or information) must be entered on appropriate cards, which is

usually done by punching holes corresponding to a given code. The accuracy of punching is to be checked and ensured. Finally, statistical computations are needed and as such averages, percentages and various coefficients must be worked out. Probability and sampling analysis may as well be used. The appropriate statistical operations, along with the use of appropriate tests of significance should be carried out to safeguard the drawing of conclusions concerning the study.

Last of all comes the question of reporting the findings. This is the task of communicating the findings to others and the researcher must do it in an efficient manner. The layout of the report needs to be well planned so that all things relating to the research study may be well presented in simple and effective style.

Thus, the research design in case of descriptive/diagnostic studies is a comparative design throwing light on all points narrated above and must be prepared keeping in view the objective(s) of the study and the resources available. However, it must ensure the minimisation of bias and maximisation of reliability of the evidence collected. The said design can be appropriately referred to as a survey design since it takes into account all the steps involved in a survey concerning a phenomenon to be studied.

3) Research design in case of hypothesis-testing research studies

Hypothesis-testing research studies (generally known as experimental studies) are those where the researcher tests the hypotheses of causal relationships between variables. Such studies require procedures that will not only reduce bias and increase reliability, but will permit drawing inferences about causality. Usually experiments meet this requirement. Hence, when we talk of research design in such studies, we often mean the design of experiments.

Professor R.A. Fisher's name is associated with experimental designs. Beginning of such designs was made by him when he was working at Rothamsted Experimental Station (Centre for Agricultural Research in England). As such the study of experimental designs has its origin in agricultural research. Professor Fisher found that by dividing agricultural fields or plots into different blocks and then by conducting experiments in each of these blocks, whatever information is collected and inferences drawn from them, happens to be more reliable. This fact inspired him to develop certain experimental designs for testing hypotheses concerning scientific investigations. Today, the experimental designs are being used in researches relating to phenomena of several disciplines. Since experimental designs originated in the context of agricultural operations, we still use, though in a

technical sense, several terms of agriculture (such as treatment, yield, plot, block etc.) in experimental designs.

BASIC PRINCIPLES OF EXPERIMENTAL DESIGNS

Professor Fisher has enumerated three principles of experimental designs:

(1) the Principle of Replication;

According to the Principle of Replication, the experiment should be repeated more than once. Thus, each treatment is applied in many experimental units instead of one. By doing so the statistical accuracy of the experiments is increased.

For example, suppose we are to examine the effect of two varieties of rice. For this purpose we may divide the field into two parts and grow one variety in one part and the other variety in the other part. We can then compare the yield of the two parts and draw conclusion on that basis. But if we are to apply the principle of replication to this experiment, then we first divide the field into several parts, grow one variety in half of these parts and the other variety in the remaining parts. We can then collect the data of yield of the two varieties and draw conclusion by comparing the same. The result so obtained will be more reliable in comparison to the conclusion we draw without applying the principle of replication. The entire experiment can even be repeated several times for better results. Conceptually replication does not present any difficulty, but computationally it does. For example, if an experiment requiring a two-way analysis of variance is replicated, it will then require a three-way analysis of variance since replication itself may be a source of variation in the data. However, it should be remembered that replication is introduced in order to increase the precision of a study; that is to say, to increase the accuracy with which the main effects and interactions can be estimated.

(2) the Principle of Randomization; and the

The Principle of Randomization provides protection, when we conduct an experiment, against the effect of extraneous factors by randomization. In other words, this principle indicates that we should design or plan the experiment in such a way that the variations caused by extraneous factors can all be combined under the general heading of "chance."

For instance, if we grow one variety of rice, say, in the first half of the parts of a field and the other variety is grown in the other half, then it is just possible that the soil fertility may be different in the first half in comparison to the other half. If this is so, our results would not be realistic. In such a

situation, we may assign the variety of rice to be grown in different parts of the field on the basis of some random sampling technique i.e., we may apply randomization principle and protect ourselves against the effects of the extraneous factors (soil fertility differences in the given case). As such, through the application of the principle of randomization, we can have a better estimate of the experimental error.

(3) Principle of Local Control

The Principle of Local Control is another important principle of experimental designs. Under it the extraneous factor, the known source of variability, is made to vary deliberately over as wide a range as necessary and this needs to be done in such a way that the variability it causes can be measured and hence eliminated from the experimental error.

This means that we should plan the experiment in a manner that we can perform a two-way analysis of variance, in which the total variability of the data is divided into three components attributed to treatments (varieties of rice in our case), the extraneous factor (soil fertility in our case) and experimental error.* In other words, according to the principle of local control, we first divide the field into several homogeneous parts, known as blocks, and then each such block is divided into parts equal to the number of treatments. Then the treatments are randomly assigned to these parts of a block. Dividing the field into several homogenous parts is known as 'blocking'. In general, blocks are the levels at which we hold an extraneous factor fixed, so that we can measure its contribution to the total variability of the data by means of a two-way analysis of variance. In brief, through the principle of local control we can eliminate the variability due to extraneous factor(s) from the experimental error.

IMPORTANT EXPERIMENTAL DESIGNS

Experimental design refers to the framework or structure of an experiment and as such there are sever

(a) Informal experimental designs:

(i) Before-and-after without control design.

(ii) After-only with control design.

(iii) Before-and-after with control design.

(b) Formal experimental designs:

(i) Completely randomized design (C.R. Design).

(ii) Randomized block design (R.B. Design).

(iii) Latin square design (L.S. Design).

(iv) Factorial designs.

1. Before-and-after without control design: In such a design a single test group or area is selected and the dependent variable is measured before the introduction of the treatment. The treatment is then introduced and the dependent variable is measured again after the treatment has been introduced. The effect of the treatment would be equal to the level of the phenomenon after the treatment minus the level of the phenomenon before the treatment.

2. After-only with control design: In this design two groups or areas (test area and control area) are selected and the treatment is introduced into the test area only. The dependent variable is then measured in both the areas at the same time. Treatment impact is assessed by subtracting the value of the dependent variable in the control area from its value in the test area.

3. Before-and-after with control design: In this design two areas are selected and the dependent variable is measured in both the areas for an identical time-period before the treatment. The treatment is then introduced into the test area only, and the dependent variable is measured in both for an identical time-period after the introduction of the treatment. The treatment effect is determined by subtracting the change in the dependent variable in the control area from the change in the dependent variable in test area.

4. Completely randomized design (C.R. design): Involves only two principles viz., the principle of replication and the principle of randomization of experimental designs. It is the simplest possible design and its procedure of analysis is also easier. The essential characteristic of the design is that subjects are randomly assigned to experimental treatments (or vice-versa).

(i) Two-group simple randomized design:

In a two-group simple randomized design, first of all the population is defined and then from the population a sample is selected randomly. Further, requirement of this design is that items, after being selected randomly from the population, be randomly assigned to the experimental and control group

(ii) Random replications design: The limitation of the two-group randomized design is usually eliminated within the random replications design. In the illustration just cited above, the teacher differences on the dependent variable were ignored, i.e., the extraneous variable was not controlled. But in a random replications design, the effect of such differences are minimised (or reduced) by providing a number of repetitions for each treatment

5. Randomized block design (R.B. design) is an improvement over the C.R. design. In the R.B. design the principle of local control can be applied along with the other two principles of experimental designs. In the R.B. design, subjects are first divided into groups, known as blocks, such that within each group the subjects are relatively homogeneous in respect to some selected variable. The variable selected for grouping the subjects is one that is believed to be related to the measures to be obtained in respect of the dependent variable. The number of subjects in a given block would be equal to the number of treatments and one subject in each block would be randomly assigned to each treatment.

6. Latin square design (L.S. design) is an experimental design very frequently used in agricultural research. The conditions under which agricultural investigations are carried out are different from those in other studies for nature plays an important role in agriculture. For instance, an experiment has to be made through which the effects of five different varieties of fertilizers on the yield of a certain crop, say wheat, it to be judged.

7. Factorial designs: Factorial designs are used in experiments where the effects of varying more than one factor are to be determined. They are specially important in several economic and social phenomena where usually a large number of factors affect a particular problem. Factorial designs can be of two types:

(i) simple factorial designs and

(ii) complex factorial designs.

DATA COLLECTION

Data collection is the process of gathering and measuring information on targeted variables in an established systematic fashion, which then enables one to answer relevant questions and evaluate outcomes.

METHODS OF DATA COLLECTION

The task of data collection begins after a research problem has been defined and research design/ plan chalked out. While deciding about the method of data collection to be used for the study, the researcher should keep in mind two types of data viz., primary and secondary. The primary data are those which are collected afresh and for the first time, and thus happen to be original in character. The secondary data, on the other hand, are those which have already been collected by someone else and which have already been passed through the statistical process. The researcher would have to

decide which sort of data he would be using (thus collecting) for his study and accordingly he will have to select one or the other method of data collection. The methods of collecting primary and secondary data differ since primary data are to be originally collected, while in case of secondary data the nature of data collection work is merely that of compilation.

1) Primary Data

Data directly collected by the researcher, with respect to problem under study, is known as primary data. Primary data is also the first hand data collected by the researcher for the immediate purpose of the study.

2) Secondary Data

Secondary data are statistics that already exists. They have been gathered not for immediate use. This may be described as "Those data that have been compiled by some agency other than the user".

OBSERVATION METHOD

The observation method is the most commonly used method specially in studies relating to behavioural sciences. In a way we all observe things around us, but this sort of observation is not scientific observation. Observation becomes a scientific tool and the method of data collection for the researcher, when it serves a formulated research purpose, is systematically planned and recorded and is subjected to checks and controls on validity and reliability. Under the observation method, the information is sought by way of investigator's own direct observation without asking from the respondent. For instance, in a study relating to consumer behaviour, the investigator instead of asking the brand of wrist watch used by the respondent, may himself look at the watch.

Advantages of Observation

- The main advantage of this method is that subjective bias is eliminated, if observation is done accurately.
- Secondly, the information obtained under this method relates to what is currently happening; it is not complicated by either the past behaviour or future intentions or attitudes.
- Thirdly, this method is independent of respondents' willingness to respond and as such is relatively less demanding of active cooperation on the part of respondents as happens to be the case in the interview or the questionnaire method.

- This method is particularly suitable in studies which deal with subjects (i.e., respondents) who are not capable of giving verbal reports of their feelings for one reason or the other

Limitations of Observation

- Firstly, it is an expensive method.
- Secondly, the information provided by this method is very limited.
- Thirdly, sometimes unforeseen factors may interfere with the observational task.
- At times, the fact that some people are rarely accessible to direct observation creates obstacle for this method to collect data effectively.

Precautions before Adopting Observation Method of Data Collection

- While using this method, the researcher should keep in mind things like:
- What should be observed?
- How the observations should be recorded? Or
- How the accuracy of observation can be ensured?

Types of Observation

1) Structured Observation

In case the observation is characterised by a careful definition of the units to be observed, the style of recording the observed information, standardised conditions of observation and the selection of pertinent data of observation, then the observation is called as structured observation. Structured observation is considered appropriate in descriptive studies

2) Unstructured Observation

But when observation is to take place without these characteristics to be thought of in advance, the same is termed as unstructured observation. Whereas in an exploratory study the observational procedure is most likely to be relatively unstructured.

3) Participant Observation

We often talk about participant and non-participant types of observation in the context of studies, particularly of social sciences. This distinction depends upon the observer's sharing or not sharing the life of the group he is observing. If the observer observes by making himself, more or less, a member of the group he is observing so that he can experience what the members of the group experience, the observation is called as the participant observation.

Merits of Participant Observation

- The researcher is enabled to record the natural behaviour of the group.
- The researcher can even gather information which could not easily be obtained if he observes in a disinterested fashion.
- The researcher can even verify the truth of statements made by informants in the context of a questionnaire or a schedule.

Demerits of Participant Observation

- The observer may lose the objectivity to the extent he participates emotionally; the problem of observation-control is not solved; and it may narrow-down the researcher's range of experience.

4) Non-Participant Observation

But when the observer observes as a detached emissary without any attempt on his part to experience through participation what others feel, the observation of this type is often termed as non-participant observation. (When the observer is observing in such a manner that his presence may be unknown to the people he is observing, such an observation is described as disguised observation.)

5) Uncontrolled Observation

If the observation takes place in the natural setting, it may be termed as uncontrolled observation, In non-controlled observation, no attempt is made to use precision instruments. The major aim of this type of observation is to get a spontaneous picture of life and persons. It has a tendency to supply naturalness and completeness of behaviour, allowing sufficient time for observing it. The main pitfall of non-controlled observation is that of subjective interpretation. There is also the danger of having the feeling that we know more about the observed phenomena than we actually do. Uncontrolled observation is resorted to in case of exploratory researches.

6) Controlled Observation

When observation takes place according to definite pre-arranged plans, involving experimental procedure, the same is then termed controlled observation. But in controlled observation, we use mechanical (or precision) instruments as aids to accuracy and standardisation. Such observation has a tendency to supply formalised data upon which generalisations can be built with some degree of assurance. Generally, controlled observation takes place in various experiments that are carried out in a laboratory or under controlled conditions

INTERVIEW METHOD

The interview method of collecting data involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses. This method can be used through personal interviews and, if possible, through telephone interviews. Interview is one of the popular methods of data collection. The term interview can be dissected into two terms as, 'inter' and 'view.'. The essence of interview is that one mind tries to read the other. The interviewer tries to assess the interviewed in terms of the aspects studied or issues analysed.

Personal interview method requires a person known as the interviewer asking questions generally in a face-to-face contact to the other person or persons. (At times the interviewee may also ask certain questions and the interviewer responds to these, but usually the interviewer initiates the interview and collects the information.) This sort of interview may be in the form of direct personal investigation or it may be indirect oral investigation. In the case of direct personal investigation the interviewer has to collect the information personally from the sources concerned. He has to be on the spot and has to meet people from whom data have to be collected. This method is particularly suitable for intensive investigations.

But in certain cases it may not be possible or worthwhile to contact directly the persons concerned or on account of the extensive scope of enquiry, the direct personal investigation technique may not be used. In such cases an indirect oral examination can be conducted under which the interviewer has to cross-examine other persons who are supposed to have knowledge about the problem under investigation and the information, obtained is recorded. Most of the commissions and committees appointed by government to carry on investigations make use of this method.

Types of Interview

1) Structured Interview

The method of collecting information through personal interviews is usually carried out in a structured way. As such we call the interviews as structured interviews. Such interviews involve the use of a set of predetermined questions and of highly standardised techniques of recording. Thus, the interviewer in a structured interview follows a rigid procedure laid down, asking questions in a form and order prescribed. But in case of descriptive studies, we quite often use the technique of structured interview because of its being more economical, providing a safe basis for generalisation and requiring relatively lesser skill on the part of the interviewer.

2) Unstructured Interview

As against it, the unstructured interviews are characterized by a flexibility of approach to questioning. Unstructured interviews do not follow a system of pre-determined questions and standardised techniques of recording information. In a non-structured interview, the interviewer is allowed much greater freedom to ask, in case of need, supplementary questions or at times he may omit certain questions if the situation so requires. He may even change the sequence of questions. He has relatively greater freedom while recording the responses to include some aspects and exclude others. But this sort of flexibility results in lack of comparability of one interview with another and the analysis of unstructured responses becomes much more difficult and time-consuming than that of the structured responses obtained in case of structured interviews. Unstructured interviews also demand deep knowledge and greater skill on the part of the interviewer. Unstructured interview, however, happens to be the central technique of collecting information in case of exploratory or formulative research studies.

3) Focused Interview

Focused interview is meant to focus attention on the given experience of the respondent and its effects. Under it the interviewer has the freedom to decide the manner and sequence in which the questions would be asked and has also the freedom to explore reasons and motives. The main task of the interviewer in case of a focussed interview is to confine the respondent to a discussion of issues with which he seeks conversance. Such interviews are used generally in the development of hypotheses and constitute a major type of unstructured interviews.

4) Clinical Interview

The clinical interview is concerned with broad underlying feelings or motivations or with the course of individual's life experience. The method of eliciting information under it is generally left to the interviewer's discretion.

5) Non-directive Interview

In case of non-directive interview, the interviewer's function is simply to encourage the respondent to talk about the given topic with a bare minimum of direct questioning. The interviewer often acts as a catalyst to a comprehensive expression of the respondents' feelings and beliefs and of the frame of reference within which such feelings and beliefs take on personal significance.

Merits of Interview

- More information and that too in greater depth can be obtained.
- Interviewer by his own skill can overcome the resistance, if any, of the respondents; the interview method can be made to yield an almost perfect sample of the general population.
- There is greater flexibility under this method as the opportunity to restructure questions is always there, specially in case of unstructured interviews.
- Observation method can as well be applied to recording verbal answers to various questions.
- Personal information can as well be obtained easily under this method.
- Samples can be controlled more effectively as there arises no difficulty of the missing returns; non-response generally remains very low.
- The interviewer can usually control which person(s) will answer the questions. This is not possible in mailed questionnaire approach. If so desired, group discussions may also be held.
- The interviewer may catch the informant off-guard and thus may secure the most spontaneous reactions than would be the case if mailed questionnaire is used.
- The language of the interview can be adopted to the ability or educational level of the person interviewed and as such misinterpretations concerning questions can be avoided.
- The interviewer can collect supplementary information about the respondent's personal characteristics and environment which is often of great value in interpreting results.

Demerits or Weakness of Interview

- It is a very expensive method, specially when large and widely spread geographical sample is taken.
- There remains the possibility of the bias of interviewer as well as that of the respondent; there also remains the headache of supervision and control of interviewers.
- Certain types of respondents such as important officials or executives or people in high income groups may not be easily approachable under this method and to that extent the data may prove inadequate.
- This method is relatively more-time-consuming, specially when the sample is large and recalls upon the respondents are necessary.

- The presence of the interviewer on the spot may over-stimulate the respondent, sometimes even to the extent that he may give imaginary information just to make the interview interesting.
- Under the interview method the organisation required for selecting, training and supervising the field-staff is more complex with formidable problems.
- Interviewing at times may also introduce systematic errors.
- Effective interview presupposes proper rapport with respondents that would facilitate free and frank responses. This is often a very difficult requirement.

Pre-requisites and Basic Tenets of Interviewing

- For successful implementation of the interview method, interviewers should be carefully selected, trained and briefed.
- They should be honest, sincere, hardworking, impartial and must possess the technical competence and necessary practical experience.
- Occasional field checks should be made to ensure that interviewers are neither cheating, nor deviating from instructions given to them for performing their job efficiently.
- In addition, some provision should also be made in advance so that appropriate action may be taken if some of the selected respondents refuse to cooperate or are not available when an interviewer calls upon them.
- In fact, interviewing is an art governed by certain scientific principles. Every effort should be made to create friendly atmosphere of trust and confidence, so that respondents may feel at ease while talking to and discussing with the interviewer.
- The interviewer must ask questions properly and intelligently and must record the responses accurately and completely. At the same time, the interviewer must answer legitimate question(s), if any, asked by the respondent and must clear any doubt that the latter has.
- The interviewers approach must be friendly, courteous, conversational and unbiased.
- The interviewer should not show surprise or disapproval of a respondent's answer but he must keep the direction of interview in his own hand, discouraging irrelevant conversation and must make all possible effort to keep the respondent on the track.

QUESTIONNAIRE

This method of data collection is quite popular, particularly in case of big enquiries. It is being adopted by private individuals, research workers, private and public organisations and even by governments. In this method a questionnaire is sent (usually by post) to the persons concerned with a request to answer the questions and return the questionnaire. A questionnaire consists of a number of questions printed or typed in a definite order on a form or set of forms. The questionnaire is mailed to respondents who are expected to read and understand the questions and write down the reply in the space meant for the purpose in the questionnaire itself. The respondents have to answer the questions on their own.

The method of collecting data by mailing the questionnaires to respondents is most extensively employed in various economic and business surveys

Merits of Questionnaire

- There is low cost even when the universe is large and is widely spread geographically.
- It is free from the bias of the interviewer; answers are in respondents' own words.
- Respondents have adequate time to give well thought out answers.
- Respondents, who are not easily approachable, can also be reached conveniently.
- Large samples can be made use of and thus the results can be made more dependable and reliable.

Demerits of Questionnaire

- Low rate of return of the duly filled in questionnaires; bias due to no-response is often indeterminate.
- It can be used only when respondents are educated and cooperating.
- The control over questionnaire may be lost once it is sent.
- There is inbuilt inflexibility because of the difficulty of amending the approach once questionnaires have been despatched.
- There is also the possibility of ambiguous replies or omission of replies altogether to certain questions; interpretation of omissions is difficult.
- It is difficult to know whether willing respondents are truly representative.
- This method is likely to be the slowest of all.

Before using this method, it is always advisable to conduct 'pilot study' (Pilot Survey) for testing the questionnaires. In a big enquiry the significance of pilot survey is felt very much. Pilot survey is infact the replica and rehearsal of the main survey. Such a survey, being conducted by experts, brings to the light the weaknesses (if any) of the questionnaires and also of the survey techniques. From the experience gained in this way, improvement can be effected.

Main Aspects of a Questionnaire

Quite often questionnaire is considered as the heart of a survey operation. Hence it should be very carefully constructed. If it is not properly set up, then the survey is bound to fail. This fact requires us to study the main aspects of a questionnaire viz., the general form, question sequence and question formulation and wording. Researcher should note the following with regard to these three main aspects of a questionnaire:

1) General form

So far as the general form of a questionnaire is concerned, it can either be structured or unstructured questionnaire. Structured questionnaires are those questionnaires in which there are definite, concrete and pre-determined questions. The questions are presented with exactly the same wording and in the same order to all respondents. Resort is taken to this sort of standardisation to ensure that all respondents reply to the same set of questions. The form of the question may be either closed (i.e., of the type 'yes' or 'no') or open (i.e., inviting free response) but should be stated in advance and not constructed during questioning. Structured questionnaires may also have fixed alternative questions in which responses of the informants are limited to the stated alternatives. Thus a highly structured questionnaire is one in which all questions and answers are specified and comments in the respondent's own words are held to the minimum. When these characteristics are not present in a questionnaire, it can be termed as unstructured or non-structured questionnaire. More specifically, we can say that in an unstructured questionnaire, the interviewer is provided with a general guide on the type of information to be obtained, but the exact question formulation is largely his own responsibility and the replies are to be taken down in the respondent's own words to the extent possible; in some situations tape recorders may be used to achieve this goal.

Structured questionnaires are simple to administer and relatively inexpensive to analyse. The provision of alternative replies, at times, helps to understand the meaning of the question clearly. But such questionnaires have limitations too. For instance, wide range of data and that too in

respondent's own words cannot be obtained with structured questionnaires. They are usually considered inappropriate in investigations where the aim happens to be to probe for attitudes and reasons for certain actions or feelings. They are equally not suitable when a problem is being first explored and working hypotheses sought. In such situations, unstructured questionnaires may be used effectively. Then on the basis of the results obtained in pretest (testing before final use) operations from the use of unstructured questionnaires, one can construct a structured questionnaire for use in the main study.

2) Question Sequence

In order to make the questionnaire effective and to ensure quality to the replies received, a researcher should pay attention to the question-sequence in preparing the questionnaire. A proper sequence of questions reduces considerably the chances of individual questions being misunderstood. The question-sequence must be clear and smoothly-moving, meaning thereby that the relation of one question to another should be readily apparent to the respondent, with questions that are easiest to answer being put in the beginning. The first few questions are particularly important because they are likely to influence the attitude of the respondent and in seeking his desired cooperation. The opening questions should be such as to arouse human interest. The following type of questions should generally be avoided as opening questions in a questionnaire:

- Questions that put too great a strain on the memory or intellect of the respondent;
- Questions of a personal character
- Questions related to personal wealth, etc.

Following the opening questions, we should have questions that are really vital to the research problem and a connecting thread should run through successive questions. Ideally, the question-sequence should conform to the respondent's way of thinking. Knowing what information is desired, the researcher can rearrange the order of the questions (this is possible in case of unstructured questionnaire) to fit the discussion in each particular case. But in a structured questionnaire the best that can be done is to determine the question-sequence with the help of a Pilot Survey which is likely to produce good rapport with most respondents. Relatively difficult questions must be relegated (tranfered) towards the end so that even if the respondent decides not to answer such questions, considerable information would have already been obtained. Thus, question-sequence should usually go from the general to the more specific and the researcher must always remember that the answer to

a given question is a function not only of the question itself, but of all previous questions as well. For instance, if one question deals with the price usually paid for coffee and the next with reason for preferring that particular brand, the answer to this latter question may be couched (understood) largely in terms of price-differences.

3) Question Formulation and Wording

With regard to this aspect of questionnaire, the researcher should note that each question must be very clear for any sort of misunderstanding can do irreparable harm to a survey. Question should also be impartial in order not to give a biased picture of the true state of affairs. Questions should be constructed with a view to their forming a logical part of a well thought out tabulation plan. In general, all questions should meet the following standards—(a) should be easily understood; (b) should be simple i.e., should convey only one thought at a time; (c) should be concrete and should conform as much as possible to the respondent's way of thinking. (For instance, instead of asking. "How many razor blades do you use annually?" The more realistic question would be to ask, "How many razor blades did you use last week?"

Multiple Choice Question and the Open-End Questions. In the former the respondent selects one of the alternative possible answers put to him, whereas in the latter he has to supply the answer in his own words. The question with only two possible answers (usually 'Yes' or 'No') can be taken as a special case of the multiple choice question, or can be named as a 'closed question.' There are some advantages and disadvantages of each possible form of question. Multiple choice or closed questions have the advantages of easy handling, simple to answer, quick and relatively inexpensive to analyse. They are most amenable to statistical analysis. Sometimes, the provision of alternative replies helps to make clear the meaning of the question. But the main drawback of fixed alternative questions is that of "putting answers in people's mouths" i.e., they may force a statement of opinion on an issue about which the respondent does not infact have any opinion. They are not appropriate when the issue under consideration happens to be a complex one and also when the interest of the researcher is in the exploration of a process. In such situations, open-ended questions which are designed to permit a free response from the respondent rather than one limited to certain stated alternatives are considered appropriate. Such questions give the respondent considerable latitude in phrasing a reply. Getting the replies in respondent's own words is, thus, the major advantage of open-ended questions. But one

should not forget that, from an analytical point of view, open-ended questions are more difficult to handle, raising problems of interpretation, comparability and interviewer bias.

In practice, one rarely comes across a case when one questionnaire relies on one form of questions alone. The various forms complement each other. As such questions of different forms are included in one single questionnaire. For instance, multiple-choice questions constitute the basis of a structured questionnaire, particularly in a mail survey. But even there, various open-ended questions are generally inserted to provide a more complete picture of the respondent's feelings and attitudes.

Researcher must pay proper attention to the wordings of questions since reliable and meaningful returns depend on it to a large extent. Since words are likely to affect responses, they should be properly chosen. Simple words, which are familiar to all respondents, should be employed. Words with ambiguous meanings must be avoided. Similarly, danger words, catch-words or words with emotional connotations should be avoided. Caution must also be exercised in the use of phrases which reflect upon the prestige of the respondent. Question wording, in no case, should bias the answer. In fact, question wording and formulation is an art and can only be learnt by practice.

Essentials of Good Questionnaire

- To be successful, questionnaire should be comparatively short and simple i.e., the size of the questionnaire should be kept to the minimum
- Questions should proceed in logical sequence moving from easy to more difficult questions
- Personal and intimate questions should be left to the end
- Technical terms and vague expressions capable of different interpretations should be avoided in a questionnaire
- Questions may be dichotomous (yes or no answers), multiple choice (alternative answers listed) or open-ended. The latter type of questions are often difficult to analyse and hence should be avoided in a questionnaire to the extent possible
- There should be some control questions in the questionnaire which indicate the reliability of the respondent. For instance, a question designed to determine the consumption of particular material may be asked first in terms of financial expenditure and later in terms of weight. The control questions, thus, introduce a cross-check to see whether the information collected is correct or not
- Questions affecting the sentiments of respondents should be avoided

- Adequate space for answers should be provided in the questionnaire to help editing and tabulation
- There should always be provision for indications of uncertainty, e.g., "do not know," "no preference" and so on
- Brief directions with regard to filling up the questionnaire should invariably be given in the questionnaire itself
- Finally, the physical appearance of the questionnaire affects the cooperation the researcher receives from the recipients and as such an attractive looking questionnaire, particularly in mail surveys, is a plus point for enlisting cooperation.
- The quality of the paper, along with its colour, must be good so that it may attract the attention of recipients

Types of Questionnaire

1) Structured non disguised Questionnaire

Here, questions are structured so as to get the facts. The interviewer will ask the questions strictly as per the pre arranged order. Structured, non disguised is widely used in market research. Questions are presented with exactly the same wording and same order to all the respondents. The reason for standardizing question is, to ensure that all respondents reply the same question. The purpose of the question is clear. The researcher wants the respondent to choose one of the five options given above. This type of questionnaire is easy to administer. The respondents have no difficulty in answering. Because it is structured, the frame of reference is obvious. In a non-disguised type, the purpose of the questionnaire is known to the respondent.

2) Structured disguised Questionnaire

This type of questionnaire is least used in Marketing research. This type of Questionnaire is used to find, peoples' attitude, when a direct undisguised question produces a bias. In this type of questionnaire what comes out is "What does the respondent know rather than what he feels". Therefore attempt in this method is to find the respondent's attitude.

3) Non-Structured and disguised Questionnaire

The main objective is to conceal the topic of enquiry by using a disguised stimulus. Though the stimulus is standardized by researcher, respondent is allowed to answer in an unstructured manner. The assumption made here is that individuals reaction is an indication of respondent's basic

perception. Projective techniques are examples of Non structured disguised technique. The techniques involve the use of a vague stimulus, that an individual is asked to expand or describe or build a story, three common types under this category are (a) Word association (b) Sentence completion (c) Story telling.

4) Non structured - Non disguised Questionnaire

Here the purpose of the study is clear, but the responses to the question is open ended. Example: "How do you feel about the cyber law currently in practice and its need for further modification"? The initial part of the question is constant. After presenting the initial question, the interview becomes very unstructured as the interviewer probes more deeply. Respondents subsequent answer determines the direction the interviewer takes next. The question asked by interviewer varies from person to person. This method is called "Depth interview". The major advantage of this method is freedom permitted to the interviewer.

PILOT STUDY

A pilot study is a research study conducted before the intended study. Pilot studies are usually executed as planned for the intended study, but on a smaller scale. Although a pilot study cannot eliminate all systematic errors or unexpected problems, it reduces the likelihood of making a Type I or Type II error. Both types of errors make the main study a waste of effort, time, and money.

Reasons to Employ a Pilot Study

There are many reasons to employ a pilot study before implementing the main study. Here are a few good reasons:

- To test the research process and/or protocol. These are often referred to as feasibility studies because the pilot study tests how possible the design is in reality. For example, are the study resources adequate, including time, finances, materials? Are there are any other logistical problems that need to be addressed?
- To identify variables of interest and decide how to operationalize each one. For instance, what are the indicators of composite variables? How will variables be measured and/or computed?
- To test an intervention strategy and identify the components that are most important to the facilitation of the intervention.
- To test methodological changes to implementation or administration of an instrument and/or train personnel on the administration of instruments.

- To develop or test the efficacy of research instruments and protocols. Are there confusing or misleading questions? Is it possible to maintain maximum objectivity and reduce observer drift?
- To estimate statistical parameters for later analyses. Certain statistical analyses require the sample size is sufficiently large and contains enough variability to detect differences between groups, given there any real differences to be detected.

SCHEDULE

This method of data collection is very much like the collection of data through questionnaire, with little difference which lies in the fact that schedules (proforma containing a set of questions) are being filled in by the enumerators who are specially appointed for the purpose. These enumerators along with schedules, go to respondents, put to them the questions from the proforma in the order the questions are listed and record the replies in the space meant for the same in the proforma.

In certain situations, schedules may be handed over to respondents and enumerators may help them in recording their answers to various questions in the said schedules. Enumerators explain the aims and objects of the investigation and also remove the difficulties which any respondent may feel in understanding the implications of a particular question or the definition or concept of difficult terms. This method requires the selection of enumerators for filling up schedules or assisting respondents to fill up schedules and as such enumerators should be very carefully selected

The enumerators should be trained to perform their job well and the nature and scope of the investigation should be explained to them thoroughly so that they may well understand the implications of different questions put in the schedule. Enumerators should be intelligent and must possess the capacity of cross-examination in order to find out the truth. Above all, they should be honest, sincere, hardworking and should have patience and perseverance. This method of data collection is very useful in extensive enquiries and can lead to fairly reliable results. It is, however, very expensive and is usually adopted in investigations conducted by governmental agencies or by some big organisations. Population census all over the world is conducted through this method.

DIFFERENCE BETWEEN QUESTIONNAIRE AND INTERVIEW SCHEDULE

1. The questionnaire is generally sent through mail to informants to be answered as specified in a covering letter, but otherwise without further assistance from the sender. The schedule is generally filled out by the research worker or the enumerator, who can interpret questions when necessary.

2. To collect data through questionnaire is relatively cheap and economical since we have to spend money only in preparing the questionnaire and in mailing the same to respondents. Here no field staff required. To collect data through schedules is relatively more expensive since considerable amount of money has to be spent in appointing enumerators and in importing training to them. Money is also spent in preparing schedules.

3. Non-response is usually high in case of questionnaire as many people do not respond and many return the questionnaire without answering all questions. Bias due to non-response often remains indeterminate. As against this, non-response is generally very low in case of schedules because these are filled by enumerators who are able to get answers to all questions. But there remains the danger of interviewer bias and cheating.

4. In case of questionnaire, it is not always clear as to who replies, but in case of schedule the identity of respondent is known.

5. The questionnaire method is likely to be very slow since many respondents do not return the questionnaire in time despite several reminders, but in case of schedules the information is collected well in time as they are filled in by enumerators.

6. Personal contact is generally not possible in case of the questionnaire method as questionnaires are sent to respondents by post who also in turn return the same by post. But in case of schedules direct personal contact is established with respondents.

7. Questionnaire method can be used only when respondents are literate and cooperative, but in case of schedules the information can be gathered even when the respondents happen to be illiterate.

8. Wider and more representative distribution of sample is possible under the questionnaire method, but in respect of schedules there usually remains the difficulty in sending enumerators over a relatively wider area.

9. Risk of collecting incomplete and wrong information is relatively more under the questionnaire method, particularly when people are unable to understand questions properly. But in case of schedules, the information collected is generally complete and accurate as enumerators can remove the difficulties, if any, faced by respondents in correctly understanding the questions. As a result, the information collected through schedules is relatively more accurate than that obtained through questionnaires.

10. The success of questionnaire method lies more on the quality of the questionnaire itself, but in the case of schedules much depends upon the honesty and competence of enumerators.

11. In order to attract the attention of respondents, the physical appearance of questionnaire must be quite attractive, but this may not be so in case of schedules as they are to be filled in by enumerators and not by respondents.

12. Along with schedules, observation method can also be used but such a thing is not possible while collecting data through questionnaires.

SECONDARY DATA

Secondary data means data that are already available i.e., they refer to the data which have already been collected and analysed by someone else. When the researcher utilises secondary data, then he has to look into various sources from where he can obtain them. In this case he is certainly not confronted with the problems that are usually associated with the collection of original data.

Secondary data may either be published data or unpublished data. Usually published data are available in: (a) various publications of the central, state are local governments; (b) various publications of foreign governments or of international bodies and their subsidiary organisations; (c) technical and trade journals; (d) books, magazines and newspapers; (e) reports and publications of various associations connected with business and industry, banks, stock exchanges, etc.; (f) reports prepared by research scholars, universities, economists, etc. in different fields; and (g) public records and statistics, historical documents, and other sources of published information.

The sources of unpublished data are many; they may be found in diaries, letters, unpublished biographies and autobiographies and also may be available with scholars and research workers, trade associations, labour bureaus and other public/ private individuals and organisations. Researcher must be very careful in using secondary data. He must make a minute scrutiny because it is just possible that the secondary data may be unsuitable or may be inadequate in the context of the problem which

the researcher wants to study. In this connection Dr. A.L. Bowley very aptly observes that it is never safe to take published statistics at their face value without knowing their meaning and limitations and it is always necessary to criticise arguments that can be based on them.

CHARACTERISTICS OF SECONDARY DATA

1) Reliability of Data

The reliability can be tested by finding out such things about the said data:

(a) Who collected the data? (b) What were the sources of data? (c) Were they colleted by using proper methods? (d) At what time were they collected? (e) Was there any bias of the compiler? (f) What level of accuracy was desired? Was it achieved?

2) Suitability of Data

The data that are suitable for one enquiry may not necessarily be found suitable in another enquiry. Hence, if the available data are found to be unsuitable, they should not be used by the researcher. In this context, the researcher must very carefully scrutinize the definition of various terms and units of collection used at the time of collecting the data from the primary source originally. Similarly, the object, scope and nature of the original enquiry must also be studied. If the researcher finds differences in these, the data will remain unsuitable for the present enquiry and should not be used

3) Adequacy of Data

If the level of accuracy achieved in data is found inadequate for the purpose of the present enquiry, they will be considered as inadequate and should not be used by the researcher. The data will also be considered inadequate, if they are related to an area which may be either narrower or wider than the area of the present enquiry

SAMPLING

All items in any field of inquiry constitute a 'Universe' or 'Population. A complete enumeration of all items in the 'population' is known as a census inquiry. It can be presumed that in such an inquiry, when all items are covered, no element of chance is left and highest accuracy is obtained. But in practice this may not be true. Even the slightest element of bias in such an inquiry will get larger and larger as the number of observation increases. Moreover, there is no way of checking the element of bias or its extent except through a resurvey or use of sample checks. Besides, this type of inquiry involves a great deal of time, money and energy. Therefore, when the field of

inquiry is large, this method becomes difficult to adopt because of the resources involved. At times, this method is practically beyond the reach of ordinary researchers. Perhaps, government is the only institution which can get the complete enumeration carried out. Even the government adopts this in very rare cases such as population census conducted once in a decade.

Further, many a time it is not possible to examine every item in the population, and sometimes it is possible to obtain sufficiently accurate results by studying only a part of total population. In such cases there is no utility of census surveys. Then, the researcher may make use of Sampling.

STEPS IN SAMPLE DESIGN

1) Type of Universe

The first step in developing any sample design is to clearly define the set of objects, technically called the universe, to be studied. The universe can be finite or infinite. In finite universe the number of items is certain, but in case of an infinite universe the number of items is infinite, i.e. we cannot have any idea about the total number of items. The population of a city, the number of workers in a factory and the like are examples of finite universes, whereas the number of stars in the sky, listeners of a specific radio programme, throwing a dice etc. are examples of infinite universes.

2) Sampling Unit

A decision has to be taken concerning a sampling unit before selecting sample. Sampling unit may be a geographical one such as state, district, village, etc., or a construction unit such as a house, flat, etc., or it may be a social unit such as family, club, school, etc., or it may be an individual. The researcher will have to decide one or more of such units that he has to select for his study.

3) Source List

It is also known as 'sampling frame' from which sample is to be drawn. It contains the names of all items of universe. If source list is not available, researcher has to prepare it. Such a list should be comprehensive, correct, reliable and appropriate. It is extremely important for the source list to be as representative of the population as possible.

4) Size of Sample

This refers to the number of items to be selected from the universe to constitute a sample. This is a major problem before a researcher. The size of sample should neither be excessively large, nor too small. It should be optimum. An optimum sample is one which fulfills the requirements of efficiency, representativeness, reliability and flexibility. While deciding the size of sample, researcher

must determine the desired precision as also an acceptable confidence level for the estimate. The size of population variance needs to be considered as in case of larger variance usually a bigger sample is needed. The size of population must be kept in view for this also limits the sample size. The parameters of interest in a research study must be kept in view, while deciding the size of sample. Costs too dictate the size of sample that we can draw. As such, budgetary constraint must invariably be taken into consideration when we decide the sample size.

5) Parameters of Interest

In determining the sample design, one must consider the question of the specific population parameters which are of interest. For instance, we may be interested in estimating the proportion of persons with some characteristics in the population or we may be interested in knowing some average or the other measure concerning the population. There may be important sub-groups in the population about whom we would like to make estimates. All this has a strong impact upon the sample design we would accept.

6) Budgetary Constraint

Cost considerations, from practical point of view, have a major impact upon decisions relating to not only the size of the sample but also to the type of sample. This fact can even lead to the use of a non-probability sample.

7) Sampling Procedure

Finally, the researcher must decide the type of sample he will use i.e. he must decide about the technique to be used in selecting the items for the sample. In fact, this technique or procedure stands for the sample design itself. There are several sample designs out of which the researcher must choose one for his study. Obviously, he must select that design which, for a given sample size and for a given cost, has a smaller sampling error.

CHARACTERISTICS OF A GOOD SAMPLE DESIGN

- Sample design must result in a truly representative sample.
- Sample design must be such which results in a small sampling error.
- Sample design must be viable in the context of funds available for the research study.
- Sample design must be such so that systematic bias can be controlled in a better way.
- Sample should be such that the results of the sample study can be applied, in general, for the universe with a reasonable level of confidence.

DETERMINATION OF SAMPLE SIZE

1) Nature of Universe

Universe may be either homogenous or heterogeneous in nature. If the items of the universe are homogenous, a small sample can serve the purpose. But if the items are heterogeneous, a large sample would be required. Technically, this can be termed as the dispersion factor.

2) Number of Classes Proposed

If many class-groups are to be formed, a large sample would be required because a small sample might not be able to give a reasonable number of items in each class-group.

3) Nature of Study

If items are to be intensively and continuously studied, the sample should be small. For a general survey the size of the sample should be large, but a small sample is considered appropriate in technical surveys.

4) Type of Sampling

Sampling technique plays an important part in determining the size of the sample. A small random sample is apt to be much superior to a larger but badly selected sample.

5) Standard of Accuracy and Acceptable Confidence Level

If the standard of accuracy or the level of precision is to be kept high, we shall require relatively larger sample. For doubling the accuracy for a fixed significance level, the sample size has to be increased fourfold.

6) Availability of Finance

In practice, size of the sample depends upon the amount of money available for the study purposes. This factor should be kept in view while determining the size of sample for large samples result in increasing the cost of sampling estimates.

7) Other Considerations

Nature of units, size of the population, size of questionnaire, availability of trained investigators, the conditions under which the sample is being conducted, the time available for completion of the study are a few other considerations to which a researcher must pay attention while selecting the size of sample.

SAMPLING TECHNIQUES

1) Probability Sampling

In probability sample, every unit in the population has equal chances for being selected as a sample unit.

2) Non–probability Sampling

In non probability sampling, units in the population has unequal or zero chances for being selected as a sample unit.

RANDOM SAMPLING PROCEDURES

The importance of randomness in sampling needs no emphasis, It is a means for securing a representative sample. How can a random sample be drawn? The layman tends to think that random sampling means picking out units "at random", i.e., in a haphazard or hit-and-miss way. Experience shows that the human being is an extremely poor instrument for the conduct of a random selection. To ensure true randomness the method of selection must be independent of human judgement. There are basic procedures.

1) Lottery Method

This is the simplest and most familiar procedure of random sampling. If a sample of 10 students is to be drawn out of a list of 50 students in a section, take 50 equal size chips or slips of paper; number them from 1 to 50 each bearing only one number. Roll each slip. Put the rolled slips in a global container and thoroughly shuffle or mix them. Take 10 chips from the container one after another. Each time before drawing a chip, mix the chips in the container thoroughly. The units bearing the numbers of chips drawn constitute the random sample.

(i) Sampling with Replacement

After a number is selected by draw, it may be replaced and consequently it has a chance of being selected again. Such method is known as sampling with replacement. This is usually referred to as unrestricted random sampling.

(ii) Sampling without Replacement

Selected numbers is set aside, and so in subsequent draws, it does not get a chance of being selected again. This type of sampling is known as sampling without replacement. This is a form of restricted sampling.

2) Use of Table o Random Numbers

This is a less cumbersome, but equally valid procedure of sample selection. Tables of random numbers have been developed by Kendall and Smith (1939), Fisher and Yates (1963) and Tippett (1927). To select a random sample out of a given frame, one should simply start to read numbers from a Table of Random Numbers at any randomly selected point and pick out numbers within the range of the frame. Let us suppose that random sample of 50 is to be selected from a College populations of 500 Commerce Students. We can use any table of random numbers.

3) Use of Computer

If the population is very large and if computer facilities are available, a computer may be used for drawing a random sample. The computer can be programmed to print out a series of random numbers as the researcher desires.

TYPES OF SAMPLING

A) Probability Sampling

1) Simple Random Sampling

This sampling technique gives each element an equal and independent chance of being selected. An equal chance means equal probability of selection, e.g., in a population of 300, each element theoretically has 1/300th chance of being selected. In a population of 1000, each element has 1/1000th chance of being selected. Equal probability selection method is described as Epsem sampling. An independent choice means that the draw of one element will not affect the chances of other elements being selected.

Where some elements are purposely excluded from the sample, the resulting sample is not a random one, Hence, all elements should be included in the sample frame to draw a random sample.

Merits

- All elements in the population have an equal chance of being selected
- Of all the probability sampling techniques, simple random sampling is the easiest to
- apply
- It is the simplest type of probability sampling to understand
- It does not required a prior knowledge of the true composition of the population
- The amount of sampling error associated with any sample drawn can easily be computed

Demerits

- It is often impractical, because of non-availability of population list, or of difficulty in enumerating the population. For example, it is difficult to get a current accurate list of households in a city of a list of landless rural agricultural labourers who migrate from area to area in search of employment or a list of households of a nomadic tribe
- The use of simple random sampling may be wasteful because we fail to use all of the known information about the population
- This technique does not ensure proportionate representation to various groups constituting the population
- The sampling error in this sampling is greater than that in other probability samples of the same size, because it is less precise than other methods
- The size of the sample required to ensure its representativeness is equally larger under this type of sampling than under other random sampling techniques
- A simple random design may be expensive in time and money

2) Stratified Random Sampling

This is an improved type of random sampling. In this method, the population is sub-divided into homogenous groups or strata, and from each stratum, random sample is drawn. For example university students may be divided on the basis of discipline, and each discipline group may again be divided into juniors and seniors; and the employees of a business undertaking may be divided into managers and non-managers and each of those two groups may be sub-divided into salary-grade wise strata.

a) Proportionate Stratified Sampling

This sampling involves drawing a sample from each stratum in proportion to the latter's share in the total population.

Specialization	No. of Students	Proportion of Each Stream
Production	40	0.4
Finance	20	0.2
Marketing	30	0.3
Rural Development	10	0.1
Total	100	1.0

Merits

- It enhances the representativeness of the sample by giving proper representation to all sub-groups in the population
- It gives higher statistical efficiency that the given by simple random sampling for a given sample size
- It is easy to carry out this sample method
- This method gives a self-weighing sample, the population mean can be estimated simply by calculating the sample mean

Demerits

- A prior knowledge of the composition of the population and the distribution of the population characteristics are required to adopt this method
- This method is very expensive in time and money. Of course its greater efficiency may offset the additional cost
- The identification of the strata might lead to classification errors. Some elements maybe included into the wrong strata. This may vitiate the interpretation of survey results.

b) Disproportionate Stratified Sampling

This method does not give proportionate representation to strata (group). It necessarily involves giving over representation to some strata and under representation to others. There may be several disproportionate schemes. All strata may be given equal weight, even though their shares in the total population vary. Alternatively some substrata may be given greater weight and others lesser weight. When is such disproportionate weighing preferable? Example : Drawing one per cent as sample irrespective on the numbers of members in the sample

Merits

- It is less time consuming compared with proportionate sampling, because the researcher is not necessarily concerned about the proportionate representativeness of his resulting sample as in the latter method
- It facilitates giving appropriate weighting to particular groups, which are small but more important.

Demerits

- This method does not give each stratum proportionate representation. Hence, the resulting sample may be less representative
- This method requires a prior knowledge of the composition of the population, which is not always possible
- This method is also subject to classification errors. It is possible that the researcher may misclassify certain elements
- Though disproportionate sampling is a means for developing an optimal stratification scheme, its practical feasibility is doubtful because one generally does not know the relative variability in the strata nor the relative costs

3) Systematic Sampling

This method of sampling is an alternative to random sampling. It consists of taking every Kth item in the population after a random start with an item form 1 to K. For example, suppose it is desired to select a sample of 20 students, from a list of 300 students, divide the population total of 300 by 20, the quotient is 15. Select a number at random between 1 and 15, using lottery method or a table of random numbers. Suppose the selected number is 9. Then the students numbered 9, 24, 39 are selected as the sample.

As the interval between sample units is fixed, this method is also known as fixed interval method.

Merits

- It is much simpler than random sampling. It is easy to use
- It is easy to instruct to field investigators to use this method
- This method may require less time. A researcher operating on a limited time schedule will prefer this method
- This method is cheaper than simple random sampling
- It is easier to check whether every 'k'th has been included in the sample
- Sample is spread evenly over the population
- It is statistically more efficient than a simple random sample when population elements are ordered chronologically, by size, class, etc., Then systematic sampling gives a better representative sample

Demerits

- This method ignores all elements between two 'k'th elements selected. Further, except the first element, other selected elements are not chosen at random. Hence, this sampling cannot be considered to be a probably sampling in the strict sense of the term
- As each element does not have an equal chance of being selected, the resulting sample is not a random one. For studies aiming at estimation or generalizations, this disadvantage would be serious one
- This method may sometimes give a biased sample. If by chance, several 'k' th elements chosen represent a particular group, that group would be over-represented in the sample

4) Cluster Sampling

Where the population elements are scattered over a wider area and a list of population elements is not readily available, the use of simple or stratified random sampling method would be too expensive and time consuming. In such cases cluster sampling is usually adopted.

Cluster sampling means random selection of sampling units consisting of population elements. Each such sampling unit is a cluster of population elements. Then from each selected sampling unit, a sample of population elements is drawn by either simple random selection or stratified random selection.

Example: Suppose a researcher wants to select a random sample of 1000 households out of 40000 estimated households in a city for a survey. A direct sample of individual households would be difficult to select, because a list of households does not exist and would be too costly to prepare. Instead, he can select a random sample of a few blocks / wards. The number of blocks to be selected depends upon the average number of estimated households per block. Suppose the average number of households per block is 200, then 5 blocks comprise the sample. Since the number of households per block varies, the actual sample size depends on the block which happen to be selected. Alternatively, he can draw a sample of more blocks and from each blocks a certain number of households may be selected by systematic sampling.

Merits

1. This method is much easier and more convenient to apply when large populations are studied or large geographical areas are covered. Even a ready list of population elements is not

necessary. A researcher can simply draw a random sample of geographical sections and adopt single or multistage sampling depending on the vastness of the area covered by the study

2. The cost of this method is much less when compared with other sampling methods
3. This method promotes the convenience of field work at it could be done in compact places
4. Sampling under this method does not require more time
5. This method is flexible. Where it involves multistage sampling, it is possible to employ different types of sampling in successive stages

Demerits

- The cluster size may vary and this variation could increase the bias of the resulting sample. For example, if the researcher were to interview all adults in households in each selected street the number of adults would vary from house to house. There would be certain bias resulting from the large coverage of big families
- The sampling error in this method of sampling is greater. Thus, this method is statistically less efficient than other probability sampling methods
- Adjacent units of study (e.g. households) tend to have more similar characteristics than do units distantly apart. This affects the 'representativeness' of the sample and this effect is reflected in a greater sampling error.

5) Area Sampling

This is an important form of cluster sampling. In larger field surveys, clusters consisting of specific geographical areas like districts, taluks, villages or blocks in a city are randomly drawn. As the geographical areas are selected as sampling units in such cases, their sampling is called area sampling. It is not a separate method of sampling, but forms a part of cluster sampling.

In a country like India where a state (previously known as province) is divided into districts, districts into talukas and talukas into towns and villages, area sampling is done on the basis of these administrative units in multi-stages.

6) Multi-stage Sampling

In this method, sampling is carried out in two or more stages. The population is regarded as being composed of a number of first stage sampling units. Each of them is made up of a number of second stage units and so forth. That is, at each stage, a sampling unit is a cluster of the sampling units of the subsequent stage. First, a sample of the first stage sampling units is drawn, then from each

of the selected first stage sampling unit, a sample of the second stage sampling units is drawn. The procedure continues down to the final sampling units or population elements. Appropriate random sampling method is adopted at each stage.

Merits

It results in concentration of fieldwork in compact small areas and consequently in a saving of time, labour and money

- It is more convenient, efficient and flexible than single-stage sampling
- It obviates the necessity of having a sampling frame covered the entire population

Demerits

The major disadvantage of the multi-stage sampling is that the procedure of estimating sampling error and cost advantage is complicated. It is difficult for a non-statistician to follow estimation procedure.

B. Non-Probability Sampling

1) Convenience Sampling

This is non-probability sampling. It means selecting sample units in a just 'hit an miss' fashion. E.g. Interviewing people whom we happen to meet. This sampling also means selecting whatever sampling units are conveniently available e.g. a teacher may select students in his class. This method is also known as accidental sampling because the respondents whom the researcher meets accidentally are included in the sample.

Merits

- Cheapest and simplest
- It does not require a list of population
- It does not require any statistical expertise

Demerits

- Convenience sampling is highly biased, because of the researcher's subjectivity, and so it does not yield a representative sample
- It is the least reliable sampling method. There is no way of estimating the representativeness of the sample
- The findings cannot be generalized

2) Purposed or Judgement Sampling

This method means deliberate selection of sample units that conform to some pre-determined criteria. This is known as judgement sampling. This involves selection of cases which we judge as the most appropriate ones for the given study. It is based on the judgement of the researcher or some expert. It does not aim at securing a cross section of a population.

The chance that a particular case be selected for the sample depends on the subjective judgement of the researcher. For example, A researcher may deliberately choose industrial undertakings in which quality circles are believed to be functioning successfully and undertakings in which quality circles are believed to be a total failure

Merits

- It is less costly and more convenient
- It guarantees inclusion of relevant elements in the sample. Probability sampling plans cannot give such guarantee

Demerits

- This does not ensure the representativeness of the sample
- This is less efficient for generalizing when compared with random sampling
- This method requires more prior extensive information about the population one studies. Without such information, it is not possible to adjudge the suitability of the sample items to be selected
- The method does not lend itself for using inferential statistics, because, this sampling does not satisfy the underlying assumption of randomness.

3) Quota Sampling

This is a form of convenient sampling involving selection of quota groups of accessible sampling units by traits such as sex, age, social class etc., when the population is known to consist of various categories by sex, age, religion, social class, etc., in specific proportions, each investigator may be given an assignment of quota groups specified by the pre-determined traits in specific proportions. He can then select accessible persons, belonging to those quota groups in the area assigned to him.

Merits

- It is considerably less costly than probability sampling
- It takes less time
- There is no need for a list of population. Thus, quota sampling is a suitable method of sampling a population for which no suitable frame is available
- Field work can easily be organized. Strict supervision need not be required

Demerits

- It may not yield a precise representative sample, and it is impossible to estimate sampling error. The findings, therefore, are not generalizable to any significant extent
- Interviewers may tent to choose the most accessible persons; they may ignore slums or areas difficult to reach. Thus, they may fail to secure a representative sample within their quota groups
- Strict control of field work is difficult
- The quota of sampling is subject to higher degree of classification error, because the investigators are likely to base their classification of respondents' social status and economic status mostly on their impressions about them
- It is difficult for sampling on more than three variable dimensions. This is because the number of categories to be selected is a multiplication of the number of values in each variable. For instances, if we want to sample proportionate number of persons by sex, social status and age and these variables consist of two, three and three categories respectively.

4) Snowball Sampling

This is the colourful name for a technique of building up a list or a sample of a special population by using an initial set of its members as informants. For example, if a researcher wants to study the problem faced by Indians through some source like Indian Embassy. Then he can ask each one of them to supply names of other Indians known to them, and continue this procedure until he gets an exhaustive list from which he can draw a sample or make a census survey.

This sampling technique may also be used in socio-metric studies. For example, the members of a social group may be asked to name the persons with whom they have social contacts, each one of the persons so named may also be asked to do so, and so on. The researcher may thus get a constellation of associates and analyse it.

Merits

- It is very useful in studying social groups, informal group in a formal organization, and diffusion of information among professionals of various kinds
- It is useful for smaller populations for which no frames are readily available

Demerits

- The major disadvantages of snowball sampling is that it does not allow the use of probability statistical methods. Elements included are dependent on the subjective choice of the original selected respondents
- It is difficult to apply this method when the population is large
- It does not ensure the inclusion of all elements in the lists

SAMPLING ERROR

A survey aims at estimating or inferring selected population characteristics or parameters by studying either population or a sample of the population. The research results may either from the 'true values' of the parameters under study. Such differences are known as Errors and Biases. The errors of a survey may be classified into (a) Sampling Errors (b) Sampling Biases (c) Non-sampling errors and (d) Non-sampling biases.

1) Sampling Errors

The errors which arise because of studying only a part of the total population are called sampling errors. These may arise due to non-representativeness of the samples and the inadequacy of sample size. When several samples are drawn from a population, their results would not be identical. The degree of variation of sample results is measured by standard deviation and it is known as the standard error of the concerned statistic. As sample size increases the magnitude of the error decreases. Sample size and sampling error are thus negatively correlated.

2) Sampling Biases

The average of the estimates of a population parameter derived from an infinite number of samples is called the expected value of the estimator. The difference between this value and 'true value' of the parameter is the bias. Bias may arise (1) if the sampling is done by a non-random method. (2) if the sampling frame is incomplete or inaccurate and (3) if some sections of the population are not available / refuse to cooperate. Any of these factors will cause non-compensating errors which cannot be reduced by an increase in sample size. The only sure way of avoiding bias

arising through the sampling method is to use a random method. Randomness is an essential part of the protection against selection bias.

3) Non-Sampling Errors

These are errors which arise from sources other than sampling. They include errors of observation, errors of measurement and errors of responses. Data are collected through the methods of observation or interviewing. The physical procedures of observation or interviewing are subject to imperfection which cause errors. Measurement errors consist of errors in processing and analysis. Errors of response include incorrect responses of the respondents, mistakes in noting their response etc.,

4) Non-Sampling Biases

These biases pose problems for scientific measurement. They affect both the population sample value and account for the difference between the population value and the true value. They consist of biases of observation and non-observation, response biases and process biases. Biases of observation are caused by obtaining and recording observations incorrectly. Non-observation biases arise from failure to obtain observations on some segments of the population due to either non-coverage or non-response. The latter may be due to refusals, non-at-homes, lost forms, etc., response biases consist of biases arising from imperfections in field observation or interviewing. Processing biases are produced during coding, tabulating and computing.

5) Total Error

In sampling theory, a popular model combines sampling and non-sampling errors and biases into the Total error. This total error is the square root of the sums of squares of variable errors and squares of bias. It is often called the root means square error. The variable error are caused only by sampling errors, and VE equals the standard error of sampling. Bias is mostly caused by measurement biases. The total error depends on the length of both the legs. The sampling error / standard error leg can be shortened by improving the sample design and by increasing the sample size. The length of biases leg may be reduced by improving the tool of data collection, the precision of method of data collection, filed work, coding, processing and analysis. The measurement of sampling error does not pose much problem but the measurement of non-sampling errors require special procedures and it is a costly effect. Hence, the reduction of non-sampling error is a challenge to the researchers.

POSSIBLE QUESTIONS

PART B

1. Define the term research design
2. Give the meaning of data
3. List out the types of data
4. Give the meaning of sample
5. What is meant by sampling design?
6. Write a short note on sampling error

PART C

1. Discuss the different types of research designs
2. Briefly explain the types of experimental designs
3. Explain the principles of experimental research designs
4. Briefly explain the types of primary data with examples
5. Define secondary data and explain the characteristics of secondary data
6. Explain the basic concepts relating to sampling designs
7. Discuss the types of sampling designs in details
8. Describe the steps involved in sampling design.

KARPAGAM ACADEMY OF HIGHER EDUCATION

BUSINESS RESEARCH METHODS (18BAU401)

MULTIPLE CHOICE QUESTIONS

UNIT II

S.NO	Questions	Option 1	Option 2	Option 3	Option 4	Answer
1	Deliberate sampling is also known as :	Purposive sampling	Probability Sampling	Random Sampling	Judgment sampling	Purposive sampling
2	When population elements are selected for inclusion in the sample based on the ase of access:	Convenience sampling	Judgment sampling	Random Sampling	Probability Sampling	Convenience sampling
3	Researcher's Judgment used for selecting items, which he considers as representative of the population, is	Judgment Sampling	Convenience sampling	Random Sampling	Systematic Sampling	Judgment Sampling
4	Simple random sampling is also called:	Chance Sampling	Convenience sampling	Random Sampling	Systematic Sampling	Chance Sampling
5	To select a sample as every 10^{th} house on one side of a street is an example of:	Non Probability sampling	Systematic Sampling	Convenience sampling	Random Sampling	Systematic Sampling
6	To draw a sample from non-homogeneous group, the sampling used is:	Stratified Sampling	Deliberate Sampling	Convenience sampling	Random Sampling	Stratified Sampling

7	Quota Sampling is an important form of :	Probability Sampling	Non-Probability Sampling	Convenience Sampling	Systematic Sampling	Non-Probability Sampling
8	Grouping the population and selecting groups for inclusion in the sampling is called:	Cluster Sampling	Area Sampling	Stratified Sampling	Systematic Sampling	Cluster Sampling
9	Sampling that helps the researcher to carry out research where there is no specific list of population concerned	Cluster Sampling	Systematic Sampling	Stratified Sampling	Area Sampling	Area Sampling
10	Sampling determined according to mathematical decisions on the basis o information yielded as Survey	Sequential Sampling	Multi-Stage Sampling	Area sampling	Quota Sampling	Sequential Sampling
11	Data Collected by filling up the Schedules by the enumerators on the basis of replies given by respondents.	Questionnaire	Schedule	Interview	observation	Schedule
12	Method of selecting items to be observed for the given study is called:	Sampling design	Statistical Design	Operational Design	Observational Design	Sampling design
13	Research Design that relates to conditions under which observations are to be made is called:	Sampling design	Statistical Design	Operational Design	Observational Design	Observational Design
14	A concept which can take on different quantitative values is called a	Variable	Research	Research Design	data	Variable
15	_____ data are those which are collected afresh and for the first time	Primary	Secondary	case study method	warranty cards	Primary

16	_____ data are to be originally collected	Secondary	Primary	warranty cards	case study method	Primary
17	_____ data's are those which have already been collected by someone else.	Primary	Secondary	Primary & Secondary	case study method	Secondary
18	_____ Method is most commonly used method specially ;in studies relating to behavioural	Interview	Questionnaires	Schedules	Observation	Observation
19	_____ Most of collecting data involves presentation of oral verbal stimuli	Questionnaires	Interview	Observation	Schedule	Interview
20	The method of collecting inform through personal interview is usually carried out in a _____ way	Structured	unstructured	formal	informal	Structured
21	_____ Interview is meant to focus attention on the given experience of the respondent and its	Focused	Clinical	Structured	Directive	Focused
22	_____ Interview is concerned with broad underlying feelings orMotivations	Unstructured	Sttructured	Clinical	Non-directive	Sttructured
23	The main Number of sources of data is	2	3	4	1	2
24	Number of methods of collection of primary data is	2	3	4	5	4

25	Number of questions in a questionnaire should be	5	10	maximum	minimum	minimum
26	Sources of secondary data are	Published sources	Unpublished sources	Neither Published sources nor Unpublished	both Published sources and Unpublished	Neither Published sources nor Unpublished sources
27	compared with primary data , secondary data are	more reliable	less reliable	equally reliable	none of these	less reliable
28	In Quantitative classification data are classified on the basis of	attributes	time	location	magnitudes	magnitudes
29	A ------- source is one that itself collects the data.	Primary	Secondary	Published	un published	Secondary
30	The data which is compiled from the records of others is called-----data	Primary	Secondary	un published	Published	Published
31	What type of data will be original in character	unpublised	source data	primary data	secondary data	primary data
32	. What type of data are those which have already been by someone else	secondary data	primary data	source data	unpublised	secondary data
33	Primary data can be collected through ,	direct method	indirect method	other mathods	direct and indirec method	direct and indirec method

34	Which method of data collection is used in studies relating to behavioral sciences	mailed questionnaire	through post	observation method	indirect collection	observation method
35	Which type of data collection is most commonly used method	mailed questionnaire	through post	observation method	indirect collection	observation method
36	If observations takes place in the natural setting, it may be termed as	uncontrolled observation	controlled observation	personal observation	controlled observation	uncontrolled observation
37	If observation takes place according to definite prearranged plans, it is called	uncontrolled observation	controlled observation	personal observation	uncontrolled observation	controlled observation
38	_____ is asking questions face to face	indirect method	mailed questionnaire	through post	personal interview.	personal interview.
39	_____ is meant to focus attention on the given experience of the respondent and its effects.	facing interview	sending post	facing indirect interview	mailing through net.	facing interview
40	In _____ interview, the interviewers function is to simply encourage the respondent to talk	Direct	in direct	through post	through mail	in direct
41	More information and depth can be obtained in _____ method	through mail	questionnaire	indirect interview	interview	interview
42	Which method of data collection is very popular	questionnaire method	pilot study	mailed questionnaire	through post	questionnaire method

43	Which method of data collection is used especially in case of big enquiries	questionnaire method	pilot study	mailed questionnaire	through post	questionnaire method
44	Which method of data collection is very much like the collection of data through questionnaires	schedules	inquires	finding	posting method	schedules
45	Journals, books, magazines etc.. are useful sources of collecting	primary data	secondary data	case study method	warranty cards	secondary data
46	Case study method is a very popular method for ,	quantitative method	qualitative method	non qualitative	non quantitative	qualitative method
47	Which method involves careful and complete observation of a unit	pilot study	questionnaire study	case study	schedule	case study
48	The collected raw data to detect errors and are called ,	editing	coding	classification	tabulation	editing
49	When editing is done to assure that the data are	accurate	informal	formal	additional	accurate
50	Pilot study should be taken for,	pre- testing the questionnaire	post testing the questionnaire	pre- testing the hypothesis	post testing the hypothesis	pre- testing the questionnaire
51	Questionnaire should be contain	simple and easy	complex	not understandable	maximum	simple and easy
52	t-test is an important	parametric test	. non-parametric test	normal distribution test	. statistical test	parametric test

53	Random sampling is	Chance sampling	Non probability sampling	Complex sampling	Deliberate sampling.	Chance sampling
54	Probability sampling is	accidental sampling	quata sampling	snow ball sampling	systematic sampling.	systematic sampling.
55	Non – probability sampling is	systematic sampling.	Random sampling.	Cluster sampling.	Quota sampling.	Quota sampling.
56	Which is not a method of non-probability sampling.	accidental sampling	quata sampling.	Purposive sampling	Random sampling.	Random sampling.
57	Which is not a method of probability sampling.	Systematic sampling.	cluster sampling.	Area sampling.	Purposive sampling.	Purposive sampling.
58	What is to be Quota sampling is a method of	Probability sampling	Unrestricted sampling	Non-probability sampling	cluster sample	Non-probability sampling
59	Random sampling conducted to test a questionnaire?	Experiment	Research	Pilot survey	Interview.	Experiment
60	The aim of schedule is	To collect the data in an objective	Reliability	Subjective	consistent	To collect the data in an objective

UNIT III MEASUREMENT AND SCALING

Concept of measurement what is measured? Problems in measurement in research Validity and Reliability. Levels of measurement Nominal, Ordinal, Interval, Ratio.

Concept of Scaling, Ratings and Ranking Scale, Thurstone, Likert and Semantic Differential scaling, Paired Comparison.

Preparing questionnaire Quality of a good questionnaire.

MEASUREMENT

Measurement is a relatively complex and demanding task, specially so when it concerns qualitative or abstract phenomena. By measurement we mean the process of assigning numbers to objects or observations, the level of measurement being a function of the rules under which the numbers are assigned.

Measurement is a process of mapping aspects of a domain onto other aspects of a range according to some rule of correspondence. In measuring, we devise some form of scale in the range (in terms of set theory, range may refer to some set) and then transform or map the properties of objects from the domain (in terms of set theory, domain may refer to some other set) onto this scale.

MEASUREMENT OF SCALES

1) Nominal scale

Nominal scale is simply a system of assigning number symbols to events in order to label them. The usual example of this is the assignment of numbers of basketball players in order to identify them. Such numbers cannot be considered to be associated with an ordered scale for their order is of no consequence; the numbers are just convenient labels for the particular class of events and as such have no quantitative value. Nominal scales provide convenient ways of keeping track of people, objects and events. One cannot do much with the numbers involved. For example, one cannot usefully average the numbers on the back of a group of football players and come up with a meaningful value. Neither can one usefully compare the numbers assigned to one group with the numbers assigned to another. The counting of members in each group is the only possible arithmetic operation when a nominal scale is employed. Accordingly, we are restricted to use mode as the measure of central tendency. There is no generally used measure of dispersion for nominal scales. Chi-square test is the most common test of statistical significance that can be utilized, and for the measures of correlation, the contingency coefficient can be worked out.

Nominal scale is the least powerful level of measurement. It indicates no order or distance relationship and has no arithmetic origin. A nominal scale simply describes differences between things by assigning them to categories. Nominal data are, thus, counted data. The scale wastes any information that we may have about varying degrees of attitude, skills, understandings, etc. In spite of all this, nominal scales are still very useful and are widely used in surveys and other ex-post-facto research when data are being classified by major sub-groups of the population.

2) Ordinal Scale

The lowest level of the ordered scale that is commonly used is the ordinal scale. The ordinal scale places events in order, but there is no attempt to make the intervals of the scale equal in terms of some rule. Rank orders represent ordinal scales and are frequently used in research relating to qualitative phenomena. A student's rank in his graduation class involves the use of an ordinal scale. One has to be very careful in making statement about scores based on ordinal scales. For instance, if Ram's position in his class is 10 and Mohan's position is 40, it cannot be said that Ram's position is four times as good as that of Mohan. The statement would make no sense at all. Ordinal scales only permit the ranking of items from highest to lowest. Ordinal measures have no absolute values, and the real differences between adjacent ranks may not be equal. All that can be said is that one person is higher or lower on the scale than another, but more precise comparisons cannot be made.

Thus, the use of an ordinal scale implies a statement of 'greater than' or 'less than' (an equality statement is also acceptable) without our being able to state how much greater or less. The real difference between ranks 1 and 2 may be more or less than the difference between ranks 5 and 6. Since the numbers of this scale have only a rank meaning, the appropriate measure of central tendency is the median. A percentile or quartile measure is used for measuring dispersion. Correlations are restricted to various rank order methods. Measures of statistical significance are restricted to the non-parametric methods.

3) Interval Scale

In the case of interval scale, the intervals are adjusted in terms of some rule that has been established as a basis for making the units equal. The units are equal only in so far as one accepts the assumptions on which the rule is based. Interval scales can have an arbitrary zero, but it is not possible

to determine for them what may be called an absolute zero or the unique origin. The primary limitation of the interval scale is the lack of a true zero; it does not have the capacity to measure the complete absence of a trait or characteristic. The Fahrenheit scale is an example of an interval scale and shows similarities in what one can and cannot do with it. One can say that an increase in temperature from 30° to 40° involves the same increase in temperature as an increase from 60° to 70°, but one cannot say that the temperature of 60° is twice as warm as the temperature of 30° because both numbers are dependent on the fact that the zero on the scale is set arbitrarily at the temperature of the freezing point of water. The ratio of the two temperatures, 30° and 60°, means nothing because zero is an arbitrary point.

Interval scales provide more powerful measurement than ordinal scales for interval scale also incorporates the concept of equality of interval. As such more powerful statistical measures can be used with interval scales. Mean is the appropriate measure of central tendency, while standard deviation is the most widely used measure of dispersion. Product moment correlation techniques are appropriate and the generally used tests for statistical significance are the 't' test and 'F' test.

4) Ratio Scale

Ratio scales have an absolute or true zero of measurement. The term 'absolute zero' is not as precise as it was once believed to be. We can conceive of an absolute zero of length and similarly we can conceive of an absolute zero of time. For example, the zero point on a centimeter scale indicates the complete absence of length or height. But an absolute zero of temperature is theoretically unobtainable and it remains a concept existing only in the scientist's mind. The number of minor traffic-rule violations and the number of incorrect letters in a page of type script represent scores on ratio scales. Both these scales have absolute zeros and as such all minor traffic violations and all typing errors can be assumed to be equal in significance. With ratio scales involved one can make statements

like "Jyoti's" typing performance was twice as good as that of "Reetu." The ratio involved does have significance and facilitates a kind of comparison which is not possible in case of an interval scale.

Ratio scale represents the actual amounts of variables. Measures of physical dimensions such as weight, height, distance, etc. are examples. Generally, all statistical techniques are usable with ratio scales and all manipulations that one can carry out with real numbers can also be carried out with ratio scale values. Multiplication and division can be used with this scale but not with other scales mentioned above. Geometric and harmonic means can be used as measures of central tendency and coefficients of variation may also be calculated.

Thus, proceeding from the nominal scale (the least precise type of scale) to ratio scale (the most precise), relevant information is obtained increasingly. If the nature of the variables permits, the researcher should use the scale that provides the most precise description. Researchers in physical sciences have the advantage to describe variables in ratio scale form but the behavioural sciences are generally limited to describe variables in interval scale form, a less precise type of measurement.

SOURCES OF ERROR IN MEASUREMENT

Measurement should be precise and unambiguous in an ideal research study. This objective, however, is often not met with in entirety. As such the researcher must be aware about the sources of error in measurement. The following are the possible sources of error in measurement.

(a) Respondent:

At times the respondent may be reluctant to express strong negative feelings or it is just possible that he may have very little knowledge but may not admit his ignorance. All this reluctance is likely to result in an interview of 'guesses.' Transient factors like fatigue, boredom, anxiety, etc. may limit the ability of the respondent to respond accurately and fully.

(b) Situation:

Situational factors may also come in the way of correct measurement. Any condition which places a strain on interview can have serious effects on the interviewer-respondent rapport. For instance, if someone else is present, he can distort responses by joining in or merely by being present. If the respondent feels that anonymity is not assured, he may be reluctant to express certain feelings.

(c) Measurer:

The interviewer can distort responses by rewording or reordering questions. His behaviour, style and looks may encourage or discourage certain replies from respondents. Careless mechanical processing may distort the findings. Errors may also creep in because of incorrect coding, faulty tabulation and/or statistical calculations, particularly in the data-analysis stage.

(d) Instrument:

Error may arise because of the defective measuring instrument. The use of complex words, beyond the comprehension of the respondent, ambiguous meanings, poor printing, inadequate space for replies, response choice omissions, etc. are a few things that make the measuring instrument defective and may result in measurement errors. Another type of instrument deficiency is the poor sampling of the universe of items of concern. Researcher must know that correct measurement depends on successfully meeting all of the problems listed above. He must, to the extent possible, try to eliminate, neutralize or otherwise deal with all the possible sources of error so that the final results may not be contaminated.

Tests of Sound Measurement

Sound measurement must meet the tests of validity, reliability and practicality. In fact, these are the three major considerations one should use in evaluating a measurement tool. “Validity refers to the

extent to which a test measures what we actually wish to measure. Reliability has to do with the accuracy and precision of a measurement procedure ... Practicality is concerned with a wide range of factors of economy, convenience, and interpretability .

1. Test of Validity*

Validity is the most critical criterion and indicates the degree to which an instrument measures what it is supposed to measure. Validity can also be thought of as utility. In other words, validity is the extent to which differences found with a measuring instrument reflect true differences among those being tested.

(i) Content validity;

(ii) Criterion-related validity and

(iii) Construct validity.

(**i) Content validity** is the extent to which a measuring instrument provides adequate coverage of the topic under study. If the instrument contains a representative sample of the universe, the content validity is good. Its determination is primarily judgemental and intuitive. It can also be determined by using a panel of persons who shall judge how well the measuring instrument meets the standards, but there is no numerical way to express it.

(ii) Criterion-related validity relates to our ability to predict some outcome or estimate the existence of some current condition. This form of validity reflects the success of measures used for some empirical estimating purpose. The concerned criterion must possess the following qualities:

Relevance: (A criterion is relevant if it is defined in terms we judge to be the proper measure.)

Freedom from bias: (Freedom from bias is attained when the criterion gives each subject an equal opportunity to score well.)

Reliability: (A reliable criterion is stable or reproducible.)

Availability: (The information specified by the criterion must be available.)

In fact, a Criterion-related validity is a broad term that actually refers to (i) Predictive validity and (ii) Concurrent validity. The former refers to the usefulness of a test in predicting some future performance whereas the latter refers to the usefulness of a test in closely relating to other measures of known validity. Criterion-related validity is expressed as the coefficient of correlation between test scores and some measure of future performance or between test scores and scores on another measure of known validity.

(iii) Construct validity is the most complex and abstract. A measure is said to possess construct validity to the degree that it confirms to predicted correlations with other theoretical propositions. Construct validity is the degree to which scores on a test can be accounted for by the explanatory constructs of a sound theory. For determining construct validity, we associate a set of other propositions with the results received from using our measurement instrument. If measurements on our devised scale correlate in a predicted way with these other propositions, we can conclude that there is some construct validity.

2. Test of Reliability

The test of reliability is another important test of sound measurement. A measuring instrument is reliable if it provides consistent results. Reliable measuring instrument does contribute to validity, but a reliable instrument need not be a valid instrument.

Two aspects of reliability viz., stability and equivalence deserve special mention. The stability aspect is concerned with securing consistent results with repeated measurements of the same person and with the same instrument. We usually determine the degree of stability by comparing the results of repeated

measurements. The equivalence aspect considers how much error may get introduced by different investigators or different samples of the items being studied. A good way to test for the equivalence of measurements by two investigators is to compare their observations of the same events.

3. Test of Practicality

The practicality characteristic of a measuring instrument can be judged in terms of economy, convenience and interpretability. From the operational point of view, the measuring instrument ought to be practical i.e., it should be economical, convenient and interpretable. Economy consideration suggests that some trade-off is needed between the ideal research project and that which the budget can afford.

TECHNIQUE OF DEVELOPING MEASUREMENT TOOLS

The technique of developing measurement tools involves a four-stage process, consisting of the following:

(a) Concept development;

(b) Specification of concept dimensions;

(c) Selection of indicators; and

(d) Formation of index.

(a) Concept development

The first and foremost step is that of concept development which means that the researcher should arrive at an understanding of the major concepts pertaining to his study. This step of concept development is more apparent in theoretical studies than in the more pragmatic research, where the fundamental concepts are often already established.

(b) Specification of concept dimensions

The second step requires the researcher to specify the dimensions of the concepts that he developed in the first stage. This task may either be accomplished by deduction i.e., by adopting a more or less intuitive approach or by empirical correlation of the individual dimensions with the total concept and/or the other concepts. For instance, one may think of several dimensions such as product reputation, customer treatment, corporate leadership, concern for individuals, sense of social responsibility and so forth when one is thinking about the image of a certain company.

(c) Selection of indicators

Once the dimensions of a concept have been specified, the researcher must develop indicators for measuring each concept element. Indicators are specific questions, scales, or other devices by which respondent's knowledge, opinion, expectation, etc., are measured. As there is seldom a perfect measure of a concept, the researcher should consider several alternatives for the purpose. The use of more than one indicator gives stability to the scores and it also improves their validity.

(d) Formation of index.

The last step is that of combining the various indicators into an index, i.e., formation of an index. When we have several dimensions of a concept or different measurements of a dimension, we may need to combine them into a single index. One simple way for getting an overall index is to provide scale values to the responses and then sum up the corresponding scores. Such an overall index would provide a better measurement tool than a single indicator because of the fact that an "individual indicator has only a probability relation to what we really want to know."2 This way we must obtain an overall index for the various concepts concerning the research study.

MEANING OF SCALING

Scaling describes the procedures of assigning numbers to various degrees of opinion, attitude and other concepts. This can be done in two ways viz., (i) making a judgement about some characteristic of an individual and then placing him directly on a scale that has been defined in terms of that characteristic and (ii) constructing questionnaires in such a way that the score of individual's responses assigns him a place on a scale.

Scale Classification Bases

The number assigning procedures or the scaling procedures may be broadly classified on one or more of the following bases:

(a) subject orientation;

(b) response form;

(c) degree of subjectivity;

(d) scale properties;

(e) number of dimensions and

(f) scale construction techniques.

(a) Subject orientation: Under it a scale may be designed to measure characteristics of the respondent who completes it or to judge the stimulus object which is presented to the respondent. In respect of the former, we presume that the stimuli presented are sufficiently homogeneous so that the betweenstimuli variation is small as compared to the variation among respondents. In the latter approach, we ask the respondent to judge some specific object in terms of one or more dimensions and we presume that the between-respondent variation will be small as compared to the variation among the different stimuli presented to respondents for judging.

(b) Response form: Under this we may classify the scales as categorical and comparative. Categorical scales are also known as rating scales. These scales are used when a respondent scores some object without direct reference to other objects. Under comparative scales, which are also known as ranking scales, the respondent is asked to compare two or more objects. In this sense the respondent may state that one object is superior to the other or that three models of pen rank in order 1, 2 and 3. The essence of ranking is, in fact, a relative comparison of a certain property of two or more objects.

(c) Degree of subjectivity: With this basis the scale data may be based on whether we measure subjective personal preferences or simply make non-preference judgements. In the former case, the respondent is asked to choose which person he favours or which solution he would like to see employed, whereas in the latter case he is simply asked to judge which person is more effective in some aspect or which solution will take fewer resources without reflecting any personal preference.

(d) Scale properties: Considering scale properties, one may classify the scales as nominal, ordinal, interval and ratio scales. Nominal scales merely classify without indicating order, distance or unique origin. Ordinal scales indicate magnitude relationships of 'more than' or 'less than', but indicate no distance or unique origin. Interval scales have both order and distance values, but no unique origin. Ratio scales possess all these features.

(e) Number of dimensions: In respect of this basis, scales can be classified as 'unidimensional' and 'multidimensional' scales. Under the former we measure only one attribute of the respondent or object, whereas multidimensional scaling recognizes that an object might be described better by using the concept of an attribute space of 'n' dimensions, rather than a single-dimension continuum.

SCALE CONSTRUCTION TECHNIQUES

(i) Arbitrary approach

It is an approach where scale is developed on ad hoc basis. This is the most widely used approach. It is presumed that such scales measure the concepts for which they have been designed, although there is little evidence to support such an assumption.

(ii) Consensus approach

Here a panel of judges evaluate the items chosen for inclusion in the instrument in terms of whether they are relevant to the topic area and unambiguous in implication.

(iii) Item analysis approach

Under it a number of individual items are developed into a test which is given to a group of respondents. After administering the test, the total scores are calculated for every one. Individual items are then analysed to determine which items discriminate between persons or objects with high total scores and those with low scores

(iv) Cumulative scales are chosen on the basis of their conforming to some ranking of items with ascending and descending discriminating power. For instance, in such a scale the endorsement of an item representing an extreme position should also result in the endorsement of all items indicating a less extreme position.

(v) Factor scales may be constructed on the basis of intercorrelations of items which indicate that a common factor accounts for the relationship between items. This relationship is typically measured through factor analysis method.

IMPORTANT SCALING TECHNIQUES

A) Rating Scale

In rating scale, the rater makes judgment about some characteristic of a subject and places him directly on some point on the scale. Rating scale may be either a graphic rating scale or an itemized random scale.

1) Graphic Rating Scale

It is quite simple and various points are usually put along the line to form a continuum and the rater indicates his rating by making a tick mark at the appropriate point on a line that runs from one extreme to other.

2) The Itemized Rating Scale

It is also known as numerical scale, presents a series of statements from which a respondent select one as best reflecting his evaluation. These statements are ordered progressively in terms of more or less of some property. It provide more information and meaning to the rater and increases reliability. This form is difficult to develop and the statement may not say exactly what the respondent would like to express.

The advantage of rating scale is that the results attained from these scales are comparable favorably with alternative methods. They require less time, interesting to us and have wide range of applications. One of the disadvantages of rating scales is that it suffers from lack of reliability and validity.

B) Attitude Scales

The attitude scales are constructed with sets of rating scales designed to measures one or more aspects of an individual's or group's attitude towards some objects. The individual responses to various

scales may be aggregated to provide a single attitude for the individual. There are different attitude scales. They are

1) Likert's Summated Scale

It was developed by Likert, which is frequently used in the measurement of social attitude. It uses only the definitely favorable and unfavorable statement and does not take into account the intermediate position, and the respondent is asked to react. The respondent indicates his agreements or disagreement with each statement. Each response is given a numerical score and the score are totaled to measure the respondent's attitude. The overall scale represents the respondent's position on the continuum of favorable – unfavorable towards an issue.

Half of the statements (usually 15) included in the questionnaire are favorable and the rest ones are unfavorable.

Strongly Agree	-5	or	+2
Agree	-4	or	+1
Undecided	-3	or	0
Disagree	-2	or	-1
Strongly Disagree	-1	or	-2

Procedure

i. At the out set, subjects are dividing in to a couple of arbitrarily defined groups. For instance, those subjects with top 25% of all total scores and those with the lowest 25% of all total scores are constructed to be in possession of the most favorable and least favorable attitudes

ii. Thereafter the researcher calculates the mean score for each statement separately

iii. The difference between the two mean scores, in respect of each statement is calculated

iv. Finally, all statements are ranked according to their difference in mean scores. Those with mean differences near zero are considered poor and therefore eliminated.

Advantages

i. Item analysis increases the degree of homogeneity or internal consistency in the set of statements
ii. This method is less difficult
iii. Since a wide range of answers are given to the subject, they don't find it difficult to respond and express the intensity of their feeling
iv. Since there is no involvement of the outside group of judges in selection of the statements, it does not suffer from the problem of subjectivity

Disadvantages

i. Ties in rank are likely to occur quite frequently due to equality in total score values
ii. The response pattern of two persons having exactly identical scores may be significantly different
iii. It suffers from the problem of interpretation which does not arise in Thurstone's scale
iv. The subject is required to respond to all statement, whereas in Thurstone scale, he is required to check only those statement with which he agrees

2) Thurstone's Equal Appearing Interval Scale

L.L. Thurstone is the inventor of this scale. This scale consists of 15 to 20 statements which form a continuum of attitudes towards a subject ranging from the most favorable to the least favorable.

Procedure

i. The researcher gather a large number of statements, usually 20 or more, that express various points of view towards a group, idea or practice

ii. These statements are then submitted to a panel of judges, each of whom arranges them in eleven group or piles ranging from one extreme to another in position. Each of the judges is requested to place generally in the first pile the statements which he thinks are unfavorable issue, in the second pile to place those statement which he thinks all next most unfavorable and he goes on doing so in this manner till in the 11^{th} pile he put the statement which he considers to be most favorable

iii. This sorting by each judge a composite position for each of the items

iv. For items that are retained, each is given its median scale value between one and 11^{th} as established by the panel. In other words the scale value of any one statement is computed as the median position to which it is assigned by the group of judges

v. A final selection of statement is then made. For this purpose a sample of statement, whose median scores is spread evenly from one extreme to the other is taken. The statement so selected constitutes the final scale to be administered to respondents

vi. After developing the scale, the respondent is asked during the administration of scale to check the statements with which they agree. Respondents score is equal to the average of scale values attached to the items he endorses. This average is either median or mean.

Disadvantages

i. The procedure involved in the construction is very costly and time consuming

ii. The scale does not allow subjects to express the intensity of their feelings

iii. The scale values assigned to statements are influenced by the attitudes, background and intelligence of judges who see things differently from actual respondents

iv. This method is not completely objective, it involves subjective decision

3) Bogardus's Scale of Social Distance

Bogardus used cumulative scale containing a number of questions regarding a particular issue. The respondent is required to express his agreement or disagreement over that issue. The respondents who answer favorably have higher aggregate score than those who answer unfavorably. The score is computed by counting the number of items which is responded favorably by the respondent. The respondent is placed on a particular position on the scale on the basis of his scores. Bogardus used this scale to know social distance by measuring the attitude of individual towards a particular social group. In this scale a number of suggested relationships are listed to which member of an ethic group are admitted. The respondent is asked to indicate to which social group is admissible to him for each specified relationship in terms of his willingness to accept social distance.

The respondent is asked to tick off against each of 7 categories of relationship, he is willing to accept a average number of a particular ethic, social or nationality group, because the respondents first feeling reactions are known by this. In this scale the respondent has to express his reaction to each race as a group without having any regard to any individual members of a group, whether he likes of dislikes.

In order to calculate social distance mathematically weights are assigned to different categories of relationship.

Procedure

i. The weight and percentage response in respect of each category are to be placed in rows

ii. The percentage responses are to be multiplied by its weight

iii. The product is to be summed up so as to indicate social distance

Limitations

i. Although it is expected that the respondent has to express his reaction to each race as a group without having any regard to any individual members of that group, in reality the influence of any individual members may not be wiped out from mind of respondent while giving preferences
ii. The score is this scale does not indicates the actual extent or exact degree of preference of a group
iii. It is not always possible on the part of the respondent to be acquainted completely with a group, difficulty to express his attitude towards that group

4) Guttman's Cumulative Scale

Cumulative scale or Louis Guttmann's scalograms analysis, consist of a series of statements to which a respondent expresses his agreement or disagreement. The special feature is that they are cumulative in nature. A respondent replies favorably to item no.3 and also to item no. 2 and 1. The score of the individual is worked out by counting the number of point concerning the number of statement he answers favorably. If the investigator knows this total score, he can estimate as to how a respondent has answered individual statements consulting cumulative scales. The major scale of this type of cumulative scales is the Guttman's scalogram.

Scalogram analysis refers to the procedure for determining whether a set of items forms an unidimensional scale. A scale is said to be unidimensional if the responses fall into a pattern in which endorsement of item reflecting extreme position results. The perfect scale in terms of Guttman's technique implies that an informant who responds to given question will have a high total score than informants who responded to it negatively.

Procedure

i. The area of concept in first defined with reference to problem in hand

ii. Ten or twelve statement are selected which are assumed to be representative of selected area

iii. The statements are arranged in form of 3 or 5 point scale so that subjects can indicates the intensity of their attitude for each item

iv. 10 or 12 items are submitted to a sample of 100 or more respondents who will check the items. This step is designed to determine the scalability of item

v. After the total score is attained for each person by adding up the weights of categories checked, the questionnaires are arranged in rank order from high to low according to total score

vi. A table of scalogram is presented from data as the questionnaire by recording separately the response of each person to each category by providing a column for each person and a row for each category

vii. The reproducibility of each item is determined on the basis that none with a tower score ranks higher in any item than any person with a higher total score. By this method the error of reproducibility is minimized.

Limitation

i. This method is not frequently used for simple reason that its development procedure is tedious and complex

ii. As regards the measurement of attitude towards some objects or prediction of behaviour relating to such objects, the unidimensional scale may not always prove to be most effective basis.

Measurement is a systematic way of assigning number or names to object and their attitudes. And scaling is the procedure for determining the quantitative measure of abstract concepts. A scale consists of a set of statements logically related referring to same attitude. Thus a scale may be used to measure the characteristic of respondent or to evaluate object presented to him.

(a) Method of paired comparisons:

Under it the respondent can express his attitude by making a choice between two objects, say between a new flavour of soft drink and an established brand of drink. But when there are more than two stimuli to judge, the number of judgements required in a paired comparison is given by the formula:

N nn = −1 2 bg

where N = number of judgements n = number of stimuli or objects to be judged. For instance, if there are ten suggestions for bargaining proposals available to a workers union, there are 45 paired comparisons that can be made with them. When N happens to be a big figure, there is the risk of respondents giving ill considered answers or they may even refuse to answer. We can reduce the number of comparisons per respondent either by presenting to each one of them only a sample of stimuli or by choosing a few objects which cover the range of attractiveness at about equal intervals and then comparing all other stimuli to these few standard objects. Thus, paired-comparison data may be treated in several ways. If there is substantial consistency, we will find that if X is preferred to Y, and Y to Z, then X will consistently be preferred to Z. If this is true, we may take the total number of preferences among the comparisons as the score for that stimulus.

(b) Method of rank order: Under this method of comparative scaling, the respondents are asked to rank their choices. This method is easier and faster than the method of paired comparisons stated above. For example, with 10 items it takes 45 pair comparisons to complete the task, whereas the method of rank order simply requires ranking of 10 items only**.**

POSSIBLE QUESTIONS

PART B

1. What is meant by measurement in research?
2. List out the sources of measurement
3. Define scaling
4. What is meant by rating scale
5. Give the meaning of validity

POSSIBLE QUESTIONS

PART C

1. Explain the levels of measurement
2. Discuss the sources errors in measurement in research in detail
3. Discuss the different types of scaling in detail
4. Briefly explain the concept of measurement in detail

KARPAGAM ACADEMY OF HIGHER EDUCATION

BUSINESS RESEARCH METHODS (18BAU401)

MULTIPLE CHOICE QUESTIONS

UNIT III

S.NO	Questions	Option 1	Option 2	Option 3	Option 4	Answer
1	A predictive statement that relates a dependant variable with an independent variable is:	Null Hypothesis	Alternate Hypothesis	Research hypothesis	non hypothesis	Research hypothesis
2	In an Experimental Hypothesis testing research when a group is exposed to usual conditions it is termed as	Experimental Group	Control Group	Experimental units	Control units	Control Group
3	In an Experimental Hypothesis testing research when a group is exposed to Special conditions it is termed as	Experimental Group	Control Group	Control units	Experimental units	Experimental Group
4	Survey of people who have had practical experience with the problem to be studied is called:	Feedback Survey	Experience Survey	Census	interview	Experience Survey
5	Assigning numbers of basket ball players in order to identify them is an example of:	Nominal Scale	Ordinal Scale	Interval scale	Ratio Scale	Nominal Scale
6	Rank orders represent ordinal scales and are frequently used in research relating to:	Quantitative phenomena	Qualitative phenomena	experimental	discrete	Qualitative phenomena
7	A students rank in his graduation class involves the sue of an	Nominal Scale	Ordinal Scale	Interval scale	Ratio Scale	Ordinal Scale
8	A Fahrenheit scale is an example of an:	Nominal Scale	Ordinal Scale	Interval scale	Ratio Scale	Interval scale

9	The extent to which a measuring instrument provides adequate coverage of the topic under study is:	Content Validity	Criterion Validity	Concurrent Validity	Construct Validity	Content Validity
10	The usefulness of a test in predicting some future performance is termed as:	Content Validity	Predictive Validity	Concurrent Validity	Construct Validity	Predictive Validity
11	Procedures of assigning numbers to various degrees of opinion , attitude and other concept is called:	Scaling	Measuring	Responding	Reliability	Scaling
12	Categorical Scales are also known as:	Nominal Scale	Ordinal Scale	Interval scale	Ratio Scale	Ratio Scale
13	Comparative Scales are also known as:	Nominal Scale	Ordinal Scale	Interval scale	Ranking Scale	Ranking Scale
14	Scales that used to measure only one attribute of the respondent or object are called	Unidimensional Scale	Multidimensional Scale	Ordinal Scales	None of the above	Unidimensional Scale
15	Approach in which the scale is developed on ad hoc basis is called:	Arbitrary Approach	Consensus Approach	Item analysis approach	Others	Arbitrary Approach
16	The method of evaluation of items to be included in the instrument by panel of judges during scale construction is	Arbitrary Approach	Consensus Approach	Item analysis approach	Others	Consensus Approach
17	The scale constructed through the Item analysis approach are called:	Arbitrary scales	Differential Scales	Summated scales	Cumulative Scales	Summated scales
18	The scale constructed through the Consensus scale approach are called:	Arbitrary scales	Differential Scales	Summated scales	Cumulative Scales	Differential Scales
19	Likert scale is an example of :	Arbitrary scales	Differential Scales	Summated scales	Cumulative Scales	Summated scales

20	.Individual observations are called ------	raw data	grouped data	ungrouped data	master data	ungrouped data
21	Which one is Geographical classification?	1990-91	North	Male	442	North
22	In discrete frequency distribution values are given---------	Class interval	grouped data	ungrouped data	raw data	grouped data
23	In continuous frequency distribution values are given---------	Class interval	grouped data	raw data	ungrouped data	Class interval
24	Classification according to class-intervals would yield	raw data	discrete data	qualitative data	grouped data	grouped data
25	In Qualitative classification data are classified on the basis of	attributes	time	location	class intervals	attributes
26	In chronological classification data are classified on the basis of	class intervals	attributes	time	location	time
27	In Geographical classification data are classified on the basis of	area	attributes	time	location	area
28	Phenomena which can take on quantitatively different values even in decimal points are called :	Discrete variables	Extraneous Variables	Continuous Variables	Independent Variables	Continuous Variables
29	Variables that can be expressed only in integer values are called	Discrete variables	Extraneous Variables	Continuous Variables	Independent Variables	Discrete variables
30	Age is an example of :	Discrete variables	Extraneous Variables	Independent Variables	Continuous Variables	Continuous Variables

31	Number of Children is an example of :	Discrete variables	Independent Variables	Continuous Variables	Extraneous Variables	Discrete variables
32	Variable that is antecedent to the dependant variable is called:	Discrete variables	Extraneous Variables	Continuous Variables	Independent Variables	Independent Variables
33	Behavioral changes that occur as a result of environmental manipulations are examples of :	Discrete variables	Extraneous Variables	Dependant Variables	Independent Variables	Dependant Variables
34	Independent variables that are not related to the study but may affect the dependant variable are termed as :	Independent Variables	Discrete Variables	Continuous Variables	Extraneous Variables	Extraneous Variables
35	Whatever effect is noticed on dependant variable as a result of extraneous variable is technically	normal error	Experimental Error	Statistical Error	standard error	Experimental Error
36	Clinical interview is concerned with the course of individuals	Experience	Motivation	Life experience	work experience	Life experience
37	_____ method consists in contacting respondents on telephone itself	Telephone interview	Personal interview	Structured interview	Unstructured interview	Telephone interview
38	_____ interviews is concerned with the course of individuals life experience	unstructured	structured	clinical	non directive	clinical
39	_____ method is consisting in contacting respondents in telephone itself	telephone interview	personnel interview	structured interview	unstructured interview	telephone interview
40	____ method is plays an important part in individual surveys	telephone interview	personal interview	Observation	schedule	telephone interview
41	telephone interview method consists in contacting respondent on _____ itself	direct	indirect	face to face	telephone	telephone

42	_____ method of data collection is quite popular particularly in case of enquires	questionnaire	schedule	interview	observation	questionnaire
43	_____ method of data collection is very much like the collection of data through	questionnaire	schedules	interview	observation	schedules
44	warranty cards are usually _____ sized cards	normal	a.4 size cards	postal	store card	postal
45	____ is a definite plan for obtaining a sample for a given population	respondents	selected items	sample design	technique	sample design
46	schedules method of data collection is very much like the collection of data through	questionnaires	schedules	interview	observation	questionnaires
47	research has its special significance for solving --------- problems	situational	economical	operational	social	operational
48	Research has its special significance in solving various operational &_____problemsin business industry	planning	scientific	structure	Business	planning
49	Research has its special significance in solving various operational & Planningproblems of _____	Business	Industry	finance	business and industry	business and industry
50	_____ scale places events in order	ordinal	ratio	interval	Nominal	ordinal
51	In interval scale, the _____ are adjusted in terms	Sequence	Interval	Numeric	ratio	Interval
52	. In _____ scale, the intervals are adjusted in terms	Ordinal	Nominal	Interval	Ratio	Interval

53	_____ scale have an absolute or true zero of measurement	Ordinal	Nominal	interval	Interval	Interval
54	Ratio scale have an absolute or two zero of _____	Measurement	Values	scales	sources	Measurement
55	. _____ scale represents the actual amount of variables	Ratio	Ordinal	Nominal	Interval	Ratio
56	Ratio scale represents the actual amount of _____	Numbers	Ratio	Values	Variable	Variable
57	Geometric & harmonic means calculated in _____ scale	Nominal	Ordinal	Interval	Ratio	Ratio
58	_____ & _____ means calculated in ratio scale	Geometric	harmonic	mean	median	Geometric and hormonic
59	_____ design is needed to facilitate the smooth sailing of the various research operation	Research	Structure	Numeric	experimental	Research
60	Prediction or a hypothesized relationship is to be tested by _____ method	Research	Experiment	Structured	Scientific	Scientific

UNIT IV - HYPOTHESIS TESTING

Hypothesis - Qualities of a good Hypothesis Null Hypothesis & Alternative Hypothesis. Hypothesis Testing Tests concerning means and proportions; ANOVA, Chi-square test and other Nonparametric tests, correlation and Regression

HYPOTHESIS

Hypothesis is usually considered as the principal instrument in research. Its main function is to suggest new experiments and observations. In fact, many experiments are carried out with the deliberate object of testing hypotheses. Decision-makers often face situations wherein they are interested in testing hypotheses on the basis of available information and then take decisions on the basis of such testing. In social science, where direct knowledge of population parameter(s) is rare, hypothesis testing is the often used strategy for deciding whether a sample data offer such support for a hypothesis that generalization can be made. Thus hypothesis testing enables us to make probability statements about population parameter(s). The hypothesis may not be proved absolutely, but in practice it is accepted if it has withstood a critical testing. Before we explain how hypotheses are tested through different tests meant for the purpose, it will be appropriate to explain clearly the meaning of a hypothesis and the related concepts for better understanding of the hypothesis testing techniques.

What is Hypothesis?

Ordinarily, when one talks about hypothesis, one simply means a mere assumption or some supposition to be proved or disproved. But for a researcher hypothesis is a formal question that he intends to resolve. Thus a hypothesis may be defined as a proposition or a set of proposition set forth

as an explanation for the occurrence of some specified group of phenomena either asserted merely as a provisional conjecture to guide some investigation or accepted as highly probable in the light of established facts. Quite often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable to some dependent variable. For example, consider statements like the following ones:

"Students who receive counselling will show a greater increase in creativity than students not receiving counselling" Or

"the automobile A is performing as well as automobile B."

These are hypotheses capable of being objectively verified and tested. Thus, we may conclude that a hypothesis states what we are looking for and it is a proposition which can be put to a test to determine its validity.

CHARACTERISTICS OF HYPOTHESIS

1. Hypothesis should be clear and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.
2. Hypothesis should be capable of being tested. In a swamp of untestable hypotheses, many a time the research programmes have bogged down. Some prior study may be done by researcher in order to make hypothesis a testable one. A hypothesis "is testable if other deductions can be made from it which, in turn, can be confirmed or disproved by observation."
3. Hypothesis should state relationship between variables, if it happens to be a relational hypothesis.
4. Hypothesis should be limited in scope and must be specific. A researcher must remember that narrower hypotheses are generally more testable and he should develop such hypotheses.

5. Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned. But one must remember that simplicity of hypothesis has nothing to do with its significance.
6. Hypothesis should be consistent with most known facts i.e., it must be consistent with a substantial body of established facts. In other words, it should be one which judges accept as being the most likely.
7. Hypothesis should be amenable to testing within a reasonable time. One should not use even an excellent hypothesis, if the same cannot be tested in reasonable time for one cannot spend a life-time collecting data to test it.
8. Hypothesis must explain the facts that gave rise to the need for explanation. This means that by using the hypothesis plus other known and accepted generalizations, one should be able to deduce the original problem condition. Thus hypothesis must actually explain what it claims to explain; it should have empirical reference.

FORMULATION OF HYPOTHESIS

1. A hypothesis may originate in different ways. A cultural environment may give rise to it. In India, for example, religion and custom dominate the way of life. This has had it reaction on economic values and individual initiative in various walks of life. Such a situation could give rise to any number of hypothesis; sociological, cultural, political and economic
2. A second source of hypothesis is folk wisdom or current popular beliefs and practices suggesting both the problems and the hypothesis

3. Analogies are often a spring of valuable hypothesis. Students of sociology in the course of their studies would have come across analogies wherein a society is compared to a biological organism, the natural law to the social law, thermo-dynamics to social dynamics etc.,
4. The history of science provides an eloquent testimony to the fact that personal and idiosyncratic experiences of the scientist contributes a great deal to the type and form of questions he may ask as also to the kinds of tentative answers to these questions that he can provide
5. Hypotheses may also rest on the findings of other studies. The researcher on the basis of the findings of other studies may hypothesise that similar relationship between specified variables will hold good in the present study, too. This is a very common way of researchers who design their study with a view to replicating another study conducted in a different concrete context
6. Another source of hypothesis formulation in cases which are expectations to accepted theory
7. Personal experience and individual reaction may give rise to hypotheses
8. A hypotheses may turn from a body of theory which, by way of logical deduction, may lead to the production that if certain conditions are present, certain results will follow. Theory is indeed an extremely fertile seed-bed of hypotheses.

PROCEDURE FOR HYPOTHESIS TESTING

To test a hypothesis means to tell (on the basis of the data the researcher has collected) whether or not the hypothesis seems to be valid. In hypothesis testing the main question is: whether to accept the null hypothesis or not to accept the null hypothesis? Procedure for hypothesis testing refers to all those steps that we undertake for making a choice between the two actions i.e., rejection and acceptance of a null hypothesis. The various steps involved in hypothesis testing are stated below:

1) Making a Formal Statement

The step consists in making a formal statement of the null hypothesis (H0) and also of the alternative Hypothesis (Ha). This means that hypothesis should be clearly stated, considering the nature of the research problem. For instance, Mr. Mohan of the Civil Engineering Department wants to test the load bearing capacity of an old bridge which must be more than 10 tons, in that case he can state his hypotheses as under:

Null Hypothesis H_0 : μ =10 tons

Alternative Hypothesis H_a: $\mu > 10$ tons

Take another example. The average score in an aptitude test administered at the national level is 80. To evaluate a state's education system, the average score of 100 of the state's students selected on random basis was 75. The state wants to know if there is a significant difference between the local scores and the national scores. In such a situation the hypotheses may be stated as under:

Null Hypothesis H_0 : $\mu = 80$

Alternative Hypothesis H_a: $\mu \neq 80$

The formulation of hypotheses is an important step which must be accomplished with due care in accordance with the object and nature of the problem under consideration. It also indicates whether we should use a one-tailed test or a two-tailed test. If Ha is of the type greater than (or of the type lesser than), we use a one-tailed test, but when Ha is of the type "whether greater or smaller" then we use a two-tailed test.

2) Selecting a Significance Level

The hypotheses are tested on a pre-determined level of significance and as such the same should be specified. Generally, in practice, either 5% level or 1% level is adopted for the purpose. The factors

that affect the level of significance are: (a) the magnitude of the difference between sample means; (b) the size of the samples; (c) the variability of measurements within samples; and (d) whether the hypothesis is directional or non-directional (A directional hypothesis is one which predicts the direction of the difference between, say, means). In brief, the level of significance must be adequate in the context of the purpose and nature of enquiry.

3) Deciding the Distribution to Use

After deciding the level of significance, the next step in hypothesis testing is to determine the appropriate sampling distribution. The choice generally remains between normal distribution and the t-distribution. The rules for selecting the correct distribution are similar to those which we have stated earlier in the context of estimation.

4) Selecting a Random Sample and Computing an Appropriate Value

Another step is to select a random sample(s) and compute an appropriate value from the sample data concerning the test statistic utilizing the relevant distribution. In other words, draw a sample to furnish empirical data.

5) Calculation of the Probability

One has then to calculate the probability that the sample result would diverge as widely as it has from expectations, if the null hypothesis were in fact true.

6) Comparing the Probability

Yet another step consists in comparing the probability thus calculated with the specified value for α□, the significance level. If the calculated probability is equal to or smaller than the α value in case of one-tailed test (and α □/2 in case of two-tailed test), then reject the null hypothesis (i.e., accept the alternative hypothesis), but if the calculated probability is greater, then accept the null hypothesis.

In case we reject H_0, we run a risk of (at most the level of significance) committing an error of Type I, but if we accept H_0, then we run some risk (the size of which cannot be specified as long as the H_0 happens to be vague rather than specific) of committing an error of Type II.

PARAMETRIC TEST

't' Test

When the size of sample is small (less than 30). In particular, it will no longer be possible for us to assume (a) that the random sampling distribution of a statistic is approximately normal and (b) that values given by the sample data are sufficiently close to the population values and can be used in their place for the calculation of the standard error of the estimate.

The removal of these assumptions makes it necessary to use entirely new techniques to deal with the problems of small samples. The division between the theories of large and small samples is, therefore, a very real one, though it is not always easy to draw a precise line of demarcation. It should be noted that as a rule, the methods and the theory of small samples are applicable to large samples, though the reverse is not true.

While dealing with small samples our main interest is not to estimate the population values as in true in large samples; rather our interest lies in testing a given hypothesis, i.e., in ascertaining whether observed values could have arisen by sampling fluctuations from some value given in advance. For example, if a sample of 15 gives a correlation coefficient of +0.4, we shall be interested not so much in the value of the correlation in the parent population, but more generally whether this value could have been arisen from an uncorrelated population. i.e. whether it is significant of correlation in the parent population.

It should be noted that the investigator who works with very small samples must know that his estimates will vary widely from sample to sample. Moreover, he must be satisfied with relatively wide confidence intervals. Precision of statement is less, of course, the wider the intervals employed. Each inference drawn from large sample results in far more precise in the limits it sets up than is an inference based on a much smaller sample.

Student's 't' Distribution

Theoretical work on t-distribution was done by W.S. Gosset (1876-1937) in the early 1900. Gosset was employed by the Guinness and Son, a Dulbin bravery, Ireland, which did not permit

employees to publish research findings under their own names. So Gosset adopted the pen name "Student" and published his findings under their name. Thereafter, the t-distribution is commonly called Student's t-distribution or simply student's distribution.

The t-distribution is used when sample size is 30 or less and the population standard deviation is unknown.

The 't' statistic is defined as

$t = \frac{X-\mu}{S_{\bar{X}}\sqrt{n}}$

Where $S = \sqrt{\sum(X-\bar{X})^2 / n-1}$

Sum 1: The manufacturer of a certain make of electric bulbs claims that his bulbs have a mean life of 25 months with a standard deviation of 5 months. A random sample of 6 such bulbs gave the following values

Life of Months	24	26	30	20	20	18

Can you regard the producer's claim to be valid at 1% level of significance? (Given that the table values of the appropriate test statistics at the said level are 4.032, 3.707 and 3.499 for 5, 6 and 7 degrees of freedom respectively)

Solution

Let us taken the hypothesis that there is no significant difference in the mean life of bulbs in the sample and that of the population, Applying t-test:

X	**$(X-\bar{X})$ X**	**X^2**
24	+1	1
26	+3	9
30	+7	49
20	-3	9
20	-3	9

18	-5	25
$\sum X=138$		$\sum X^2=102$

$$t= \frac{\bar{X}-\mu}{SD} X\sqrt{n}$$

Average of $X= \sum X/n = 138/6 = 23$

$$SD = \sqrt{\sum X^2/n-1} = \sqrt{102/5} = \sqrt{20.4} = 4.517$$

$$= \frac{(23-25)}{4.517}\sqrt{6} = \frac{2 X 2.449}{4.517} = 1.084$$

$\nu=n-1 = 6-1 = 5$

For $\nu=5$ $t_{0.01}=4.032$

The calculated value of t is less than the table value. The hypothesis is accepted. Hence, the producer's claim is not valid at 1% level of significance.

Sum 2: A random sample of size 16 has 53 as mean. The sum of the squares of the deviation taken from mean is 135. Can this sample be regarded as taken from the population having 56 as mean? Obtain 95% and 99% confidence limits of the mean of the population. (For $\nu=15$, $t_{0.05}=2.13$ for $\nu=15$, $t_{0.01}=2.95$)

Solution

Let us take the hypothesis that there is no significant difference between the sample mean and hypothetical mean, Applying t-test.

$$t= \frac{\bar{X}-\mu}{SD} X\sqrt{n}$$

$$SD = \sqrt{\sum X^2/n-1} = \sqrt{135/15} = 3$$

$$= (53-56) / 3 \quad X\sqrt{16}$$

$$= 3 X 4/ 3$$

= 4

v=16-1=15. For v=16, $t_{0.05}$=2.13.

The calculated value is more than the table value. The hypothesis is rejected. Hence, the sample has not come from a population having 56 as mean.

Sum: 3 The life time of electric bulbs for a random sample of 10 from a large consignment gave the following data:

Item	1	2	3	4	5	6	7	8	9	10
Life in '000 hours	4.2	4.6	3.9	4.1	5.2	3.8	3.9	4.3	4.4	5.6

Can we accept the hypothesis that the average life time of bulbs is 4000 hours.

Solution

Let us take the hypothesis that there is no significant difference in the sample mean and the hypothetical population mean

X	**$(X-\overline{X})$**	**$(X-\overline{X})^2$**
4.2	-0.2	0.04
4.6	+0.2	0.04
3.9	-0.5	0.25
4.1	-0.3	0.09
5.2	+0.8	0.64
3.8	-0.6	0.36
3.9	-0.5	0.25
4.3	-0.1	0.01
4.4	0.0	0.00
5.6	+1.2	1.44
$\sum X=44$		$\sum(X-X)^2=3.12$

$t = \bar{X}-\mu/S \times n$

Where $S=\sqrt{\sum(X-X)^2/ n-1}$

$$t = \frac{4.4-4}{0.589}\sqrt{10} = \frac{0.4 \times 3.162}{0.589} = 0.2148$$

$\nu = n-1 = 10-1 = 9$

For $\nu=9$ $t_{0.05}=2.262$

The calculated value of t is less than the table value. The hypothesis is accepted. The average life time of the bulbs could be 4000 hours.

Sum 4: Two types of drugs were used on 5 and 7 patients for reducing their weight.

Drug A was imported and drug B indigenous. The decrease in the weight after using the drugs for six months was as follows:

Drug A	10	12	13	11	14		
Drug B	8	9	12	14	15	10	9

Is there a significant difference in the efficacy of the two drugs? If not, which drug should you buy (For $\nu=10$, $t_{0.05}=2.228$)

Solution

Let us take the hypothesis that there is no significant difference in the efficacy of the two drugs.

X_1	$(X_1 - \bar{X}_1)$	$(X_1 - \bar{X}_1)^2$	X_2	$(X_2 - \bar{X}_2)$	$(X_2 - \bar{X}_2)^2$
10	-2	4	8	-3	9
12	0	0	9	-2	4
13	+1	1	12	+1	1

11	-1	1	14	+3	9
14	+2	4	15	+4	16
			10	-1	1
			9	-2	4
$\sum X_1=60$		$\sum (X_1 - X_1)^2=10$	$\sum X_2=77$		$\sum (X_2 - X_2)^2=44$

$$t = \frac{\bar{X}_1+\bar{X}_2}{S} \times \sqrt{\frac{n_1 n_2}{n_1+n_2}}$$

$$S = \sqrt{\frac{\sum(X_1-\bar{X}_1)^2 + \sum(X_2-\bar{X}_2)^2}{n_1+n_2-2}}$$

$$S = \sqrt{\frac{10 + 44}{5+7-2}} = \sqrt{\frac{54}{10}} = 2.324$$

$$= \frac{12-11}{2.324} \times \frac{5 \times 7}{5+7} = \frac{1.708}{2.324} = 0.735$$

$\nu = n_1+n_2-2 = 5+ 7 -2 = 10$

$\nu = 10$, $t_{0.05}=2.228$

The calculated value of t is less than the table value, the hypothesis is accepted. Hence, there is no significance in the efficacy of two drugs. Since drug B is indigenous and there is no difference in the efficacy of imported and indigenous drug, we should buy indigenous drug, i.e., B.

Sum 5 : For a random sample of 10 persons, fed on diet A, the increased weight in pounds in a certain period were:

10	6	16	17	13	12	8	14	15	9

For another random sample of 12 persons, fed on diet B, the increase in the same period were:

7	13	22	15	12	14	18	8	21	23	10	17

Test whether the diets A and diet B differ significantly as regards their effect on increase in weight, Given the following.

Degrees of Freedom	19	20	21	22	23
Value at t at 5% level	2.09	2.09	2.08	2.07	2.07

Solution: Let us take the null hypothesis that A and B do not differ significantly weight regard to their effect on increase in weight.

X_1	$(X_1 - \bar{X}_1)$	$(X_1 - \bar{X}_1)^2$	X_2	$(X_2 - \bar{X}_2)$	$(X_2 - \bar{X}_2)^2$
10	-2	4	7	-8	64
6	-6	36	13	-2	4
16	+4	16	22	+7	49
17	+5	25	15	0	0
13	+1	1	12	-3	9
12	0	0	14	-1	1
8	-4	16	18	+3	9
14	+2	4	8	-7	49
15	+3	9	21	+6	36
9	-3	9	23	+8	64
			10	-5	25
			17	+2	4

$\sum X_1=120$		$\sum (X_1 - X_1)^2=120$	$\sum X_2=180$		$\sum (X_2 - X_2)^2=314$

Mean increase in weight of 10 persons fed on diet A

Mean increase in weight of 10 persons fed on diet B

$$t = \frac{\bar{X}_1 + \bar{X}_2}{-S-} \times \sqrt{\frac{n_1 n_2}{n_1+n_2}}$$

$$S = \sqrt{\frac{\sum(X_1-X_1)^2 + \sum(X_2-X_2)^2}{n_1+n_2-2}}$$

$$SD = \frac{120 + 314}{10+12-2} = \frac{434}{20} = 4.66$$

$X_1=12$, $X_2=15$, $n_1=10$, $n_2 = 12$, $S=4.66$. Substituting the values in the above formula:

$$t = \frac{12 - 15}{4.66} \times \frac{10 \times 12}{10 + 12} = \frac{3}{4.66} \times 2.34 = 1.51$$

For v=20, the table value of t at 5 per cent level is 2.09. The calculated value is less than the table value and hence the experiment provides no evidence against the hypothesis. We, therefore, conclude that diets A and B do not differ significantly as regards their effect on increase in weight is concerned.

Sum 6: In a test given to two groups of students, the marks obtained are as follows:

I Group	18	20	36	50	49	36	34	49	41
II Group	29	28	26	35	30	44	46		

Examine the significance of difference between the arithmetic mean of the marks secured by the students of the above two groups. (The value of t at 5% level of significance for v=14 is 2.14)

Solution

Let us take the hypothesis that there is no significant difference in the arithmetic mean of the marks secured by the students of the two groups.

Group I X_1	$(X_1 - \bar{X}_1)$	$(X_1 - \bar{X}_1)^2$	**Group II** X_2	$(X_2 - \bar{X}_2)$	$(X_2 - \bar{X}_2)^2$
18	-19	361	29	-5	25
20	-17	289	28	-6	36
36	-1	1	26	-8	64
50	+13	169	35	+1	1
49	+12	144	30	-4	16
36	-1	1	44	+10	100
34	-3	9	46	+12	144
49	+12	144			
41	+4	16			
$\sum X_1=333$		$\sum (X_1 - X_1)^2=1134$	$\sum X_2=238$		$\sum (X_2 - X_2)^2=386$

$$t = \frac{\bar{X}_1 + \bar{X}_2}{\bar{S}} \times \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

$$S = \sqrt{\frac{\sum(X_1-X_1)^2 + \sum(X_2-X_2)^2}{n_1+n_2-2}}$$

$$SD = \frac{1134 + 386}{9 + 7 - 2} = 10.42$$

$$t = \frac{37-34}{10.42} = \frac{9 \times 7}{9+7} = \frac{3}{10.42} \times 1.984 = 0.571$$

$\nu = n_1+n_2-2 = 9 + 7 - 2 = 14$; For $\nu = 14$, $t_{0.05} = 2.14$

The calculated value of t is less than the table value and hence the hypothesis hold true. We, therefore, conclude that the mean marks of the students of the two groups do not differ significantly.

F-Test

The F-test is named in honor of the great Statistician R.A. Fisher. The object of F –test is to find out whether the two independent estimates of population variance differ significantly, or whether the two samples may be regarded as drawn from the normal populations having the same variance. For carrying out the test of significance, we calculate the ratio F. F is defined as

$F = S_1^2/S_2^2$, Where $S_1^2 = \sum(X_1-\bar{X}_1)^2/n_1-1$ and

$$S_2^2 = \sum(X_2-\bar{X}_2)^2/n_2-1$$

It should be noted that S_1^2 is always the larger estimate of variance, i.e., $S_1^2 > S_2^2$

$$F = \frac{\text{Larger estimate of Variance}}{\text{Smaller estimate of Variance}}$$

The calculated value of F is compared with the table value for v1 and v2 at 5% or 1% level of significance. If calculated value of F is greater than the table value then the F ratio is considered significant and the null hypothesis is rejected. On the other hand, if the calculated value of F is less than the table value the null hypothesis is accepted and it is inferred that both the samples have come from the population having same variance.

Since F Test is based on the ratio of two variances, it is also known as the Variance Ratio Test. The ratio of two variances follows a distribution called the F distribution named after the famous statistician R.A. Fisher.

Sum 1: Two random samples were drawn from two normal populations and their values are :

A	66	67	75	76	82	84	88	90	92		
B	64	66	74	78	82	85	87	92	93	95	97

Test whether the two populations have the same variance at the 5% level of significance. (F=3.36) at 5% level of significance level v1=10 and v2=8.

Solution

Let us take the hypothesis that the two populations have the same variance

A X_1	**$(X_1-\bar{X}_1)$; $\bar{X}1$**	**X_1^2**	**B X_2**	**$(X_2-\bar{X}_2)$; X_2**	**c X_2^2**
66	-14	196	64	-19	361
67	-13	169	66	-17	289
75	-5	25	74	-9	81
76	-4	16	78	-5	25
82	2	4	82	-1	1

84	4	16	85	2	4
88	8	64	87	4	16
90	10	100	92	9	81
92	12	144	93	10	100
			95	12	144
			97	14	196
$\sum X_1=720$	**$\sum X_1=0$**	**$\sum X_1^2=734$**	**$\sum X_2=913$**	**$\sum X_2=0$**	**$\sum X_2^2=1298$**

Average of $X_1 = \sum X_1/n1 = 720 / 9 = 80$;

Average of $X_2 = \sum X_2/n2 = 913/ 11 = 83$

$S_1^2 = \sum(X_1-X_1)^2/n_1-1$

$= 734 / 9-1 = 91.75$

$S_2^2 = \sum(X_2-X_2)^2/n_2-1$

$= 1298 / 11-1 = 129.80$

$F = S_1^2/S_2^2$

$= 129.8 / 191.75$

$= 1.415$

The calculated value of F is less than the table value. The hypothesis is accepted. Hence, it may be calculated that the two populations have the same variance.

Sum 2: In a sample of 8 observations, the sum of squared deviations of items from the mean was 84.4. In another sample of 10 observations, the value was found to be 102.60. Test whether the difference is significant at 5% level.

You are given that at 5% level, critical value of F for v1=7 and v2=9 degrees of freedom is 3.29 and for v1=8 and v2=10 degrees of freedom, its value is 3.07.

Solution

Let us take hypothesis that the difference in the variance of the two samples is not significant. We are given

$S_1^2 = \sum(X_1-X_1)^2/n_1-1 = 84.4/7 = 12.06$

$S_2^2 = \sum(X_2-X_2)^2/n_2-1 = 102.3/9 = 11.40$

F $=S_1^2/S_2^2$ $= 12.06/11.40 = 1.06$

The calculated value of F is less than the table value. Hence, we accept the hypothesis and conclude that the difference in the variance of two samples is not significant at 5% level.

Sum 3: Two samples are drawn from two normal populations. From the following data test whether the two samples have the same variance at 5% level.

Sample 1	60	65	71	74	76	82	85	87		
Sample 2	61	66	67	85	78	63	85	86	88	91

Solution: Let us take the hypothesis that the two populations have the same variance.

F $=S_1^2/S_2^2$

Sample 1 X_1	**$(X_1-\bar{X}_1)$; X1**	**X_1^2**	**Sample 2 X_2**	**$(X_2-\bar{X}_2)$; X_2**	**X_2^2**
60	-15	225	61	-16	256
65	-10	100	66	-11	121
71	-4	16	67	-10	100
74	-1	1	85	8	64
76	1	1	78	1	1
82	7	49	63	-14	196
85	10	100	85	8	64
87	12	144	86	9	81
			88	11	121
			91	14	196
$\sum X_1=600$	**$\sum X_1=0$**	**$\sum X_1^2=636$**	**$\sum X_2=770$**	**$\sum X_2=0$**	**$\sum X_2^2=1200$**

Average of $X_1 = 600/8 = 75$

Average of $X_2 = 770/10 = 77$

$S_1^2 = \sum(X_1-X_1)^2/n_1-1 = 636 / 8-1 = 90.857$

$S_2^2 = \sum(X_2-X_2)^2/n_2-1 = 1200/10-1 = 133.33$

$F = S_1^2/S_2^2$

$= 133.33/90.857$

$= 1.467$

For v1=9 and v2=7, $F_{0.05} = 3.68$. The calculated value of F is less than the table value. The hypothesis holds good and hence we conclude that the two populations have the same variance.

Sum 4: The following data present the yields in Quintals of common ten subdivisions of equal area of two agricultural plots.

Plot 1	6.2	5.7	6.5	6.0	6.3	5.8	5.7	6.0	6.0	5.8
Plot 2	5.6	5.9	5.6	5.7	5.8	5.7	6.0	5.5	5.7	5.5

Test whether two samples taken from two random populations have the same variance. (5% point of F for v1=9 and v2=9 is 3.18)

Solution: Let us take the null hypothesis that the samples come from populations having the same variance

Plot 1 X_1	**$(X_1-\bar{X}_1)$; X1**	**X_1^2**	**Plot 2 X_2**	**$(X_2-\bar{X}_2)$; X_2**	**c X_2^2**
6.2	0.2	0.04	5.6	-0.1	0.01
5.7	-0.3	0.09	5.9	0.2	0.04
6.5	0.5	0.25	5.6	-0.1	0.01
6.0	0	0	5.7	0	0
6.3	0.3	0.09	5.8	0.1	0.01
5.8	-0.2	0.04	5.7	0	0
5.7	-0.3	0.09	6.0	0.3	0.09
6.0	0	0	5.5	-0.2	0.04
6.0	0	0	5.7	0	0
5.8	-0.2	0.04	5.5	-0.2	0.04
$\sum X_1=60$	**$\sum X_1=0$**	**$\sum X_1^2=0.64$**	**$\sum X_2=57$**	**$\sum X_2=0$**	**$\sum X_2^2=0.24$**

$F = S_1^2/S_2^2$

$S_1^2 = \sum(X_1-X_1)^2/n_1-1 = 0.64 / 9 = 0.071$

$S_2^2 = \sum(X_2-X_2)^2/n_2-1 = 0.24 / 9 = 0.027$

$F = S_1^2/S_2^2 = 0.071/0.027 = 2.63$

The value of F for 9 and 6 at 5% level of significance is 3.18. The calculated value is less than the table value. The hypothesis holds true. Hence, the samples come from population having the same variance.

CHI-SQUARE

The chi-square test is an important test amongst the several tests of significance developed by statisticians. Chi-square, symbolically written as χ^2 (Pronounced as Ki-square), is a statistical measure used in the context of sampling analysis for comparing a variance to a theoretical variance. As a non-parametric test, it "can be used to determine if categorical data shows dependency or the two classifications are independent. It can also be used to make comparisons between theoretical populations and actual data when categories are used." Thus, the chi-square test is applicable in large number of problems. The test is, in fact, a technique through the use of which it is possible for all researchers to (i) test the goodness of fit; (ii) test the significance of association between two attributes, and (iii) test the homogeneity or the significance of population variance.

Chi-square is an important non-parametric test and as such no rigid assumptions are necessary in respect of the type of population. We require only the degrees of freedom (implicitly of course the size of the sample) for using this test. As a non-parametric test, chi-square can be used (i) as a test of goodness of fit and (ii) as a test of independence.

As a test of goodness of fit, χ^2 test enables us to see how well does the assumed theoretical distribution (such as Binomial distribution, Poisson distribution or Normal distribution) fit to the observed data. When some theoretical distribution is fitted to the given data, we are always interested in knowing as to how well this distribution fits with the observed data. The chi-square test can give answer to this. If the calculated value of χ^2 is less than the table value at a certain level of significance, the fit is considered to be a good one which means that the divergence between the observed and expected frequencies is attributable to fluctuations of sampling. But if the calculated value of χ^2 is greater than its table value, the fit is not considered to be a good one.

As a test of independence, χ^2 test enables us to explain whether or not two attributes are associated. For instance, we may be interested in knowing whether a new medicine is effective in controlling fever or not, χ^2 test will helps us in deciding this issue. In such a situation, we proceed with the null hypothesis that the two attributes (viz., new medicine and control of fever) are independent which means that new medicine is not effective in controlling fever. On this basis we first calculate the expected frequencies and then work out the value of χ^2 . If the calculated value of χ^2 is less than the table value at a certain level of significance for given degrees of freedom, we conclude that null hypothesis stands which means that the two attributes are independent or not associated (i.e., the new medicine is not effective in controlling the fever). But if the calculated value of χ^2 is greater than its table value, our inference then would be that null hypothesis does not hold good which means the two attributes are associated and the association is not because of some chance factor but it exists in reality (i.e., the new medicine is effective in controlling the fever and as such may be prescribed). It may, however, be stated here that χ^2 is not a measure of the degree of relationship or the form of relationship between two attributes, but is simply a technique of judging the significance of such association or relationship between two attributes.

In order that we may apply the chi-square test either as a test of goodness of fit or as a test to judge the significance of association between attributes, it is necessary that the observed as well as theoretical or expected frequencies must be grouped in the same way and the theoretical distribution must be adjusted to give the same total frequency as we find in case of observed distribution. χ^2 is then calculated as follows:

$$\chi^2 = \Sigma \frac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}}$$

If two distributions (observed and theoretical) are exactly alike, $\chi 2 = 0$; but generally due to 2 sampling errors, $\chi 2$ is not equal to zero and as such we must know the sampling distribution of $\chi 2$ so that we may find the probability of an observed $\chi 2$ being given by a random sample from the hypothetical universe. Instead of working out the probabilities, we can use ready table which gives probabilities for given values of $\chi 2$. Whether or not a calculated value of $\chi 2$ is significant can be ascertained by looking at the tabulated values of $\chi 2$ for given degrees of freedom at a certain level of

significance. If the calculated value of $\chi 2$ is equal to or exceeds the table value, the difference between the observed and expected frequencies is taken as significant, but if the table value is more than the calculated value of $\chi 2$, then the difference is considered as insignificant i.e., considered to have arisen as a result of chance and as such can be ignored.

As already stated, degrees of freedom play an important part in using the chi-square distribution and the test based on it, one must correctly determine the degrees of freedom. If there are 10 frequency classes and there is one independent constraint, then there are (10 – 1) = 9 degrees of freedom. Thus, if 'n' is the number of groups and one constraint is placed by making the totals of observed and expected frequencies equal, the d.f. would be equal to (n – 1). In the case of a contingency table (i.e., a table with 2 columns and 2 rows or a table with two columns and more than two rows or a table with two rows but more than two columns or a table with more than two rows and more than two columns), the d.f. is worked out as follows: d.f. = (c – 1) (r – 1), where 'c' means the number of columns and 'r' means the number of rows.

CONDITIONS FOR THE APPLICATION OF $\chi 2$ TEST

1. Observations recorded and used are collected on a random basis.
2. All the items in the sample must be independent.
3. No group should contain very few items, say less than 10. In case where the frequencies are less than 10, regrouping is done by combining the frequencies of adjoining groups so that the new frequencies become greater than 10. Some statisticians take this number as 5, but 10 is regarded as better by most of the statisticians.
4. The overall number of items must also be reasonably large. It should normally be at least 50, howsoever small the number of groups may be.
5. The constraints must be linear. Constraints which involve linear equations in the cell frequencies of a contingency table (i.e., equations containing no squares or higher powers of the frequencies) are known are know as linear constraints.

Sum 1: A die is thrown 132 times with following results:

Number turned up	1	2	3	4	5	6
Frequency	16	20	25	14	29	28

Is the die unbiased?

Solution

Let us take the hypothesis that the die is unbiased. If that is so, the probability of obtaining any one of the six numbers is 1/6 and as such the expected frequency of any one number coming upward is 132 ×1/6 = 22. Now we can write the observed frequencies along with expected frequencies and work out the value of $\chi 2$ as follows:

No. Turned UP	Observed Frequency	Expected Frequency	(Oi – Ei)	(Oi – Ei)	(Oi – Ei) /Ei
1	16	22	–6	36	36/22
2	20	22	–2	4	4/22
3	25	22	3	9	9/22
4	14	22	–8	64	64/22
5	29	22	7	49	49/22
6	28	22	6	36	36/22

$\sum (O-E)^2/E = 9$

Hence, the calculated $\chi^2=9$

DF = (n-1) (6-1)=5

The table value of $\chi 2$ for 5 degrees of freedom at 5 per cent level of significance is 11.071. Comparing calculated and table values of $\chi 2$, we find that calculated value is less than the table value and as such could have arisen due to fluctuations of sampling. The result, thus, supports the hypothesis and it can be concluded that the die is unbiased.

Sum 2: Find the value of □2 for the following information:

Class	*A*	*B*	*C*	*D*	*E*
Observed frequency	8	29	44	15	4
Theoretical (or expected) frequency	7	24	38	24	7

Solution : Since some of the frequencies less than 10, we shall first re-group the given data as follows and then will work out the value of $\chi 2$

Class	Observed Frequency	Expected Frequency	O-E	$(O-E)^2/E$
A and *B*	(8 + 29) = 37	(7 + 24) = 31	6	36/31
C	44	38	6	36/38
D and *E*	(15 + 4) = 19	(24 + 7) = 31	–12	144/31

$\sum (O-E)^2/E = 6.76$ (Approximate)

Sum 3: Genetic theory states that children having one parent of blood type A and the other of blood type B will always be of one of three types, A, AB, B and that the proportion of three types will on an average be as 1 : 2 : 1. A report states that out of 300 children having one A parent and B parent, 30 per cent were found to be types A, 45 per cent per cent type AB and remainder type B. Test the hypothesis by $\chi 2$ test.

Solution: The observed frequencies of type A, AB and B is given in the question are 90, 135 and 75 respectively.

The expected frequencies of type A, AB and B (as per the genetic theory) should have been 75, 150 and 75 respectively.

We now calculate the value of $\chi 2$ as follows:

Type	Observed Frequency	Expected Frequency	O-E	$(O-E)^2$	$(O-E)^2/E$
A	90	75	15	225	225/75 = 3
AB	135	150	–15	225	225/150 = 1.5
B	75	75	0	0	0/75 = 0

$\sum (O-E)^2/E = 3 + 1.5 = 4.5$

Table value of $\chi 2$ for 2 d.f. at 5 per cent level of significance is 5.991.

The calculated value of $\chi 2$ is 4.5 which is less than the table value and hence can be ascribed to have taken place because of chance. This supports the theoretical hypothesis of the genetic theory that on an average type A, AB and B stand in the proportion of 1 : 2 : 1.

Sum 4: The table given below shows the data obtained during outbreak of smallpox:

Particulars	Attacked	Not attacked	Total
Vaccinated	31	469	500
Not vaccinated	185	1315	1500
Total	**216**	**1784**	**2000**

Test the effectiveness of vaccination in preventing the attack from smallpox. Test your result with the help of $\chi 2$ at 5 per cent level of significance.

Solution:

Let us take the hypothesis that vaccination is not effective in preventing the attack from smallpox i.e., vaccination and attack are independent.

Group	Observed Frequency	Expected Frequency	O-E	$(O-E)^2$	$(O-E)^2/E$

AB	31	54	–23	529	529/54 = 9.796
Ab	469	446	+23	529	529/44 = 1.186
aB	158	162	+23	529	529/162 = 3.265
ab	1315	1338	–23	529	529/1338 = 0.395

$\sum (O-E)^2/E = 14.462$

Degrees of freedom in this case = $(r – 1) (c – 1) = (2 – 1) (2 – 1) = 1$.

The table value of χ^2 for 1 degree of freedom at 5 per cent level of significance is 3.841. The calculated value of χ^2 is much higher than this table value and hence the result of the experiment does not support the hypothesis. We can, thus, conclude that vaccination is effective in preventing the attack from smallpox.

Sum 5: Two research workers classified some people in income groups on the basis of sampling studies. Their results are as follows:

Investigators	**Income groups**			**Total**
	Poor	**Middle**	**Rich**	
A	160	30	10	200
B	140	120	40	300
Total	**300**	**150**	**50**	**500**

Show that the sampling technique of at least one research worker is defective.

Solution

Let us take the hypothesis that the sampling techniques adopted by research workers are similar (i.e., there is no difference between the techniques adopted by research workers). This being so, the expectation of A investigator classifying the people in

OF	EF	(O-E)	$(O-E)^2/E$
160	120	40	1600/120 = 13.33
30	60	–30	900/60 = 15.00

10	20	–10	100/20 = 5.00
140	180	–40	1600/180 = 8.88
120	90	30	900/90 = 10.00
40	30	10	100/30 = 3.33

$\sum (O-E)^2/E = 55.54$

Degrees of freedom = $(c - 1)(r - 1)$ = = (3 – 1) (2 – 1) = 2.

The table value of $\chi 2$ for two degrees of freedom at 5 per cent level of significance is 5.991. The calculated value of $\chi 2$ is much higher than this table value which means that the calculated value cannot be said to have arisen just because of chance. It is significant. Hence, the hypothesis does not hold good. This means that the sampling techniques adopted by two investigators differ and are not similar. Naturally, then the technique of one must be superior than that of the other.

Sum 6: In an anti a malarial campaign in a certain area, quinine was administered to 812 persons out of a total population of 3248. The number of fever cases is shown below:

Treatment	Fever	No Fever	Total
Quinine	20	792	812
No Quinine	220	2216	2436
Total	**240**	**3008**	**3248**

Discuss the usefulness of Quinine in checking malaria.

Solution Let us take the hypothesis that quinine is not effective in checking malaria.

Observed Frequency	Expected Frequency	$(O-E)^2$	$(O-E)^2/E$
20	60	1600	26.667
220	180	1600	8.889
792	752	1600	2.128
2216	2256	1600	0.709
			$(\sum((O-E)^2/E)=38.393$

$$\chi^2 = \Sigma \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

= 38.393

v= (r-1)(c-1) = (2-1) (2-1)=1

v=1, $\chi^2_{0.05}$ = 3.84

The calculated value of χ^2 is greater than the table value. The hypothesis is rejected. Hence, quinine is useful in checking malaria.

Sum 7: Based on information on 1000 randomly selected fields about the tenancy status of the cultivation of these fields and use of fertilizers, collected in an agro-economic survey, the following classification was noted:

Treatment	Owned	Rented	Total
Using Fertilizer	416	184	600
Not using Fertilizer	64	336	400
Total	**480**	**520**	**1000**

Would you conclude that owner cultivators are more inclined towards the use of fertilizer at 5% level? Carry out chi-square test as per testing procedure.

Solution

Let us take the hypothesis that ownership of fields and the use of fertilizers are independent attributes.

Observed Frequency	Expected Frequency	$(O-E)^2$	$(O-E)^2/E$
416	288	16384	56.889
64	192	16384	85.333
184	312	16384	52.513
336	208	16384	78.769
			$(\sum((O-E)^2/E)=273.504$

$$\chi^2 = \Sigma \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

= 273.504

v= (r-1)(c-1) = (2-1) (2-1)=1

v=1, $\chi^2_{0.05}$ = 3.84

The calculated value of χ^2 is much more than the table value. The hypothesis is rejected. Hence, it can be concluded that owner's cultivators are more inclined towards the use of fertilizers.

Sum 8: In an experiment on immunization of cattle from tuberculosis, the following results were obtained.

Particulars	Affected	Not Affected
Inoculated	12	26
Not Inoculated	16	6

Calculate χ^2 and discuss the effect of vaccine in controlling suspectability to tuberculosis. (5% value of χ^2 for one degree of freedom =3.84)

Solution:

Let us take the hypothesis that the vaccine is not effective in controlling susceptibility to tuberculosis.

Observed Frequency	Expected Frequency	$(O-E)^2$	$(O-E)^2/E$
12.5	17.7	27.04	1.528
15.5	10.3	27.04	2.625
25.5	20.3	27.04	1.332
6.5	11.7	27.04	2.311
			$(\sum((O-E)^2/E)=7.796$

$$\chi^2 = \Sigma \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

= 7.796

v= (r-1)(c-1) = (2-1) (2-1)=1

v=1, $\chi^2_{0.05}$ = 3.84

Since the calculated value of χ^2 is greater than the table value, the hypothesis is not true. We, therefore, conclude that vaccine is effective in controlling susceptibility to tuberculosis.

Sum 9: From the data given below about the treatment of 250 patients suffering from a disease, state whether the new treatment is superior to the conventional treatment.

Treatment	Favourable	Unfavourable	Total
New	140	30	170
Conventional	60	20	80
Total	**200**	**50**	**250**

Solution

Observed Frequency	Expected Frequency	$(O-E)^2$	$(O-E)^2/E$
140	136	16	0.118
60	64	16	0.250
30	34	16	0.471
20	16	16	1.000
			$(\sum((O-E)^2/E)=1.839$

$$\chi^2 = \Sigma \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

= 1.839

v= (r-1)(c-1) = (2-1) (2-1)=1

v=1, $\chi^2_{0.05} = 3.84$

The calculated value of χ^2 is less than the table value. The hypothesis is accepted. Hence, there is no significant difference between the new and conventional treatment.

Sum 10: 1000 students at College level are graded according to IQ and their economic conditions. Use Chi-square test to find out whether there is any association between economic conditions and the level of IQ.

Economic Condition	Intelligent Quotient			Total
	High	Medium	Low	
Rich	160	300	140	600
Poor	140	100	160	400
Total	**300**	**400**	**300**	**1000**

Solution

Let us take the hypothesis that there is no association between economic conditions and the level of IQ. On the basis of this hypothesis the expected frequencies corresponding to (a) and (b) are:

Observed Frequency	Expected Frequency	$(O-E)^2$	$(O-E)^2/E$
160	180	400	2.222
140	120	400	3.333
300	240	3600	15.000
100	160	3600	22.500
140	180	1600	8.889
160	120	1600	13.333
			$(\sum((O-E)^2/E)=65.277$

$$\chi^2 = \Sigma \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

= 65.277

v= (r-1)(c-1) = (2-1) (3-1)=2

v=2, $\chi^2_{0.05}$ = 5.99

The calculated value of χ^2 is much greater than the table value. The hypothesis is rejected. Hence, there is association between economic condition and the level of IQ.

IMPORTANT NONPARAMETRIC

Tests of hypotheses with 'order statistics' or 'nonparametric statistics' or 'distribution-free' statistics are known as nonparametric or distribution-free tests. The following distribution-free tests are important and generally used

1. Sign Tests

The sign test is one of the easiest parametric tests. Its name comes from the fact that it is based on the direction of the plus or minus signs of observations in a sample and not on their numerical magnitudes. The sign test may be one of the following two types:

(a) One sample sign test;

(b) Two sample sign test.

(a) One sample sign test

The one sample sign test is a very simple non-parametric test applicable when we sample a continuous symmetrical population in which case the probability of getting a sample value less than mean is 1/2 and the probability of getting a sample value greater than mean is also 1/2. To test the null hypothesis μ μ = *H*0 against an appropriate alternative on the basis of a random sample of size '*n*', we replace the value of each and every item of the sample with a plus (+) sign if it is greater than μ*H*0, and with a minus (–) sign if it is less than μ*H*0 . But if the value happens to be equal to μ*H*0 , then we simply discard it. After doing this, we test the null hypothesis that these + and – signs are values of a random variable, having a binomial distribution with p = 1/2*. For performing one sample sign test when the sample is small, we can use tables of binomial probabilities, but when sample happens to be large, we use normal approximation to binomial distribution.

(b) Two sample sign test (or the sign test for paired data)

The sign test has important applications in problems where we deal with paired data. In such problems, each pair of values can be replaced with a plus (+) sign if the first value of the first sample (say *X)* is greater than the first value of the second sample (say *Y*) and we take minus (–) sign if the first value of *X* is less than the first value of *Y.* In case the two values are equal, the concerning pair is

discarded. (In case the two samples are not of equal size, then some of the values of the larger sample left over after the random pairing will have to be discarded.) The testing technique remains the same as started in case of one sample sign test.

2. Fisher-Irwin Test

Fisher-Irwin test is a distribution-free test used in testing a hypothesis concerning no difference among two sets of data. It is employed to determine whether one can reasonably assume, for example, that two supposedly different treatments are in fact different in terms of the results they produce. Suppose the management of a business unit has designed a new training programme which is now ready and as such it wishes to test its performance against that of the old training programme.

3. McNemer Test

McNemer test is one of the important nonparametric tests often used when the data happen to be nominal and relate to two related samples. As such this test is specially useful with before-after measurement of the same subjects. The experiment is designed for the use of this test in such a way that the subjects initially are divided into equal groups as to their favourable and unfavourable views about, say, any system. After some treatment, the same number of subjects are asked to express their views about the given system whether they favour it or do not favour it

4. Wilcoxon Matched-pairs Test (or Signed Rank Test)

In various research situations in the context of two-related samples (i.e., case of matched paires such as a study where husband and wife are matched or when we compare the output of two similar machines or where some subjects are studied in context of before-after experiment) when we can determine both direction and magnitude of difference between matched values, we can use an important non-parametric test viz., Wilcoxon matched-paires test. While applying this test, we first find the differences (di) between each pair of values and assign rank to the differences from the smallest to the largest without regard to sign. The actual signs of each difference are then put to corresponding ranks and the test statistic T is calculated which happens to be the smaller of the two sums viz., the sum of the negative ranks and the sum of the positive ranks.

5. Rank Sum Tests

Rank sum tests are a whole family of test, but we shall describe only two such tests commonly used viz., the U test and the H test. U test is popularly known as Wilcoxon-Mann-Whitney test, whereas H test is also known as Kruskal-Wallis test.

a) **Wilcoxon-Mann-Whitney test (or U-test)**

This is a very popular test amongst the rank sum tests. This test is used to determine whether two independent samples have been drawn from the same population. It uses more information than the sign test or the Fisher-Irwin test. This test applies under very general conditions and requires only that the populations sampled are continuous. However, in practice even the violation of this assumption does not affect the results very much. To perform this test, we first of all rank the data jointly, taking them as belonging to a single sample in either an increasing or decreasing order of magnitude. We usually adopt low to high ranking process which means we assign rank 1 to an item with lowest value, rank 2 to the next higher item and so on. In case there are ties, then we would assign each of the tied observation the mean of the ranks which they jointly occupy. For example, if sixth, seventh and eighth values are identical, we would assign each the rank $(6 + 7 + 8)/3 = 7$. After this we find the sum of the ranks assigned to the values of the first sample (and call it R1) and also the sum of the ranks assigned to the values of the second sample (and call it R2). Then we work out the test statistic i.e., U.

b) **The Kruskal-Wallis test (or H test)**

This test is conducted in a way similar to the U test described above. This test is used to test the null hypothesis that 'k' independent random samples come from identical universes against the alternative hypothesis that the means of these universes are not equal. This test is analogous to the one-way analysis of variance, but unlike the latter it does not require the assumption that the samples come from approximately normal populations or the universes having the same standard deviation.

MULTIVARIATE ANALYSIS

Techniques which simultaneously analyse more than two variables on a sample of observations can be categorized as multivariate techniques. We may as well use the term 'multivariate analysis' which is a a collection of methods for analyzing data in which a number of observations are available for each object.

Growth of Multivariate Techniques

Of late, multivariate techniques have emerged as a powerful tool to analyse data represented in terms of many variables. The main reason being that a series of univariate analysis carried out separately for each variable may, at times, lead to incorrect interpretation of the result. This is so because univariate analysis does not consider the correlation or inter-dependence among the variables.

Characteristics and Applications

Multivariate techniques are largely empirical and deal with the reality; they possess the ability to analyse complex data. Accordingly in most of the applied and behavioural researches, we generally resort to multivariate analysis techniques for realistic results. Besides being a tool for analyzing the data, multivariate techniques also help in various types of decision-making.

A simplified way. In other words, multivariate techniques transform a mass of observations into a smaller number of composite scores in such a way that they may reflect as much information as possible contained in the raw data obtained concerning a research study. Thus, the main contribution of these techniques is in arranging a large amount of complex information involved in the real data into a simplified visible form. Mathematically, multivariate techniques consist in "forming a linear composite vector in a vector subspace, which can be represented in terms of projection of a vector onto certain specified subspaces. For better appreciation and understanding of multivariate techniques, one must be familiar with fundamental concepts of linear algebra, vector spaces, orthogonal and oblique projections and univariate analysis.

Even then before applying multivariate techniques for meaningful results, one must consider the nature and structure of the data and the real aim of the analysis. We should also not forget that multivariate techniques do involve several complex mathematical computations and as such can be utilized largely with the availability of computer facility.

FACTOR ANALYSIS

There are several methods of factor analysis, but they do not necessarily give same results. As such factor analysis is not a single unique method but a set of techniques. Important methods of factor analysis are:

(i) the centroid method;

(ii) the principal components method;

(ii) the maximum likelihood method.

(i) Factor: A factor is an underlying dimension that account for several observed variables. There can be one or more factors, depending upon the nature of the study and the number of variables involved in it.

(ii) Factor-loadings: Factor-loadings are those values which explain how closely the variables are related to each one of the factors discovered. They are also known as factor-variable correlations. In

fact, factor-loadings work as key to understanding what the factors mean. It is the absolute size (rather than the signs, plus or minus) of the loadings that is important in the interpretation of a factor.

(iii) Communality (h2): Communality, symbolized as h2, shows how much of each variable is accounted for by the underlying factor taken together. A high value of communality means that not much of the variable is left over after whatever the factors represent is taken into consideration.

CLUSTER ANALYSIS

Cluster analysis consists of methods of classifying variables into clusters. Technically, a cluster consists of variables that correlate highly with one another and have comparatively low correlations with variables in other clusters. The basic objective of cluster analysis is to determine how many mutually and exhaustive groups or clusters, based on the similarities of profiles among entities, really exist in the population and then to state the composition of such groups. Various groups to be determined in cluster analysis are not predefined as happens to be the case in discriminant analysis.

Steps: In general, cluster analysis contains the following steps to be performed:

(i) First of all, if some variables have a negative sum of correlations in the correlation matrix,one must reflect variables so as to obtain a maximum sum of positive correlations for the matrix as a whole.

(ii) The second step consists in finding out the highest correlation in the correlation matrix and the two variables involved (i.e., having the highest correlation in the matrix) form the nucleus of the first cluster.

(iii) Then one looks for those variables that correlate highly with the said two variables and includes them in the cluster. This is how the first cluster is formed.

(iv) To obtain the nucleus of the second cluster, we find two variables that correlate highly but have low correlations with members of the first cluster. Variables that correlate highly with the said two variables are then found. Such variables along the said two variables thus constitute the second cluster.

(v) One proceeds on similar lines to search for a third cluster and so on.

DISCRIMINANT ANALYSIS

Regression based statistical technique used in determining which particular classification or group (such as 'ill' or 'healthy') an item of data or an object (such as a patient) belongs to on the basis of its characteristics or essential features. It differs from group building techniques such as cluster analysis in that the classifications or groups to choose from must be known in advance.

Discriminant function analysis is a statistical analysis to predict a categorical dependent variable (called a grouping variable) by one or more continuous or binary independent variables (called

predictor variables). The original dichotomous discriminant analysis was developed by Sir Ronald Fisher in 1936. It is different from an ANOVA or MANOVA, which is used to predict one (ANOVA) or multiple (MANOVA) continuous dependent variables by one or more independent categorical variables. Discriminant function analysis is useful in determining whether a set of variables is effective in predicting category membership.

Discriminant analysis is used when groups are known a priori (unlike in cluster analysis). Each case must have a score on one or more quantitative predictor measures, and a score on a group measure.[3] In simple terms, discriminant function analysis is classification - the act of distributing things into groups, classes or categories of the same type.

Moreover, it is a useful follow-up procedure to a MANOVA instead of doing a series of one-way ANOVAs, for ascertaining how the groups differ on the composite of dependent variables. In this case, a significant F test allows classification based on a linear combination of predictor variables. Terminology can get confusing here, as in MANOVA, the dependent variables are the predictor variables, and the independent variables are the grouping variables**.**

REGRESSION

After having established the fact that two variables are closely related we may be interested in estimating (predicting) the value of one variable given the value of another. For example, if we know that advertising and sales are correlated we find out expected amount of sales for a given advertising expenditure or the required amount of expenditure for attaining a given amount of sales. Similarly, if we know that the yield of rice and rainfall are closely related we may find out the amount of rain required to achieve a certain production figure. Regression analysis reveals average relationship between two variables and this makes possible estimation or prediction.

The dictionary meaning of the term 'regression' is the act of returning or going back. The term 'regression' was first used by Sir Francis Galton (1822-1911) in 1877 while studying the relationship between the height of fathers and sons. This term was introduced by him in the paper 'Regression towards fathers and sons revealed a very interesting relationship, i.e., tall fathers tend to have tall sons and short fathers short sons, but the average height of the sons of a group of tall fathers is less than that of the fathers and the average fathers. The line describing the tendency to regress or going back was called by Galton s 'Regression Line'. The term is still used to describe that line drawn for a group of points to represent the trend present, but it no longer necessarily carries the original implication of

"stepping back" that Galton intended. These days there is a growing tendency to the modern writers to use the term estimating line instead of regression line because the expression estimating line is more clarificatory in character.

DEFINITIONS

Regression is the measure of the average relationship between two or more variables in terms of the original units of the data.

The term 'regression analysis' refers to the methods by which estimates are made of the values of a variable from a knowledge of the values of one or more other variables and to the measurement of the errors involved in this estimation process – Morris Hamburg.

One of the most frequently used techniques in economics and business research to find a relation between two or more variables that are related causally, is regression analysis – Taro Yamane

Regression analysis attempts to establish the 'nature of the relationship' between variables – that is, to study the functional relationship between the variables and thereby provide a mechanism for prediction, or forecasting" – Ya Lun Chou

It is clear from the above definitions that regression analysis is a statistical device with the help of which we are in a position to estimate (or predict) the unknown values of one variable from known values of another variable. The variable which is used to predict the variable of interest is called the independent variable or exploratory variable and the variable we are trying to predict is called the dependent variable or "explained variable. The independent variable is denoted by X and the dependent variable by Y. The analysis used is called the simple regression analysis – simple because there is only one predictor or independent variable, and linear because of the assumed linear relationship between the dependent and the independent variables. The term "linear" means that an equation of a straight line of the form Y=a+bx, where a and b are constants, is used to describe the average relationship that exists between the two variables.

It should be noted that the term 'dependent' and 'independent' refer to the mathematical or functional meaning of dependence – they do not imply that there is necessarily any cause and effect relationship between the variables. What is meant is simply that estimates of values of the dependent variable Y may be obtained for given values of the independent variable X from a mathematical function involving X and Y. In that sense, the values of Y are dependent upon the values of X. The X variable may or may not be causing change in the Y variable. For example, while estimating sales of a

product from figures on advertising expenditures, sale is generally taken as the dependent variable. However, there may or may not be causal connection between these two factors in the sense that changes in advertising expenditures cause change in sales. In fact, in certain cases, the cause-effect relation may be just opposite of what appears to be the obvious one.

Uses of Regression Analysis

Regression analysis is a branch of statistical theory that is widely used in almost all the scientific disciplines. In economics it is the basic technique for measuring or estimating the relationship among economic variables that constitute the essence of economic theory and economic life. For example, if we know that two variables, Price (X) and Demand (Y), are closely related we can find out the most probable value of X for a given value of Y or the most probable value of Y for a given value of X. Similarly, if we closely related, we can find out the expected price for a certain price for a certain amount of tax levy. Thus, we find that the study of regression is of considerable help to the economists and businessmen. The uses of regression are not confined to economics and business field only. Its applications are extended to almost all the natural, physical and social sciences. The regression analysis attempts to accomplish the following:

1. Regression analysis provides estimates of values of the dependent variable from values of the independent variable. The device used to accomplish this estimation procedure is the regression line. The regression line describes the average relationship existing between X and Y variables. i.e., it displays mean values of X for given values of Y. The equation of this line, known as the regression equation, provides estimates of the dependent variable when values of the independent variable are inserted into the equation.
2. A second goal of regression analysis is to obtain a measure of the error involved in using the regression line as a basis for estimation. For this purpose the standard error of estimate is calculated. This is a measure of the scatter or spread of the observed values of Y around the corresponding values estimated from the regression line. If the line fits the data closely, that is, if there is little scatter of the observations around the regression line, good estimates can be made of the Y variable. On the other hand, if there is a great deal of scatter or the observations around the fitted regression line, the line will not produce accurate estimates of the dependent variable
3. With the help of regression coefficients we can calculate the correlation coefficient. The square of correlation coefficient (r) called coefficient of determination, measures the degree of association of

correlation that exists between the two variables. It assesses the proportion of variance in the dependent variable that has been accounted for by the regression equation. In general, the greater the value of r^2 the better is the fit and the more useful the regression equations as a predictive device.

DIFFERENCE BETWEEN CORRELATION AND REGRESSION

Correlation	Regression
Correlation is the relationship between variables. It is expressed numerically	Regression means going back. The average relation between the variables is given as an equation
Between two variables, none is identified as independent variable	One of the variables is independent variable and the other is dependent variable in any particular context
Correlation does not mean causation. One variable need not be the cause and the other, effect	Independent variable may be the 'the cause' and dependent variable, 'the effect'
There is spurious or nonsense correlation	There is no such possibility. Regression is considered only when the variables are related
Correlation coefficient is independent of change of origin and scale	Regression coefficients are independent of change or origin but are affected by change of scale
Correlation coefficient is a number -1 and +1	The two regression coefficients have the same sign, + or -. One of them can be greater than 1 numerically. But they can not be greater than 1 numerically simultaneously.
Correlation coefficient is not in any unit of measurement	Each regression coefficient is in the unit of measurement of the dependent variable

Correlation	Regression
Correlation coefficient indicates the direction of co-variation and the closeness of the linear relation between two variables	Regression equations give the value of the dependent variable corresponding to any value of the independent variable
The significance of the sample correlation coefficient can be tested. The limits between which the population correlation coefficient is expected to lie can be found	Target can be reached. The value of the independent variable can be chosen so as to get the target value of the dependent variable. For example, a specific amount can be spent on advertisement to get the targeted revenue.

Sum 1: From the following data, obtain the two regression equations:

X	6	2	10	4	8
Y	9	11	5	8	7

Solution

X	Y	XY	X^2	Y^2
6	9	54	36	81
2	11	22	4	121
10	5	50	100	25
4	8	32	16	64
8	7	56	64	49
$\sum X=30$	**$\sum Y=40$**	**$\sum XY=214$**	**$\sum X^2=220$**	**$\sum Y^2=340$**

Let the regression equation of Y on X be Y=A+BX

The normal equations are $\sum Y = NA + B\sum X$

$\sum XY = A\sum X + B\sum X^2$

By substituting the value from the table,

$5A + 30B = 40$ Say (1)

$30A + 220B = 214$ Say (2)

(1) X 6 $30A + 180B = 240$ Say (3)

(2) – (3) 40 B = -26

B = -26 / 40

= -0.6500

From (1), 5A-30X0.6500 = 40

A = 40 + 19.5 / 5

= 11.90

The regression equation of Y on X is

Y = 11.90 – 0.6500X

Let the regression equation of X on Y be $X = A + BY$

The normal equations are $\sum X = NA + B\sum Y$

$\sum XY = A\sum Y + B\sum Y^2$

By substituting the values from the table,

5A + 40B = 30 Say (4)

40A + 340 B = 214 Say (5)

(4) X 8 40A = 320 B = 240 Say (6)

(5) – (6) 20B = - 26

B = -26/20

= -1.300

From (4), 5A+40 X (-1.30) = 30

A = 30 + 52 /5

= 16.40

The regression equation of X on Y is X = 16.40 – 1.300

Sum 2: You are given the following data:

	X	**Y**
Arithmetic Mean	36	85
Standard Deviation	11	8
Correlation coefficient between X and Y	0.66	

(a) Find the two regression equations

(b) Estimate the value of X when Y=75

Solution

bxy = rσx/σy = 0.66 x 11 / 8 = 0.9075

byx = rσy/σx = 0.66 X 8 / 11 = 0.4800

a) Regression equation of Y on X

$Y - \bar{Y} = byx (X-\bar{X})$

$Y - 85 = 0.4800 (X-36)$

$= 0.4800 X - 17.28$

$Y = 67.72 + 0.4800 X$

Regression equation of X on Y

$X - \bar{X} = bxy (Y-\bar{Y})$

$X - 36 = 0.9075 (Y-85)$

$= 0.9075 - 77.14$

$X = 0.9075 Y - 41.14$

b) When Y=75, $X = 0.9075 X 75 - 41.14$

$= 26.92$

Sum 3: From the following information on values of two variables X and Y find the two regression lines and the correlation coefficient.

N=10; $\sum X=20$; $\sum Y=40$; $\sum X^2=240$; $\sum Y^2=410$; $\sum XY=200$

Solution

$\bar{X} = \sum X/N = 20/10 = 2.00$

$\bar{Y} = \sum Y/N = 40/10 = 4.00$

$$bxy = \frac{N\sum XY-(\sum X)(\sum Y)}{N\sum Y^2-(\sum Y)^2} \text{ as } \sum X\neq 0 \text{ and } \sum Y\neq 0$$

$$= \frac{10 X 200 - 20 X 40}{10 X 410 - (40)^2}$$

$$= \frac{2000 - 800}{4100 - 1600}$$

$$= \frac{1200}{2500} = 0.4800$$

$$byx = \frac{N\sum XY - (\sum X)(\sum Y)}{N\sum X^2 - (\sum X)^2} \text{ as } \sum X \neq 0 \text{ and } \sum Y \neq 0$$

$$= \frac{1200}{10X240 - (20)^2}$$

$$= \frac{1200}{2000} = 0.6000$$

Regression equation of Y on X

$Y - \bar{Y} = byx\ (X - \bar{X})$

$Y - 4 = 0.6000\ (X - 2)$

$= 0.6000\ X - 1.20$

$Y = 2.80 + 0.6000X$

Regression equation of X on Y

$X - \bar{X} = bxy\ (Y - \bar{Y})$

$X - 2 = 0.4800\ (Y - 4)$

$= 0.4800\ Y - 1.92$

$X = 0.08 + 0.4800Y$

Sum 4: Calculate the two regression equations from the following data:

X	10	12	13	12	16	15
Y	40	38	43	45	37	43

Also estimate Y when X=20.

Solution

X	**Y**	**XY**	**X^2**	**Y^2**
10	40	400	100	1600
12	38	458	144	1444
13	43	559	169	1849
12	45	540	144	2025
16	37	592	256	1369
15	43	645	225	1849
$\sum X=78$	**$\sum Y=246$**	**$\sum XY=3192$**	**$\sum X^2=1038$**	**$\sum Y^2=10136$**

$\bar{X} = \sum X/N = 78/6 = 13.00$

$Y = \sum Y/N = 246/6 = 41.00$

$$bxy = \frac{N\sum XY-(\sum X)(\sum Y)}{N\sum Y^2-(\sum Y)^2}$$

$$= \frac{6 \text{ X } 3192 - 78 \text{ X } 246}{6 \text{ X } 10316 - (246)^2}$$

$$= \frac{19152 - 19188}{60816 - 60516} = \frac{-36}{300} = 0.1200$$

$$byx = \frac{N\sum XY - (\sum X)(\sum Y)}{N\sum X^2 - (\sum X)^2}$$

$$= \frac{-36}{6X1038 - (78)^2}$$

$$= \frac{-36}{6228 - 6084} = 0.6000$$

$$= \frac{-36}{144} = 0.2500$$

Regression equation of Y on X

$Y - \bar{Y} = byx\ (X - \bar{X})$

$Y - 41 = -0.2500\ (X - 13)$

$= -0.2500\ X + 3.25$

$Y = 44.25 + 0.25X$

When X = 20, Y=44.25-0.25 X 20 = 39.25

Regression equation of X on Y

$X - \bar{X} = bxy\ (Y - \bar{Y})$

X-13 = -0.1200 (Y-41)

= -0.1200 Y + 4.92

X = 17.92 - 0.12Y

Sum 5: From the data given below, find two regression equations

Marks in Mathematics	25	28	35	32	31	36	29	38	34	32
Marks in Statistics	43	46	49	41	36	32	31	30	33	39

Solution

X	**Y**	**$X=X-\bar{X}$** **$\bar{X}=32$**	**$Y=Y-\bar{Y}$** **$\bar{Y}=38$**	**XY**	**X^2**	**Y^2**
25	43	-7	5	-35	49	25
28	46	-4	8	-32	16	64
35	49	3	11	33	9	121
32	41	0	3	0	0	9
31	36	-1	-2	2	1	4
36	32	4	-6	-24	16	36
29	31	-3	-7	21	9	49
38	30	6	-8	-48	36	64
34	33	2	-5	-10	4	25
32	39	0	1	0	0	1
$\sum X=320$	**$\sum Y=380$**	**$\sum X=0$**	**$\sum Y=0$**	**$\sum XY=-93$**	**$\sum X^2=140$**	**$\sum Y^2=398$**

Solution

$\bar{X} = \sum X/N = 320/10 = 32.00$

$Y = \sum Y/N$ = 380/10 = 38.00

bxy = $\sum xy/\sum y^2$ = -93/398 = -0.2337

byx = $\sum xy/\sum x^2$ = -93/140 = -0.6643

a) Regression equation of Y on X

$Y - Y$ = byx (X-X)

Y-38 = -0.6643 X (X-32)

= -0.6643 X + 21.26

= 59.26 – 0.6643X

Regression equation of X on Y

$X - \overline{X}$ = bxy $(Y-\overline{Y})$

X-32 = -0.2337 (Y-38) = -0.2337Y + 8.88 = 40.88 – 0.2337Y

POSSIBLE QUESTIONS

PART B

1. Define hypothesis
2. List out the Qualities of a good Hypothesis
3. Write a short note on Chi Square Test
4. What is meant by Regression Analysis?
5. Give the Meaning of Correlation Analysis

PART C

1. Raju Resraurant near the railway station at falna has been having average sales 500 tea Cups per day. Because of the development of bus stand nearby, it expects to increase in Sales. During the first 12 days after the start of the bustand, the daily sales were as under:

550,570,490,615,505,580,570,460,600,580,530,526.

On the basis of this sample information, can one conclude that raju restaurants sales have increased? Use t test at 5% level of significance

Note: (The t value at 5 per cent level of significance for 11 degrees of freedom is 1.796)
(The t value at 1 per cent level of significance for 11 degrees of freedom is 2.718)

2. From the data given below about the treatment of 250 patients suffering from a disease, state whether the new treatment is superior to the conventional treatment.

No.of patients

	Favourable	**Not favourable**	**Total**
New	140	30	170
Conventional	60	20	80
Total	**200**	**50**	**250**

Use Chi-square test at 5per cent level of significance.

Note: (The chi square value at 5 per cent level of significance for 1 degrees of freedom is 3.84)
(The chi square value at 1 per cent level of significance for 1 degrees of freedom is 6.635)

3. 200 digits are chosen at random from a set of tables. The frequencies of the digits are as follows.

Digit	0	1	2	3	4	5	6	7	8	9
Frequency	18	19	23	21	16	25	22	20	21	15

Use Chi square test to assess the correctness of the hypothesis that the digits were distributed in equal numbers in the tables from which they were chosen.

4. Memory capacity of 9 students was tested before and after training. State at 5% level of significance whether the training was effective from the following cases.

Student	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Before	10	15	9	3	7	12	16	17	4
After	12	17	8	5	6	11	18	20	3

Use t test.

Note: (The chi square value at 5 per cent level of significance for 8 degrees of freedom is 1.860)
(The chi square value at 1 per cent level of significance for 8 degrees of freedom is 2.896)

5. The table given below shows the data obtained during outbreak of smallpox

	Attacked	**Not Attacked**	**Total**
Vaccinated	31	469	500
Not Vaccinated	185	1315	1500
Total	216	1784	2000

Test the effectiveness of vaccination in preventing the attack from smallpox. Test your result with the help of chi-square at 5 per cent level of significance.

Note: (The chi square value at 5 per cent level of significance for 1 degrees of freedom is 3.84)
(The chi square value at 1 per cent level of significance for 1 degrees of freedom is 6.635)

6. A group of 150 college students were asked to indicate their most liked film star from among six different well known film actors viz., A,B,C,D,E and F in order to ascertain their relative popularity. The observed frequency data were as follows.

Actors	A	B	C	D	E	F	Total
Frequency	24	20	32	25	28	21	150

Test at 5 percent whether all actors are equally popular.

Note:(The chi square value at 5 per cent level of significance for 5 degrees of freedom is 11.071)
(The chi square value at 1 per cent level of significance for 5 degrees of freedom is 15.086)

7. A die is thrown 132 times with following results.

Number turned up	1	2	3	4	5	6
Frequency	16	20	25	14	29	28

Use Chi-square test.

Note: (The chi square value at 5 per cent level of significance for 5 degrees of freedom is 11.071)
(The chi square value at 1 per cent level of significance for 5 degrees of freedom is 15.086)

8. Discuss the different types of multivariate techniques?

9. Describe the important methods of factor analysis?

10. The sales data of an item in six shops before and after a special promotional campaign are:

Shops	**A**	**B**	**C**	**D**	**E**	**F**
Before the promotional campaign	53	28	31	48	50	42
After the campaign	58	29	30	55	56	45

Can the campaign be judged to be success? Test at 5 per cent level of significance.
Use paired t – test.

Note: (The t value at 5 per cent level of significance for 5 degrees of freedom is 2.015)
(The t value at 1 per cent level of significance for 5 degrees of freedom is 3.365)

KARPAGAM ACADEMY OF HIGHER EDUCATION

BUSINESS RESEARCH METHODS (18BAU401)

MULTIPLE CHOICE QUESTIONS

UNIT IV

S.NO	Questions	Option 1	Option 2	Option 3	Option 4	Answer
1	The word ---------- is used to indicate various statistical measures like mean,	standard deviation, correlation etc, in the universe.	parameter	statistic	hypothesis	parameter
2	The term STATISTIC refers to the statistical measures relating to the	population	sample	universe	sample unit	universe
3	Type two error is called as_____	alpha error	standard error	beta error	statistic error	beta error
4	The hypothesis under test is .	Simple hypothesis___	alternative hypothesis	null hypothesis	complex hypothesis	null hypothesis
5	Level of significance is the probability of	Type I error	Type II error	Not committing error	committing error	Type I error
6	A test based on a test statistic is classified as	Randomized test	non-randomized test	sequential test	Bayes test	Randomized test
7	Degrees of freedom is related to .	No. of observations in a set	hypothesis under test	no. of independent observations in a set]	No.of samples under test	hypothesis under test

8	A critical function provides the basis for ----------.	accepting H_0	rejecting H_0	no decision about H_0	no decision about Ha	rejecting H_0
9	Student's t-test is applicable in case of ----------.	small samples	for sample of size between 5 and 30	large samples	optimum samples	small samples
10	If the sample size is ------- 30 then those samples may be regarded as large samples.	less than	greater than	less than or greater than	smaller than	greater than
11	The random sampling distribution of statistics is approximately,	normal	binomial	poission	quantitative	normal
12	Reject H_0 when it is true is known as	Type I error	Type II error	Correct decision	wrong decision	Type I error
13	Reject H_0 when it is false is known as	Type I error	Type II error	wrong decision	Type II error	Correct decision
14	Accept H_0 when it is true is known as,	Type I error	wrong decision	Correct decision	Type II error	Correct decision
15	Accept H_0 when it is false is known as,	Type I error	Type II error	wrong decision	Correct decision	Type II error
16	If $\|Z\| < Z_a$ the null hypothesis is,	rejected	accepted	zero	not accepted	accepted
17	Any statistical measure computed from population data is known as,	parameter	sample	statistic	event	statistic
18	Any statistical measure computed from population data is known as,	event	sample	statistic	parameter	statistic

19	A part of the population selected for study is called a	parameter	statistic	sample	event	sample
20	The standard deviation of the sampling distribution is known as,	standard error	proportion	hypothesis	normal error	standard error
21	Testing of hypothesis was initiated by	Neyman	spearman	poison	kothari. C. R	Neyman
22	The value of 5 % level of significance is	2.58	1.96	1,64	2.33	1.96
23	The value of 1 % level of significance is,	2.58	1.96	1,64	2.33	2.58
24	type one error is denoted as	alpha error	beta error	normal error	standard error	alpha error
25	The vertical scale of a bar diagram possesses data of	Percentage	Frequency	Nominal scale	Discrete data.	Discrete data.
26	“Frequency Polygon” is formed in connecting	Variables	Quantitative data	Numerical numbers	Mid point	Mid point
27	The second part of the Bibliography contains	Author name	Publications	Double authors	Magazines.	Magazines.
28	Who used the term ANOVA for the first time?	RA fisher	Sne décor	Cohen	Kothari	RA fisher
29	----------refers to the process of assigning numerals or symbols to answers of response	Coding	Editing	Classification	tabulation	Coding

30	The analysis, which studies the joint variation of two or more variables	Casual	Correlation	Multiple regression	Canonical.	Multiple regression
31	. ---------- is the most commonly or frequently occurring value in a series in Research	Median	Mean	Mode	standard deviation	Mean
32	.The deviation, which is used mostly in research studies and is regarded as a satisfaction	Mean deviation	Standard deviation	Skewness	Mode	Standard deviation
33	The test used to judge the significance of difference between the means of two samples	Karl Pearson's test	T- test	F-test	Chi square-test	T- test
34	Who used the term ANOVA for the I time?	RA Fisher	Sne décor	Kothari	Cohen	RA Fisher
35	.Data are converted into symbols at what stage?	Graphing	Coding	Tabulation	Figural depiction.	Coding
36	What is to be conducted to test a questionnaire?	Pilot survey	Experiment	Pretest	Interview	Pretest
37	The research study, which is based on describing the characteristic of a particular individual or group	Experience survey	Descriptive	Diagnostic	Exploratory	Diagnostic
38	Under which sampling design does every item of universe has an equal chance of inclusion	Non-probability	Probability	Random	None	Probability
39	The whole data put in concise, precise and logical order called	Objects	Sampling	Tabulation	Arrangement	Tabulation
40	It is an approach where scale is developed in Adhoc basis	Arbitrary approach	consensus approach	interval scale	ratio scale	Arbitrary approach

41	I t is used to measure concepts	consensus approach	arbitrary approach	interval scale	ratio scale	arbitrary approach
42	_____ is used to find out the relationship between the items	Arbitrary approach	consensus approach	ratio scale	factor scale	factor scale
43	_____ method are used to find out the individual items	consensus approach	arbitrary approach	item analysis approach	factor approach	item analysis approach
44	_____ is used to assigning number to symbols	nominal scale	ordinal scale	interval scale	ratio scale	nominal scale
45	_____ places events in order	nominal scale	ordinal scale	interval scale	ratio scale	ordinal scale
46	Normally rank orders represent in _____	ordinal scale	nominal scale	interval scale	ratio scale	ordinal scale
47	_____ scale intervals are adjusted in terms of some rule	ordinal scale	nominal scale	interval scale	ratio scale	interval scale
48	_____ is an absolute or true zero measurement	ratio scale	nominal scale	interval scale	ordinal scale	ratio scale
49	_____ represents the actual amount of variables	ordinal scale	nominal scale	interval scale	ratio scale	ratio scale
50	It is used to deduct errors and omissions	coding	editing	classification	tabulation	editing
51	____ consists in the review of the reporting forms by the investigator	field editing	central editing	classification	coding	field editing

52	It refers to the process of assigning numerals or other symbols to answers	coding	editing	classification	tabulation	coding
53	___ can be done by hand or by mechanical or electronical devices	coding	editing	classification	tabulation	tabulation
54	Multiplication and division is possible in _____	ordinal scale	nominal scale	ratio scale	factor scale	ratio scale
55	_____ or a hypothesized relationship is to be tested by scientific method	Orders	Values	Prediction	Thoughts	Prediction
56	_____ is an underlying dimension that account of factor analysis	factor	sign test	multivariate techniques	correlation	factor
57	_____ is not a method of factor analsis	centroid method	principal components method	maximum liklihood method	minimum liklihood method	minimum liklihood method
58	the term path analysis is first introduced by	sewall wright	kothari	gilbreth	poission	sewall wright
59	_____ analysis consists methods of classifying variables into	Cluster	factor	structure	MDS	Cluster
60	_____ Test is based on plus or minus signs	MDS	Cluster	sign test	MDS	sign test

UNIT V - REPORT PREPARATION

Meaning, types and layout of research report; Steps in report writing; Citations, Bibliography and Annexure in report.

REPORT WRITING

Research report is considered a major component of the research study for the research task remains incomplete till the report has been presented and/or written. As a matter of fact even the most brilliant hypothesis, highly well designed and conducted research study, and the most striking generalizations and findings are of little value unless they are effectively communicated to others. The purpose of research is not well served unless the findings are made known to others. Research results must invariably enter the general store of knowledge. All this explains the significance of writing research report. There are people who do not consider writing of report as an integral part of the research process. But the general opinion is in favour of treating the presentation of research results or the writing of report as part and parcel of the research project. Writing of report is the last step in a research study and requires a set of skills somewhat different from those called for in respect of the earlier stages of research. This task should be accomplished by the researcher with utmost care; he may seek the assistance and guidance of experts for the purpose.

STEPS IN WRITING REPORTS

Research reports are the product of slow, painstaking (careful / meticulous), accurate inductive (logical / reasonable) work

1) Logical Analysis of the Subject Matter

It is the first step which is primarily concerned with the development of a subject. There are two ways in which to develop a subject – (a) logically and (b) Chronologically (arranging data as per time of occurrence). The logical development is made on the basis of mental connections and associations between the one thing and another by means of analysis. Logical treatment often consists in developing the material from the simple possible to the most complex structures. Chronological development is based on a connection or sequence in time or occurrence. The directions for doing or making something usually follow the chronological order.

2) Preparation of the Final Outline

It is the next step in writing the research report. Outlines (hints) are the framework upon which long written works are constructed. They are in aid (help) to the logical organization of the material and a reminder of the points to be stressed in the report.

3) Preparation of the Rough Draft

This follows the logical analysis of the subject and the preparation of the final outline. Such a step is of utmost importance for the researcher now sits to write down what he has done in the context of his research study. He will write down the procedure adopted by him in collecting the material for his study along with various limitations faced by him, the technique of analysis for adopted by him, the broad findings and generalizations and the various suggestions he wants to offer regarding the problem concerned

4) Rewriting and Polishing of the Rough Draft

This step happens to be most difficult part of all formal writing. Usually this step requires more time than the writing of the rough report. The careful revision makes the difference between a mediocre

(ordinary) and a good piece of writing. While rewriting and polishing, one should check the report for weaknesses in logical development or presentation. The researcher should also 'see whether or not the material, as it is presented, has unity and cohesion (organization); does the report stand upright and firm and exhibit a definite pattern, like a marble arch? Or does it resemble an old wall of moldering cement and loose bricks. In addition, the researcher should give due attention to the fact that in his rough draft he has been consistent (reliably / steady) or not. He should check the mechanics of writing – grammar, spelling and usage

5) Preparation of the Final Bibliography

Next in order comes the task of the preparation of the final bibliography. The bibliography, which is generally appended (add on) to the research report, is a list of books in some way pertinent to the research which has been done. It should contain all those works which the researcher has consulted. The bibliography should be arranged alphabetically and may be divided into two parts; the first part may contain the names of books and pamphlets, and the second part may contain the name of magazines and newspaper articles. Generally, this pattern of bibliography is considered convenient and satisfactory from the point of view of reader, thought it is not the only way of presenting bibliography

6) Writing the Final Draft

This consists the last step. The final draft should be written in a concise (brief) and objective style and in simple language, avoiding vague expressions such as "it seems". While writing the final draft, the researcher must avoid abstract (theoretical) terminology and technical jargon. Illustrations and examples based on common experiences must be incorporated in the final draft as they happen to most effective in communicating the research findings to others. A research report should not be dull (boring), but must enthuse (motivate) people and maintain interest and must show originality. It must

be remembered that every report should be an attempt to solve some intellectual problem and must contribute to the solution of a problem and must add to the knowledge of both the researcher and the reader

LAYOUT OF THE RESEARCH REPORT

The layout of the report means as to what the research report should contain. A comprehensive layout of the research report should comprise

(A) Preliminary pages

(B) The main text; and

(C) The end matter.

(A) Preliminary Pages

In its preliminary pages the report should carry a title and date, followed by acknowledgements in the form of 'Preface' or 'Foreword'. Then there should be a table of contents followed by list of tables and illustrations so that the decision-maker or anybody interested in reading the report can easily locate the required information in the report.

(B) Main Text

The main text provides the complete outline of the research report along with all details. Title of the research study is repeated at the top of the first page of the main text and then follows the other details on pages numbered consecutively, beginning with the second page. Each main section of the report should begin on a new page. The main text of the report should have the following sections

(i) Introduction

(ii) Statement of findings and recommendations

(iii) The results

(iv) The implications drawn from the results

(v) The summary.

i) Introduction

The purpose of introduction is to introduce the research project to the readers. It should contain a clear statement of the objectives of research i.e., enough background should be given to make clear to the reader why the problem was considered worth investigating. A brief summary of other relevant research may also be stated so that the present study can be seen in that context. The hypotheses of study, if any, and the definitions of the major concepts employed in the study should be explicitly stated in the introduction of the report.The methodology adopted in conducting the study must be fully explained. The scientific reader would like to know in detail about such thing: How was the study carried out? What was its basic design? If the study was an experimental one, then what were the experimental manipulations? If the data were collected by means of questionnaires or interviews, then exactly what questions were

asked (The questionnaire or interview schedule is usually given in an appendix)? If measurements were based on observation, then what instructions were given to the observers? Regarding the sample used in the study the reader should be told: Who were the subjects? How many were there? How were they selected? All these questions are crucial for estimating the probable limits of generalizability of the findings. The statistical analysis adopted must also be clearly stated. In addition to all this, the scope of the study should be stated and the boundary lines be demarcated. The various limitations, under which the research project was completed, must also be narrated.

(ii) Statement of findings and recommendations

After introduction, the research report must contain a statement of findings and recommendations in non-technical language so that it can be easily understood by all concerned. If the findings happen to be extensive, at this point they should be put in the summarised form.

(iii) Results

A detailed presentation of the findings of the study, with supporting data in the form of tables and charts together with a validation of results, is the next step in writing the main text of the report. This generally comprises the main body of the report, extending over several chapters. The result section of the report should contain statistical summaries and reductions of the data rather than the raw data. All the results should be presented in logical sequence and splitted into readily identifiable sections. All relevant results must find a place in the report. But how one is to decide about what is relevant is the basic question. Quite often guidance comes primarily from the research problem and from the hypotheses, if any, with which the study was concerned. But ultimately the researcher must rely on his own judgement in deciding the outline of his report. "Nevertheless, it is still necessary that he states clearly the problem with which he was concerned, the procedure by which he worked on the problem, the conclusions at which he arrived, and the bases for his conclusions.

(iv) Implications of the results

Toward the end of the main text, the researcher should again put down the results of his research clearly and precisely. He should, state the implications that flow from the results of the study, for the general reader is interested in the implications for understanding the human behaviour.

v) Summary

It has become customary to conclude the research report with a very brief summary, resting in brief the research problem, the methodology, the major findings and the major conclusions drawn from the research results.

(C) End Matter

At the end of the report, appendices should be enlisted in respect of all technical data such as questionnaires, sample information, mathematical derivations and the like ones. Bibliography of sources consulted should also be given. Index (an alphabetical listing of names, places and topics along with the numbers of the pages in a book or report on which they are mentioned or discussed) should invariably be given at the end of the report. The value of index lies in the fact that it works as a guide to the reader for the contents in the report.

MECHANICS OF WRITING A RESEARCH REPORT

There are very definite and set rules which should be followed in the actual preparation of the research report or paper. Once the techniques are finally decided, they should be scrupulously adhered to, and no deviation permitted. The criteria of format should be decided as soon as the materials for the research paper have been assembled. The following points deserve mention so far as the mechanics of writing a report are concerned:

1. Size and physical design: The manuscript should be written on unruled paper 8 1 $2^2 \times 11^2$ in size. If it is to be written by hand, then black or blue-black ink should be used. A margin of at least one and one-half inches should be allowed at the left hand and of at least half an inch at the right hand of the paper. There should also be one-inch margins, top and bottom. The paper should be

neat and legible. If the manuscript is to be typed, then all typing should be double-spaced on one side of the page only except for the insertion of the long quotations.

2. Procedure: Various steps in writing the report should be strictly

3. Layout: Keeping in view the objective and nature of the problem, the layout of the report should be thought of and decided and accordingly adopted (The layout of the research report and various types of reports have been described in this chapter earlier which should be taken as a guide for report-writing in case of a particular problem).

4. Treatment of quotations: Quotations should be placed in quotation marks and double spaced, forming an immediate part of the text. But if a quotation is of a considerable length (more than four or five type written lines) then it should be single-spaced and indented at least half an inch to the right of the normal text margin.

5. The footnotes: Regarding footnotes one should keep in view the followings:

(a) The footnotes serve two purposes viz., the identification of materials used in quotations in the report and the notice of materials not immediately necessary to the body of the research text but still of supplemental value. In other words, footnotes are meant for cross references, citation of authorities and sources, acknowledgement and elucidation or explanation of a point of view. It should always be kept in view that footnote is not an end nor a means of the display of scholarship. The modern tendency is to make the minimum use of footnotes for scholarship does not need to be displayed.

(b) Footnotes are placed at the bottom of the page on which the reference or quotation which they identify or supplement ends. Footnotes are customarily separated from the textual material by a space of half an inch and a line about one and a half inches long.

(c) Footnotes should be numbered consecutively, usually beginning with 1 in each chapter separately. The number should be put slightly above the line, say at the end of a quotation. At the foot of the page, again, the footnote number should be indented and typed a little above the line. Thus, consecutive numbers must be used to correlate the reference in the text with its corresponding note at the bottom of the page, except in case of statistical tables and other numerical material, where symbols such as the asterisk (*) or the like one may be used to prevent confusion.

(d) Footnotes are always typed in single space though they are divided from one another by double space.

6. Documentation style: Regarding documentation, the first footnote reference to any given work should be complete in its documentation, giving all the essential facts about the edition used. Such documentary footnotes follow a general sequence. The common order may be described as under:

(i) Regarding the single-volume reference

1. Author's name in normal order (and not beginning with the last name as in a bibliography) followed by a comma;
2. Title of work, underlined to indicate italics;
3. Place and date of publication;
4. Pagination references (The page number).

(iii) Regarding works arranged alphabetically

(iv) Regarding periodicals reference

1. Name of the author in normal order;
2. Title of article, in quotation marks;
3. Name of periodical, underlined to indicate italics;

4. Volume number;

5. Date of issuance;

6. Pagination.

(v) Regarding anthologies and collections reference

Quotations from anthologies or collections of literary works must be acknowledged not only by author, but also by the name of the collector.

(vi) Regarding second-hand quotations reference

In such cases the documentation should be handled as follows:

1. Original author and title;

2. "quoted or cited in,";

3. Second author and work.

7. Punctuation and abbreviations in footnotes

The first item after the number in the footnote is the author's name, given in the normal signature order. This is followed by a comma. After the comma, the title of the book is given: the article (such as "A", "An", "The" etc.) is omitted and only the first word and proper nouns and adjectives are capitalized. The title is followed by a comma. Information concerning the edition is given next. This entry is followed by a comma. The place of publication is then stated; it may be mentioned in an abbreviated form, if the place happens to be a famous one such as Lond. for London, N.Y. for New York, N.D. for New Delhi and so on. This entry is followed by a comma. Then the name of the publisher is mentioned and this entry is closed by a comma. It is followed by the date of publication if the date is given on the title page. If the date appears in the copyright notice on the reverse side of the title page or elsewhere in the volume, the comma should be omitted

and the date enclosed in square brackets [c 1978], [1978]. The entry is followed by a comma. Then follow the volume and page references and are separated by a comma if both are given. A period closes the complete documentary reference. But one should remember that the documentation regarding acknowledgements from magazine articles and periodical literature follow a different form as stated earlier while explaining the entries in the bibliography.

8. Use of statistics, charts and graphs

A judicious use of statistics in research reports is oftenconsidered a virtue for it contributes a great deal towards the clarification and simplification of the material and research results. One may well remember that a good picture is often worth more than a thousand words. Statistics are usually presented in the form of tables, charts, bars and line-graphs and pictograms. Such presentation should be self explanatory and complete in itself. It should be suitable and appropriate looking to the problem at hand. Finally, statistical presentation should be neat and attractive.

9. The final draft

Revising and rewriting the rough draft of the report should be done with great care before writing the final draft. For the purpose, the researcher should put to himself questions like: Are the sentences written in the report clear? Are they grammatically correct? Do they say what is meant'? Do the various points incorporated in the report fit together logically? "Having at least one colleague read the report just before the final revision is extremely helpful. Sentences that seem crystal-clear to the writer may prove quite confusing to other people; a connection that had seemed self evident may strike others as a non-sequitur. A friendly critic, by pointing out passages that seem unclear or illogical, and perhaps suggesting ways of remedying the difficulties, can be an invaluable aid in achieving the goal of adequate communication.

10. Bibliography

Bibliography should be prepared and appended to the research report

11. Preparation of the index

At the end of the report, an index should invariably be given, the value of which lies in the fact that it acts as a good guide, to the reader. Index may be prepared both as subject index and as author index. The former gives the names of the subject-topics or concepts along with the number of pages on which they have appeared or discussed in the report, whereas the latter gives the similar information regarding the names of authors. The index should always be arranged alphabetically. Some people prefer to prepare only one index common for names of authors, subject-topics, concepts and the like ones.

PRECAUTIONS FOR WRITING RESEARCH REPORTS

Research report is a channel of communicating the research findings to the readers of the report. A good research report is one which does this task efficiently and effectively. As such it must be prepared keeping the following precautions in view:

1. While determining the length of the report (since research reports vary greatly in length), one should keep in view the fact that it should be long enough to cover the subject but short enough to maintain interest. In fact, report-writing should not be a means to learning more and more about less and less.
2. A research report should not, if this can be avoided, be dull; it should be such as to sustain reader's interest.
3. Abstract terminology and technical jargon should be avoided in a research report. The report should be able to convey the matter as simply as possible. This, in other words, means that report should

be written in an objective style in simple language, avoiding expressions such as "it seems," "there may be" and the like.

4. Readers are often interested in acquiring a quick knowledge of the main findings and as such the report must provide a ready availability of the findings. For this purpose, charts, graphs and the statistical tables may be used for the various results in the main report in addition to the summary of important findings.
5. The layout of the report should be well thought out and must be appropriate and in accordance with the objective of the research problem.
6. The reports should be free from grammatical mistakes and must be prepared strictly in accordance with the techniques of composition of report-writing such as the use of quotations, footnotes, documentation, proper punctuation and use of abbreviations in footnotes and the like.
7. The report must present the logical analysis of the subject matter. It must reflect a structure wherein the different pieces of analysis relating to the research problem fit well.
8. A research report should show originality and should necessarily be an attempt to solve some intellectual problem. It must contribute to the solution of a problem and must add to the store of knowledge.
9. Towards the end, the report must also state the policy implications relating to the problem under consideration. It is usually considered desirable if the report makes a forecast of the probable future of the subject concerned and indicates the kinds of research still needs to be done in that particular field.
10. Appendices should be enlisted in respect of all the technical data in the report.
11. Bibliography of sources consulted is a must for a good report and must necessarily be given.

12. Index is also considered an essential part of a good report and as such must be prepared and appended at the end.
13. Report must be attractive in appearance, neat and clean, whether typed or printed.
14. Calculated confidence limits must be mentioned and the various constraints experienced in conducting the research study may also be stated in the report.
15. Objective of the study, the nature of the problem, the methods employed and the analysis techniques adopted must all be clearly stated in the beginning of the report in the form of introduction.

TYPES OF REPORTS

1. Research reports vary greatly in length and type. In each individual case, both the length and the form are largely dictated (determined / ordered) by the problems at hand
2. For instance, business firms prefer reports in the letter form, just one or two pages in length.
3. Banks, Insurance organizations and financial institutions are generally fond of (having a liking for) the short balance-sheet type of tabulation for their annual reports to their customers and shareholders
4. Mathematicians prefer to write the results of their investigations in the form of algebraic (numerical) notations (Symbols + / -)
5. Chemists (Scientist trained in Chemistry) report their results in symbols and formulae (method)
6. Students of literature usually write long reports presenting the critical analysis of some writer or period or the like with a liberal use of quotations from the works of the author under discussion
7. In the field of education and psychology, the favorite form in the report on the results of experimentation accompanied by the detailed statistical tabulations

8. Clinical psychologists and social pathologists (diagnosis of disease) frequently find it necessary to make use of the case-history (all the relevant information previous gatherer) form
9. News items in the daily papers are also forms of report writing. They represent firsthand on-the-scene accounts of the events described or compilation (collection) of interviews with persons who were on the scene (area). In such report the first paragraph usually contains the important information in detail and the succeeding paragraphs contain material which is progressively less and less important
10. Book – reviews which analyze the content of the book and report on the author's intentions, his success or failure in achieving his aims, his language, his style, scholarship (learning / research / study), bias or his point of view, such reviews also happen to be a kind of short report
11. The reports prepared by governmental bureaus (agency) special commissions, and similar other organizations are generally very comprehensive (full / complete) reports on the issues involved. Such reports are usually considered as important research products
12. Similarly, Ph.D.theses and dissertation are also a form of report-writing, usually completed by students in academic institutions
13. The above narration throws light on the fact that the results of a research investigation can be presented in a number of ways viz., a technical report, popular report,
14. Which method of presentation to be used in a particular study depends on the circumstances under which the study arose (take place) and the nature of the results
15. A technical report is used whenever a full written report of the study is required whether for record-keeping or for public dissimilation
16. A popular report is used if the research results have policy implications.

A) TECHNICAL REPORT

In technical report the main emphasis is on (i) the methods employed (ii) assumptions made in the course of the study (iii) the detailed presentation of the findings including their limitations and supporting data

1) Summary of Results

A brief review of the main findings just in two or three pages

2) Nature of the Study

Description of the general objectives of study, formulation of the problem in operational terms, the working hypothesis, the type of analysis and data required

3) Methods Employed

Specific methods used in the study and their limitations. For instance, in sampling studies we should give details of sample design viz. sample size, sample selection etc.,

4) Data

Discussion of data collected, their sources, characteristics and limitations. If secondary data are used, their suitability of the problem at hand be fully assessed.

5) Analysis of Data and Presentation of Findings

The analysis of data and presentation of the findings of the study with supporting data in the form of tables and charts be fully narrated (explained). This, in fact, happens to be the main body of the report usually extending over several chapters

6) Conclusions

A detailed summary of the findings and the policy implications drawn from the results be explained

7) Bibliography

Bibliography of various sources consulted be prepared and attached

8) Technical Appendices

Appendices be given for all technical matters relating to questionnaire, mathematical derivations, elaboration on particular technique of analysis and the like ones

9) Index

Index must be prepared and be given invariably in the report at the end. Even in technical report, simple presentation and ready availability of the findings remain an important consideration and as such the liberal use of charts and diagrams is considered desirable

B) POPULAR REPORT

The popular report is one which emphasis on simplicity and attractiveness. The simplification should be sought (required) through clear writing, minimization of technical, particularly mathematical, details and liberal use of charts and diagrams. Attractive layout along with large print, many subheadings, even an occasional cartoon now and then is another characteristic feature of the popular report

1) Findings and their Implications

Emphasis (importance) in the report is given on the findings of most practical interest and on the implication of these findings

2) Recommendation for Action

Recommendations for action on the basis of the findings of the study is made in this section of the report

3) Objectives of the Study

A general review of how the problem arise is presented along with the specific objectives of the project under study

4) Methods Employed

A brief and non-technical description of the methods and techniques used, including a short review of the data on which the study is based, is given in this part of the report

5) Results

This section constitutes the main body of the report wherein the results of the study are presented in clear and non-technical terms with the liberal use of all sorts of illustrations such as charts, diagrams and the like ones

6) Technical Appendices

More detailed information on methods used, forms etc, is presented in the form of appendices. But the appendices are often not detailed if the report is entirely meant for general public

CITATIONS

A citation is a reference to a published or unpublished source. More precisely, a citation is an abbreviated alphanumeric expression embedded in the body of an intellectual work that denotes an entry in the bibliographic references section of the work for the purpose of acknowledging the relevance of the works of others to the topic of discussion at the spot where the citation appears.

Generally the combination of both the in-body citation and the bibliographic entry constitutes what is commonly thought of as a citation (whereas bibliographic entries by themselves are not). References to single, machine-readable assertions in electronic scientific articles are known as nanopublications, a form of microattribution

Citations have several important purposes: to uphold intellectual honesty (or avoiding plagiarism), to attribute prior or unoriginal work and ideas to the correct sources, to allow the reader to determine independently whether the referenced material supports the author's argument in the claimed way, and to help the reader gauge the strength and validity of the material the author has used.

A specific source that you mention in the body of your paper. The format of the citation may change depending on the style you use (e.g. MLA and APA) and the way that you weave the citation into your writing, but the basic elements of the citation that you need to include are:

- Name of the author(s)
- Year of publication
- Page number or page range

APPENDIX: NORMS FOR USING INDEX AND BIBLIOGRAPHY

CONVENTIONS RELATING TO PREPARATION OF RESEARCH REPORTS.

Organization of the Research Report Most scientific research reports, irrespective of the field, parallel the method of scientific reasoning. That is: the problem is defined, a hypothesis is created, experiments are devised to test the hypothesis, experiments are conducted, and conclusions are drawn. The exact format of scientific reports is often discipline dependent with variations in order and content. The student is encouraged to adopt the format that is most appropriate to the discipline of the research. Many journals offer a formatting template to aid the author. One example of such a framework is as follows:

- Title
- Abstract
- Introduction

- Experimental Details or Theoretical Analysis
- Results
- Discussion
- Conclusions and Summary
- References

POSSIBLE QUESTIONS

PART B

1. What is meant by interpretation?
2. Give the meaning of citation
3. List out the types of report
4. What is meant by bibliography?
5. Give the meaning of annexure in report

PART C

1. Explain the types of report writing with suitable examples
2. Discuss the significance of writing research report
3. Describe the steps in report writing in detail
4. Discuss the layout of research report in detail

KARPAGAM ACADEMY OF HIGHER EDUCATION

BUSINESS RESEARCH METHODS (18BAU401)

MULTIPLE CHOICE QUESTIONS

UNIT V

S.NO	Questions	Option 1	Option 2	Option 3	Option 4	Answer
1	A simple table represent	only one factor or variable	always two factor or variable	two or more number of factors or variable	multiple variable	multiple variable
2	A complex table represent:	only one factor variable	always two factor variable	two or more factor or variables.	multiple variable	two or more factor or variables.
3	The headings of the rows given in the first column of a table are called	stub	captions	titles	prefatory notes.	stub
4	The column headings of a table are known as	sub-title	stubs	reference notes	captions	captions
5	A frequency distribution can be	discrete	continuous	compound	discrete and continuous	discrete and continuous
6	Frequency of a variable is always,	in percentage	a fraction	an integer	a point	an integer
7	The data given as, 5,12,16,24,35,44 will be called as	continuous series	a discrete series	an individual series	time series	an individual series

8	Charts and graphs are the presentation of numerical facts by means of:	points and lines	area and other geometrical forms	symbols	points lines symbols	points lines symbols
9	Graphs and charts facilitate:	comparison of values	to know the trend	to know relationship	to know the objective	comparison of values
10	The purpose served by diagrams and chart is,	simple presentation of data	to avoid tabulation	to avoid textual form	to avoid chart	simple presentation of data
11	Choice of a particular chart depends on	the purpose of study	the nature of data	the type of audience	the source of data	the nature of data
12	Which of the following is one-dimensional diagram	Bar- diagram	Pie-diagram	cylinder	a graph	Bar- diagram
13	Which of the following is not a two-dimensional diagram	square diagram	multiple bar diagram	rectangular diagram	pie-chart.	pie-chart.
14	Non-dimensional diagrams are also known as,	cubes	spheres	pictograms	charts	pictograms
15	An alternative chart to pie-chart is,	step bar diagram	Rctangular chart	Sphere	charts	Rctangular chart
16	Pie-chart represents the components of a factory by,	percentages	angles	sectors	circles	angles

17	Histogram is suitable for the data presented as	continuous grouped frequency	discrete grouped frequency distribution	individual series	multiple series	continuous grouped frequency
18	Which one is considered a major component of the research study	interpretation	research report	finding	draft	research report
19	Research task remains incomplete till the _____ has been presented.	report	objective	finding	suggestions	report
20	The purpose of the research is not well served unless the _____ are made known to others	interpretation	research report	finding	draft	finding
21	What is the last step in a research study	writing report	writing finding	writing limitations	writing suggestions	writing report
22	What report are the product of slow,painstaking,accurate inductive work	interpretation	research report	finding	draft	research report
23	What is the first step in report writing	logical analysis of the subject	objective	interpretation	findings	logical analysis of the subject matters
24	Which is the finial step in report writing.	writing report	writing finding	writing draft	writing suggestions	writing draft
25	The two ways in which to develop a subject in logical analysis of subject matter are	logically	chronologically	simple	order	logical and chronological

26	What are the frame work upon which long written works are constructed	outline	draft	finding	interpretation.	outline
27	What is usually appended to the research work	editing	coding	bibliography	tabulation	bibliography
28	Which one follows the logical analysis of the subject and the preparation of the final out line	rough draft	bibliography	main draft	content page	rough draft
29	Which page carry title, acknowledgements, preface or forward, table of contents, list of contests,	introduction part	preliminary pages	finding pages	objective pages	preliminary pages
30	The _____ provides the complete outline of the research report along with all details	preliminary text	finding text	main text	conclusion pages.	main text
31	Which one is the detailed presentation of the findings of the study	rough draft	bibliography	result	main draft	result
32	.Which contains appendices in respect of all technical data such as questionnaires, sample information, mathematical	end matter	finding text	main draft	bibliography	end matter
33	In a technical report _____ must be invariably given at the end of the report	interpretation	index	finding	result.	index
34	The _____ is one which gives emphasis on simplicity and attractiveness	article report	research report	popular report	technical report	popular report

35	Which one of the results of the study is considered effective especially in thecases where policy recommendations are	oral presentations	writing presentations	verbal presentations	writing limitations	oral presentations
36	Oral presentations is effective when supplemented by various	logical devices	visual devices	coding devices	ending devices	visual devices
37	Which should be avoided in a research report	abstract terminology	technical jargon	abstract terminology and technical jargon	footnotes	abstract terminology and technical jargon
38	_____ should slow originality and should necessarily be on attempt tosolve some intellectual problem	interpretation	research report	finding	draft	research report
39	Which one is a fundamental component of research process	interpretation	research report	draft	finding	interpretation
40	_____ refers to the task of drawing inferences to collected facts	interpretation	research report	finding	draft	interpretation
41	objectives, nature of problem, methods employed and the analysis technique adopted must be clearly stated at the	specifying	interpreting	beginning	findings	beginning
42	Usefulness and utility of research finding lie in proper	interpretation	research report	finding	analysis	interpretation
43	_____ requires great skill and dexterity on the part of researcher	analysis	interpretation	research report	finding	interpretation

44	The researcher must remain caution about the _____ that can possibly arise in the process of interpreting results	analysis	error	findings	conclusions	error
45	Which one should be considered while interpreting a given data	validity	reliability	practicality	accessability	reliability
46	the main text provides the complete	analysis	text	outline	structure	outline
47	_____ is the last step of research report	writing main draft	writing final draft	writing suggesstions	writing introduction	writing final draft
48	_____ comsidered as major component of research stydy at final	research report	research hypothesis	research design	research structure	research report
49	which one is not the steps in writing research report	logical analysis of subject matter	preparation of final outline	preparation of rough draft	formulating hypothesis	formulating hypothesis
50	_____ is appended in the to the research report	bibiliography	hypothesis	design	sources	bibiliography
51	_____ report shuold give siplicity and attractiveness	popular report	technical jargon	technical report	short report	popular report
52	which one is not the type of research report	technical report	popular report	short report	hypothesis report	short report

53	the bibiliography should be placed in	end of the research report	beginning og the research report	middle of the research report	side of the research report	end of the research report
54	surveys are conducted in _____ studies	descriptive	experimental	quantitative	qualitative	descriptive
55	which of the following is not the essential element of report writing	research methods	research methodology	reference notes	conclusion	research methodology
56	testing hypothesis is a	inferential statistics	descriptive statistics	data preparation	data analysis	inferential statistics
57	which of the following is non probability sampling	snowball	random	cluster	stratified	snowball
58	uniting various qualitative methods with quantitative methods can be called as	coalesce	triangulation	bipartitle	impassive	triangulation
59	_____ Test is also known as h Test	Kruskal Wallis test	sign test	MDS	Factor analysis	Kruskal Wallis test

KARPAGAM ACADEMY OF HIGHER EDUCATION

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DEPARTMENT OF MANAGEMENT(UG)

Name: **Sumathi. G**
Department: **Management**
Subject Code: **18BAU401** Semester: **IV** Year: **2018-21 Batch**
Subject: **Business Research Methods**

S.No.	REGISTER NO.	ASSIGNMENT TITLE
1	18BAU002	Research meaning and significance
2	18BAU003	Scope of research in business
3	18BAU005	Purpose and utility of research
4	18BAU006	Problem identification
5	18BAU007	Types of research
6	18BAU008	Concept of theory
7	18BAU009	Concept of construct
8	18BAU010	Research process
9	18BAU011	Research design concept and importance
10	18BAU012	Types and features of research design
11	18BAU013	Data collection – observation method
12	18BAU014	Interview method of data collection
13	18BAU015	Questionnaire method of data collection
14	18BAU016	Schedule method of data collection
15	18BAU017	Types of research design
16	18BAU019	Probability sampling
17	18BAU020	Non probability sampling
18	18BAU023	Concept of measurement in research
19	18BAU024	Problems in measurement

20	18BAU025	Levels of measurement
21	18BAU026	Concept of scaling
22	18BAU027	Thurstone and Likert scale
23	18BAU028	Semantic and differential scale
24	18BAU029	Importance of scaling in research
25	18BAU030	Types of scaling
26	18BAU031	Preparation of questionnaire
27	18BAU032	Semantic and differential scale
28	18BAU034	Essentials of good questionnaire
29	18BAU035	Concept of hypothesis ant its types
30	18BAU036	Steps in hypothesis testing
31	18BAU037	ANOVA
32	18BAU038	Chi square test ant its types
33	18BAU039	Non parametric test
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35	18BAU041	Correlation analysis
36	18BAU043	Regression analysis
37	18BAU044	Report writing – concept and its types
38	18BAU045	Types of report writing
39	18BAU046	Layout of research report
40	18BAU047	Purpose and utility of research
41	18BAU048	Types of research
42	18BAU049	Research problem
43	18BAU050	Concept of theory
44	18BAU051	Concept of construct
45	18BAU052	Research process
46	18BAU053	Research design concept and importance
47	18BAU054	Types and features of research design
48	18BAU055	Data collection – observation method
49	18BAU056	Interview method of data collection

50	18BAU057	Questionnaire method of data collection
51	18BAU058	Schedule method of data collection
52	18BAU059	Concept of sampling
53	18BAU060	Probability sampling
54	18BAU061	Non probability sampling
55	18BAU062	Concept of measurement in research
56	18BAU063	Problem in measurement
57	18BAU064	Levels of measurement
58	18BAU065	Concept of scaling
59	18BAU066	Types of scaling
60	18BAU067	Report writing meaning and steps
61	18BAU068	Types of report writing

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established under section 3 of UGC Act 1956)
Coimbatore-641021

DEPARTMENT OF MANAGEMENT(UG)

Name: **Sumathi. G**
Department: **Management**
Subject Code: **18BAU401** Semester: **IV** Year: **2018-21 Batch**
Subject: **Business Research Methods**

S.No.	REGISTER NO.	SEMINAR TITLE
1	18BAU002	Research meaning and significance
2	18BAU003	Scope of research in business
3	18BAU005	Purpose and utility of research
4	18BAU006	Problem identification
5	18BAU007	Types of research
6	18BAU008	Concept of theory
7	18BAU009	Concept of construct
8	18BAU010	Research process
9	18BAU011	Research design concept and importance
10	18BAU012	Types and features of research design
11	18BAU013	Data collection – observation method
12	18BAU014	Interview method of data collection
13	18BAU015	Questionnaire method of data collection
14	18BAU016	Schedule method of data collection
15	18BAU017	Types of research design
16	18BAU019	Probability sampling
17	18BAU020	Non probability sampling
18	18BAU023	Concept of measurement in research
19	18BAU024	Problems in measurement

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Register No.: …….

[18BAU401]

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COIMBATORE – 641021

(For the candidates admitted from 2017 onwards)

I INTERNAL EXAMINATION – DECEMBER 2019

FOURTH SEMESTER

II BBA

BUSINESS RESEARCH METHODS

Date: 18 .12.2019 **Maximum: 50 Marks**

Session : AN **Time: 2 Hours**

PART – A (20 X 1 = 20 Marks)

Answer All the Questions

1. A study to gain familiarity with a phenomenon to achieve new insights is_____
   a) Exploratory research b) Descriptive Research
   c) Diagnostic Research d) Qualitative Research
2. Critical evaluation made by the researcher with the facts and information already available is called _____
   a) Exploratory research b) Analytical Research
   c) Diagnostic Research d) Historical Research
3. The methods or techniques used by researchers in performing research operations is called___
   a) Research Design b) Research Methodology
   c) Research techniques d) Research process
4. To develop new concepts or to reinterpret existing ones, philosophers and thinkers use____
   a) Empirical Research b) Conceptual Research
   c) Pure Research d) Basic Research
5. Gathering knowledge for knowledge sake is termed as ____
   a) Exploratory research b) Pure Research
   c) Diagnostic Research d) Hypothesis testing Research
6. Empirical literature comprises of _____
   a)Concepts and Theories b) Earlier studies
   c)Scientific enquiry d) Specific Details
7. The overall structure of research work is called as _____
   a) Research Process b) Research design
   c) research methods d) research methodology
8. Research aiming to find solutions for an immediate problem is called _____
   a) Basic research b) Applied Research
   c) Diagnostic Research d) Exploratory research
9. Decision-oriented Research is always for the need of the _____
   a) Researcher b) Society c) Decision maker d) respondent

10. If the researcher has no control over the variables it is termed as_____
    a) Exploratory research b) Ex post facto research
    c) Diagnostic Research d) Hypothesis testing Research
11. Characteristics of research that allows research results to be verified by replicating the study is called_____
    a) Logical b) Empirical c) Historical d) Replicable
12. _____ determines the data which are to be collected
    a) Objective of Study b) Research Design
    c) Review of Literature d) Hypothesis
13. Data Collected by filling up the Schedules by the enumerators on the basis of replies given by respondents_____
    a) Questionnaire b) Schedule c) Interview d) observation
14. Method of selecting items to be observed for the given study is called_____
    a) Sampling design b) Statistical Design
    c) Operational Design d) Observational Design
15. Quota Sampling is an important form of _____
    a) Probability Sampling `b) Non-Probability Sampling
    c) Convenience Sampling d) random sampling
16. _____ data are those which are collected afresh and for the first time
    a) Primary b) Secondary c) case study method d) warranty card
17. _____ Most of collecting data involves presentation of oral verbal stimuli
    a) Questionnaires b) Interview c) Observation d) Schedule
18. If observations takes place in the natural setting, it may be termed as _____ observation
    a) uncontrolled b) controlled c) personal d) Non personal
19. _____ method of data collection is very popular
    a) questionnaire method b) pilot study c) mailed questionnaire d) through post
20. _____ data are to be originally collected
    a) Secondary b) Primary c) case study method d) warranty card

PART – B (3 X 2 = 6 Marks)
Answer All the Questions

21. Define the term Research
22. State the characteristics of good research
23. What is meant by research design?

PART – C (3 X 8 = 24 Marks)
Answer All the Questions

24. a) Briefly explain the types of research with suitable examples.

(Or)

b) Describe the process of research with diagram.

25. a) Discuss the problems faced by the researchers in India

(Or)

b) Define research problem and explain the techniques involved in research problem

26. a) Explain the basic principles of experimental design in detail

(Or)

b) Explain the observation method of data collection with its merits and demerits