Definition of research
Different authors have defined research as follows:
➢ Research is carrying out a diligent inquiry or a critical examination of a given phenomenon.
➢ Research involves a critical analysis of existing conclusions or theories with regard to newly discovered facts i.e. it's a continued search for new knowledge and understanding of the world around us.
➢ Research is a process of arriving at effective solutions to problems through systematic collection, analysis and interpretation of data.

What is Business Research?
It is a systematic inquiry whose objective is to provide information to solve managerial problems (Cooper and Schindler, 2003).

Research and Scientific Method
The scientific method encourages a rigorous, impersonal mode of procedure dictated by the demands of logic and objective procedure. It is based on the following basic postulates:
➢ It relies on empirical evidence
➢ It utilizes relevant concepts
➢ It is committed to only objective considerations
➢ It presupposes ethical neutrality i.e. it aims at nothing but making only adequate and correct statements about population objects
➢ It results into probabilistic predictions
➢ Its methodology is made known to all concerned for critical scrutiny and for use in testing the conclusions through replication.
➢ It aims at formulating most general axioms or what can be termed as scientific theories.

Purpose of Research
➢ To discover new knowledge
➢ To describe a phenomenon
➢ To enable prediction.
➢ To enable control i.e. the ability to regulate the phenomenon under study.
➢ To enable explanation of a phenomenon i.e. accurate observation and measurement of a given phenomenon.
➢ To enable theory development and validation of existing theories. Theory development involves formulating concepts, laws and generalizations about a given phenomenon.
➢ Research provides one with the knowledge and skills needed for the fast-paced decision-making environment

Why Managers need Better Information
➢ Global and domestic competition is more vigorous
➢ Workers, shareholders, customers and the general public are demanding to be included in company decision-making.

➢ Organisations are increasingly practicing data mining and data warehousing.
➢ Communication and measurement techniques within research have been enhanced.
➢ The quality of theories and models to explain tactical and strategic results is improving
➢ The power and ease of use of today's computers to analyze data, which help in decision-making.
➢ There are more variables to consider in every decision.
➢ More knowledge exists in every field of management.

Sources of Knowledge
➢ Research
➢ Experience: Empiricists attempt to describe, explain, and make predictions through observation.
➢ Tradition: Rationalists believe all knowledge can be deduced from known laws or basic truths of nature
➢ Authority: They serve as important sources of knowledge, but should be judged on integrity and willingness to present a balanced case.
➢ Intuition: it is the perception, explanation or insight into phenomena by instinct.

The Value of Acquiring Research Skills
➢ To gather more information before selecting a course of action
➢ To do a high-level research study
➢ To understand research design
➢ To evaluate and resolve a current management dilemma
➢ To establish a career as a research specialist

Definition of basic terms used in research
➢ **Population:** it refers to an entire group of individuals, events or objects having a common observable characteristic.
➢ **Sample:** It is a smaller group obtained from the accessible population.
➢ **Sampling:** It is the process of selecting a number of individuals for a study in such a way that the individuals selected represent the population.
➢ **Variable:** It is a measurable characteristic that assumes different values among the subjects. They can be dependent, independent, intervening, confounding or antecedent variables.
➢ **Data:** refers to all information a researcher gathers for his or her study. Can be secondary data or primary data.
➢ **Parameter**: It is a characteristic that is measurable and can assume different values in the population.
➢ **Statistics:** it is the science of organizing, describing and analyzing data. Descriptive and inferential statistics.
➢ **Objective:** it refers to the specific aspects of the phenomenon under study that the researcher desires to bring out at the end of the research study.
➢ **Literature review:** It involves locating, reading and evaluating reports of previous studies, observations and opinions related to the planned study.

> **Hypothesis:** It is a researcher's anticipated explanation or opinion regarding the result of the study.
> **Theory:** It is a set of concepts or constructs and the interrelations that are assumed to exist among those concepts. It provides the basis for establishing the hypothesis to be tested in the study.
> **A** *construct* is an image or idea specifically invented for a given research and/or theory-building purpose
> **A** *concept* is a bundle of meanings or characteristics associated with certain events, objects, conditions, situations, and behaviors. Concepts have been developed over time through shared usage

Components of research
1. Identification of the research area and topic.
2. Statement of the problem.
3. Literature review.
4. Methodology design
5. Sampling frame and sampling techniques.
6. Data collection tools, design and techniques.
7. Data analysis methods.
8. Report writing techniques.

TYPES OF RESEARCH
Different authors have classified research into various categories.

Qualitative and Quantitative Research
Qualitative Research: It includes designs, techniques and measures that do not produce discrete numerical data. Qualitative data can be collected through direct observation, participant observation or interview method. Qualitative research includes an "array of interpretive techniques which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world. Qualitative research aims to achieve an in-depth understanding of a situation. Qualitative research is designed to tell the researcher how (process) and why (meaning) things happen as they do. Qualitative techniques are used at both the data collection and data analysis stages of a research project. At the data collection stage, the array of techniques includes focus groups, individual depth interviews, case studies, ethnography, grounded theory, action research and observation. During analysis, the qualitative researcher uses content analysis of written or recorded materials drawn from personal expressions by participants and behavioural observations.

Quantitative research: It includes designs, techniques and measures that produce discreet numerical or quantifiable data.

	Qualitative	Quantitative
Focus of research	Understand and interpret	Describe, explain and predict
Researcher involvement	High, researcher is	Limited, controlled to

	participant or catalyst	prevent bias
Research purpose	In-depth understanding : theory building	Describe or predict: Build and test theory
Sample design	Non-probabilistic : purposive	Probabilistic
Research design	May evolve or adjust during the course of the period Often uses multiple methods simultaneously or sequentially Consistency is not expected Involves longitudinal approach	Determined before commencing the project Uses single method or mixed methods Consistency is critical Involves either a cross-sectional or a longitudinal approach
Participant preparation	Pre-tasking is common	No preparation desired to avoid biasing the participant
Data type and preparation	Verbal or pictorial descriptions Reduced to verbal codes	Verbal descriptions Reduced to numerical codes for computerized analysis
Data analysis	Human analysis following computer or human coding	Computerized analysis

Advantages of using both qualitative and quantitative methods
1. Since in many cases a researcher has several objectives, some of these objectives are better assessed using quantitative methods.
2. Both methods supplement each other i.e. qualitative methods provide the in-depth explanations while quantitative methods provide the data needed to test hypotheses.
3. Since both methods have a bias, using both types of research helps to avoid such bias in that each method can be used to check the other.

Disadvantages of using both qualitative and quantitative methods
1. It is expensive
2. Researchers may not have sufficient training in both methods to be able to use them effectively.

Classification by purpose
1. **Basic / Pure / Fundamental Research**
   Basic researchers are interested in deriving scientific knowledge i.e. they are motivated by intellectual curiosity and need to come up with a particular solution. It focuses on generating new knowledge in order to refine or expand existing theories. It does not consider the practical application of the findings to actual problems or situations.
2. **Applied research**

It is conducted for the purpose of applying or testing theory and evaluating its usefulness in solving problems. It provides data to support a theory, guide theory revision or suggest the development of a new theory.

3. **Action research**

   It is conducted with the primary intention of solving a specific, immediate and concrete problem in a local setting e.g. investigating ways of overcoming water shortage in a given area. It is not concerned with whether the results can be generalized to any other setting.

4. **Evaluation Research**

   It is the process of determining whether the intended results were realized.

Types of evaluation research

   i.   *Needs assessment*

   A need is a discrepancy between an existing set of conditions and a desired set of conditions. The results of needs assessment study provide the foundation for developing new programmes and for making changes in existing ones.

   ii. *Formative evaluation*

   Helps to collect data about a programme while it is still being developed e.g. an educational programme, a marketing strategy etc.

   iii. *Summative evaluation*

   It is done after the programme has been fully developed. It is conducted to evaluate how worthwhile the final programme has been especially compared to similar programmes.

Classification by methods of analysis

1. **Descriptive research**

   It is the process of collecting data in order to test hypotheses or to answer questions concerning the current status of the subjects in the study. It determines and reports the way things are. It attempts to describe such things as possible behaviour, attitudes, values and characteristics.

   Steps involved in descriptive research
   - Formulating the objectives of a study
   - Designing the methods of data collection
   - Selecting the sample
   - Data collection
   - Analyzing the results

2. **Causal-comparative research**

   It is used to explore relationships between variables. It determines reasons or causes for the current status of the phenomenon under study. The variables of interest cannot be manipulated unlike in experimental research.

   Steps in causal-comparative research
   - Define the research question
   - Select a group that possesses the characteristics, which the researcher wants to study.
   - Select a comparison group which does not display the characteristics under study but which is similar to the group in other respects.

➢ Collect data on both the experimental and control groups
➢ Analyze the data

Advantages of causal-comparative study

➢ Allows a comparison of groups without having to manipulate the independent variables
➢ It can be done solely to identify variables worthy of experimental investigation
➢ They are relatively cheap.

Disadvantages of causal-comparative study

➢ Interpretations are limited because the researcher does not know whether a particular variable is a cause or result of a behaviour being studied.
➢ There may be a third variable which could be affecting the established relationship but which may not be established in the study.

3. Correlation Methods

It describes in quantitative terms the degree to which variables are related. It explores relationships between variables and also tries to predict a subject's score on one variable given his or her score on another variable.

Steps in correlational research

➢ Problem statement
➢ Selection of subjects
➢ Data collection
➢ Data analysis

Advantages of the correlational method

➢ Permits one to analyze inter-relationships among a large number of variables in a single study.
➢ Allows one to analyze how several variables either singly or in combination might affect a particular phenomenon being studied.
➢ The method provides information concerning the degree of relationship between variables being studied.

Disadvantages of the correlational method

➢ Correlation between two variables does not necessarily imply causation although researchers often tend to interpret such a relationship to mean causation.
➢ Since the correlation coefficient is an index, any two variables will always show a relationship even when commonsense dictates that such variables are not related.
➢ The correlation coefficient is very sensitive to the size of the sample.

Classification by type of research

1. Survey Research

A survey is an attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables. Survey study is therefore a self-report study, which requires the collection of quantifiable information from the sample. It is a descriptive research.

Steps involved in Survey research

➢ Problem statement

> Defining Objectives
> Selecting a Sample
> Preparing the instruments
> Data analysis

Purpose of survey research

i.   It seeks to obtain information that describes existing phenomena by asking individuals about their perceptions, attitudes, behaviour or values.
ii. Can be used for explaining or exploring the existing status of two or more variables, at a given point in time.
iii. It is the most appropriate to measure characteristics of large populations.

Limitations of Survey research

i.   They are dependent on the cooperation of respondents.
ii. Information unknown to the respondents cannot be tapped in a survey e.g. amount saved per year
iii. Requesting information which is considered secret and personal, encourages incorrect answers.
iv. Surveys cannot be aimed at obtaining forecasts of things to come.

2. Historical research

Involves the study of a problem that requires collecting information from the past

Purpose of Historical Research

> Aims at arriving at conclusions concerning causes, effects or trends of past occurrences that may help explain present events and anticipate future events.
> Attempts to interpret ideas or events that had previously seemed unrelated.
> Synthesizes old data or merges old data with new historical facts that the researcher or other researchers have discovered.
> To reinterpret past events that have been studied.

Steps involved in historical research

> Identifying and delineating the problem.
> Developing hypothesis or hypotheses that one is interested in testing.
> Collecting and classifying resource materials, determining facts by internal and external criticism.
> Organizing facts into results
> Interpreting data in terms of stated hypothesis or theory.
> Synthesizing and presenting the research in an organized form.

3. Observational Research

The current status of a phenomenon is determined not by asking but by observing. This helps to collect objective information.

Steps

> Selection and definition of the problem.
> Sample selection.

➢ Definition of the observational information.
➢ Recording observational information
➢ Data analysis and interpretation.

Types of observational research

1. *Non-participant observation*
   The observer is not directly involved in the situation to be observed.
2. *Naturalistic Observation*
   Behaviour is studied and recorded as it normally occurs.
3. *Simulation observation.*
   The researcher creates the situation to be observed and tells subjects to be observed what activities they are to engage in. Disadvantage – the setting is not natural and the behaviour exhibited by the subjects may not be the behaviour that would occur in a natural setting.
4. *Participant observation*
   The observer becomes part of or a participant in the situation. May not be ethical
5. *Case studies*
   A case study is an in-depth investigation of an individual, group, institution or phenomenon. It aims to determine factors and relationships among the factors that have resulted in the behaviour under study.
6. *Content analysis*
   It involves observation and detailed description of objects, items or things that comprise the sample. The purpose is to study existing documents such as books, magazines in order to determine factors that explain a specific phenomenon.
   Steps
➢ Decide on the unit of analysis
➢ Sample the content to be analyzed
➢ Coding
➢ Data analysis
➢ Compiling results and interpretations.

Advantages
➢ Researchers are able to economize in terms of time and money.
➢ Errors that arise during the study are easier to detect and correct.
➢ The method has no effect on what is being studied.

Disadvantages
➢ It is limited to recorded communication.
➢ It is difficult to ascertain the validity of the data.

Characteristics of a Good Research

Following the standards of the scientific method
➢ Purpose clearly defined
➢ Research process detailed
➢ Research design thoroughly planned
➢ Limitations frankly revealed
➢ High ethical standards applied

- ➢ Findings presented unambiguously
- ➢ Conclusions justified
- ➢ Researcher's experience reflected
- ➢ Adequate analysis for decision-maker's needs

IDENTIFICATION OF RESEARCH AREA

The research process starts by formulating a research problem that can be investigated through research procedures.

Identifying a research problem

The first step in selecting a research problem is to identify the broad area that one is interested in. Such an area should be related to the professional interests and goals of the researcher e.g. low-cost housing, productivity of workers, small-scale businesses etc.

The second step is to identify a specific problem within it that will form the basis of the research study. The research problem should be an important one i.e. it should

- ➢ Lead to findings that have widespread implications in a particular area
- ➢ Challenge some commonly held truism
- ➢ Review the inadequacies of existing laws, views or policies
- ➢ Cover a reasonable scope e.g. not too narrow or too general.

Defining the research problem

A research problem refers to some difficulty which the researcher experiences in the context of either a theoretical or practical situation and wants to obtain a solution for the same. A research problem exists if the following conditions are met:-

- ➢ There must be an individual or a group which has some difficulty or the problem.
- ➢ There must be some objective(s) to be attained.
- ➢ There must be alternative means or courses of action for obtaining the objective(s) one wishes to attain.
- ➢ There must be some doubt in the mind of a researcher with regard to the selection of alternatives.
- ➢ There must be some environment(s) to which the difficulty pertains.

Selecting the problem

The following points must be observed by a researcher in selecting a research problem or a subject of study:

- ➢ 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.
- ➢ Controversial subject should not become the choice of an average researcher.
- ➢ Too narrow or too vague problems should be avoided.
- ➢ 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.
- ➢ The importance of the subject, the qualifications and the training of a researcher, the costs involved and the time factor must be considered.
- ➢ The selection of a study must be preceded by a preliminary study.

Defining the problem

It involves the task of laying down boundaries within which a researcher shall study the problem with a predetermined objective in view. The following steps can be followed:-

➢ Statement of the problem in a general way
➢ Understanding the nature of the problem: Understand the origin and nature of the problem e.g. by discussing it with those who raised it in order to find out how the problem originally came about. The researcher should keep in view the environment within which the problem is to be studied and understood.
➢ Surveying the available literature: the researcher must be well conversant with relevant theories in the field, reports and records as also all other relevant literature.
➢ Developing ideas through discussions:
➢ Rephrasing the research problem: Its putting 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.

The following should also be observed when defining a research problem:

➢ Technical terms and words or phrases with special meanings used in the statement of the problem, should be clearly defined.
➢ Basic assumptions or postulates if any relating to the research problem should be clearly stated.
➢ A straight forward statement of the value of the investigation should be provided.
➢ The suitability of the time-period and the sources of data available must also be considered by the researcher in defining the problem.
➢ The scope of the investigation or the limits within which the problem is to be studied must be mentioned explicitly in defining a research problem.

Certain factors determine the scope of a research study. These include:

1. The time available to carry it out
2. The money available to carry it out
3. The availability of equipment if needed to carry it out
4. The availability of subjects or the units of study.

Ways of identifying a specific research problem from the broad area.

(a) Existing theories
(b) Existing literature
(c) Discussions with experts
(d) Previous research studies
(e) Replication
(f) The media
(g) Personal experiences.

Stating the Problem

A research study starts with a brief introductory section. The researcher introduces briefly the general area of study, and then narrows down to the specific problem to be studied.

Characteristics of a good problem statement
- It should be written clearly and in such a way that the reader's interest is captured immediately.
- The specific problem identified in the problem statement should be objectively researchable
- The scope of the specific research problem should be indicated
- The importance of the study in adding new knowledge should be stated clearly
- The problem statement must give the purpose of the research.

STATING THE PURPOSE

The purpose of a study crystallizes the researcher's inquiry into a particular area of knowledge in a given field. If the purpose is accurately expressed, the research process will be carried out with ease. The purpose of the study should meet the following criteria:
- It must be indicated clearly, unambiguously and in a declarative manner.
- The purpose should indicate the concepts or variables in the study.
- Where possible, the relationships among the variables should be stated.
- The purpose should state the target population.
- The variables and target population given in the purpose should be consistent with the variables and target population operationalised in the methods section of the study.

In stating the purpose of the study, the researcher should choose the right words to convey the focus of the study effectively. Use of subjective or biased words or sentences should be avoided.

Examples

Biased	Neutral
To show	To determine
To prove	To compare
To confirm	To investigate
To verify	To differentiate
To check	To explore
To demonstrate	To find out
To indicate	To examine
To validate	To inquire
To explain	To establish
To illustrate	To test

STATING THE OBJECTIVES

Research objectives are those specific issues within the scope of the stated purpose that the researcher wants to focus upon and examine in the study.

Characteristics of a good objective
- Specific:
- Measurable
- Achievable
- Reliable
- Time bound

Objectives guide the researcher in formulating testable hypotheses.

In stating the objectives of the study, the researcher should choose the right words to convey the focus of the study effectively. Use of subjective or biased words or sentences should be avoided.

FORMULATING HYPOTHESES

A hypothesis is a researcher's prediction regarding the outcome of the study. It states possible differences, relationships or causes between two variables or concepts. Hypothesis are derived from or based on existing theories, previous research, personal observations or experiences. The test of a hypothesis involves collection and analysis of data that may either support or fail to support the hypothesis. If the results fail to support a stated hypothesis, it does not mean that the study has failed but it implies that the existing theories or principles need to be revised or retested under various situations.

Purpose of hypothesis
- It provides direction by bridging the gap between the problem and the evidence needed for its solution.
- It ensures collection of the evidence necessary to answer the question posed in the statement of the problem.
- It enables the investigator to assess the information he or she has collected from the standpoint of both relevance and organisation.
- It sensitizes the investigator to certain aspects of the situation that are relevant regarding the problem at hand.
- It permits the researcher to understand the problem with greater clarity and use the data to find solutions to problems.
- It guides the collection of data and provides the structure for their meaningful interpretation in relation to the problem under investigation.
- It forms the framework for the ultimate conclusions as solutions.

Characteristics of a good hypothesis
A sound review of literature or of existing theories often leads to good hypothesis.
1. Should state clearly and briefly the expected relationships between variables.
2. Must be based on a sound rationale derived from theory or previous research or professional experience.
3. Must be consistent with common sense or generally accepted truths.
4. Must be testable.
5. Must be related to empirical phenomena. Words like ought, should, bad should be avoided since they reflect moral judgment.
6. Should be testable within a reasonable time.
7. Variables stated in the hypothesis must be consistent with the purpose statement,

objectives and operationalised variables in the method section.

8. Must be as simple and as concise as the complexity of the concepts involved allows.
9. It must be stated in such a way that its implications can be deduced in the form of empirical operations with respect to which relationship can be validated or refuted.

Assumptions and Limitations

➢ An assumption is any fact that a researcher takes to be true without actually verifying it. It puts some boundary around the study and provides the reader with vital information, which influences the way results of the study are interpreted.

➢ A limitation is an aspect of a research that may influence the results negatively but over which the researcher has no control. A common limitation in social science studies is the scope of the study, which sometimes may not allow generalizations. Sample size may also be another limitation.

LITERATURE REVIEW

The review of literature involves the systematic identification, location and analysis of documents containing information related to the research problem being investigated. It should be extensive and thorough because it is aimed at obtaining detailed knowledge of the topic being studied.

Purpose of literature review

➢ To determine what has already been done related to the research problem being studied. This will help the researcher to:
- Avoid unnecessary and unintentional duplication.
- Form the framework within which the research findings are to be interpreted.
- Demonstrate his or her familiarity with the existing body of knowledge.

➢ Helps reveal the strategies, procedures and measuring instruments that have been found useful in investigating the problem in question. This will help the researcher to:
- Avoid mistakes that have been made by other researchers
- Benefit from other researcher's experiences
- Clarify how to use certain procedures, which one may only have learned in theory.

➢ Helps to suggest other procedures and approaches, which will help, improve the research study.

➢ Familiarizes the researcher with previous studies, which facilitates interpretation of the results of the study. If there is a contradiction, the literature review might provide rationale for the discrepancy.

➢ It helps the researcher to limit the research problem and to define it better.

➢ Helps to determine new approaches and stimulates new ideas. The researcher may be alerted to research possibilities, which have been overlooked in the past.

➢ Approaches that have been proved to be futile will be revealed through literature review.

➢ Specific suggestions and recommendations for further research can be found by reviewing literature.

➢ It pulls together, integrates and summarizes what is known in an area. Thus helping to reveal gaps in information and areas where major questions still remain.

Steps in carrying out literature review
1. Familiarize yourself with the library before beginning the literature review.
2. Make a list of key words or phrases to guide your literature search.
3. With the key words and phrases related to the study, one should go to the source of literature.
4. Summarize the references on cards for easy organisation of the literature.
5. Once collected, the literature should be analyzed, organized and reported in an orderly manner.
6. Make an outline of the main topics or themes in order of presentation.
7. Analyze each reference in terms of the outline made and establish where it will be most relevant.
8. The literature should be organized in such a way that the more general is covered first before the researcher narrows down to that which is more specific to the research problem.

Sources of literature
(a) *Primary sources*: are direct descriptions of any occurrence by an individual who actually observed or witnessed the occurrence.
(b) *Secondary source*: they include any publications written by an author who was not a direct observer or participant in the events described.

Examples
➢ Scholarly journals
➢ Theses and dissertations
➢ Government documents
➢ Papers presented at conferences
➢ Books
➢ References quoted in books
➢ International indices
➢ Abstracts
➢ Periodicals
➢ The Africana section of the library
➢ Reference section of the library
➢ Grey literature
➢ Inter-library loan
➢ The British lending library
➢ The internet
➢ Microfilm

Evaluating information sources
Researchers evaluate and select information sources based on five factors that can be applied to any type of source, whether printed or electronic. These are:-

RESEARCH METHODS NOTES

(a) **Purpose:** The purpose is what the author is trying to accomplish e.g. to enlighten, to define terms, to entertain etc.

(b) **Scope:** what is the date of publication? What time period does this source cover? How much of the topic is covered and to what depth? Is the material covered local, regional or international?

(c) **Authority:** The author and the author's credentials should be given both in printed and electronic sources.

(d) **Audience:** When evaluating the plausible audience of a source, look for key indicators including vocabulary, types of information and questions or directions that guide the search.

(e) **Format:** It relates to how the information is presented and how easy it is to find a specific piece of information.

Tips on good review of literature
- Do not conduct a hurried review for fear of overlooking important studies.
- Do not rely too heavily on secondary sources.
- Check daily newspapers as they contain very educative, current information.
- Copy the references correctly in the first place so as to avoid the frustration of trying to retrace a reference later.
- Do not only concentrate on findings, check on methodology and measurement of variables.

ETHICS IN RESEARCH

Ethics are norms or standards of behaviour that guide moral choices about our behaviour and our relationship with others. Ethics differ from legal constraints, in which generally accepted standards have defined penalties that are universally enforced. The goal of ethics in research is to ensure that no one is harmed or suffers adverse consequences from research activities.

As the research is designed, several ethical considerations must be balanced e.g.
- Protect the rights of the participant or subject.
- Ensure the sponsor receives ethically conducted and reported research.
- Follow ethical standards when designing research
- Protect the safety of the researcher and team
- Ensure the research team follows the design

1. Ethical treatment of participants

In general, the research must be designed in such a manner that the respondent does not suffer physical harm, discomfort, pain, embarrassment or loss to privacy. To safeguard against these, the researcher should follow the following guidelines:
- Explain the study benefits
- Obtain informed consent
- Explain respondents rights and protection

(a) **Benefits**

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RESEARCH METHODS NOTES

Whenever direct contact is made with a respondent, the researcher should discuss the study benefits, being careful to neither overstate nor understate the benefits. An interviewer should begin an introduction with his or her name, the name of the research organisation and a brief description of the purpose and benefits of the research. This puts the respondent at ease, lets them know to whom they are speaking and motivates them to answer questions truthfully. Inducements to participate, financial or otherwise, should not be disproportionate to the task or presented in a fashion that results in coercion.

Deception occurs when the respondents are told only part of the truth or when the truth is fully compromised. The benefits to be gained by deception should be balanced against the risks to the respondents. When possible, an experiment or interview should be designed to reduce reliance on deception. In addition, the respondent's rights and well-being must be adequately protected. In instances where deception in an experiment could produce anxiety, a subject's medical condition should be checked to ensure that no adverse physical harm follows.

(b) Informed consent
Securing informed consent from respondents is a matter of fully disclosing the procedures of the proposed survey or other research design before requesting permission to proceed with the study. There are exemptions that argue for a signed consent form. When dealing with children, it is wise to have a parent or other person with legal standing sign a consent form. If the researchers offer only limited protection of confidentiality, a signed form detailing the types of limits should be obtained. For most business research, oral consent is sufficient.

In situations where respondents are intentionally or accidentally deceived, they should be debriefed once the research is complete. Debriefing involves several activities following the collection of data e.g.
- Explanation of any deception.
- Description of the hypothesis, goal or purpose of the study.
- Post study sharing of results.
- Post study follow-up medical or psychological attention.

According to Neuman and Wiegand (2000), a full blown consent statement would contain the following: -
- A brief description of the purpose and procedure of the research, including the expected duration.
- A statement of any risks, discomforts or inconveniences associated with participation.
- A guarantee of anonymity or at least confidentiality, and an explanation of both.
- The identification, affiliation and sponsorship of the research as well as contact information.
- A statement that participation is completely voluntary and can be terminated at any time without penalty.
- A statement of any procedures that may be used.
- A statement of any benefits to the class of subjects involved.
- An offer to provide a free copy of a summary of the findings.

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(c) Rights to privacy

All individuals have a right to privacy and researchers must respect that right. The privacy guarantee is important not only to retain validity of the research but also to protect respondents. Once the guarantee of confidentiality is given, protecting that confidentiality is essential. The researcher can protect respondent's confidentiality in several ways, which include: -

- ➢ Obtaining signed nondisclosure documents
- ➢ Restricting access to respondent identification.
- ➢ Revealing respondent information only with written consent.
- ➢ Restricting access to data instruments where the respondent is identified.
- ➢ Nondisclosure of data subsets.

Researchers should restrict access to information that reveals names, telephone numbers, address or other identifying features. Only researchers who have signed nondisclosure, confidentiality forms should be allowed access to the data. Links between the data or database and the identifying information file should be weakened. Individual interview response sheets should be inaccessible to everyone except the editors and data entry personnel.

Occasionally, data collection instruments should be destroyed once the data are in a data file. Data files that make it easy to reconstruct the profiles or identification of individual respondents should be carefully controlled. For very small groups, data should not be made available because it is often easy to pinpoint a person within the group. Employee-satisfaction survey feedback in small units can be easily used to identify an individual through descriptive statistics.

Privacy is more than confidentiality. A right to privacy means one has the right to refuse to be interviewed or to refuse to answer any question in an interview. Potential participants have a right to privacy in their own homes, including not admitting researchers and not answering telephones. They have the right to engage in private behaviour in private places without fear of observation. To address these rights, ethical researchers can do the following:-

- ➢ Inform respondents of their right to refuse to answer any questions or participate in the study.
- ➢ Obtain permission to interview respondents
- ➢ Schedule field and phone interviews.
- ➢ Limit the time required for participation.
- ➢ Restrict observation to public behaviour only.

2. Ethics and the sponsor

There are ethical considerations to keep in mind when dealing with the research client or sponsor. Whether undertaking product, market, personnel, financial or other research, a sponsor has the right to receive ethically conducted research.

(a) Confidentiality

Sponsors have a right to several types of confidentiality including sponsor nondisclosure, purpose nondisclosure and findings nondisclosure.

- ➢ **Sponsor nondisclosure**: Companies have a right to dissociate themselves from the sponsorship of a research project. Due to the sensitive nature of the management dilemma or the research question, sponsors may hire an outside consulting or research firm to complete research projects. this is often done when a company is testing a new product idea, to avoid potential consumers from being influenced by the company's current image or industry standing. If a company is contemplating entering a new market, it may not wish to reveal its plans to competitors. In such cases, it is the responsibility of the researcher to respect this desire and device a plan to safeguard the identity of the sponsor.
- ➢ **Purpose nondisclosure**: It involves protecting the purpose of the study or its details. A research sponsor may be testing a new idea that is not yet patented and may not want the competitor to know his plans. It may be investigating employee complaints and may not want to spark union activity. The sponsor might also be contemplating a new public stock offering, where advance disclosure would spark the interest of authorities or cost the firm thousands of shillings.
- ➢ **Findings nondisclosure**: If a sponsor feels no need to hide its identity or the study's purpose, most sponsors want research data and findings to be confidential, at least until the management decision is made.

(b) Right to quality research

An important ethical consideration for the researcher and the sponsor is the sponsor's right to quality research. The right entails:

- ➢ Providing a research design appropriate for the research question.
- ➢ Maximizing the sponsor's value for the resources expended
- ➢ Providing data handling and reporting techniques appropriate for the data collected.

From the proposal through the design to data analysis and the final report, the researcher guides the sponsor on the proper techniques and interpretations. Often sponsors would have heard about sophisticated data handling technique and will want it used even when it is inappropriate for the problem at hand. The researcher should propose the design most suitable for the problem. The researcher should not propose activities designed to maximize researcher revenue or minimize researcher effort at the sponsor's expense. The ethical researcher should report findings in ways that minimize the drawing of false conclusions. He should also use charts, graphs and tables to show the data objectively, despite the sponsor's preferred outcomes.

(c) Sponsor's Ethics

Occasionally, research specialists may be asked by sponsors to participate in unethical behaviour. Compliance by the researcher would be a breach of ethical standards. Some examples to be avoided are:

- ➢ Violating respondent confidentiality
- ➢ Changing data or creating false data to meet a desired objective
- ➢ Changing data presentations or interpretations.
- ➢ Interpreting data from a biased perspective.

➢ Omitting sections of data analysis and conclusions.
➢ Making recommendations beyond the scope of the data collected.

The ethical course often requires confronting the sponsor's demand and taking the following actions: -
➢ Educating the sponsor on the purpose of research
➢ Explain the researcher's role in fact finding versus the sponsor's role in decision-making.
➢ Explain how distorting the truth or breaking faith with respondents leads to future problems
➢ Failing moral suasion, terminate the relationship with the sponsor.

3.   Researchers and team members
Researchers have an ethical responsibility to their team's safety as well as their own and also protecting the anonymity of both the sponsor and the respondent.
   (a) Safety
It is the researcher's responsibility to design a project so the safety of all interviewers, surveyors, experimenters, or observers is protected. Several factors may be important to consider in ensuring a researcher's right to safety e.g. some urban areas and undeveloped rural areas may be unsafe for research assistants, therefore a team member can accompany the researcher. It is unethical to require staff members to enter an environment where they feel physically threatened. Researchers who are insensitive to these concerns face both research and legal risks.

   (b) Ethical behaviour of assistants
Researchers should require ethical compliance from team members just as sponsors expect ethical behaviour from the researcher. Assistants are expected to carry out the sampling plan, to interview or observe respondents without bias and to accurately record all necessary data. Unethical behaviour such as filling in an interview sheet without having asked the respondent the questions cannot be tolerated. The behaviour of the assistants is under the direct control of the responsible researcher or field supervisor. If an assistant behaves improperly in an interview or shares a respondents interview sheet with unauthorized person, it is the researcher's responsibility. All researchers' assistants should be well trained and supervised.

   (c) Protection of anonymity
Researchers and assistants protect the confidentiality of the sponsor's information and the anonymity of the respondents. Each researcher handling data should be required to sign a confidentiality and nondisclosure statement.

RESEARCH DESIGN

Definition of research design
Kerlinger, N.F (1986) defines research design as
    " The plan and structure of investigation so conceived as to obtain answers to research questions. The plan is overall scheme or program of the research. It

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includes an outline of what the investigator will do from writing hypotheses and their operational implications to the final analysis of data….a research design expresses both the structure of the research problem and the plan of investigation used to obtain empirical evidence on relations of the problem"

Therefore a research design is the strategy for a study and the plan by which the strategy is to be carried out. It specifies the methods and procedures for the collection, measurement, and analysis of data.

ESSENTIALS OF RESEARCH DESIGN
The design:
➢ Is an activity and time based plan
➢ Is always based on the research question
➢ Guides the selection of sources and types of information
➢ Is a framework for specifying the relationships among the study's variables
➢ Outlines procedures for every research activity.

CLASSIFICATIONS OF DESIGNS
Research can be classified using eight different descriptors as shown in the table below:

Category	Options
The degree to which the research questions has been crystallized	➢ Exploratory study ➢ Formal study
The method of data collection	➢ Monitoring ➢ Interrogation / communication
The power of the researcher to produce effects in the variables under study	➢ Experimental ➢ Ex post facto
The purpose of the study	➢ Descriptive ➢ Causal
The time dimension	➢ Cross-sectional ➢ Longitudinal
The topical scope – breath and depth of the study	➢ Case ➢ Statistical study
The research environment	➢ Field setting ➢ Laboratory research ➢ Simulation
The participants perceptions of research activity	➢ Actual routine ➢ Modified routine

1. Degree to which the research questions has been crystallized
A study may be viewed as exploratory study or formal study. The essential distinctions between these two options are the degree of structure and the immediate objective of the study.
➢ **Exploratory studies** tend toward loose structures with the objective of discovering future research tasks. Its immediate purpose is to develop hypotheses or questions for further study.

➢ **Formal study** begins where the exploration leaves off- it begins with a hypothesis or research question and involves precise procedures and data source specifications. Its goal is to test the hypotheses or answer the research questions posed.

2. **Method of data collection**
➢ **Monitoring:** It includes studies in which the researcher inspects the activities of a subject or the nature of some material without attempting to elicit responses from anyone e.g. an observation of the actions of a group of decision makers.

➢ **Interrogation / communication**: the researcher questions the subjects and collects their responses by personal or impersonal means. The collected data may result from
   i.   Interview or telephone conversations
   ii.   Self-administered or self-reported instruments sent through the mail, left in convenient locations, or transmitted electronically or by other means
   iii. Instruments presented before and / or after a treatment or stimulus condition in an experiment.

3. **Researcher control of variables**
➢ **Experimental**: the researcher attempts to control and / or manipulate the variables in the study. It is appropriate when one wishes to discover whether certain variables produce effects in other variables. Experimentation provides the most powerful support for a hypothesis of causation.
➢ **Ex post facto**: Investigators have no control over the variables in the sense of being able to manipulate them. They can only report what has happened or what is happening. It is important that the researcher's using this design do not influence the variables since doing so will introduce bias. The researcher is limited to holding factors constant by judicious selection of subjects according to strict sampling procedures and by statistical manipulation of findings.

4. **Purpose of the study**
➢ **Descriptive study**: it is a research that is concerned with finding out who, what, where, when, or how much.
➢ **Causal study**: It is concerned with learning why i.e. how one variable produces changes in another. It tries to explain the relationships among variables.

5. **The time dimension**
➢ **Cross-sectional studies**: they are carried out once and represent a snapshot of one point in time.
➢ **Longitudinal studies**: are repeated over an extended period. It tracks changes over time.
6. **The topical scope**
   ➢ **Statistical studies:** they are designated for breadth rather than depth. They attempt to capture a population's characteristics by making inferences from a sample's characteristics. Hypotheses are tested quantitatively. Generalizations about findings are presented based on the representativeness of the sample and the validity of the design.

> ➢ **Case studies:** they place more emphasis on a full contextual analysis of fewer events or conditions and their interrelations. Although hypotheses are often used, the reliance on qualitative data makes support or rejection more difficult. An emphasis on detail provides valuable insight for problem solving, evaluation and strategy. This detail is secured from multiple sources of information. It allows evidence to be verified and avoids missing data.

7. The research environment
➢ **Field setting**: it is where the research occurs under actual environmental conditions
➢ **Laboratory research:** it is where the research occurs under staged or manipulated conditions
➢ **Simulation:** To simulate is to replicate the essence of a system or process. Simulations are increasingly used in operations research. The major characteristics of various conditions and relationships in actual situations are often represented in mathematical models. Role-playing and other behavioural activities may also be viewed as simulations.

8. Participants' perceptions
The usefulness of a design may be reduced when people in a disguised study perceive that research is being conducted. Participants' perceptions influence the outcomes of the research in subtle ways. There are three levels of perception:
➢ Participants perceive no deviations from everyday routines
➢ Participants perceive deviations, but as unrelated to the researcher.
➢ Participants perceive deviations as researcher-induced.
In all research environments and control situations, researchers need to be vigilant to effects that may alter their conclusions. Participant's perceptions serve as a reminder to classify one's study by type, to examine validation strengths and weaknesses and to be prepared to qualify results accordingly.

MAJOR TYPES OF RESEARCH DESIGN
(a) Exploratory studies
Exploration is particularly useful when researchers lack a clear idea of the problems they will meet during the study. Through exploration researchers develop concepts more clearly, establish priorities, develop operational definitions and improve the final research design. Other factors that necessitate the use of exploration are
➢ To save time and money
➢ If the area of investigation is new
➢ Important variables may not be known or thoroughly defined
➢ Hypothesis for the research may be needed
➢ A researcher can explore to be sure if it is practical to do a formal study in the area.

Despite its obvious value, researchers and managers give exploration less attention that it deserves. Exploration is sometimes linked to old biases about qualitative research i.e. subjective ness, non-representativeness and non-systematic design.

When we consider the scope of qualitative research, several approaches are adaptable for exploratory investigations of management questions:
- In-depth interviewing – usually conversational rather than structured.
- Participant observation – to perceive first hand what participants in the setting experience
- Films, photographs and videotapes – to capture the life of the group under study.
- Case studies – for an in-depth contextual analysis of a few events or conditions
- Document analysis – to evaluate historical or contemporary confidential or public records, reports, government documents and opinions.

Where these approaches are combined, four exploratory techniques emerge with wide applicability for the management researcher: -
    i.   Secondary data analysis
    ii.   Experience surveys
    iii. Focus groups
    iv. Two-stage designs

An exploratory research is finished when the researchers have achieved the following:
- Established the major dimensions of the research task
- Defined a set of subsidiary investigative questions that can be used as a guide to a detailed research design.
- Developed several hypotheses about possible causes of a management dilemma. Learned that certain other hypotheses are such remote possibilities that they can be safely ignored in any subsequent study.
- Concluded additional research is not needed or is not feasible.

(b) Descriptive Studies

It is the process of collecting data in order to test hypotheses or to answer questions concerning the current status of the subjects in the study. It determines and reports the way things are. Provides answers to questions like Who? What? When? Where? How? It attempts to describe such things as possible behaviour, attitudes, values and characteristics.

(c) Causal Research

It is used to explore relationships between variables. It determines reasons or causes for the current status of the phenomenon under study. The variables of interest cannot be manipulated unlike in experimental research.

Advantages of causal study
- Allows a comparison of groups without having to manipulate the independent variables
- It can be done solely to identify variables worthy of experimental investigation
- They are relatively cheap.

Disadvantages of causal study
- Interpretations are limited because the researcher does not know whether a particular variable is a cause or result of a behaviour being studied.
- There may be a third variable which could be affecting the established relationship but which may not be established in the study.

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(d) Correlation Methods

It describes in quantitative terms the degree to which variables are related. It explores relationships between variables and also tries to predict a subject's score on one variable given his or her score on another variable.

Advantages of the correlational method
  - Permits one to analyze inter-relationships among a large number of variables in a single study.
  - Allows one to analyze how several variables either singly or in combination might affect a particular phenomenon being studied.
  - The method provides information concerning the degree of relationship between variables being studied.

Disadvantages of the correlational method
  - Correlation between two variables does not necessarily imply causation although researchers often tend to interpret such a relationship to mean causation.
  - Since the correlation coefficient is an index, any two variables will always show a relationship even when commonsense dictates that such variables are not related.
  - The correlation coefficient is very sensitive to the size of the sample.

THE SAMPLE DESIGN

It refers to the techniques of the procedure the researcher would adopt in selecting items for the sample.

Population: It's a complete set of individuals, cases or objects with some observable characteristics.

A census is a count of all the elements in a population.

Sample: A sample is a subset of a particular population. The target population is that population to which a researcher wants to generalize the results of the study. There must be a rationale for defining and identifying the accessible population from the target population.

Sampling; It's the process of selecting a sample from a population.

Reasons for sampling
  - Cost
  - Time: Greater speed of data collection
  - Destructive nature of certain tests
  - Greater accuracy of results
  - Physical impossibility of checking all items in the population.
  - Availability of population elements.

Factors to consider in developing a sample design
1. Type of universe; finite or infinite
2. Sampling unit; geographic: state, district or village, construction unit: house, flat. Social unit: family, club, school or individual.

3. Source list: sampling frame- contains all the names of all items of a universe. The list should be comprehensive, correct, reliable and appropriate.
4. The size of the sample. Should be efficient, representative, reliable and flexible.
5. Parameters of interest
6. Budgetary constraint
7. Sampling procedure.

Criteria for selecting a sampling procedure
Two costs are involved in a sampling analysis i.e. the cost of collecting the data and the cost of an incorrect inference resulting from the data. Two causes of incorrect inferences are systematic bias and sampling error. A systematic bias results from errors in the sampling procedures and it cannot be reduced or eliminated by increasing the sample size. Systematic bias is the result of the following factors:-
➢   Inappropriate sampling frame
➢   Defective measuring device
➢   Non-respondents
➢   Indeterminancy principle – individuals act differently when kept under observation.
➢   Natural bias in reporting data e.g. government tax – downward bias, social organizations – upward bias.
Sampling errors are the random variations in the sample estimates around a true population parameter. It decreases with the increase in the size of the sample and it happens to be of a smaller magnitude in case of a homogenous population. While selecting a sampling procedure, the researcher must ensure that the procedure causes a relatively small sampling error and helps to control the systematic bias in a better way.

Steps in sampling design
Identification of the: -
➢   Relevant population
➢   Type of universe i.e. finite or infinite
➢   Parameters of interest
➢   Sampling frame
➢   Type of sample i.e. probabilistic or non-probabilistic
➢   Size of the sample needed

Characteristics of a good sample design
➢   Must result in a truly representative sample
➢   Must result in a small sampling error
➢   Must be viable in the context of funds available for the research study
➢   Must ensure that systematic bias is controlled in a better way
➢   Must be such that the results of the sample study can be applied in general for the universe with a reasonable level of confidence.

Characteristics of a good sample
➢   *Accuracy*: It's the degree to which bias is absent from the sample. An unbiased sample is the one in which the underestimators and the overestimators are balanced among the members of the sample.

➢ *Precision of estimate*: Precision is measured by the standard error of estimate a type of standard deviation measurement. The smaller error of estimate, the higher is the preciseness of the sample.

Factors that influence the sample size
➢ *Dispersion / variance*: The greater the dispersion or variance within the population, the larger the sample must be to provide estimation precision.
➢ *Precision of the estimate*: the greater the desired precision of the estimate, the larger the sample must be.
➢ *Interval range*: The narrower the interval range, the larger the sample must be.
➢ *Confidence level*: The higher the confidence level in the estimate, the larger the sample must be.
➢ *Number of subgroups*: The greater the number of subgroups of interest within a sample, the greater the sample size must be, as each subgroup must meet minimum sample size requirements.
➢ If the calculated sample size exceeds 5% of the population, sample size may be reduced without sacrificing precision.

Sampling procedures:
There are two major ways of selecting samples;
➢ Probability sampling methods
➢ Non - Probability sampling methods

1. Probability Sampling Methods
Samples are selected in such a way that each item or person in the population has a known (Nonzero) likelihood of being included in the sample.

Types of Probability sampling methods
a) **Simple Random Sampling**:
A sample is selected so that each item or person in the population has the same chance of being included.
Advantages
➢ Easy to implement with automatic dialing and with computerized voice response systems.
Disadvantages
➢ Requires a listing of population elements.
➢ Takes more time to implement
➢ Uses larger sample sizes
➢ Produces larger errors
➢ Expensive

b) **Systematic Random Sampling**:
The items or individuals of the population are arranged in some manner. A random starting point is selected and then every k^{th} member of the population is selected for the sample.
Advantages
➢ Simple to design

➢ Easier to use than the simple random.
➢ Easy to determine sampling distribution of mean or proportion.
➢ Less expensive than simple random.

Disadvantages
➢ Periodicity within the population may skew the sample and results.
➢ If the population list has a monotonic trend, a biased estimate will result based on the start point.

c) **Stratified Random Sampling:**

A population is   divided into subgroups called strata and a sample is selected from each stratum. After the population is divided into strata, either a proportional or a non-proportional sample can be selected. In a proportional sample, the number of items in each stratum is in the same proportion as in the population while in a non-proportional sample, the number of items chosen in each stratum is disproportionate to the respective numbers in the population.

Advantages
➢ Researcher controls sample size in strata
➢ Increased statistical efficiency
➢ Provides data to represent and analyze subgroups.
➢ Enables use of different methods in strata.

Disadvantages
➢ Increased error will result if subgroups are selected at different rates
➢ Expensive especially if strata on the population have to be created.

d) **Cluster Sampling:**

The population is divided into internally heterogeneous subgroups and some are randomly selected for further study. It is used when it is not possible to obtain a sampling frame because the population is either very large or scattered over a large geographical area. A multi-stage cluster sampling method can also be used.

Advantages
➢ Provides an unbiased estimate of population parameters if properly done.
➢ Economically more efficient than simple random.
➢ Lowest cost per sample, especially with geographic clusters.
➢ Easy to do without a population list.

Disadvantages
➢ More error (Lower statistical efficiency) due to subgroups being homogeneous rather the heterogeneous.

2.   Non - Probability Sampling Methods

It is used when a researcher is not interested in selecting a sample that is representative of the population.

a) **Convenience or Accidental Sampling**

It involves selecting cases or units of observation as they become available to the researcher e.g. asking a question to the radio listeners, roommates or neighbours.

b) **Purposive Sampling:** There are two main types; judgmental and quota

i. **Judgement Sampling**: Occurs when a researcher selects sample members to conform to some criterion. It allows the researcher to use cases that have the required information with respect to the objectives of his or her study e.g. educational level, age group, religious sect etc.

ii. **Quota Sampling**

The researcher purposively selects subjects to fit the quotas identified e.g.
  ➢ Gender: Male or Female.
  ➢ Class Level: Graduate or Undergraduate
  ➢ School: Humanities, Science or human resource development.
  ➢ Religion: Muslim, Protestant, catholic, Jewish.
  ➢ Fraternal affiliation: member or nonmember.
  ➢ Social economic class: Upper, middle or lower.

Advantage
Widely used by pollsters, marketers and other researchers.
Disadvantages
  ➢ It gives no assurance that the sample is representative of the variables being studied.
  ➢ The data used to provide controls may be outdated or inaccurate.
  ➢ There is a practical limit on the number of simultaneous controls that can be applied to ensure precision.
  ➢ Since the choice of subjects is left to field workers, they may choose only friendly looking people.

c)   Snow ball sampling
It is used when the population that possesses the characteristics under study is not well known and can be best located through referral networks. It is used when the sample characteristic is rare. Initial subjects are identified who in turn identify others. Commonly used in drug cultures, teenage gang activities, Mungiki sect, insider trading, Mau Mau etc.

Sampling error
It's the difference between a sample statistic and its corresponding population parameter. The sampling distribution of the sample means is a probability distribution of possible sample means of a given sample size.

Statistical Inference
Sample information is used to shade some light on the population characteristics i.e. we infer population properties based on findings on the sample. Statistical inference falls into two main areas i.e. statistical estimation and hypothesis testing.
Statistical Estimation: The characteristics of the sample (sample statistic) are used to estimate or approximate some unknown population characteristics.
Hypothesis testing: The population characteristics are known or assumed. The sample characteristics are used to verify or ascertain this assumed or known population characteristic. The assignment of values to a population parameter is based on a sample is called **estimation.** The value assigned to a population parameter based on the value of a sample statistic is called **an estimate** of the population parameter. The sample statistic

used to estimate a population parameter is called **an estimator.** Estimation can be undertaken in two forms namely, Point estimation or Interval estimation

Selecting the sample size to estimate a population mean

One of the most common questions asked of statisticians is, how large should the sample taken in a survey be? The answer to this question depends on three factors:-

   i.   The parameter to be estimated

   ii. The desired confidence level of the interval estimator

   iii. The maximum error of estimation, where **error of estimation** is the absolute difference between the point estimator and the parameter e.g. the point estimator of μ is $\bar{x}$ so that the error of estimation $= \left| \bar{x} - \mu \right|$

The maximum error of estimation is also called the **error bound** and is denoted B. Suppose the parameter of interest in an experiment is the population mean μ. The confidence interval estimator (assuming a normal population, with the population variance known) is $\bar{x} \pm z_{\alpha/2} \dfrac{\sigma}{\sqrt{n}}$. If we want to estimate μ to within a certain specified bound B, we will want the confidence interval estimator to be $\bar{x} \pm B$. As a consequence, we have $z_{\alpha/2} \dfrac{\sigma}{\sqrt{n}} = B$. Solving for n, we get the following result $n = \left[\dfrac{z_{\alpha/2}\sigma}{B} \right]^2$

A popular method of approximating σ is to begin by approximating the range of the random variable. A conservative estimate of σ is the range divided by 4 i.e. $\sigma \approx \dfrac{\text{Range}}{4}$. This produces a larger value of σ, which results in a larger value of n, which then estimates μ with an interval at least as good as was specified.

Examples

1. A production manager would like to estimate the mean time required for workers to complete a task on an assembly line. Assume that she knows that σ is 80 seconds. How large a sample should she draw to estimate μ to within 5 seconds with (i) 90% confidence (ii) 95% confidence (iii) 99% confidence

2. Find n, given that we want to estimate μ to within 10 units with 95% confidence, assuming that $\sigma = 100$

3. The operations manager of a large production plant would like to estimate the average amount of time a worker takes to assemble a new electronic component. After observing a number of workers assembling similar devices, she noted that the shortest time taken was 10 minutes and the longest time taken was 22 minutes. How large a sample of workers should she take if she wants to estimate the mean assembly time to within 20 seconds? Assume that the confidence level is to be 99%.

4. Determine the sample size necessary to estimate μ to within 10 units with 99% confidence. We know that the range of the population is 200 units.

Selecting the sample size to estimate a population proportion

The sample size necessary to estimate p is $\; n = \left[\dfrac{z_{\alpha/2} \sqrt{\hat{p}\hat{q}}}{B} \right]^2$

1. The manager of a bank feels that 35% of branches will have enhanced yearly collection of deposits after introducing a hike in interest rate. Determine the sample size such that the mean proportion is within plus or minus 0.06 at a confidence level of (i) 90% (ii) 95% and (iii) 99%.

2. How large a sample should be taken in order to estimate p to within 0.01 with 95% confidence ? assume that

   a) You have no information about the value of p

   b) p is believed to be approximately 0.10

   c) p is believed to be approximately 0.90

3. The director of a management school feels that 55% of students will have enhanced performance if additional input is given to them. Determine the sample size such that the mean proportion is within plus or minus 0.10 at a confidence level of 95%.

<u>MEASUREMENT</u>

Introduction

While people measure things casually in daily life, research measurement is more precise and controlled. In measurement, one settles for measuring properties of the objects rather than the objects themselves. An event is measured in terms of its duration i.e. what happened during it, who was involved, where it occurred etc. Measurement is the basis for all systematic inquiry because it provides us with the tools for recording differences in the outcome of variable change.

Definition of Measurement

Measurement is the procedure by which we assign numerals, numbers, or other distinguishing values to variables according to rules. These rules help us determine the kinds of values we will assign to certain observable phenomena or variables. They also determine the quality of measurement. Precision and exactness in measurement are vitally important. The measures are what are actually used to test the hypotheses. A researcher needs good measures for both independent and dependent variables.

Measurement is a three – part process that includes:-

 i.   Selecting observable empirical events
 ii.   Developing a set of mapping rules: a scheme for assigning numbers or symbols to represent aspects of the event being measured.
 iii. Applying the mapping rules to each observation of that event

Mapping rules have four characteristics:-

 1. **Classification**: Numbers are used to group or sort responses. No order exists.
 2. **Order:** Numbers are ordered. One number is greater than, less than or equal to another number.
 3. **Distance:** Differences between numbers are ordered. The difference between any pair of numbers is greater than, less than or equal to the difference between any other pair of numbers.
 4. **Origin:** The number series has a unique origin indicated by the number zero. This is an absolute and meaningful zero point.

Measurement consists of two basic processes called **conceptualization** and **Operationalization,** then an advanced process called determining the **levels of measurement**, and then even more advanced methods of measuring **reliability** and **validity.**

Conceptualization is the process of taking a construct or concept and refining it by giving it a conceptual or theoretical definition. Ordinary dictionary definitions will not do. Instead, the researcher takes keywords in their research question or hypothesis and finds a clear and consistent definition that is agreed-upon by others in the scientific community. Conceptualization is often guided by the theoretical framework, perspective, or approach the researcher is committed to.

 Operationalization is the process of taking a conceptual definition and making it more precise by linking it to one or more specific, concrete indicators or operational definitions. These are usually things with numbers in them that reflect empirical or observable reality. For example, if the type of crime one has chosen to study is theft (as representative of crime in general), creating an operational definition for it means at least choosing between petty theft and grand theft (false taking of less or more than $150).

LEVELS OF MEASUREMENT

A **level of measurement** is a scale by which a variable is measured. For 50 years, with few detractors, science has used the Stevens (1951) typology of measurement levels (**scales**). There are three things to remember about this typology:

➢ Anything that can be measured falls into one of the four types;
➢ The higher the level of measurement, the more precision in measurement; and
➢ Every level up contains all the properties of the previous level.

RESEARCH METHODS NOTES

The four levels of measurement, from lowest to highest, are:

(a) **Nominal level**. The observations are classified under a common characteristic e.g. sex, race, marital status, employment status, language, religion etc. helps in sampling.
(b) **Ordinal level**: items or subjects are not only grouped into categories, but they are ranked into some order e.g. greater than, less than, superior, happier than, poorer, above etc. helps in developing a likert scale.
(c) **Interval level**: numerals are assigned to each measure and ranked. The intervals between numerals are equal. The numerals used represent meaningful quantities but the zero point is not meaningful e.g. test scores, temperature.
(d) **Ratio level**: has all the characteristics of the other levels and in addition the zero point is meaningful. Mathematical operations can be applied to yield meaningful values e.g. height, weight, distance, age, area etc.

Sources of measurement differences

The ideal study should be designed and controlled for precise and unambiguous measurement of the variables. Since 100% control is unattainable, error occurs. Much potential error is systematic (results from a bias) while the remainder is random (occurs erratically). Some of the major sources of error are:
(a) **The respondent**: opinion differences that affect measurement come from relatively stable characteristics of the respondent e.g. employee status, ethnic group and social class. Temporary factors like fatigue, boredom, anxiety and other distractions also limit the ability to respond accurately and fully. Hunger, impatience or general variations in mood will also have an impact.
(b) **The situational factors:** any condition that places a strain on the interview or measurement session can have serious effects on the interviewer – respondent rapport. If another person is present, that person can distort responses by joining in, by distracting or by merely being present. If the respondents believe anonymity is not ensured, they may be reluctant to express certain feelings.
(c) **The measurer:** the interviewer can distort responses by re-wording, paraphrasing, or re-ordering questions. Stereotypes in appearance and action introduce bias. Inflections of voice or unconscious prompting with smiles and nods may encourage or discourage certain replies. Incorrect coding, careless tabulation and faulty statistical calculation may introduce further errors in data analysis.
(d) **The data collection instrument**: a defective instrument can cause distortion in two major ways:
> ➢ It can be too confusing and ambiguous e.g. the use of complex words, leading questions, ambiguous meanings, multiple questions.
> ➢ Leads to poor selection from the universe of content items. Seldom does the instrument explore all the potentially important issues.

TYPES OF VARIABLES

A variable is a measurable characteristic that assumes different values among the subjects. According to Mugenda and Mugenda (2003), variables can be classified into the following categories: -

1. Independent variables / Predictor variables

It is a variable that a researcher manipulates in order to determine its effect or influence on another variable. They predict the amount of variation that occurs in another variable.

Types of independent variables

i. **Experimental variables**: They are variables which the researcher has manipulative control over them. Are commonly used in biological and physical sciences e.g. influence of amount of fertilizer on the yield of wheat, influence of alcohol on reaction time.

ii. **Measurement types of independent variables**: Are variables, which have already occurred. They have fixed manipulative and uninfluenceable properties. Most of the variables are either environmental or personalogical e.g. age, gender, marital status, race, colour, geographical location, nationality, soil type, altitude etc. (e.g. influence of nationality on choice of food).

2. Dependent variables / criterion variables

It is the variable that is measured, predicted or monitored and is expected to be affected by manipulation of an independent variable. They attempt to indicate the total influence arising from the effects of the independent variable. It varies as a function of the independent variable e.g. influence of hours studied on performance in a statistical test, influence of distance from the supply center on cost of building materials.

3. Extraneous variables

They are those variables that affect the outcome of a research study either because the researcher is not aware of their existence or if the researcher is aware, she or he has no control over them.

Extraneous variables are often classified into three types:

1. **Subject variables,** which are the characteristics of the individuals being studied that might affect their actions. These variables include age, gender, health status, mood, background, etc.
2. **Experimental variables** are characteristics of the persons conducting the experiment which might influence how a person behaves. Gender, the presence of racial discrimination, language, or other factors may qualify as such variables.
3. **Situational variables** are features of the environment in which the study or research was conducted, which have a bearing on the outcome of the experiment in a negative way. Included are the air temperature, level of activity, lighting, and the time of day.

4. Control variables / concomitant / covariate or blocking variables

They are extraneous variables that are built into the study. Extraneous variables are variables, which influence the results of a study when they are not controlled.

Reasons for introducing control variables:
  ➢ It increases the validity of the data.
 ➢ It leads to more convincing generalizations.

Since absolute control of extraneous variables is not possible in any study, results are interpreted on the basis of degrees of confidence rather than certainty.

Once the major extraneous variables are identified, the researcher can control them by:-
  i.   Building the extraneous variable into the study: i.e. including it as an independent variable. E.g. in determining the effect of alcohol on reaction time, sex may influence reaction time. Therefore, sex can be introduced as an independent variable. Using regression, one can measure the effect of alcohol on reaction time, controlling sex.
  ii.   Include them in the study but only at one level e.g. time is the dependent variable, alcohol level - the independent and sex the extraneous variable. Sex can be controlled by sampling only females or males of a given age. The disadvantage of this method is that generalizations are limited to a smaller population.
  iii. By removing the effects of the extraneous variables by statistical procedures i.e. by siphoning its effects on the dependent variable. This can be done by:
        ➢ Analysis of co-variance
        ➢ Partial correlation.

5. Intervening variables

They are a special case of extraneous variables. The difference between the intervening and extraneous variables is in the assumed relationship among the variables. An **intervening variable** is a hypothetical internal state that is used to explain relationships between observed variables, such as independent and dependent variables, in empirical research. With an extraneous variable, there is no causal link between the independent and dependent variable, but they are independently associated with a third variable – the extraneous variable. An intervening variable is recognized as being caused by the independent variable and as being a determinant of the dependent variable.

Independent   intervening   dependent
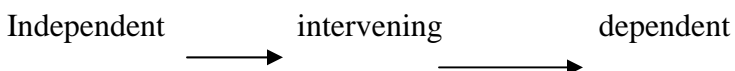
The total effect of an independent variable on a dependent variable can be subdivided into direct and indirect effects.

  ➢ Indirect effects are those effects of an intervening variable.
  ➢ Direct effects are not transmitted through another variable.

The choice of the right intervening variables helps one not only to determine accurately the total effects of an independent variable on the dependent variable but also partition the total effects into direct and indirect.

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Examples of intervening variables include: motivation, intelligence, intention, and expectation.

6. Antecedent variables

They do not interfere with the established relationship between an independent and dependent variable but clarifies the influence that precedes such a relationship.

Antecedent ⟶ independent ⟶ dependent

Conditions that must hold for a variable to be classified as a antecedent variable:-

➢ The variables including the antecedent variable must be related in some logical sequence.
➢ When the antecedent variable is controlled for, the relationship between the independent and the dependent variables should not disappear. Rather it should be enhanced.
➢ When the independent variable is controlled for or its influence removed, there should not be any relationship between the antecedent variable and the dependent variable.

e.g. political stability – attracts investors – increased job opportunities – high standards of living – reduction of poverty.

7. Suppressor variables

It is an extraneous variable which when not controlled for, removes a relationship between the two variables. When a suppressor variable is introduced in the study as a control variable, a true relationship emerges.

8. Distorter variables

It is a variable that converts what was thought of as a positive relationship into a negative relationship and vice-versa. Its effects lead a researcher into drawing erroneous conclusions from the data. When the distorter variable is controlled, a true relationship is obtained. Consideration of distorter variables in a study reduces the chances of making a type I (rejecting a true null hypothesis) or type two error (accepting a false null hypothesis).

9. Exogenous and endogenous variables

They are commonly used in testing hypothesized causal models. Path analysis (a procedure that tests causal links among several variables) is often used in testing the validity of causal relationships in a theory or model.
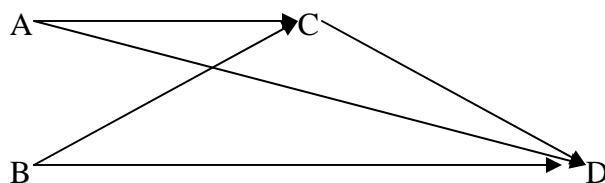
C and D are called endogenous variables. Each endogenous variable is caused or explained by the variable that precedes it. E.g. D is caused by A, B and C.

A and B are called exogenous variables. They lack hypothesized causes in the model.

Validity and Reliability in Research

The quality of a research study depends to a large extent on the accuracy of the data collection procedures. Reliability and validity measures the relevance and correctness of the data.

Reliability

Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials. Without the agreement of independent observers able to replicate research procedures, or the ability to use research tools and procedures that yield consistent measurements, researchers would be unable to satisfactorily draw conclusions, formulate theories, or make claims about the generalizability of their research. In addition to its important role in research, reliability is critical for many parts of our lives, including manufacturing, medicine and sports. Reliability is such an important concept that it has been defined in terms of its application to a wide range of activities.

Reliability is influenced by random error. Random error is the deviation from a true measurement due to factors that have not effectively been addressed by the researcher. As random error increases, reliability decreases.

Causes of random error
➢ Inaccurate coding
➢ Ambiguous instruction to the subjects
➢ Interviewer's fatigue
➢ Interviewee's fatigue
➢ Interviewer's bias
Research instruments yield data that have two components; the true value or score and an error component. The error component of the data reflects the limitations of the instrument. There are three types of errors that arise at the time of data collection;
➢ Error due to the inaccuracy of the instrument
➢ Error due to the inaccuracy of scoring by the researcher

➢ Unexplained error

Ways of Assessing Reliability
> ➢ Test-Retest
> ➢ Equivalent form
> ➢ Internal consistency
> ➢ Interrater reliability

1. The Test-Retest technique

It involves administering the same instruments twice to the same group of subjects, but after some time. Stability reliability (sometimes called test, re-test reliability) is the agreement of measuring instruments over time. To determine stability, a measure or test is repeated on the same subjects at a future date. Results are compared and correlated with the initial test to give a measure of stability.

An example of stability reliability would be the method of maintaining weights used by the Kenya Bureau of Standards. Platinum objects of fixed weight (one kilogram, half kilogram, etc...) are kept locked away. Once a year they are taken out and weighed, allowing scales to be reset so they are "weighing" accurately. Keeping track of how much the scales are off from year to year establishes stability reliability for these instruments. In this instance, the platinum weights themselves are assumed to have a perfectly fixed stability reliability

Disadvantages
➢ Subjects may be sensitized by the first testing hence will do better in the second test
➢ Difficulty in establishing a reasonable period between the two testing sessions.

2. Equivalent form

Equivalent reliability is the extent to which two items measure identical concepts at an identical level of difficulty. Equivalency reliability is determined by relating two sets of test scores to one another to highlight the degree of relationship or association. In quantitative studies and particularly in experimental studies, a correlation coefficient, statistically referred to as *r*, is used to show the strength of the correlation between a dependent variable (the subject under study), and one or more independent variable, which are manipulated to determine effects on the dependent variable. An important consideration is that equivalency reliability is concerned with correlational, not causal, relationships.

For example, a researcher studying university Bachelor of commerce students happened to notice that when some students were studying for finals, their holiday shopping began. Intrigued by this, the researcher attempted to observe how often, or to what degree, these two behaviors co-occurred throughout the academic year. The researcher used the results of the observations to assess the correlation between studying throughout the academic year and shopping for gifts. The researcher concluded there was poor equivalency reliability between the two actions. In other words, studying was not a reliable predictor of shopping for gifts.

Two instruments are used. Specific items in each form are different but they are designed to measure the same concept. They are the same in number, structure and level of difficulty e.g. TOEFL, GRE

Advantages
➢ Estimates the stability of the data as well as the equivalence of the items in the two forms

Disadvantages
➢ Difficulty in constructing two tests, which measure the same concept (time and resources).

3. Internal consistency technique
Internal consistency is the extent to which tests or procedures assess the same characteristic, skill or quality. It is a measure of the precision between the observers or of the measuring instruments used in a study. This type of reliability often helps researchers interpret data and predict the value of scores and the limits of the relationship among variables.

For example, a researcher designs a questionnaire to find out about college students' dissatisfaction with a particular textbook. Analyzing the internal consistency of the survey items dealing with dissatisfaction will reveal the extent to which items on the questionnaire focus on the notion of dissatisfaction.

4. Interrater reliability
Interrater reliability is the extent to which two or more individuals (coders or raters) agree. Interrater reliability addresses the consistency of the implementation of a rating system.

A test of interrater reliability would be the following scenario: Two or more researchers are observing a high school classroom. The class is discussing a movie that they have just viewed as a group. The researchers have a sliding rating scale (1 being most positive, 5 being most negative) with which they are rating the student's oral responses. Interrater reliability assesses the consistency of how the rating system is implemented. For example, if one researcher gives a "1" to a student response, while another researcher gives a "5," obviously the interrater reliability would be inconsistent. Interrater reliability is dependent upon the ability of two or more individuals to be consistent. Training, education and monitoring skills can enhance interrater reliability.

Ways of improving reliability
➢ Minimize external sources of variation
➢ Standardize conditions under which measurements occurs
➢ Improve investigator consistency by using only well trained, supervised and motivated persons to conduct the research
➢ Broaden the sample of measurement questions by adding similar questions to the data collection instrument or adding more observers or occasions to an observation study.
➢ Improve internal consistency of an instrument by excluding data from analysis drawn from measurement questions eliciting extreme responses.

Validity

Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. It is the degree to which results obtained from the analysis of data actually represent the phenomenon under study. It is the accuracy and meaningfulness of inferences, which are based on the research results. It has to do with how accurately the data obtained in the study represents the variables of the study. If such data is a true reflection of the variables, then inferences based on such data will be accurate and meaningful. Validity is largely determined by the presence or absence of systematic error in the data e.g. using a faulty scale to measure.

Types of validity
 (a)   Construct validity

Construct validity seeks agreement between a theoretical concept and a specific measuring device or procedure. For example, a researcher inventing a new IQ test might spend a great deal of time attempting to "define" intelligence in order to reach an acceptable level of construct validity.

Construct validity can be broken down into two sub-categories: Convergent validity and discriminate validity. Convergent validity is the actual general agreement among ratings, gathered independently of one another, where measures should be theoretically related. Discriminate validity is the lack of a relationship among measures which theoretically should not be related.

To understand whether a piece of research has construct validity, three steps should be followed. First, the theoretical relationships must be specified. Second, the empirical relationships between the measures of the concepts must be examined. Third, the empirical evidence must be interpreted in terms of how it clarifies the construct validity of the particular measure being tested.

 (b)   Content validity
Content Validity is based on the extent to which a measurement reflects the specific intended domain of content.
Content validity can be illustrated using the following examples: Researchers aim to study mathematical learning and create a survey to test for mathematical skill. If these researchers only tested for multiplication and then drew conclusions from that survey, their study would not show content validity because it excludes other mathematical functions. Although the establishment of content validity for placement-type exams seems relatively straight-forward, the process becomes more complex as it moves into the more abstract domain of socio-cultural studies. For example, a researcher needing to measure an attitude like self-esteem must decide what constitutes a relevant domain of content for that attitude. For socio-cultural studies, content validity forces the researchers to define the very domains they are attempting to study.

The usual procedure in assessing the content validity of a measure is to use professional or experts in the particular field. The instrument is given to two groups of experts, one group is requested to assess what concept the instrument is trying to measure. The other group is asked to determine whether the set of items or checklist accurately represents the concept under study.

 (c)   Criterion related validity
Criterion related validity, also referred to as instrumental validity, is used to demonstrate the accuracy of a measure or procedure by comparing it with another measure or procedure which has been demonstrated to be valid. For example, imagine a hands-on driving test has been shown to be an accurate test of driving skills. By comparing the scores on the written driving test with the scores from the hands-on driving test, the written test can be validated by using a criterion related strategy in which the hands-on driving test is compared to the written test.
Types
➢ **Predictive validity** – refers to the degree to which obtained data predicts the future behaviour of subjects e.g. B. Com graduates
➢ **Concurrent validity**- refers to the degree to which data are able to predict the behaviour of subjects in the present and not in the future e.g. psychiatry

Internal and external validity
Researchers should be concerned with both *external* and *internal* validity.
➢ External validity refers to the extent to which the results of a study are generalizable or transferable. External validity is the degree to which research findings can be generalized to populations and environments outside the experimental setting. It has to do with representativeness of the sample with regard to the target population.
➢ Internal validity refers to (1) the rigor with which the study was conducted (e.g., the study's design, the care taken to conduct measurements, and decisions concerning what was and wasn't measured) and (2) the extent to which the designers of a study have taken into account alternative explanations for any causal relationships they explore. In studies that do not explore causal relationships, only the first of these definitions should be considered when assessing internal validity. Internal validity depends on the degree to which extraneous variables have been controlled for in the study
Internal and external validity are inversely related to each other.

Threats to internal validity
➢ History   – refers to occurrence of events that influence experimental units during t he course of the study
➢ Maturation – refers to the biological or psychological processes which occur among the subjects in a relatively short time and which influence research findings
➢ Instrumentation -
➢ Pre-testing – solution – use equivalent form tests
➢ Statistical regression

➢ Attrition- subjects dropping out of the study before completion- leads to error, biasness in the sample
➢ Differential selection – occurs when subjects are systematically selected for a study - volunteers and non-volunteers – biasness leads error
➢ Selection – maturation interaction
➢ Ambiguity - when correlation is taken for causation
➢ Apprehension - when people are scared to respond to your study
➢ Demoralization - when people get bored with your measurements
➢ Diffusion - when people figure out your test and start mimicking symptoms

Threats to external validity
➢ Accessible and target population
➢ Control of extraneous variables
➢ Pre-test treatment interaction
➢ Explicit description of the sample
➢ Multi-treatment interference

RESEARCH INSTRUMENTS

The research instruments that are widely used include
➢ Questionnaires
➢ Interviews
➢ Observations

QUESTIONNAIRES
Each item in the questionnaire is developed to address a specific objective, research question or hypothesis of the study. The researcher must also know how information obtained from each questionnaire item will be analysed.

Types of questions used in questionnaires
    1   **Structured or closed-ended questions**
They are questions, which are accompanied by a list of possible alternatives from which respondents select the answer that best describes their situation.
Advantages of Structured or closed-ended questions
    ➢ They are easier to analyse since they are in an immediate usable form
    ➢ They are easier to administer
    ➢ They are economical to use in terms of time and money

Disadvantages of Structured or closed-ended questions
➢ They are more difficult to construct
➢ Responses are limited and the respondent is compelled to answer questions according to the researcher's choices

    2   **Unstructured or open – ended questions**

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They refer to questions, which give the respondent complete freedom of response. The amount of space provided is always an indicator of whether a brief or lengthy answer is desired.

Advantages of Unstructured or open – ended questions
➢ They permit a greater depth of response
➢ They are simple to formulate
➢ The respondent's responses may give an insight into his feelings, background, hidden motives, interest and decisions.

Disadvantages of Unstructured or open – ended questions
➢ There is a tendency of the respondents providing information, which does not answer the stipulated research questions or objectives.
➢ The responses given may be difficult to categorize and hence difficult to analyze quantitatively
➢ Responding to open ended questions is time consuming, which may put some respondent off.

3 Contingency questions
In particular cases, certain questions are applicable to certain groups of respondents. In such cases, follow-up questions are needed to get further information from the relevant sub-group only. These subsequent questions, which are asked after the initial questions, are called 'contingency questions' or ' filter questions'. The purpose of these kinds of questions is to probe for more information. They also simplify the respondent's task, in that they will not be required to answer questions that are not relevant to them.

4 Matrix questions
These are questions, which share the same set of response categories. They are used whenever scales like likert scale are being used.

Advantages of matrix questions
➢ When questions or items are presented in matrix form, they are easier to complete and hence the respondent is unlikely not to be put off.
➢ Space is used efficiently
➢ It is easy to compare responses given to different items.

Disadvantages of matrix questions
➢ Some respondents, especially the ones that may not be too keen to give right responses, might form a pattern of agreeing or disagreeing with statements.
➢ Some researchers use them when in fact the kind of information being sought could better be obtained in another format.

Rules for constructing questionnaires and questionnaire items
1. List the objectives that you want the questionnaire to accomplish before constructing the questionnaire.

2. Determine how information obtained from each questionnaire item will be analyzed.
3. Ensure clarity and avoid ambiguity.
4. If a concept has several meanings and that concept must be used in a question, the intended meaning must be defined.
5. Construct short questions.
6. Items should be stated positively as possible.
7. Double-barreled items should be avoided.
8. Leading and biased questions should be avoided.
9. Very personal and sensitive questions should be avoided.
10. Simple words that are easily understandable should be used.
11. Questions that assume facts with no evidence should be avoided.
12. Avoid psychologically threatening questions.
13. Include enough information in each item so that it is meaningful to the respondent.

Tips on how to organize or order items in a questionnaire
1. Begin with non-threatening, interesting items.
2. It is not advisable to put important questions at the end of a long questionnaire.
3. Have some logical order when putting items together.
4. Arrange the questions according to themes being studied.
5. If the questionnaire is arranged into content sub-sections, each section should be introduced with a short statement concerning its content and purpose.
6. Socio-economic questions should be asked at the end because respondents may be put off by personal questions at the beginning of the questionnaire.

Presentation of the questionnaire
1. Make the questionnaire attractive by using quality paper. It increases the response rate.
2. Organize and lay out the questions so that the questionnaire is easy to complete.
3. All the pages and items in a questionnaire should be numbered.
4. Brief but clear instruction must be included.
5. Make your questionnaire short.

Pretesting the questionnaire
The questionnaire should be pretested to a selected sample, which is similar to the actual sample, which the researcher plans to study. This is important because:-
  ➢ Questions that are vague will be revealed in the sense that the respondents will interpret them differently.
  ➢ Comments and suggestions made by respondents during pretesting should be seriously considered and incorporated.
  ➢ Pretesting will reveal deficiencies in the questionnaire.
  ➢ It helps to test whether the methods of analysis are appropriate.

Ways of administering questionnaires
Questionnaires are mainly administered using three methods:

i.   **Self administered questionnaires**
Questionnaires are send to the respondents through mail or hand-delivery, and they complete on their own.

ii.   **Researcher administered questionnaires**
The researcher can decide to use the questionnaire to interview the respondents. This is mostly done when the subjects may not have the ability to easily interpret the questions probably because of their educational level.

iii.   **Use of the internet**
The people sampled for the research receive and respond to the questionnaires through their web sites or e-mail addresses.

The letter of transmittal / Cover letter
The letter of transmittal / Cover letter should accompany every questionnaire.

Contents of a letter of transmittal
➢ It should explain the purpose of the study.
➢ It should explain the importance and significance of the stuidy.
➢ A brief assurance of confidentiality should be included in the letter.
➢ If the study is affiliated to a certain institution or organisation, it is advisable to have an endorsement from such an institution or organisation.
➢ In a sensitive research, it may be necessary to assure the anonymity of respondents.
➢ The letter should contain specific deadline dates by which the completed questionnaire is to be returned.

Follow-up techniques
➢ Sending a follow-up letter which should be polite, and asking the subjects to respond
➢ A questionnaire and a follow-up letter.

Response rate
It refers to the percentage of subjects who respond to questionnaires. Many authors believe that a response rate of 50% is adequate for analysis and reporting. If the response rate is low, the researcher must question the representativeness of the sample.

INTERVIEWS
An interview is an oral (face to face) administration of a questionnaire or an interview schedule. To obtain accurate information through interviews, a researcher needs to obtain the maximum co-operation from respondents. Interviews are particularly useful for getting the story behind a participant's experiences. The interviewer can pursue in-depth information around a topic. Interviews may be useful as follow-up to certain respondents to questionnaires, e.g., to further investigate their responses. Usually open-ended questions are asked during interviews.

Guidelines for preparation for Interview
1. Choose a setting with little distraction. Avoid loud lights or noises, ensure the interviewee is comfortable (you might ask them if they are), etc. Often, they may feel more comfortable at their own places of work or homes.

2. Explain the purpose of the interview.
3. Address terms of confidentiality. Note any terms of confidentiality. (Be careful here. Rarely can you absolutely promise anything. Courts may get access to information, in certain circumstances.) Explain who will get access to their answers and how their answers will be analyzed. If their comments are to be used as quotes, get their written permission to do so.
4. Explain the format of the interview. Explain the type of interview you are conducting and its nature. If you want them to ask questions, specify if they're to do so as they have them or wait until the end of the interview.
5. Indicate how long the interview usually takes.
6. Tell them how to get in touch with you later if they want to.
7. Ask them if they have any questions before you both get started with the interview.
8. Don't count on your memory to recall their answers. Ask for permission to record the interview or bring along someone to take notes.

Types of Interviews approaches
(a) *Informal, conversational interview* - no predetermined questions are asked, in order to remain as open and adaptable as possible to the interviewee's nature and priorities; during the interview, the interviewer "goes with the flow".
(b) *General interview guide approach* - the guide approach is intended to ensure that the same general areas of information are collected from each interviewee; this provides more focus than the conversational approach, but still allows a degree of freedom and adaptability in getting information from the interviewee.
(c) *Standardized, open-ended interview* - here, the same open-ended questions are asked to all interviewees (an open-ended question is where respondents are free to choose how to answer the question, i.e., they don't select "yes" or "no" or provide a numeric rating, etc.); this approach facilitates faster interviews that can be more easily analyzed and compared
(d) *Closed, fixed-response interview* - where all interviewees are asked the same questions and asked to choose answers from among the same set of alternatives. This format is useful for those not practiced in interviewing.

Sequence of Questions
1. Get the respondents involved in the interview as soon as possible.
2. Before asking about controversial matters (such as feelings and conclusions), first ask about some facts. With this approach, respondents can more easily engage in the interview before warming up to more personal matters.
3. Intersperse fact-based questions throughout the interview to avoid long lists of fact-based questions, which tends to leave respondents disengaged.
4. Ask questions about the present before questions about the past or future. It's usually easier for them to talk about the present and then work into the past or future.
5. The last questions might be to allow respondents to provide any other information they prefer to add and their impressions of the interview.

Wording of Questions

- ➢ Wording should be open-ended. Respondents should be able to choose their own terms when answering questions.
- ➢ Questions should be as neutral as possible. Avoid wording that might influence answers, e.g., evocative, judgmental wording.
- ➢ Questions should be asked one at a time.
- ➢ Questions should be worded clearly. This includes knowing any terms particular to the program or the respondents' culture.
- ➢ Be careful asking "why" questions. This type of question infers a cause-effect relationship that may not truly exist. These questions may also cause respondents to feel defensive, e.g., that they have to justify their response, which may inhibit their responses to this and future questions.
- ➢ While Carrying Out Interview
- ➢ Occasionally verify the tape recorder (if used) is working.
- ➢ Ask one question at a time.
- ➢ Attempt to remain as neutral as possible. That is, don't show strong emotional reactions to their responses. Patton suggests to act as if "you've heard it all before."
- ➢ Encourage responses with occasional nods of the head, "uh huh"s, etc.
- ➢ Be careful about the appearance when note taking. That is, if you jump to take a note, it may appear as if you're surprised or very pleased about an answer, which may influence answers to future questions.
- ➢ Provide transition between major topics, e.g., "we've been talking about (some topic) and now I'd like to move on to (another topic)."
- ➢ Don't lose control of the interview. This can occur when respondents stray to another topic, take so long to answer a question that times begins to run out, or even begin asking questions to the interviewer.

Immediately After Interview
- ➢ Verify if the tape recorder, if used, worked throughout the interview.
- ➢ Make any notes on your written notes, e.g., to clarify any scratchings, ensure pages are numbered, fill out any notes that don't make senses, etc.
- ➢ Write down any observations made during the interview. For example, where did the interview occur and when, was the respondent particularly nervous at any time? Were there any surprises during the interview? Did the tape recorder break?

Personal interviews
People selected to be part of the sample are interviewed in person by a trained interviewer.
Requirements for success
Three broad conditions must be met in order to have a successful personal interview:
- ➢ The participant must possess the information being targeted by the investigative questions
- ➢ The participant must understand his or her role in the interview as the provider of accurate information
- ➢ The participant must perceive adequate motivation to cooperate

Increasing the participant's receptiveness

The first goal in an interview is to establish a friendly relationship with the participant. Three factors will help increase participant receptiveness. The participant must:
➢ Believe that the experience will be pleasant and satisfying
➢ Believe that answering the survey is an important and worthwhile use of his or her time
➢ Dismiss any mental reservations that he or she might have about participation.

The technique of stimulating participants to answer more fully and relevantly is termed probing. Since it presents a great potential for bias, a probe should be neutral and appear as a natural part of the conversation. Appropriate probes should be specified by the designer of the data collection instrument. There are several probing styles e.g.
➢ A brief assertion of understanding and interest e.g. comments such as "I see" "yes".
➢ An expectant pause
➢ Repeating the question
➢ Repeating the participant's reply
➢ A neutral question or comment
➢ Question clarification.

Problems likely to be encountered during personal interviews
In personal interviews, the researcher must deal with bias and cost.
Biased results is as a result of three types of errors:
 (a)   Sampling error
    It's the difference between a sample statistic and its corresponding population parameter. The sampling distribution of the sample means is a probability distribution of possible sample means of a given sample size.

 (b)   Non-response error
This occurs when the responses of participants differ in some systematic way from the responses of non-participants. It occurs when the researcher:
➢ Cannot locate the person to be studied
➢ Is unsuccessful in encouraging that person to participate
Solutions to reduce errors of non-response are
        ➢ Establishing and implementing callback procedures
        ➢ Creating a non response sample and weighting results from this sample
        ➢ Substituting another individual for the missing non-participant.
 (c)   Response error
Occurs when the data reported differ from the actual data. It can occur during the interview or during preparation of data analysis.
➢ Participant-initiated error occurs when the participant fails to answer fully and accurately either by choice or because of inaccurate or incomplete knowledge. Can be solved by using trained interviewers who are knowledgeable about such problems.
➢ Interviewer error can be caused by:-
    - Failure to secure full participant cooperation
    - Failure to consistently execute interview procedures
    - Failure to establish appropriate interview environment
    - Falsification of individual answers or whole interviews

- Inappropriate influencing behaviour
- Failure to record answers accurately and completely
- Physical presence bias.

Advantages of Personal interviews
- Good cooperation from the respondents
- Interviewer can answer questions about survey, probe for answers, use follow-up questions and gather information by observation.
- Special visual aids and scoring devices can be used.
- Illiterate and functionally illiterate respondents can be reached
- Interviewer can prescreen respondent to ensure he / she fits the population profile.
- Responses can be entered directly into a portable microcomputer to reduce error and cost when using computer assisted personal interviewing.

Disadvantages of Personal interviews
- High costs
- Need for highly trained interviewers
- Longer period needed in the field collecting data
- May be wide geographic dispersion
- Follow-up is labour intensive
- Not all respondents are available or accessible
- Some respondents are unwilling to talk to strangers in their homes
- Some neighbourhoods are difficult to visit
- Questions may be altered or respondent coached by interviewers.

Telephone interviews
People selected to be part of the sample are interviewed on the telephone by a trained interviewer.
Advantages of Telephone interviews
- Lower costs than personal interviews
- Expanded geographic coverage without dramatic increase in costs
- Uses fewer, more highly skilled interviewers
- Reduced interview bias
- Fates completion time
- Better access to hard-to-reach respondents through repeated callbacks
- Can use computerized random digit dialing
- Responses can be entered directly into a computer file to reduce error and cost when using computer assisted telephone interviewing.

Disadvantages of Telephone interviews
- Response rate is lower than for personal interview
- Higher costs if interviewing geographically dispersed sample
- Interview sample must be limited
- Many phone numbers are unlisted or not working, making directory listings unreliable
- Some target groups are not available by phone

➢ Responses may be less complete
➢ Illustrations cannot be used.
➢ Respondents may not be honest with their responses since it is not a face to face situation

Rules pertaining to interviews
The interviewer must
➢ Be pleasant
➢ Show genuine interest in getting to know respondents without appearing like spies.
➢ Be relaxed and friendly.
➢ Be very familiar with the questionnaire or the interview guide.
➢ Have a guide which indicates what questions are to be asked and in what order.
➢ Interact with the respondent as an equal.
➢ Pretest the interview guide before using it to check for vocabulary, language level and how well the questions will be understood.
➢ Inform the respondent about the confidentiality of the information given.
➢ Not ask leading questions
➢ Remain neutral in an interview situation in order to be as objective as possible.

An interview schedule
It's a set of questions that the interviewer asks when interviewing. It makes it possible to obtain data required to meet specific objectives of the study.

Note taking during interviews
It refers to the method of recording in which the interviewer records the respondent's responses during the interview.

Advantages
➢ It facilitates data analysis since the information is readily accessible and already classified into appropriate categories.
➢ If taken well, no information is left out.

Disadvantages of note taking
➢ It may interfere with the communication between the respondent and the interviewer.
➢ It might upset the respondent if the answers are personal and sensitive.
➢ If it is delayed, important details may be forgotten.
➢ It makes the interview lengthy and boring.

Tape recording
The interviewer's questions and the respondent's answers are recorded either using a tape recorder or a video tape.
Advantages
➢ It reduces the tendency for the interviewer to make unconscious selection of data in the course of the recording.
➢ The tape can be played back and studied more thoroughly.

- ➢ A person other than the interviewer can evaluate and categorize responses.
- ➢ It speeds up the interview.
- ➢ Communication is not interrupted.

Disadvantages
- ➢ It changes the interview situation since respondents get nervous.
- ➢ Respondents may be reluctant to give sensitive information if they know they are being taped.
- ➢ Transcribing the tapes before analysis is time consuming and tedious.

Advantages of interviews
- ➢ It provides in-depth data, which is not possible to get using a questionnaire.
- ➢ It makes it possible to obtain data required to meet specific objectives of the study.
- ➢ Are more flexible than questionnaires because the interviewer can adapt to the situation and get as much information as possible.
- ➢ Very sensitive and personal information can be extracted from the respondent.
- ➢ The interviewer can clarify and elaborate the purpose of the research and effectively convince respondents about the importance of the research.
- ➢ They yield higher response rates

Disadvantages of interviews
- ➢ They are expensive – traveling costs
- ➢ It requires a higher level of skill
- ➢ Interviewers need to be trained to avoid bias
- ➢ Not appropriate for large samples
- ➢ Responses may be influenced by the respondent's reaction to the interviewer.

OBSERVATION

Observation is one of the few options available for studying records, mechanical processes, small children and complex interactive processes. Data can be gathered as the event occurs. Observation includes a variety of monitoring situations that cover non-behavioural and behavioural activities.

The observer-participant relationship

Interrogation presents a clear opportunity for interviewer bias. The problem is less pronounced with observation but is still real. The relationship between observer and participant may be viewed from three perspectives:
- ➢ Whether the observation is direct or indirect
- ➢ Whether the observer's presence is known or unknown to the participant
- ➢ What role the observer plays

Guidelines for the qualification and selection of observers
- ➢ Concentration: Ability to function in a setting full of distractions
- ➢ Detail-oriented: Ability to remember details of an experience
- ➢ Unobtrusive: Ability to blend with the setting and not be distinctive
- ➢ Experience level: Ability to extract the most from an observation study

Advantages of observation

Enables one to:
➢ Secure information about people or activities that cannot be derived from experiment or surveys
➢ Reduces obtrusiveness
➢ Avoid participant filtering and forgetfulness
➢ Secure environmental context information
➢ Optimize the naturalness of the research setting

Limitations of observation
➢ Difficulty of waiting for long periods to capture the relevant phenomena
➢ The expense of observer costs and equipment
➢ Reliability of inferences from surface indicators
➢ The problem of quantification and disproportionately large records

Observation forms, schedules or checklists
The researcher must define the behaviours to be observed and then develop a detailed list of behaviours. During data collection, the researcher checks off each as it occurs. This permits the observer to spend time thinking about what is occurring rather than on how to record it and this enhances the accuracy of the study.

DATA ANALYSIS
DATA PREPARATION AND DESCRIPTION
Once the data begins to flow in, attention turns to data analysis. If the project has been done correctly, the analysis planning is already done.
Data preparation
This includes editing, coding and data entry. These activities ensure the accuracy of the data and their conversion from raw form to reduced and classified forms that are more appropriate for analysis.
Editing
Editing detects errors and omissions, corrects them when possible and certifies that minimum data quality standards have been achieved. The editor's purpose is to guarantee that data are:
➢ Accurate
➢ Consistent with intent of the question and other information in the survey
➢ Uniformly entered
➢ Complete
➢ Arranged to simplify coding and tabulation
Field editing
In large projects, field editing review is a responsibility of the field supervisor. It should be done soon after the data have been gathered. During the stress of data collection, the researcher often uses ad hoc abbreviations and special symbols. Soon after the interview, experiment or observation, the investigator should review the reporting forms. It is difficult to complete what was abbreviated or written in shorthand or noted illegibly if the entry is not caught that day. When entry gaps are present from interviews, a call back

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should be made rather than guessing what the respondent 'probably would have said'. Self-interviewing has no place in quality research.

Central editing

For a small study, the use of a single editor produces maximum consistency. In large studies, the tasks may be broken down so that each editor can deal with one entire section. This approach will not identify inconsistencies between answers in different sections. However, this problem can be handled by identifying points of possible inconsistency and having one editor check specifically for them.

Rules to guide editors in their work
- Be familiar with instructions given to interviewers and coders
- Do not destroy, erase or make illegible the original entry by the interviewer, original entries should be crossed out with a single line to remain legible.
- Make all entries on an instrument in some distinctive colour and in a standardized form.
- Initial all answers changed or supplied.
- Place initials and date of editing on each instrument completed.

Coding

Coding involves assigning numbers or other symbols to answers so the responses can be grouped into a limited number of classes or categories. The classifying of data into limited categories sacrifices some data detail but is necessary for efficient analysis. Coding helps the researcher to reduce several thousand replies to a few categories containing the critical information needed for analysis. In coding, categories are the partitioning of a set and categorization is the process of using rules to partition a body of data.

Coding rules

The categories should be:
- Appropriate to the research problem and purpose: Categories must provide the best partitioning of data for testing hypotheses and showing relationships.
- Exhaustive
- Mutually exclusive
- Derived from one classification principle

Coding closed questions

The responses to closed questions include scaled items and others for which answers can be anticipated. When codes are established early in the research process, it is possible to pre-code the questionnaire. Pre-coding is particularly helpful for data entry because it makes the intermediate step of completing a coding sheet unnecessary. The data are accessible directly from the questionnaire. A respondent, interviewer, field supervisor or researcher is able to assign an appropriate numerical response on the instrument by checking, circling or printing it in the proper coding location.

Coding open-ended questions

Open-ended questions are always used where insufficient information or lack of a hypothesis prohibits preparing response categories in advance, need to measure sensitive or disapproved behaviour, discover salience or encouraging natural modes of expressions. Content analysis is always used to analyse open-ended questions. Converse and Presser

(1986) define content analysis as a research technique for the objective, systematic and quantitative description of the manifest content of a communication.

Content analysis follows a systematic process i.e.
- ➢ Selection of a unitization scheme. The units may be syntactical, referential, prepositional or thematic
- ➢ Selection of a sampling plan
- ➢ Development of recording and coding instructions
- ➢ Data reduction
- ➢ Inferences about the context
- ➢ Statistical analysis

Content analysis guards against selective perception of the content, provides for the rigorous application of reliability and validity criteria and is amenable to computerization.

"Don't know" replies

"Don't know" replies are evaluated in light of the questions nature and the respondent. While many don't know are legitimate, some result from questions that are ambiguous or from an interviewing situation that is not motivating. It is better to report don't knows as a separate category unless there are compelling reasons to treat them otherwise.

Data entry

Data entry converts information gathered by secondary or primary methods to a medium for viewing and manipulation. Data entry is accomplished by keyboard entry from pre-coded instruments, optical scanning, real time keyboarding, telephone pad data entry, bar codes, voice recognition, optical mark recognition (OMR) and data transfers from electronic notebooks and laptop computers. Database programs, spreadsheets and editors in statistical software programs e.g. SPSS and SAS offer flexibility for entering, manipulating and transferring data for analysis, warehousing and mining.

Data description

The objective of descriptive statistical analysis is to develop sufficient knowledge to describe a body of data. This is accomplished by understanding the data levels for the measurements we choose, their distributions and characteristics of location, spread and shape. The discovery of miscoded values, missing data and other problems in the data set is enhanced with descriptive statistics

There are three general areas that make up the field of statistics: descriptive statistics, relational statistics, and inferential statistics:

Descriptive Statistics

Descriptive statistics fall into one of two categories: measures of central tendency (mean, median, and mode) or measures of dispersion (standard deviation and variance). Their purpose is to explore hunches that may have come up during the course of the research process, but most people compute them to look at the normality of their numbers. Examples include descriptive analysis of sex, age, race, social class, and so forth.

Visual Displays of Data

In addition to numerical summaries of location, spread and shape, visual displays can be used to provide a complete and accurate impression of distribution and variable relationships.

- ➢ Frequency table arrays data from highest to lowest values with counts and percentages. They are most useful for inspecting the range of responses and their repeated occurrence.
- ➢ Bar charts and pie charts are appropriate for relative comparisons of nominal data.
- ➢ Histograms are optimally used with continuous variables where intervals group the responses.
- ➢ Stem and leaf displays present actual data values using a histogram type device that allows inspection of spread and shape.
- ➢ Box plots use the five-number summary to convey a detailed picture of a distribution's main body, tails and outliers.
- ➢ Control charts displays sequential measurements of a process together with a centre line and control limits. The selection of a control chart depends on the level of data one is measuring. It helps manager's focus on special causes of variation by revealing whether a system is under control and substantiating results from improvements.
- ➢ The Pareto diagram is a bar chart whose percentages sum to 100 percent. The causes of the problem under investigation are sorted in decreasing importance with bar height descending from left to right. Its pictorial array reveals the highest concentration of quality improvement potential in the fewest number of remedies.

Inferential Statistics

Hypothesis: It's a statement about a population parameter developed for the purpose of testing.

Hypothesis testing: It's a procedure based on sample evidence and probability theory to determine whether the hypothesis is a reasonable statement.

    Procedure for testing a hypothesis
1. State the null and alternate hypothesis
2. Identify the test statistic
3. Formulate a decision rule and identify the rejection region
4. Compute the value of the test statistic
5. Make a conclusion.

State the null hypothesis (H_O) and alternate hypothesis (H_A)
- ➢ The null hypothesis is a statement about the value of a population parameter. It should be stated as "There is no significant difference between ……………". It should always contain an equal sign.
- ➢ The alternate hypothesis is a statement that is accepted if sample data provide enough evidence that the null hypothesis is false.

One-tailed and Two-tailed tests
- ➢ A test is one tailed when the alternate hypothesis states a direction e.g.
  - H_o: The mean income of women is equal to the mean income of men
  - H_A: The mean income of women is greater than the mean income of men

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> A test is two tailed if no direction is specified in the alternate hypothesis
> H$_o$:   There is no difference between the mean income of women and the mean income of   men
> H$_A$:   There is a difference between the mean income of women and the mean income of   men

Identify the test statistic
A test statistic is the statistic that will be used to test the hypothesis e.g. $Z, T, F and \chi^2 (chi-square)$

Formulating a decision rule and identifying the rejection region
A decision rule is a statement of the conditions under which the null hypothesis is rejected and the conditions under which it is not rejected. It is determined by the level of significance which is designated by α and should be between 0 –1.

Compute the value of the test statistic and make a conclusion.
The value of the test statistic is determined from the sample information, and is used to determine whether to reject the null hypothesis or not.

Types of errors that can be committed
  i.   Type I error: it is rejecting the null hypothesis, when it is true.
  ii.   Type II error: It is not rejecting the null hypothesis, when it is false.

Null hypothesis	Do not reject H$_O$	Reject H$_O$
H$_O$ is True	Correct decision	Type I error
H$_O$ is false	Type II error	Correct decision

Testing the Population Mean When the Population Variance is Known
When the population variance is known and the population is normally distributed, the test statistic for testing hypothesis about μ is $Z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}$.

Estimating the population mean when the population variance is known
The confidence interval estimator of μ when σ^2 is known is
$$\bar{x} \pm Z_{\alpha/2} \sigma / \sqrt{n}$$

Examples
1. A study by the Coca-Cola Company showed that the typical adult Kenyan consumes 18 gallons of Coca-Cola each year. According to the same survey, the standard deviation of the number of gallons consumed is 3.0. A random sample of 64 college students showed they consumed an average (mean) of 17 gallons of cola last year. At the 0.05 significance level, can we conclude that there is a significance difference between the mean consumption rate of college students and other adults?
2. The manager of a departmental store is thinking about establishing a new billing system for the stores credit customers. After a thorough financial analysis, she determines that the new system will not be cost effective if the average monthly

account is less than 70,000. A random sample of 200 monthly accounts is drawn, for which the mean monthly account is Sh. 66,000. With $\alpha = 0.05$, is there sufficient evidence to conclude that the new system will not be cost effective? Assume that the population standard deviation is Sh. 30,000.

3. Past experience indicates that the monthly long distance telephone bill per household in a particular community is normally distributed, with a mean of Sh. 1012 and a standard deviation of Sh. 327. After an advertising campaign that encouraged people to make long distance telephone calls more frequently, a random sample of 57 households revealed that the mean monthly long distance bill was Sh. 1098. Can we conclude at the 10% significance level that the advertising campaign was successful?

Testing the population proportion

The null and alternate hypotheses of tests of proportions are set up in the same way as the hypothesis of tests about mean and variance. The test statistic for p is $Z = \dfrac{\hat{p} - p}{\sqrt{\dfrac{pq}{n}}}$

Confidence interval estimator of p is $\hat{p} \pm Z_{\alpha/2}\sqrt{\dfrac{\hat{p}\hat{q}}{n}}$

Example:

1. An inventor has developed a system that allows visitors to museums, zoos and other attractions to get information at the touch of a digital code. For example, zoo patrons can listen to an announcement (recorded on a microchip) about each animal they see. It is anticipated that the device would rent for $3.00 each. The installation cost for the complete system is expected to be about $400,000. The ABC zoo is interested in having the system installed, but the management is uncertain about whether to take the risk. A financial analysis of the problem indicates that if more than 10% of the zoo visitors rent the system, the zoo will make a profit. To help make the decision, a random sample of 400 zoo visitors is given details of the systems capabilities and cost. If 48 people say that they would rent the device, can the management of the zoo conclude at the 5% significance level that the investment would result in a profit?

2. In a random sample of 100 units from an assembly line, 22 were defective.
   (a)   Does this provide sufficient evidence at the 10% significance level to allow us to conclude that the defective rate among all units exceeds 10%?
   (b)   Find a 99% confidence interval estimate of the defective rate.

3. A manufacturer of computer chips claims that more than 90% of his products conform to specifications. In a random sample of 1,000 chips drawn from a large production run, 75 were defective. Do the data provide sufficient evidence at the 1% level of significance to enable us to conclude that the manufacturer's claim is true?

Chi-square test of a multinomial experiment

A multinomial experiment is a generalized version of a binomial experiment that allows for more than two possible outcomes on each trial of the experiment.

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Properties of a multinomial experiment
➤ The experiment consists of a fixed number n of trials.
➤ The outcome of each trial can be classified into exactly one of k categories called cells
➤ The probability P_i that the outcome of a trial will fall into a cell i remains constant for each trial, for $i = 1, 2, 3, ...k$. moreover, $P_1 + P_2 ....P_k = 1$.
➤ Each trial of the experiment is independent of the other trials.

Test statistic is $\quad \chi^2 = \sum_{i=1}^{k} \frac{(o_i - e_i)^2}{\ell_i}$

Rejection region is $\chi^2 > \chi^2_{\alpha, \, k-1}$

Example
1. Two companies A and B have recently conducted aggressive advertising campaigns in order to maintain and possibly increase their respective shares of the market for a particular product. These two companies enjoy a dominant position in the market. Before advertising campaigns began, the market share for Company A was 45% while Company B had a market share of 40%. Other competitors accounted for the remaining market share of 15%. To determine whether these market shares changed after the advertising campaigns, a marketing analyst solicited the preferences of a random sample of 200 consumers of this product. Of the 200 consumers, 100 indicated a preference for Company's A's product, 85 preferred Company's B product and the remainder preferred one or another of the products distributed by other competitors. Conduct a test to determine at the 5% level of significance, whether the market shares have changed from the levels they were at before the advertising campaigns occurred.
2. To determine if a single die, is balanced, or fair, the die was rolled 600 times. The observed frequencies with which each of the six sides of the die turned up are recorded in the following table: -

Face	1	2	3	4	5	6
Observed frequency	114	92	84	101	107	102

Is there sufficient evidence to conclude at the 5% level of significance, that the die is not fair?
3. Grades assigned by an economics instructor have historically followed a symmetrical distribution.

Grade	A	B	C	D	F
Percentage	5	25	40	25	5

A sample of 150 grades revealed the following

Grade	A	B	C	D	F
Number	11	32	62	29	16

Can we conclude at the 1% level of significance that this year's grades are distributed differently than they were in the past?

Rule of five

For the discrete distribution of the test statistic χ^2 to be adequately approximated by the continuous chi-square distribution, the conventional rule is to require that the expected frequency for each cell be at least 5. Where necessary, cells should be combined in order to satisfy this condition. The choice of cells to be combined should be made in such a way that meaningful categories result from the combination.

Chi-Square Test of a Contingency Table

A contingency table is a rectangular table which items from a population are classified according to two characteristics. The objective is to analyze the relationship between two qualitative variables i.e. to investigate whether a dependence relationship exists between two variables or whether the variables are statistically independent. The number of degrees of freedom for a contingency table with r rows and c columns is $d.f. = (r-1)(c-1)$.

Examples

1. The trustee of a company's pension plan has solicited the opinions of a sample of the company's employees regarding a proposed revision of the plan. A breakdown of the responses is shown in the table below: -

Response	Lower level management	Middle management	Top management
For	67	32	11
Against	63	18	9

Is there sufficient evidence at the 5% significance level, to conclude that the responses differ among the three groups of employees?

2. The operations manager at a shirt manufacturing plant has been concerned about the large number of defects that the company's three shifts have been producing. They appear to be three types of defects: Improper stitching, buttons not aligned with button holes and inconsistent colouring. The manager decides to investigate the problem. As a first step to improving the quality, she wants to know if the number and type of defects are the same for all three shifts. A random sample of one day's shirt production is taken. The number of each type of defect and the number of perfect shirts for each are shown in the following table.

| Shirt condition | Shift | | | |
	1	2	3	Total
Perfect	224	249	238	711
Improperly stitched	15	19	21	55
Unaligned buttons	8	12	12	32
Inconsistent colour	17	16	11	44
Total	**264**	**296**	**282**	**842**

Do these results allow the operations manager to conclude that at the 10% significance level, there are differences in quality among the three shifts?

3. There are three distinct types of hardware wholesalers; independents (independently owned), Wholesaler voluntaries (groups of independents acting together) and retailer cooperatives (retailer owned). In a random sample of 137 retailers, the retailers were categorized according to the type of wholesaler they primarily used and according to their store location as shown in the table below:

Store Location	Retailer cooperatives	Wholesaler Voluntaries	Independents
Multiple locations	14	10	5
Free- standing	29	26	13
Others (Mall, strips)	20	14	6

At the 5% significance level, is there sufficient evidence to conclude that the type of wholesaler primarily used by a retailer is related to the retailers location?

Relational Statistics

Relational statistics fall into one of three categories: univariate, bivariate, and multivariate analysis. Univariate analysis is the study of one variable for a sub-population. Bivariate analysis is the study of a relationship between two variables. Multivariate analysis is the study of relationship between three or more variables. The relational statistics include correlation, regression, discriminant analysis, conjoint analysis, factor analysis and cluster analysis

➤ **Discriminant analysis:** It is used to classify people or objects into groups based on several predictor variables. The groups are defined by a categorical variable with two or more values, whereas the predictors are metric. The effectiveness of the discriminant equation is based not only on its statistical significance but also on its success in correctly classifying cases to groups.

➤ **Conjoint analysis:** It is a technique that typically handles non-metric independent variables. It allows the researcher to determine the importance of product or service attributes and the levels or features that are most desirable. Respondents provide preference data by ranking or rating cards that describe products. These data become utility weights of product characteristics by means of optimal scaling and log linear algorithms.

➤ **Factor analysis:** It attempts to reduce the umber of variables and discover the underlying constructs that explain the variance. A correlation matrix is used to derive a factor matrix from which the best linear combination of variables may be extracted.

➤ **Cluster analysis:** It is a set of techniques for grouping similar objects or people. The cluster procedure starts with an undifferentiated group of people, events or objects and attempts to reorganize them into homogeneous sub-groups.

REGRESSION ANALYSIS

Regression involves developing a mathematical equation that analyses the relationship between the variable to be forecast (dependent variable) and the variables that the statistician believes are related to the forecast variable (independent variable).

Regression is the estimation of unknown values or the prediction of one variable from known values of other variables.

Types of regression

➤ **Simple linear regression**: Involves a relationship between two variables only.

➢ **Multiple regression**: Analyses or considers the relationship between three or more variables.

Simple Regression

The first step in establishing the relationship between X and Y is to obtain observations on the two variables and analyze the data using a scatter diagram to indicate whether a positive or negative relationship exists between X and Y. the relationship can be approximated by a straight line. Algebraically, the relationship is $Y_t = b_0 + b_1 X_t$

The above function is deterministic since it gives exact relationship between X and Y. when the line is plotted, not all the points will fall on the line because of the following reasons:-
➢ Omission of other explanatory variables from the function
➢ Random behavior of human beings
➢ Imperfect specification of the functional form of the model
➢ Errors of aggregation
➢ Errors of measurement

To account for the deviations of some points from the straight line, the error term is introduced. The introduction of the error term makes the function stochastic $Y_t = b_0 + b_1 X_t + e_t$. To estimate the values of the coefficients b_0 and b_1, we need observations on Y, X and the error term. However, the error term is not observable and therefore we make assumptions about the error term.

Assumptions of the error term
➢ The error term is a real random variable which has a mean of zero and constant variance (Assumption of homoscedasticity)
➢ The error term is normally distributed
➢ The error term corresponding to different values of X for different periods are not correlated (assumption of no autocorrelation)
➢ There is no relationship between the explanatory variables and the error term
➢ The explanatory variables are measured without error. The error absorbs the influence of omitted variables and errors of measurement in the dependent variable.
   All the above assumptions are called stochastic assumptions

   Other assumptions
➢ The explanatory variables are not perfectly linearly related or correlated (No multicollinearity)
➢ The variables are correctly aggregated
➢ The relation being estimated is identified
➢ The relationship is correctly specified

The regression equation of Y on X
   ➢ It used to predict the values of Y from the given values of X.
   ➢ It is expressed as follows $Y = b_0 + b_1 X$

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> To determine the values of b_0 and b_1 the following two normal equations are to be solved simultaneously

$$\sum Y = nb_0 + b_1 \sum X$$
$$\sum XY = b_0 \sum X + b_1 \sum X^2$$

> Alternatively the values of b_0 and b_1 can be got using the following formula's

$$b_0 = \overline{Y} - b_1 \overline{X}$$
$$b_1 = \frac{\sum XY - n\overline{X}\,\overline{Y}}{\sum X^2 - n\overline{X}^2}$$

Example

1. A random sample of eight auto drivers insured with a company and having similar auto insurance policies was selected. The following table lists their driving experience (in years) and the monthly auto insurance premium (in Sh.000) paid by them.

Driving experience (Years)	5	2	12	9	15	6	25	16
Monthly auto insurance premium (In Sh.000)	64	87	50	71	44	56	42	60

   i. Find the least squares regression line by identifying the appropriate dependent and independent variable
   ii. Interpret the meaning of the constants calculated in part (i) above.
   iii. Compute the coefficient of correlation and coefficient of determination and interpret their values.

2. A farmer wanted to find out the relationship between the amount of fertilizer used and the yield of corn. He selected seven acres of his land on which he used different amounts of fertilizer to grow corn. The following table gives the amount (in kg) of fertilizer used and the yield (in Tonnes) of corn for each of the seven acres.

Fertilizer used	120	80	100	70	88	75	110
Yield of corn	138	112	129	96	119	104	134

   i. Find the least squares regression line by identifying the appropriate dependent and independent variable.
   ii. Interpret the meaning of the constants calculated in part (i) above.
   iii. Compute the coefficient of correlation and coefficient of determination and interpret their values.
   iv. Predict the yield of corn per acre for 105 kg of fertilizer used.

3. In an attempt to get a better idea of some of the determinants of medical expenditures by families, a social worker collected data on family size and average weekly medical bills, with the results shown in the following table;

Family size	2	2	4	5	7	3	8	10	5	2	3	5	2
Weekly medical expenses (in Sh. '00')	20	28	52	50	78	35	102	88	51	22	29	49	25

i. Find the least squares regression line by identifying the appropriate dependent and independent variable.
ii. Interpret the meaning of the constants calculated in part (i) above.
iii. Compute the coefficient of correlation and coefficient of determination and interpret their.

CORRELATION

Definition: It is the existence of some definite relationship between two or more variables. Correlation analysis is a statistical tool used to describe the degree to which one variable is linearly related to another variable.

Types of Correlation
Correlation may be classified in the following ways:-
Positive and negative correlation
Correlation is said to be positive if two series move in the same direction, otherwise it is negative (opposite Direction).
Linear and Non-Linear correlation
Correlation is linear if the amount of change in one variable tends to bear a constant ratio to the amount of change in the other variable otherwise it is non-linear.
Simple, partial and multiple correlation
Simple correlation is where two variables are studied while partial or multiple involves three or more variables.

Methods of calculating simple correlation
1. Scatter diagram
2. Karl Pearson's coefficient of correlation
3. Spearman's rank correlation coefficient
4. Method of least squares

Scatter diagram
It is a chart that potrays the relationship between two variables.
Advantages
➢ It is simple and non-mathematical method of studying correlation between variables.
➢ It is not influenced by the size of extreme values
Limitation
➢ One cannot establish the exact degree of correlation between the variables.

Karl Pearson's coefficient of correlation (Product moment coefficient of correlation)
The coefficient of correlation (r) is a measure of strength of the linear relationship between two variables.

$$r = \frac{\sum XY - n\overline{X}\,\overline{Y}}{\sqrt{\sum X^2 - n\overline{X}^2}\,\sqrt{\sum Y^2 - n\overline{Y}^2}}$$

Interpretation of the coefficient of correlation
➢ When r = +1, there is a perfect positive correlation between the variables
➢ When r = -1, there is a perfect negative correlation between the variables
➢ When r = 0, there is no correlation between the variables

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➢ The closer r is to +1 or to –1, the closer the relationship between the variables and the closer r is to 0, the less close the relationship.
➢ The closeness of the relationship is not proportional to r.

The following table lists the interpretations for various correlation coefficients:

Value	Comment
0.8 to 1.0	Very strong
0.6 to 0.8	Strong
0.4 to 0.6	Moderate
0.2 to 0.4	Weak
0.0 to 0.2	Very weak

Advantage
➢ It summarizes in one figure the degree of correlation and whether it is positive or negative.

Limitations
➢ It assumes linear relationship regardless of the fact whether that assumption is true or not.
➢ The coefficient can be misinterpreted.
➢ The value of the coefficient is unduly affected by the extreme values.
➢ It is time consuming.

Method of least squares

$$r = \frac{SS_{xy}}{\sqrt{SS_{xx} * SS_{yy}}}$$

Spearman's Rank Correlation
Definition
➢ It is the correlation between the ranks assigned to individuals by two different characters.
➢ It is a non-parametric technique for measuring strength of relationship between paired observations of two variables when the data are in ranked form.

It is denoted by R or p

$$R = 1 - \frac{6\sum d_i^2}{N(N^2 - 1)} = 1 - \frac{6\sum d^2}{N^3 - N}$$

In rank correlation, there are two types of problems:-
  i.   Where actual ranks are given
  ii. Where actual ranks are not given

Where actual ranks are given
Steps:
➢ Take the differences of the two ranks i.e. (R_1-R_2) and denote these differences by d.
➢ Square these differences and obtain the total $\sum d^2$
➢ Use the formula $R = 1 - \frac{6\sum d^2}{N^3 - N}$

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Example

The ranks given by two judges to 10 individuals are given below.

Individual	1	2	3	4	5	6	7	8	9	10
Judge 1(X)	1	2	7	9	8	6	4	3	10	5
Judge 2 (Y)	7	5	8	10	9	4	1	6	3	2

Calculate the spearman's rank correlation.

Where ranks are not given

Ranks can be assigned by taking either the highest value as 1 or the lowest value as 1. the same method should be followed in case of all the variables.

Example

Calculate the Rank correlation coefficient for the following data of marks given to 1st year B Com students:

CMS 100	45	47	60	38	50
CAC 100	60	61	58	48	46

Merits of the Rank method

➢ It is simpler to understand and easier to apply compared to the Karl Pearson's method.
➢ Where the data are of qualitative nature like honesty, efficiency, intelligence etc, the method can be used with great advantage.
➢ It is the only method that can be used where we are given the ranks and not the actual values.

Limitations

➢ The method cannot be used for finding out correlation in a grouped frequency distribution.
➢ Where the number of observations exceeds 30, the calculations become quite tedious and require a lot of time.

Coefficient of determination (r^2)

It is the square of the correlation coefficient. It shows the proportion of the total variation in the dependent variable Y that is explained or accounted for by the variation in the independent variable X. e.g. If the value of $r = 0.9$, $r^2 = 0.81$, this means 81% of the variation in the dependent variable has been explained by the independent variable.

REPORT WRITING TECHNIQUES

A quality presentation of research findings can have an inordinate effect on a reader's or a listener's perceptions of a study's quality. Recognition of this fact should prompt a researcher to make a special effort to communicate skillfully and clearly. Research reports contain findings, analysis, interpretations, conclusions and recommendations. Research reports differ depending on their aims and their readership. Reports should be clearly organized, physically inviting and easy to read. Writers can achieve these goals if they are careful with mechanical details, writing style and comprehensibility.

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Writing a research proposal and research reports

A proposal is a document, which details an intended activity. The formats for writing proposals differ from institution to institution or from department to department. Generally, a research proposal should include the following prefatory items; the title page, declaration, table of contents, list of figures and tables, list of acronyms and abbreviations and an abstract. It will also have chapter one: Introduction, Chapter Two: Literature review and Chapter Three: Methodology. In addition it will also have the references, time schedule, budget and any appendices.

The final research report will have what is contained in the proposal (apart from the time schedule and budget) and in addition dedication, acknowledgement, chapter four: Data analysis and findings and chapter five: Summary, conclusions and recommendations.

Prefatory items

Prefatory items do not have a direct bearing on the research itself. They assist the reader in using the research report. They can include: -

Title page:

The title page should include the title of the report, the date and for whom and by whom it was prepared. The title should be brief but should include the variables included in the study, the type of relationship among the variables and the population to which the results may be applied.

Declaration

This is whereby the researcher declares that the work s his/her original work.

Dedication

Some researchers would always wish to dedicate their work to a person or persons they deem special in their lives.

Acknowledgements

During the research process, the researcher may require help from other individuals or organisations. It would be necessary if the researcher acknowledged received from these individuals and organisations.

Table of contents and list of figures and tables

Any report with several sections that total more than six to ten pages should have a table of contents. If there are many tables, charts or other exhibits, they should also be listed after the table of contents in a separate list of tables or list of figures.

List of abbreviations and acronyms

All abbreviations and acronyms used in report should be explained. An abbreviation is a short form of a word while an acronym is a contraction formed by taking the first letter of several words.

Abstract

A proposal abstract is a summary of what the researcher intends to do. It should be brief, precise and to the point.

Chapter One

1.0 Introduction

The introduction prepares the reader for the report by describing the parts of the report.

1.1 Background to the problem

In the background, the researcher should broadly introduce the topic under investigation. The researcher introduces briefly the general area of study, and then narrows down to the specific problem to be studied. The background enables the reader to have an idea of what is happening regarding the area under investigation.

1.2 The problem Statement

The researcher states the problem under investigation. The researcher should describe the factors that make the stated problem a critical issue to warrant the study. Relevant literature can be referred to. It should be brief and precise.

1.3 The objectives of the study

Research objectives are those specific issues within the scope of the stated purpose that the researcher wants to focus upon and examine in the study. The objectives should be specific, measurable, achievable, reliable and time bound. Objectives guide the researcher in formulating testable hypotheses.

1.4 Research questions

These are the questions, which the researcher would like to be answered by undertaking the study. They should be formulated from the objectives of the study.

1.5 Research Hypothesis

A hypothesis is a researchers prediction regarding the outcome of the study. It states possible differences, relationships or causes between two variables or concepts. Hypothesis are derived from or based on existing theories, previous research, personal observations or experiences. The test of a hypothesis involves collection and analysis of data that may either support or fail to support the hypothesis. If the results fail to support a stated hypothesis, it does not mean that the study has failed but it implies that the existing theories or principles need to be revised or retested under various situations.

1.6 Scope of the study

This section indicates the boundary of the study

1.7 Significance / Justification of the study

The justification helps to answer the following questions. Why is this work important? What are the implications of doing it? How does it link to other knowledge? How does it stand to inform policy making? The significance must be strong enough to warrant the use of time, energy and money in carrying out the research.

1.8 Assumptions and limitations of the study

An assumption is any fact that a researcher takes to be true without actually verifying it. It puts some boundary around the study and provides the reader with vital information, which influences the way results of the study are interpreted. A limitation is an aspect of a research that may influence the results negatively but over which the researcher has no control. A common limitation in social science studies is the scope of the study, which sometimes may not allow generalizations. Sample size may also be another limitation.

Chapter Two
2.0 Literature Review

The purpose of the literature review is to situate your research in the context of what is already known about a topic. It need not be exhaustive, it needs to show how your work will benefit the whole. It should provide the theoretical basis for your work, show what

has been done in the area by others, and set the stage for your work.

In a literature review you should give the reader enough ties to the literature that they feel confident that you have found, read, and assimilated the literature in the field. It should probably move from the more general to the more focused studies, but need not be exhaustive, only relevant.

The literature review should clearly present the holes in the knowledge that need to be plugged and by so doing, situate your work. It is the place where you establish that your work will fit in and be significant to the discipline.

Chapter Three

3.0 Research Methodology

This section should make clear to the reader the way that you intend to approach the research question and the techniques and logic that you will use to address it.

3.1 **Research design**

The coverage of the design must be adapted to the purpose. In an experimental study, the materials, tests, equipment, control conditions and other devices should be described. In descriptive or ex post facto designs, it may be sufficient to cover the rationale for using one design instead of competing alternatives. The strengths and weaknesses of the design can be identified and the instrumentation and materials discussed.

3.2 **The target population**

The researcher should explicitly define the target population being studied

3.3 Sampling strategy

Explanations of the sampling methods, uniqueness of the chosen parameters or other points that need explanation should be covered with brevity.

3.4 Data Collection Tools and Techniques

This part of the report describes the specifics of gathering the data. Its contents depend on the design. This might include the data that you anticipate collecting and a description of the instruments you will use. Detailed copies of the data collection tools e.g. questionnaires, interview schedule or observation schedule should be attached as an appendix.

3.5 Data Analysis

This section summarizes the methods used to analyze the data. It describes data handling, preliminary analysis, statistical tests, computer programs and other technical information. The rationale for the choice of analysis approaches should be clear. A brief commentary on assumptions and appropriateness of use should be presented.

Chapter Four
4.0 Data analysis and Findings

The objective is to explain the data rather than draw interpretations or conclusions. When quantitative data can be presented, it should be done as simply as possible with charts, graphics and tables. The data need not include everything collected. Only material important to the reader's understanding of the problem and the findings should be

included. Both findings that support or do not support the hypothesis should be included.

Chapter Five
5.0 Summary and Conclusions

The summary is a brief statement of the essential findings. Sectional summaries may be used if there are many specific findings. These may be combined into an overall summary. Conclusions represent inferences drawn from the findings. Conclusions may be presented in a tabular form for easy reading and reference. Summary findings may be subordinated under the related conclusion statement.

Recommendations

There are usually a few ideas about corrective actions. In academic research, the recommendations are often further study suggestions that broaden or test understanding of the subject area. In applied research, the recommendations will usually be for managerial action rather than research action. The writer may offer several alternatives with justifications.

References
The use of secondary data requires a reference or a bibliography. Proper citation, style and formats are unique to the purpose of the report. The

Appendixes
The appendixes are the place for complex tables, statistical tests, supporting documents, copies of forms and questionnaires, detailed descriptions of the methodology, instructions to field workers and other evidence important for later support. The reader who wishes to learn about technical aspects of the study and to look at statistical breakdowns will want a complete appendix.

Time schedule

It is a listing of the major activities and the corresponding anticipated time period it will take to accomplish that activity. The time is usually given in months. Activities to be undertaken can always overlap.

Budget

A budget is a list of items that will be required to carry out the research and their approximate cost. It should be detailed enough and precise on items needed, prices per unit and total cost. Details of requirements in each budget will be governed by the type of research.

Characteristics of a Good Proposal:

➢ The need for the proposed activity is clearly established, preferably with data.

➢ The most important ideas are highlighted and repeated in several places.

➢ The objectives of the project are given in detail.

➢ There is a detailed schedule of activities for the project, or at least sample portions of such a complete project schedule.

➢ Collaboration with all interested groups in planning of the proposed project is evident in the proposal.

➢ The commitment of all involved parties is evident, e.g., letters of commitment in the

appendix and cost sharing stated in both the narrative of the proposal and the budget.

➢ The budget and the proposal narrative are consistent.

➢ The uses of money are clearly indicated in the proposal narrative as well as in the budget.

➢ All of the major matters indicated in the proposal guidelines are clearly addressed in the proposal.

➢ The agreement of all project staff and consultants to participate in the project was acquired and is so indicated in the proposal.

➢ All governmental procedures have been followed with regard to matters such as civil rights compliance and protection of human subjects.

➢ Appropriate detail is provided in all portions of the proposal.

➢ All of the directions given in the proposal guidelines have been followed carefully.

➢ Appendices have been used appropriately for detailed and lengthy materials which the reviewers may not want to read but are useful as evidence of careful planning, previous experience, etc.

➢ The length is consistent with the proposal guidelines and/or funding agency expectations.

➢ The budget explanations provide an adequate basis for the figures used in building the budget.

➢ If appropriate, there is a clear statement of commitment to continue the project after external funding ends.

➢ The qualifications of project personnel are clearly communicated.

➢ The writing style is clear and concise. It speaks to the reader, helping the reader understand the problems and proposal. Summarizing statements and headings are used to lead the reader.

Guidelines for writing a good research report
➢ Break large units of text into smaller units with headings to show organisation of the topics
➢ Relieve difficult text with visual aids when possible
➢ Emphasize important material and de-emphasize secondary material through sentence construction and judicious use of italising, underlining, capitalizing and parentheses.
➢ Use ample space and wide margins to create a positive psychological effect on the reader.
➢ Choose words carefully, opting for the known and short rather than the unknown and long.
➢ Repeat and summarize critical and difficult ideas so readers can have time to absorb them.
➢ Review the writing to ensure the tone is appropriate
➢ Proof read the final document to correct any errors.
➢ Use short paragraphs
➢ Indent parts of text that represent listings, long quotations or examples.

RESEARCH METHODS NOTES

> ➤ Use headings and subheadings to divide the report and its major sections into homogeneous topical parts.