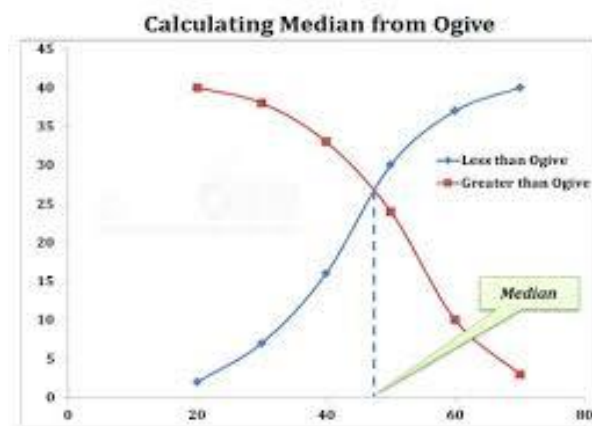**NATIONAL OPEN UNIVERSITY OF NIGERIA**

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCES

COURSE CODE: EHS 407

COURSE TITLE: RESEARCH METHODOLOGY AND PROPOSAL WRITING

COURSE GUIDE

EHS 407: RESEARCH METHODOLOGY AND PROPOSAL WRITING

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INTRODUCTION

EHS 407: Research Methodology and Proposal Writing is a two (2) unit course with three (3) modules and nine (9) units. Research Methodology refers to the set of systematic techniques used in research. It provides the guide to research and describes how the analysis is carried out. It gives insight on the nature of resources available for the research, the assumption, limitations and probable consequences of decision. Proposal Writing is a technical report that seeks to sets out the background information, identify a research problem, information gaps and suggest a methodology for carrying out a research or project to address the problem identified. It may also cover information on the basic philosophies and principles concerned with the problem and then create hypothesis to be tested by the research.

WHAT YOU WILL LEARN IN THIS COURSE
In this course, you have the course units and a course guide. The course guide will tell you what the course is all about. It is general overview of the course materials you will be using and how to use those materials. It also helps you to allocate the appropriate time to each unit so that you can successfully complete the course within the stipulated time limit. The course guide also helps you to know how to go about your Tutor-Marked Assignment which will form part of your overall assessment at the end of the course. Also, there will be regular tutorial classes that are related to this course, where you can interact with your facilitator and other students. I encourage you to attend these tutorial classes.

Course Aim

The aim of this course is to enable the students understand the basic principles and methods used in conducting research in environmental science.Students will also be taught the process of preparing and presenting a research proposal.

Course Objectives

After going through this course, you should be able to:

1. Define basic concepts used in research and proposal writing
2. Define a data, sample and sampling methods and their importance in research
3. Mention the methods of collecting data in lab and field studies
4. Process data and present them in a format that can be analysed
5. Use common methods of descriptive data analysis
6. Define and develop a well structured hypothesis
7. Know some common computer based statistical packages
8. Be able to analyse data using standard techniques like ANOVA

9. Write a research proposal
10. Prepare technical reports of research studies

WORKING THROUGH THIS COURSE

To successfully complete this course, you are required to read each study unit, read the textbooks materials provided by the National Open University of Nigeria. Reading the referenced materials can also be of great assistance. Each unit has self-assessment exercises which you are advised to do and at certain periods during the course you will be required to submit your assignment for the purpose of assessment. There will be a final examination at the end of the course. The course should take you about 17 weeks to complete. This course guide will provide you with all the components of the course how to go about studying and hour you should allocate your time to each unit so as to finish on time and successfully.

THE COURSE MATERIALS

The main components of the course are:

1. The Study Guide
2. Study Units
3. Reference / Further Reading
4. Assignments
5. Presentation Schedule

STUDY UNITS

The modules and study units in this course are given below:

MODULE 1 - RESEARCH METHODOLOGY

Unit 1   Research: methodology and research methods

Unit 2   Research Data and Sampling methods: Qualitative and Quantitative data, Samples and sampling methods and sample size determination

Unit 3   Data collection methods: Type and design of questionnaire, focus Group Discussion, Key informant interviews, Environmental Sampling, data collection

MODULE 2 – DATA AND ANALYSIS

Unit 1   Research hypothesis

Unit 2   Descriptive data analysis: mean, mode, median, graphs, percentiles and quartile, Mean and standard deviations, degrees of freedom, significant differences, standard error of means

Unit 3   Analysis of Variance (ANOVA) and Research Designs: completely randomized design, blocking, multi-factorial experiments, analysis of variance, Computer based analytical packages e.g. SPSS, EPI-IFO, Eview, SAS etc.

MODULE 3: RESEARCH COMMUNICATION

Unit 1   Proposal writing: Background information, literature search, research question, justification, study scope, objectives

Unit 2   Data processing and Presentation

Unit 3   Technical report writing: types, topic selection, justification, objectives, literature review, methodology, results and discussion, conclusion and recommendation

There are activities related to the lecture in each unit which will help your progress and comprehension of the unit. You are required to work on these exercises which together with the TMAs will enable you to achieve the objectives of each unit.

ASSIGNMENT FILE

There are two types of assessments in this course. First are the Tutor-Marked Assessments (TMAs); second is the written examination. In solving the questions in the assignments, you are expected to apply the information, knowledge and experience acquired during the course. The assignments must be submitted to your facilitator for formal assessment in accordance with prescribed deadlines stated in the assignment file. The work you submit to your facilitator for assessment accounts for 30 percent of your total course mark. At the end of the course, you will be required to sit for a final examination of 1½ hours duration at your study centre. This final examination will account for 70 % of your total course mark.

PRESENTATION SCHEDULE

There is a time-table prepared for the early and timely completion and submissions of your TMAs as well as attending the tutorial classes. You are required to submit all

your assignments by the stipulated time and date. Avoid falling behind the schedule time.

ASSESSMENT

There are three aspects to the assessment of this course. The first one is the self-assessment exercises. The second is the tutor marked assignments and the third is the written examination or the examination to be taken at the end of the course.

Do the exercises or activities in the unit by applying the information and knowledge you acquired during the course. The tutor-marked assignments must be submitted to your facilitator for formal assessment in accordance with the deadlines stated in the presentation schedule and the assignment file.

The work submitted to your tutor for assessment will count for 30% of your total course work. At the end of this course, you have to sit for a final or end of course examination of about a three-hour duration which will count for 70% of your total course mark.

TUTOR-MARKED ASSIGNMENTS

This is the continuous assessment component of this course and it accounts for 30% of the total score. You will be given four (4) TMAs by your facilitator to answer. Three of which must be answered before you are allowed to sit for the end of course examination.

These answered assignments must be returned to your facilitator. You're expected to complete the assignments by using the information and material in your readings references and study units. Reading and researching into your references will give you a wider view point and give you a deeper understanding of the subject.

1. Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you are not able to complete your assignment, make sure you contact your facilitator before the assignment is due to discuss the possibility of an extension. Request for extension will not be granted after the due date unless there in exceptional circumstances.

2. Make sure you revise the whole course content before sitting or the examination. The self-assessment activities and TMAs will be useful for this purposes and if you have any comment please do before the examination. The end of course examination covers information from all parts of the course.

COURSE MARKING SCHEME

Assignments	Marks
Assignments 1 – 4	Four assignments, best three marks of the four count at 10% each = 30% of course marks.
End of course examination	70% of overall course marks
Total	100% of course materials

Course Organisation

Unit	Title of work	Weeks activity	Assessment (End of the week)
	Course Guide	Week	
1	Research methodology and research methods	Week 1	Assignment 1
2	Research Data and Sampling methods	Week 2	Assignment 2
3	Data collection methods:	Week 3	Assignment 5
4	Research hypothesis	Week 4	Assignment 4
5	Descriptive data analysis	Week 5	Assignment 5
6	Analysis of Variance (ANOVA) and experimental designs	Week 6	Assignment 6
7	Research Proposal writing	Week 8	Assignment 8
8	Data processing and Presentation	Week 7	Assignment 7
9	Technical report writing	Week 9	Assignment 9

HOW TO GET THE MOST OUT OF THIS COURSE

In distance learning, the study units replace the university lecturer. This is one of the huge advantages of distance learning mode. You can read and work through specially designed study materials at your own pace and at a time and place that suit you best. Think of it as reading from the teacher, the study guide tells you what to read, when to read and the relevant texts to consult. You are provided exercises at appropriate points, just as a lecturer might give you an in-class exercise.

Each of the study units follows a common format. The first item is an introduction to the subject matter of the unit and how a particular unit is integrated with the other units and the course as a whole. Next to this is a set of learning objectives. These

learning objectives are meant to guide your studies. The moment a unit is finished, you must go back and check whether you have achieved the objectives. If this is made a habit, then you will significantly improve your chances of passing the course.

The main body of the units also guides you through the required readings from other sources. This will usually be either from a set book or from other sources.

Self-assessment exercises are provided throughout the unit, to aid personal studies and answers are provided at the end of the unit. Working through these self-tests will help you to achieve the objectives of the unit and also prepare you for tutor marked assignments and examinations. You should attempt each self-test as you encounter them in the units.

The following are practical strategies for working through this course

1. Read the Course Guide thoroughly.

2. Organize a study schedule. Refer to the course overview for more details. Note the time you are expected to spend on each unit and how the assignment relates to the units. Important details, e.g. details of your tutorials and the date of the first day of the semester are available. You need to gather together all this information in one place such as a diary, a wall chart calendar or an organizer. Whatever method you choose, you should decide on and write in your own dates for working on each unit.

3. Once you have created your own study schedule, do everything you can to stick to it. The major reason that students fail is that they get behind with their course works. If you get into difficulties with your schedule, please let your tutor know before it is too late for help.

4. Turn to Unit 1 and read the introduction and the objectives for the unit.

5. Assemble the study materials. Information about what you need for a unit is given in the table of contents at the beginning of each unit. You will almost always need both the study unit you are working on and one of the materials recommended for further readings, on your desk at the same time.

6. Work through the unit, the content of the unit itself has been arranged to provide a sequence for you to follow. As you work through the unit, you will be encouraged to read from your set books.

7. Keep in mind that you will learn a lot by doing all your assignments carefully. They have been designed to help you meet the objectives of the course and will help you pass the examination.

8. Review the objectives of each study unit to confirm that you have achieved them. If you are not certain about any of the objectives, review the study material and consult your tutor.

9. When you are confident that you have achieved a unit's objectives, you can start on the next unit. Proceed unit by unit through the course and try to pace your study so that you can keep yourself on schedule.

10. When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments, both on the tutor-marked assignment form and also that written on the assignment. Consult you tutor as soon as possible if you have any questions or problems.

11. After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in this course guide).

FACILITATORS/TUTORS AND TUTORIALS

Sixteen (16) hours are provided for tutorials for this course. You will be notified of the dates, times and location for these tutorial classes. As soon as you are allocated a tutorial group, the name and phone number of your facilitator will be given to you.

These are the duties of your facilitator: He or she will mark and comment on your assignment. He will monitor your progress and provide any necessary assistance you need. He or she will mark your TMAs and return to you as soon as possible. You are expected to mail your tutored assignment to your facilitator at least two days before the schedule date.

Do not delay to contact your facilitator by telephone or e-mail for necessary assistance if you do not understand any part of the study in the course material. You have difficulty with the self-assessment activities. You have a problem or question with an assignment or with the grading of the assignment.

It is important and necessary you acted the tutorial classes because this is the only chance to have face to face content with your facilitator and to ask questions which will be answered instantly. It is also period where you can say any problem encountered in the course of your study.

FINAL EXAMINATION AND GRADING

The final examination for EHS 407: Research Methodology and Proposal Writing will be of 2 hours duration. The exam score shall account for 70 % of the total course grade. The examination will consist of questions which reflect the practice, exercises and the tutor-marked assignments you have already attempted in the past. Note that all areas of the course will be assessed. To revise the entire course, you must start from the first unit to the tenth unit in order to get prepared for the examination. It may be

useful to go over your TMAs and probably discuss with your course mates or group if need be. This will make you to be more prepared, since the examination covers information from all aspects of the course.

SUMMARY

Research methodology and proposal writing is a course that introduces students to the basic principles of scientific research in general and the environmental sciences in particular. It is intended to expose students to the basic terminologies used in scientific research and work them through the process of data collection and sampling methods. The process of data processing and analysis such as measures of central tendency, dispersion and relationships between data sets would be dealt with. Analysis of variance (ANOVA) will be covered alongside some common experimental designs. The use of common statistical softwares will be introduced. Finally, it also covers the process of proposal and technical report writing. At the end of the course, you would have basic knowledge of research design, data analysis, proposal and technical report writing.

In addition, you will be able to answer the following questions:

1. Distinguish between Research methods and methodology
2. What is a primary or secondary research data
3. Discuss the basic steps involved in processing research data prior to analysis
4. Why is data processing important to a statistician?
5. Describe the basic methods of descriptive data analysis and their uses
6. What id the role of hypothesis in research?
7. List the basic components of an ANOVA table, describe the uses
8. What is a research proposal?
9. Discus the main components of technical reports of research studies

The list of questions is expected to answer is not limited to the above list. Finally, you are expected to apply the knowledge you have acquired during this course to your practical life. I wish you success in this course!

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MODULE 1 - RESEARCH METHODOLOGY

Unit 1   Research Methodology and Research Methods

Unit 2   Research Data and Sampling Methods

Unit 3   Data and Data Collection Methods

UNIT 1: RESEARCH METHODOLOGY AND RESEARCH METHODS

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1.1   INTRODUCTION

This unit will introduce you to the meaning and purpose of research and describe the basic process involved in scientific research.

1.2   OBJECTIVES

At the end of this unit, students are expected to;

1. Define and state the primary objectives of research
2. List the common types of research
3. State basic processes involved in scientific research
4. Differentiate between research methods and methodology

1.3   MAIN CONTENT

Research is commonly defined as the art of scientific investigation. It is a careful inquiry for new facts in any branch of knowledge; a methodological search for the truth through study, observation, comparison and experiment. According to Kothari and Garg (2014), the term 'research' refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data,

analysing the facts and reaching certain conclusions either in the form of solutions(s) towards the concerned problem or in certain generalisations for some theoretical formulation

1.3.1 Objectives of Research

The major aim of every research is to find out what is not known. Depending of the specific purpose, the objective of a research will either be to

1. Gain new insight about or familiarity with a phenomenon
2. Describe the characteristics of an object, person or group
3. To establish relationship between variables
4. Understand the frequency of an event or phenomenon

1.3.2 Types of research

The common types of research are

1. **Fundamental research**: This type of research is interested in finding out the general or basic principles which govern nature or human behaviour. The end products are usually theories and principles which help to under natural processes or behaviour. Examples are research aimed at producing a mathematical theory or a theory of social behaviour.

2. **Applied Research**: these aim at finding solutions to societal problems. They usually derive from the general principles or theories to attempt finding solutions to specific social or physical problem. An example is to study the effect of a marketing strategy on consumer acceptance of a new nutritionally enhanced food product.

3.**Descriptive research**: these use surveys and fact finding enquiries to describe the state of affairs as they exist at the moment. Here the researcher do not have or try to control the variables

4.**Analytical research**: this is similar to descriptive research except that the researcher tries to control the variables in order to understand the nature or behaviour of the organism, system or phenomenon.

5.**Empirical or conceptual research**: Empirical research relies principally on facts and experience and observation to derive its conclusion. In other words, it is a data based research while conceptual research deals with ideas, logic and reasoning (rationalization) to make conclusions or deductions. It is also known as abstract research.

6.**Quantitative orqualitative research**: Research is quantitative if the parameters used can be measured in quantitative terms such as numbers, weight, etc but when the

values cannot be easily measured such as taste, intelligence, choice, etc., it is referred to as a qualitative research

Based on the mode of data collection, research can also be grouped into three namely

a) **Library research**: This involves the collation and review of already published data which may be the form newspapers, journals, books, videos and tapes, etc. the data here is largely secondary
b) **Field research**: Here data is collected from the field using tools such as questionnaires, surveys or interviews
c) **Laboratory research**: here, the data is collected by means of controlled experiments.

In practice, many scientific studies may involve all the three to reach a reliable conclusion.

1.3.3 Importance of Research

1. It inculcates discipline and promotes habits of logical thinking and organization
2. Research provides the basis all government policies and programs
3. It is used to provide operational solutions to industrial or business problems
4. It helps to understand social problems and provides answers to societal problems
5. It provides means of livelihood for persons engaged in it
6. It leads to the development of new products, styles and behaviour

1.3.4 Research Methods and Research Methodology

Research methods refer to those methods or techniques used to carry out research or perform and experiment. They include means for data collection (survey, questionnaire, experiments, etc) and data analysis (statistical techniques). Research methodology deals with studying how a research is done. It evaluates the suitability of the research methods to the problem studied and so gives indication of how reliable the data generated is or would be. Methodology indicates which of the methods or techniques is relevant or suit the problem studied by the researcher.

1.4 CONCLUSION

Research is very important for the development of the world technologically and socially. It is a methodological search for the truth and so it is important that methods and techniques used are suitable to the problem being studied. An understanding and use of appropriate research methodology therefore ensures that both the methods and

techniques applied to the scientific study is appropriate in dealing with the research problem

1.5   SUMMARY

In this unit, we have dealt with basic concept involved in understanding the nature and purpose of research, research methods and research methodology.

1.6   TUTOR-MARKED ASSIGNMENT

1) What do you understand by research? Explain its significant in modern times.
2) Distinguish between research methods and research methodology
3) List and explain different types of research

1.7   REFERENCES/FURTHER READING

Kothari C.R. and Garg G. (2014) Research Methodology, Methods and Techniques. New Delhi, New Age International (P) Limited, Publishers.

UNIT 2: RESEARCH DATA AND SAMPLING METHODS

CONTENTS

2.1   INTRODUCTION

This unit is designed to help you understand the nature and types of scientific data, methods of collection, samples and choice of sample size

2.2   OBJECTIVES

At the end of this unit, students should be able to

1. Identify and classify scientific data
2. Enumerate the different methods of collecting scientific data
3. Choose an appropriate sample size for an experiment

2.3   MAIN CONTENT

Data is an existing information or knowledge represented or coded in some form suitable for usage or further processing

2.3.1   Types of Data

Scientific data are broadly grouped into two, **primary** and **secondary** data. Primary data are those that are fresh or have been collected for the first time by the researcher and so are original in nature. Secondary data those sets of data or information collected by someone else and or may have been subjected to varying degrees of processing or editing. Scientific data can also be described as either **quantitative** or **qualitative**. The later is descriptive such as taste and feel, while quantitative data are measurable in numerical terms e.g. Height, weight, etc. quantitative data can be

discrete or continuous. **Discrete** data take only certain values like whole numbers whereas **continuous** data take values within a range for instance 1 to 10.

2.3.2 Data Collection

As stated in unit one, research can be grouped into library, field or laboratory research based on the mode of data collection used. The type of research, the means or method of data collection and the techniques involved as summarized by Kothari

Type of Research	Methods	Techniques
1. Library	(i) Analysis of historical	Recording of notes, Content analysis, Tape and Film listening and Research records analysis
	ii) Analysis of documents	Statistical compilations and manipulations, reference and abstract guides, contents analysis
2. Field Research	(i) Non-participant direct observation	Observational behavioural scales, use of score cards, etc.
	ii) Participant observation	Interactional recording, possible use of tape recorders, photo graphic techniques
	(iii) Mass observation	Recording mass behaviour, interview using independent observers in public places
	(iv) Mail questionnaire	Identification of social and economic background of respondents
	(v) Opinionnaire	Use of attitude scales, projective techniques, use of sociometric scales

	(vi) Personal interview	Interviewer uses a detailed schedule with open and closed questions
	(vii) Focused interview	Interviewer focuses attention upon a given experience and its effects
	(viii) Group interview	Small groups of respondents are interviewed simultaneously
	(ix) Telephone survey	Used as a survey technique for information and for discerning opinion; may also be used as a follow up of questionnaire
	(x) Case study and life history	Cross sectional collection of data for intensive analysis, longitudinal collection of data of intensive character
3. Laboratory	Small group study of random behaviour, play and role analysis	Use of audio-visual recording devices, use of observers, etc

Source; Kothari and Garg (2014)

2.3.3 Research Sample and Sampling Methods

Sample in research is defined as a representative group of a study population. In many research studies, it is not possible to collect data from all the people or sources or respondents. For instance, if a researcher is interested in finding out the effect on milk consumption on the performance of school children in a country, it won't be possible to collect data from all the children of school age in that country. Hence a representative group will have to select for the study, that representative group is known as 'sample'. The process of selecting a sample is known as 'sample design' and a survey carried out on the basis of a sample is known as 'sample survey'. The sampling method used depends largely on the nature and the aim of the study. Common examples of sampling methods are

1. **Random sampling**: This is also known as probability sampling and members of the sample are chosen without any bias provided they belong to the population. Random sampling can be **simple**; in which all members of the population are given equal population of getting into the sample or **complex** random sampling which combines a mixture of random and non random methods. Examples of complex random sampling are

  a) **Systematic random sampling**: This selects every i^{th} item of a population. For instance, the village heads or the first student in every class
  b) **Stratified sampling**: here the population is first subdivided into smaller homogenous groups (strata) and members are then selected to represent each group in the sample
  c) **Cluster sampling**: Here the population is grouped into a non homogeneous group such as cluster. The cluster may be geographical. Then a cluster is selected and members are assumed to be representative of the whole population
  d) **Multistage sampling**: This involves selecting for instance regions within a country, then states from the regions selected, next LGAs are selected from the preselected states and some schools are then selected from the selected LGAs to evaluate the effectiveness of a newly introduced school curriculum.

2. **Purposive Sampling**: In purposive sampling, the basis for choosing a member of the sample is set prior to the sampling. This is particularly useful in cases where all the members of the population may not have the features required in the survey. For instance, a researcher interested in knowing problem of cocoa farmers in Nigeria is likely to sample respondents from only cocoa growing states of Nigeria instead of the whole country.

2.3.4 Importance of sampling

Sampling helps to

  a) Save time and money
  b) Ensure accurate measurement especially where the population is infinite or not well defined
  c) Save resources in experiments where the materials may be damaged or destroyed
  d) Estimate sampling error and hence accuracy of research finding

2.3.5 Sampling Size

Whichever technique employed, it is important that the size of the sample be big enough to represent the population so studied. Adequate sample size depends on the

population, the nature of the study and the sample technique to be used. Students should consult the recommended texts for techniques of determination of sample size.

2.4   CONCLUSION

Data collection is key to understanding of any topic studied in scientific research. The nature of problem studied influence affect the methods used in collecting scientific data. Since in most cases, it may not be possible to study the whole population, it is important in data collection that the sample used adequately represent the population but in nature and size.

2.5   SUMMARY

In this unit, we have discussed the types and importance of data collection in research, types of scientific data and means of collecting them as well as the sample size.

2.6   TUTOR-MARKED ASSIGNMENT

a) What is Sampling and state reasons why it is important in scientific studies?
b) Mention any five sampling methods you know and explain them
c) State two characteristics that make a sample adequate for a research

2.7   References/Further Reading

1) Elfil, M. & Negida, A. (2017). Sampling methods in clinical research; an educational review emergency 5(1)
2) Etikan, I., Musa, S.A., & Alkassim R.S. (2016) Comparism of convenience sampling and purposive sampling. American journal of theoretical and applied statistics 5(1), 1-4
3) Kothari C.R. and Garg G. (2014) Research Methodology, Methods and Techniques. New Delhi, New Age International (P) Limited, Publishers

UNIT THREE: DATA COLLECTION

CONTENTS

3.1   INTRODUCTION

Now having appreciated the basic principles and importance of data collection, this chapter will focus on exposing you to the principal instruments used to collect data from representative samples particularly in the environmental sciences. These include observation, questionnaires, interviews and environmental surveys/sampling

3.2   OBJECTIVES

At the end of this unit, the student should be able to

1) Mention the types and roles of different data collection methods
2) Differentiate between observation, interviews and questionnaires
3) Mention the common types of interviews and questionnaires

3.3   MAIN BODY

3.3.1 Primary data

Primary data are largely collected by the following means (i) observation (ii) interview (iii) questionnaires, (iv) schedules (v) consumer panels and (e) mechanical devices. The observation is the commonest method of collecting data in social science research. However, for the data to be valid and reliable, the process has to be designed systematically planned to fit the research purpose, adequately recorded and subjected to checks and controls. If done accurately, observation method eliminates subjective biases (little complicated by either the past behaviour or future intentions or attitudes), is independent of respondents' willingness to respond and as such is relatively less demanding of active cooperation on the part of respondents. The method may be expensive method and the information provided by this method is very limited by unforeseen factors and respondents may not be accessible.

Interviews usually involve collection of oral-verbal responses from a sample of the population. The responses (data) can be collected via personal or telephone interviews. Personal interviews usually require face-to-face contact. Interviews may also be structured or unstructured interviews**.**

Structured interviews use a set of predetermined questions and highly standardised techniques of recording.

In a **non-structured interview**, the interviewer is allowed much greater freedom to ask, in case of need, supplementary questions or may omit certain questions if the situation so requires. This flexibility makes comparison between different sets of data difficult. Unstructured interviews also require deep knowledge and greater skill on the part of the interviewer. They are used more for exploratory or formulatory studies while structured interviews are better used for descriptive studies. Interviews may also be described as focussed, clinical or non-directive.

Focussed interviews pay attention on the given experience of the respondent and its effects and are used mainly to develop hypotheses.

Clinical interview is concerned discovering the motivations underlying an experience or effect.

Non-directive interview uses the barest minimum of direct questioning only to encourage the respondents to talk about the given.

Non-personal (Tele) interviews involve soliciting for information from remote respondents without significant contact between respondents and interviewer. It used the mean of mass communication such as telephone, mails, radio, etc. to collect for oral information (data). Generally, interviews help to generate bigger and in-depth data particularly where the interviewer possess the skills needed to overcome the resistance and bias, but it is usually very expensive particularly where the sample size is large and widely distributed.

A **questionnaire** consists of a number of questions printed or typed in a well defined order or manner. It is usually sent to respondents who are expected to read and understand the questions and write down their responses in the spaces provided. It is widely used in economic and business surveys. Unlike interviews, it is cheap and can be easily administered where sample size is large and geographically wide. Its efficacy is limited by literacy level of respondents and low rate of return for response. For a questionnaire to be effective; it must comparatively short and simple, the questions should proceed in logical sequence, free of technical terms and vague expressions, make provision for indications of uncertainty, e.g., "do not know," "no preference". Questionnaires usually appear in two form, structured and unstructured.

Structured questionnaires have definite, concrete and pre-determined questions and often with predetermined graded responses. When these are lacking, it is termed **unstructured questionnaire**, though in practice, most questionnaires contain a mixture of both and hence are termed **mixed questionnaires.**

Very similar to questionnaires is the **schedule**, which used selected and trained enumerators to collect responses (data) from respondents using pre-tested questionnaires. The enumerators help to explain the aims and objectives of the study assist respondents in understanding questions and fill out their responses properly. Though this method is expensive, it is widely used extensive enquiries such as population census and can lead to fairly reliable results provided the enumerators are properly skilled. Other methods of collecting primary data include; Warranty cards, Distributor or store audits, Pantry audits, Consumer panels, Use of mechanical devices, Projective techniques.

3.3.2 Secondary Data

Secondary data refers to data that had been collected and analysed previously. They include data collected from journals, conference proceedings, periodicals, newspapers, government agencies, etc. for secondary data to be useful, the source of the data must be **reliable**, **suitable** for the purpose and **adequate** to justify the conclusion(s) derived.

3.3.3 Selection of Appropriate Method

In selection of adequate method of data collection, the following factors should be considered;

1. Nature, scope and object of enquiry
2. Availability of funds
3. Time factor
4. Level of Precision required

3.4 CONCLUSION

The method used in collecting data is as important as the data itself. The choice of an appropriate method will help ensure that the data collected is reliable, suitable and adequate for the study. These qualities ultimately influence the outcome or deductions made from the research.

3.5   SUMMARY

In the unit, the methods of collecting primary and secondary data have been discussed. The peculiarities of each method are discussed and the factors to be considered in choosing and appropriate method highlighted.

3.6   TUTOR-MARKED ASSIGNMENT

1. Enumerate the different methods of collecting data.
2. Which of methods do you consider most effective for conduction consumer preference for dairy food product brands in Nigeria?
3. Give reasons for your answer

3.7   REFERENCES/FURTHER READING

1) Kothari C.R. and Garg G. (2014) Research Methodology, Methods and Techniques. New Delhi, New Age International (P) Limited, Publishers

MODULE 2: DATA ANALYSIS

Unit 4   Research hypothesis

Unit 5   Descriptive data analysis

Unit 6   Analysis of Variance (ANOVA) and Research Designs

Unit 4: RESEARCH HYPOTHESIS

CONTENTS
4.1   Introduction
4.2   Objectives
4.3   Main Content: Research hypothesis
4.3.1 Characteristics of a Research hypothesis
4.3.2 Types of hypothesis
4.3.3 Test of hypothesis
4.4   Conclusion
4.5   Summary
4.6   Tutor Marked Assignments
4.7   References and Further Reading

4.1   INTRODUCTION

The ultimate goal of research is to validate or discard an assumption based on empirical evidence. The empirical evidence is generated by the data collected. The yet to be verified assumption is known as hypothesis and the use of empirical data to evaluate or validate this hypothesis is known as test of hypothesis.

4.2   OBJECTIVES

At the end of this unit, students should be able to

1. Define hypothesis and give examples of hypothesis
2. State characteristics of a good hypothesis
3. State the procedure for testing hypothesis

4.3   MAIN BODY

Research Hypothesis

Hypothesis refers to assumptions or some suppositions to be proved or disproved by the research. It is a formal question that he intends to resolve. A hypothesis may be defined as a proposition or a set of proposition set forth as an explanation for the occurrence of some specified group of phenomena either asserted merely as a

provisional conjecture to guide some investigation or accepted as highly probable in the light of established facts (Kothari and Karg, 2014).

4.3.1 Characteristics of hypothesis

To be effective, a hypothesis should

1. Be clear and precise.
2. Be capable of being tested. A hypothesis "is testable if other deductions can be made from it which, in turn, can be confirmed or disproved by observation" (Emory, C.W.)
3. State relationship between variables, if it happens to be a relational hypothesis.
4. Be limited in scope and must be specific.
5. stated in simple terms and free of ambiguity
6. Be consistent with most known facts i.e., it must be consistent with a substantial body of established facts.
7. be testable within reasonable time
8. Explain the facts that gave rise to the need for explanation. This means that by using the hypothesis plus other known and accepted generalizations, one should be able to deduce the original problem condition.

4.3.2 Types of hypothesis

There are two types of hypothesis

- **Null hypothesis (H_0)**: The null hypothesis assumes that there are no differences between two sets of data. A null hypothesis represents the hypothesis we are trying to reject and should always be specific hypothesis i.e., it should not state about or approximately a certain value. For example, "there is no difference between rainfall pattern in Enugu and Imo states of Nigeria".

- **Alternate hypothesis (H_a):** is what should be accepted if the null is found not to be true. The alternative hypotheses represent all other possibilities.

4.3.3 Procedure for testing hypothesis

The basic procedure for testing hypothesis as outlined by Kothari and Karg (2014) are shown below.
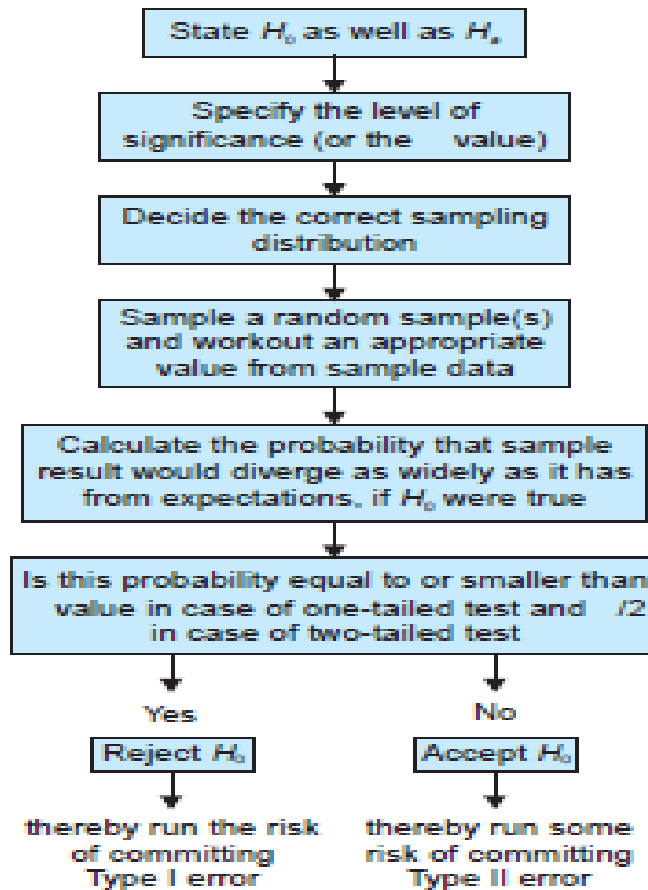
- Significance level: This is the tolerance level (usually in percentage) for accepting or rejecting the null hypothesis. In case we take the significance level at 5 per cent, then this implies that H_0 will be rejected when the sampling result (i.e., observed evidence) has a less than 0.05 probability of occurring if H_0 is true

- **Parametric tests:** These are tests which are used to test the hypothesis using the limit or level of significance previously set for the research or parameter. Most common and important parametric tests are: z-test, t-test; Chi-square test and F-test. These tests are based on the assumption that the data is normally distributed.

  o **Z-test** is generally used for comparing the mean of a sample to some known or hypothesised mean for the population, or when population variance is known.
  o The **t-test** is used for comparing means of two small samples when population variance is not known.
  o The **chi-square** (X^2-test) is based on chi-square distribution and is used for comparing a sample variance to a theoretical population variance.

- o **F-test** is based on F-distribution and is used to compare the variance of the two-independent samples. It is also used in the **analysis of variance** (ANOVA) to simultaneously judge for the significance between more than two sample means and for testing the significance of multiple correlation coefficients.

4.4   CONCLUSION

A well structured hypothesis is very important because it guides the researcher in making deductions from the results of his data. It also helps him to know which sets of data are needed and in which manner they are analysed

4.5   SUMMARY

In this unit, the types and importance of hypothesis are discussed. The characteristics of a good hypothesis and the processed of testing hypothesis is discussed

4.6   TUTOR-MARKED ASSIGNMENT

1. What is a hypothesis? State the characteristics it must possess to be useful to researcher.
2. A manufacturer considers his production process to be working properly if the mean length of the rods the manufactures is 8.5". The standard deviation of the rods always runs about 0.26". Suppose a sample of 64 rods is taken and this gives a mean length of rods equal to 8.6". What are the null and alternative hypotheses for this problem? Can you infer at 5% level of significance that the process is working properly?
3. Describe in brief all such steps involved in testing hypothesis
4. The following nine observations were drawn from a normal population: 27 19 20 24 23 29 21 17 27
(i) Test the null hypothesis H_0: mean = 26 against the alternative hypothesis H_a : mean >26. At what level of significance can H_0 be rejected? (ii) At what level of significance can H_0: mean = 26 be rejected when tested against H_a: mean < 26?

4.7   REFERENCES/FURTHER READING

1) Kothari C.R. and Garg G. (2014) Research Methodology, Methods and Techniques. New Delhi, New Age International (P) Limited, Publishers

UNIT 5: DESCRIPTIVE DATA ANALYSIS

CONTENT

5.1   INTRODUCTION

Data analysis involves the computation of certain indices or measures of comparison between sets of data as well as patterns of relationship that exist among the data groups. It always involves the estimation of the unknown values of parameters of the population and testing of hypotheses for drawing inferences. There are two major types of analysis; descriptive analysis and inferential analysis.

Descriptive analysis provides information on the nature, attributes and characteristics of a sample such as the size and shape of a distribution(s) and relationships between two or more variables.

Inferential analyses are used to test the validity of data and indicate what conclusions or deductions that can be reasonably made from the available data. The details of these analyses will be studied in subsequent units.

5.2   OBJECTIVES

At the end of this unit; students should be able to

1. List common descriptive methods of data analysis
2. State their significance and conditions where it is appropriate to use them
3. Calculate common and simpler ones
4. Make inferences or deductions using them

5.3   MAIN BODY

Descriptive Data Analysis

Descriptive statistics or data analysis is those measures that are used to summarise the research data. They include

(1) measures of central tendency or statistical averages

(2) measures of dispersion

(3) measures of asymmetry (skewness)

(4) measures of relationship and

(5) Other measures.

5.3.1 Measures of central tendency

These measures tell us the point around which members of a set of data tend to aggregate. The common measures of central tendency are mean, mode and median. There are three types of mean, arithmetic mean, geometric and harmonic mean.

The **arithmetic mean**, also known as average, is the most common measure of central tendency and is gotten by dividing the sum of all the values in the sample or population by number of items.

The **mode** is the item in the population with the highest frequency, i.e. the item that occur the greatest number of times in the sample or population.

The **median** refers for the middle item of the population when the items are arranged sequentially in ascending of descending order. The mean can be calculated thus;

$$\text{Mean (or } \overline{X})^* = \frac{\Sigma X_i}{n} = \frac{X_1 + X_2 + ... + X_n}{n}$$

where $\overline{X}$ = The symbol we use for mean (pronounced as X bar)

Σ = Symbol for summation

X_i = Value of the ith item X, $i = 1, 2, ..., n$

n = total number of items

In case of grouped data, the mean is calculated thus

$$\overline{X} = \frac{\Sigma f_i X_i}{\Sigma f_i} = \frac{f_1 X_1 + f_2 X_2 + ... + f_n X_n}{f_1 + f_2 + ... + f_n = n}$$

Geometric mean is also useful under certain conditions. It is defined as the nth root of the product of the values of n times in a given series. It is calculated thus:

$$\text{Geometric mean (or G.M.)} = \sqrt[n]{\pi X_i}$$

$$= \sqrt[n]{X_1 \cdot X_2 \cdot X_3 \dots X_n}$$

where

G.M. = geometric mean,

n = number of items.

X_i = ith value of the variable X

π = conventional product notation

Harmonic mean is defined as the reciprocal of the average of reciprocals of the values of items of a series. Symbolically, we can express it as under:

$$\text{Harmonic mean (H. M.)} = \text{Rec.} \frac{\sum \text{Rec} X_i}{n}$$

$$= \text{Rec.} \frac{\text{Rec.} X_1 + \text{Rec.} X_2 + \dots + \text{Rec.} X_n}{n}$$

For the calculation of geometric and arithmetic means, refer to the recommended texts

5.3.2 Measures of dispersion

These measures give indication about the scatter or distribution of the values of items in the sample or population around the mean. Important measures of dispersion are (a) range, (b) mean deviation, and (c) standard deviation.

Range is the simplest possible measure of dispersion and is defined as the difference between the values of the extreme items of a series such as the highest and the lowest. It is a rough measure of dispersion and is not consistent between different samples of a population

$$\text{Range} = \left(\begin{array}{c} \text{Highest value of an} \\ \text{item in a series} \end{array} \right) - \left(\begin{array}{c} \text{Lowest value of an} \\ \text{item in a series} \end{array} \right)$$

Mean deviation is the average of difference of the values of items of the sample or population from the mean, mode or median. The differences are known as deviation and so have no sign (+ or -). Hence in calculating mean deviation, the minus sign of in the deviations are ignored. Mean deviation is, thus, obtained as under:

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$$\text{Mean deviation from mean } (\delta_{\bar{X}}) = \frac{\Sigma |X_i - \bar{X}|}{n}, \quad \text{if deviations, } |X_i - \bar{X}|, \text{ are obtained from}$$

or arithmetic average.

$$\text{Mean deviation from median } (\delta_m) = \frac{\Sigma |X_i - M|}{n}, \quad \text{if deviations, } |X_i - M|, \text{ are obtained}$$

or from median

$$\text{Mean deviation from mode } (\delta_z) = \frac{\Sigma |X_i - Z|}{n}, \quad \text{if deviations, } |X_i - Z|, \text{ are obtained from}$$

mode.

where δ = Symbol for mean deviation (pronounced as delta);
X_i = ith values of the variable X;
n = number of items;
$\bar{X}$ = Arithmetic average;
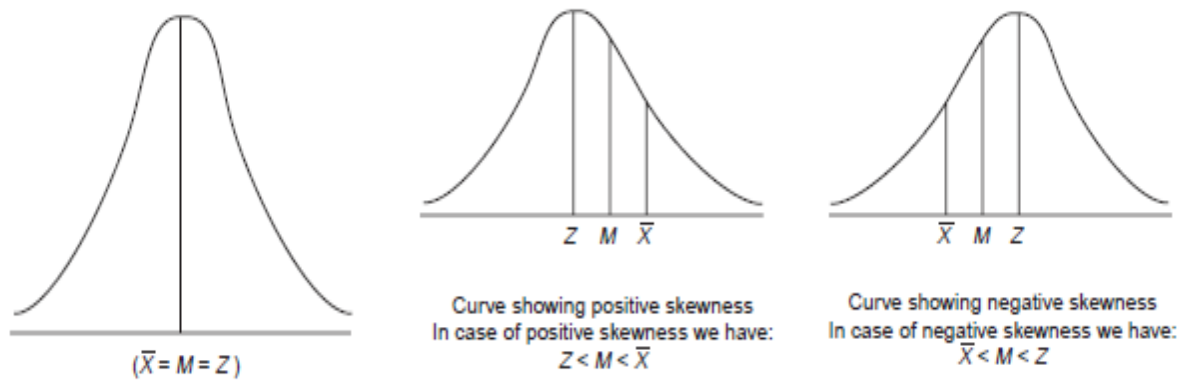M = Median;
Z = Mode.

When mean deviation is divided by the value used in calculating it (mean, mode or median), it is called coefficient of mean deviation.

Standard deviation is the square-root of the average of squares of deviations, and is most widely used measure of dispersion. When such deviations for the values of individual items are obtained from the arithmetic average, it is calculated thus:

$$\text{Standard deviation}^* (\sigma) = \sqrt{\frac{\Sigma (X_i - \bar{X})^2}{n}}$$

5.3.3 Measures of asymmetry (skewness)

These measure the manner in which the items are clustered or distributed around the average (mean, mode or median). If the distribution is normal, the mean, mode and median are virtually equal to each other (Fig. 5.1), otherwise it is said to be skewed. We have positive skewness but when the curve is distorted towards left, we have negative skewness

$$(\overline{X} = M = Z)$$

Z M $\overline{X}$

Curve showing positive skewness
In case of positive skewness we have:
$$Z < M < \overline{X}$$

$\overline{X}$ M Z

Curve showing negative skewness
In case of negative skewness we have:
$$\overline{X} < M < Z$$

Normal distribution

Figure 5.1 distribution curves

5.3.4 Measures of relationship

This refers to parameters that are used to measure the nature and degree of relationships between two or more variables within a population or that between two samples or populations. They try to answer two questions viz;

1. Is there an association or correlation between the two (or more) variables? If yes, of what degree?
2. Is there any cause and effect relationship between the two variables in population or between one variable on one side and two or more variables on the other side.

The first question is answered by the use of **correlation technique** and the second question by the technique of **regression**. Refer to the recommended texts for details of instruction on the calculation of correlation and regression.

5.4   CONCLUSION

Adequate data analysis helps the researcher to determine the nature of relationships between two sets of data and variables within a sample or population of study. It sets the foundation for correct deduction to be made and ensures the hypothesis is correctly tested.

5.5   SUMMARY

In this unit, we have dealt with the role of data analysis in general and the importance of some descriptive data analysis methods such as measures of central tendency, skewness and relationships between sets of data.

5.6   TUTOR-MARKED ASSIGNMENT

1. Differentiate between descriptive statistics and inferential statistics? List the important statistical measures you will use to summarise the survey data.
2. What does a measure of central tendency indicate? List measures of central tendency and discus the situation where is ideal to use as a method of comparison.
3. Which are measures of relationships and why are they important in research studies?

5.7   REFERENCES/FURTHER READING

Gastel B. and Day R. A. (2016) How to Write and Publish a Scientific Paper 8th*Ed., California,* Greenwood

UNIT 6: ANALYSIS OF VARIANCE

CONTENT

6.1   INTRODUCTION

Many scientific studies involve the collection and analysis of data from more than one set of samples or population. To compare these samples or populations will be very cumbersome and time consuming. Consequently, statisticians have developed procedures known as analysis of variance which enable data to be compared across more than two samples simultaneously. This is known as analysis of variance (ANOVA).

6.2   OBJECTIVES

At the end of this unit, students should be able to

1. Define ANOVA
2. State features of a typical ANOVA
3. Define an experimental design and give common examples
4. Explain mean separation
5. List common statistical softwares used in data analysis

6.3   MAIN BODY

Analysis of variance

The ANOVA technique is used to compare more than two populations such as the performance of students in a several varieties of subjects. ANOVA separates variation in a set of data into two; the amount which can be attributed to chance and that which can be attributed to specified causes. It in general, investigates any number of factors which are hypothesized to influence the dependent variable.

6.3.1 Basic principles of ANOVA

In using ANOVA, it is assumed that

1. each of the samples is drawn from a normal population
2. each of these populations has the same variance
3. All factors other than the one or more being tested are effectively controlled

6.3.2 ANOVA technique

For details of the methods involved in computation of ANOVA, refer to the recommended text. An explanation of the terms is given below. There are three types of ANOVA, one-way (single factor), two-way (two factors) and multiple factors analysis of variance (MANOVA).

Sources of variation	Degrees of freedom	Sums of square	Mean square	F-ratio	F-value
Total	$n-1$	SS_T			
Treatment/Row	$r-1$	SS_R	MS_R	MS_R/MS_E	$F_{dR/dE}$
Error	$n-t$	SS_E	MS_E		

Where:

n –   Total number of samples

r –   Number of treatments

SS_T – sums of squares for total (population/sample)

SS_R – sums of squares for treatment

SS_E – sums of squares for error

$F_{dR/dE}$ – F-distribution for the degree of freedom of treatment against degree of freedom of error

For a 2-way

Sources of variation	Degrees of freedom	Sums of square	Mean square	F-ratio	F-value
Total	$n-1$	SS_T			
Treatment/Row	$r-1$	SS_R	MS_R	MS_R/MS_E	$F_{dR/dE}$
Block/Column	$b-1$	SS_B	MS_B	MS_B/MS_E	$F_{dB/dE}$
Error	$n-t$	SS_E	MS_E		

Where:

b   – number of blocks or columns

SS_B – sums of squares for block or column

MS_B – mean square for block or column

$F_{dB/dE}$ - F-distribution value for the degree of freedom of block/column against degree of freedom of error

In all cases, the Null hypothesis is accepted if the F-value $\geq$ F-ratio. If not, if not it shows that a difference is statistically significant, the alternate hypothesis is presumed suggesting that the difference is probably not due to chance.

6.3.3 Mean Separation

This is used to determine which of the means or treatments are statistically different from each other. Means are separated using the standard error of the mean (SEM) which is calculated thus;

$$SEM = \sqrt{\frac{2MSE}{r}}$$

Where

MSE – mean square for error and

r – No of times each experiment is replicated

The SEM is basic but the method of separation ultimately depends on the experimental design

6.3.4 Experimental Design

The procedures or cautions taken by the researcher to ensure casual circumstances do not affect results significantly are known as experimental design. The goal of experimental designs is to ensure that the results observed in an experiment are attributable to the treatment variables and to these casual circumstances. Common among the designs include

1. **Completely Randomised Design**: this is used where the study has only one variable factor. All the other variables or causal circumstances are controlled by the researcher and the one-way ANOVA is used for analysis and

significantly different means are separated by Least Significant Difference (LSD) calculated as

$$LSD = t \times SEM$$

Where t – students t-distribution value at the desired level of significance

2. **Completely Randomised Block design**: Here two factors or variables are involved. For instance the performance of students in varying subjects at different levels such as SS1 to SS3. In which case, the subjects are treatments and level is block. The two-way ANOVA is used and means are separated by procedures such as Duncan's multiple range test

3. **Latin square or Split block designs**: These are used in situations where locations are expected to significantly influence the results. For instance, the performance of students in different subjects at different levels from various schools or region or country. The ANOVA technique here is essentially two-way, except that the variance is split into four parts viz:
   a. variance between columns;
   b. variance between rows;
   c. variance between varieties;
   d. Residual variance (error).

4. **Factorial design**: This is used where graded levels of two or more variables are considered. For instance, the effect of graded levels of three types of fertilizer on performance of crops. The ANOVA is similar to that in two-way except that all factors and levels are considered alongside any interaction effects

5. **Multi-factorial designs**: These are used in situations where different and often interrelated variable factors may affect the end results, for instance the effects of education, income, social status, health and location on the plane of nutrition of school children. Here the data is analyzed using the multiple analysis of variance techniques (MANOVA), which is a little complex technique and may require the use of computer softwares.

6.3.5 Common Statistical softwares

SPSS (IBM): SPSS means "Statistical Package for the Social Sciences" and was first launched in 1968. It was acquired by IBM in 2009, since then is officially known as IBM SPSS Statistics. It is used for processing, editing and analyzing all sorts of data such as scientific research, a customer database, etc. SPSS can open all file formats that are commonly used for structured data such as spreadsheets from MS Excel or

Open Office; plain text files (.txt or .csv); relational (SQL) databases; Stata and SAS. For details on how to use SPSS, you can refer the https://www.ibm.com/analytics/spss-statistics-software

R Core: is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing. The R language is widely used among statisticians and data miners for developing statistical software and data analysis. It provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, …) and graphical techniques, and is highly extensible. For details, refer to https://www.r-project.org

MATLAB: this is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks. It allows for matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages. Although MATLAB is intended primarily for numerical computing, it is designed to allow access to symbolic computing abilities, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems. This makes it an excellent tool for data presentation

Microsoft Excel: Microsoft Excel is a spreadsheet program. It is used to create grids of text, numbers and formulas specifying calculations. It is widely used in business computing and data analysis. Microsoft Excel uses a grid of cells arranged in numbered rows and letter-named columns to organize and manipulate data. It readily supplied functions can be used to deal with statistical, engineering and financial analysis. In addition, it can display data as line graphs, histograms and charts, but has a very limited three-dimensional graphical display. It allows sectioning of data to view its dependencies on various factors from different perspectives

Statistical Analysis Software (SAS): is a statistical software suite developed by SAS Institute for advanced analytics, multivariate analysis, business intelligence, criminal investigation, data management, and predictive analytics. It was developed at North Carolina State University. It consists of a group of computer programs that work together to store data values and retrieve them, modify data, compute simple and complex statistical analyses, and create report. It is increasing becoming the software of choice for research and business.

6.4   CONCLUSION

Analysis of variance (ANOVA) is used for comparing means from more than two groups of samples and significantly different means are then separated using the least significant different (LSD), Duncan's multiple range test (DMRT), etc. the process used in calculating the ANOVA depends on the experimental design of the study.

6.5   SUMMARY

In this unit, we have studied the process of calculating the ANOVA for common experimental designs such as CRD, CRBD, Factorial and Latin square. The process of mean separation is explained and some common software used in research analysis was introduced.

6.6   TUTOR-MARKED ASSIGNMENT

1. Explain the meaning of analysis of variance. Describe briefly the technique of analysis of variance for one-way and two-way classifications.
2. State the basic assumptions of the analysis of variance.
3. Write short notes on the following:

   (i)   Latin-square design.

   (ii)   Coding in context of analysis of variance.

   (iii) F-ratio and its interpretation.

   (iv)   Significance of the analysis of variance.

6.7   REFERENCES/FURTHER READING

Kothari C.R. and Garg G. (2014) Research Methodology, Methods and Techniques. New Delhi, New Age International (P) Limited, Publishers

SPSS https://www.ibm.com/analytics/spss-statistics-software

R core.https://www.r-project.org

MODULE 3: RESEARCH COMMUNICATION

Unit 7   Research Proposal writing

Unit 8   Data processing and Presentation

Unit 9   Technical report writing

UNIT 7 – RESEARCH PROPOSAL

CONTENT

7.1   INTRODUCTION

Research is not only expensive and time consuming; it also demands a lot of technical skills from the researcher and his team. The time, energy and resources invested in research will be wasted if it fails to address or make contribution towards solving the problem. Hence, researchers are usually expected to present a pre-research report which clearly identifies the problem and the need for the research known as research proposal. In many cases, a research proposal will include the composition and characteristics of the research team.

7.2   OBJECTIVES

At the end of this chapter, students should be able to;

1. Describe a research proposal
2. Define the basic components of research proposal
3. State the importance of research proposal writing
4. Write a simple proposal

7.3 MAIN BODY

Research proposal

A research proposal is a technical report which used to conceptualize and present an intended study. It outlines the need for a research; methods to be used, human and material resources needed, anticipated results and expected impacts it will have on the society. A typical research proposal has the following section of subunits; introduction (background information and/or literature search/review, research question, objectives, justification and scope of the research, the materials and methods needed for the study and expected results and its contribution to humanity.

7.3.1 Introduction

Depending on the situation, the introduction is used to present he background ideas or situation which led to the research idea. It is often accompanied by a literature review/summary whose aim is present a summary of known or documentated information around the subject matter in a logical, coherent but brief manner.

7.3.2 Research question is a concrete statement which identifies his problem to be studied and sets the tone for research hypothesis, while the **objective** states he goals expected at the end of research and helps to set or select he methodology to be used. **Justification** of the study presents the reasons why investment in it will be worthwhile for government or private investors. Scope is used to specify the segments of the problem which he research tends to address and is very important in studies which has several aspects or facets.

7.3.3 Materials and methods: This is also known as Research Methodology. It gives a summary of all human and material resources as well as procedures intended to be used for the research work. The methodology is very important because it determines the value and reliability of the research results. If the methodology is not adequate, the results will be largely suitable and the deductions made from the results unreliable. In many cases, cost of the material and human resources and he work plan are also needed in a proposal as part of or a separate section of the proposal. The summary of the costs is known as **budget** and are used to evaluate financial feasibility and cost benefit analysis of the research and its outcome. The **work plan** is often prepared with a Gantt chart and used to ensure that the research work fits in well into the program of participants and will deliver results when needed.

7.3.4 Expected Results and Impact: This is usually a short sketch of anticipated results from the study. It is usually based on logical and empirical information available on the matter being studied. The impact of the study is its anticipated contributions to humanity

7.4   CONCLUSION

A research proposal is essential for evaluating the technical and economic feasibility of a research project. This is important to avoid reducing to the minimum the waste of time, energy and resource in project. It also helps to ascertain the usefulness of the research project to the community and humanity in general.

7.5   SUMMARY

In this chapter, we have reviewed the basic principles and process needed for writing a research proposal, its components and importance.

7.6   TUTOR-MARKED ASSIGNMENT

1. What do you understand by research hypothesis
2. State the characteristics a good research hypothesis
3. Differentiate between Null and Alternate hypothesis
4. List and explain the major components of a typical research hypothesis

7.7   References/Further Reading

Ya-Lun-Chou, "Applied Business and Economic Statistics

UNIT 8: DATA PROCESSING AND PRESENTATION

CONTENT

8.1   INTRODUCTION

Data processing and analysis are very essential in a scientific study because they help to ensure that adequate and correct deductions are made from the data generated from the research study and also that they are in accord with purpose of the research. Technically speaking, processing implies editing, coding, classification and tabulation of collected data so that they are amenable to analysis. (Kotthari and Garg, 2014)

8.2   OBJECTIVES

In this chapter you will learn about

1. Methods of processing data in quantitative and qualitative research
2. Importance of data processing
3. How to present your data in tables
4. Different types of graphs and how to use them to represent your data

8.3 MAIN BODY

Data processing: Data processing involves transforming the data collected into forms which will make them easy for analysis. The processes involved include editing, coding, classification and tabulation of collected data.

8.3.1   Editing

This process is also known as 'cleaning up'. It involves transforming the raw data into forms or format which can be easily understood and used for analysis. It is particularly important where the data will be analysed by persons different from the original collectors of the data. It usually involves scrutinising the instruments and data for

possible errors such as incompleteness, misclassification and gaps in the information obtained from the respondents. There two types of editing, field/personal and central editing. Field edition is usually done enumerators and may be limited to the review of the reporting forms (translating or rewriting) what had been written in abbreviations and/or in illegible form. Central editing take place when all forms or schedules have been completed and returned and may be done by a single editor in a small studies and by a team of editors in case of a large inquiries.

8.3.2 Coding

Coding refers to the process of assigning numerals or other symbols to data or responses so that responses can be put into a limited number of categories or classes. Coding enables data to be easily subjected to empirical analysis and the codes are usually preset during the design of questionnaires. For instance, the degree of likeness for a product can be coded as follows; strongly dislike (1), dislike (2), slightly dislike (3), neither like or dislike (4), like slightly (5), like (6), like strongly (7). The number codes can be easily fed into computer or given to statistician who is not directly involved in the study to analyse and draw inferences. This helps to reduce bias.

8.3.3 Classification

This involves the sorting the large volume of raw data into classes based on some predetermined characteristics. The classification is usually based on attributes or intervals. The attributes might be sex, literacy level, income, social status, profession, etc. the class intervals are usually range of numeric attributes such as $1 - 4$, $20 - 29$, $51 - 100$, etc. it is important that in assigning classes or categories to data that;

1. The categories are mutually exclusive i.e. a response/data cannot belong to two categories.
2. The categories should be exhaustive; that is every response/data must qualify or belong to a category.
3. Data that could not fall within any category is less than 5%.

Consult the recommended text for guidelines or procedures for assigning class intervals.

8.3.4 Presentation of Data

After the processing or even analysis of data, it has to be presented in a manner that is not only legible but can be easily understood by users. Generally, data is presented in four major forms, text, tables, graphs and statistical measures

The use of **texts** involves presenting data with written words and expressions. It is the commonest method of presenting data. In fact, other methods are usually accompanied texts to provide clarity and guide to the user. It is important that the writing must have a specific theme; the data/findings are properly related to previously published literature; the references are properly cited; the thought process is logical and the layout is attractive.

Data may also be presented in **tables**. Each table must be properly titled, and the columns and rows properly identified. The first column on the left (stud) normally contains a vertical listing of categories or individuals about which information is given in the columns of the table. Many tables have footnote, which explain terms or unfamiliar codes used in the table or may indicate the source of the data.

Graphs are used to show the data trends in pictures. They present data in a way that is easy to understand and interpret, and interesting to look at. The type of graph depends on the nature of the data, the audience, the information the researcher wants to conver and the number of variables involved. Bar charts, histograms or pie charts are used for categorical variables, whereas for continuous variables, line or trend graphs can be constructed. Consult recommended texts for instructions on the construction of common types of graphs

Statistical measures are extremely effective in communicating the findings in a precise and succinct manner. They range from simple descriptive measures such as mean, mode, median to inferential statistical measures like analysis of variance, factorial analysis, multiple regressions. The choice of statistical measures depends on the type of data, skill/knowledge of the researcher, the purpose of the research and the audience.

8.5 CONCLUSION

No matter how big or adequate a set of data collected is, adequate processing, analysis and presentation of data is important to enable it be understood, interpreted or used. Once data is properly processed, it become is to analyse and present. Appropriately presented data makes it more useful

8.6 SUMMARY

In this unit, we have discussed to methods and importance of data processing, analysis and presentation

8.7   TUTOR-MARKED ASSIGNMENT

1. Identify two specific examples where you could use a table rather than just text to communicate findings and two examples where graphs would be better
2. Narrate the characteristics of a good table.
3. Distinguish between Field editing and central editing

8.8   REFERENCES/FURTHER READING

1) Kothari C.R. and Garg G. (2014) Research Methodology, Methods and Techniques. New Delhi, New Age International (P) Limited, Publishers.
2) Gastel B. and Day R. A. (2016) How to Write and Publish a Scientific Paper 8th*Ed., California,* Greenwood.

UNIT 9: TECHNICAL REPORT WRITING

CONTENT

9.1   INTRODUCTION

A research study is judged incomplete until the results are effectively communicated to others particularly the end users. This communication may be oral, written or in electronic form. Here we shall deal with written form of research communication. The first step in this communication is known usually through a technical report presented by the researcher at the end of his work. The rudiments of preparing these reports will be dealt with in his unit.

9.2   OBJECTIVES

At the end of this unit, students will be expected to

1. Define and state the characteristics of technical reports
2. Components a technical report
3. Steps involved in technical report writing
4. Referencing methods

9.3   MAIN BODY

A technical report is a systematic presentation of research results in written form. To serve its purpose a technical report must be

1. correct and true: A good report is very clear about the exact and definite purpose of writing the report and the information contained in a report must be based on accurate fact
2. appropriate for its intended audience
1. Concise
2. Comprehensive

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3. Organized in a logical and sequential manner and
4. action oriented

9.3.1 Components a technical report

Every technical report has three major components; the **Preliminary pages, Main body** and **End matter**. The preliminary pages cover the title and date, acknowledgements, Preface or Foreword, list of tables and illustrations, and in some cases an abstract or book summary.

The **main body** of the report would normally have the following sections:

1. Introduction: this introduces the reader to the research project. It contains a clear statement of the background information, objectives of research, and the problems which made it worth investigating, hypotheses of study, if any, and the definitions of the major concepts employed in the study. In some cases, a briefsummary of other related and relevant research may be here or in a separate section known as literature review.
2. Methodology: this provides a description of the materials and methods used to collect the data and all the necessary precaution made to ensure the data is correct and relevant to the subject matter.
3. results and discussions
4. conclusions and recommendations
5. implications drawn from the results and
6. summary

End Matter includes appendices, bibliography and the index

9.3.2 Steps involved in technical report writing

Some of the key steps noted to be effective include

1. Logical analysis of the subject matter
2. Preparation of the final outline
3. Preparation of the rough draft
4. Rewriting and polishing of the rough draft
5. Preparation of the final bibliography
6. Writing the final draft

9.3.3 Bibliography referencing methods

Bibliography refers to the sources of information consulted or referred to during the research process. They should be presented in an orderly manner. The common methods of referencing methods are

1. MLA – Modern Language association
2. APA – American Psychology Association
3. Chicago Manual of Style
4. Havard Referencing style
5. Vancouver Reference style

For details of this format, refer to recommended texts and the website

9.4   CONCLUSION

A research project is incomplete till the report has been presented and in a manner that will make it useful to the end users. The types and basic steps involved in writing technical reports have been presented in this unit and students are advised to refer to recommended texts and website for guide

9.5   SUMMARY

In this unit, we have discussed types and characteristics of technical reports, its components and basic steps and skills required in writing common technical reports. The referencing/bibliographic methods are also introduced

9.6   TUTOR-MARKED ASSIGNMENT

1. Explain the significance of a research report and narrate the various steps involved in writing such a report.
2. Describe, in brief, the layout of a research report, covering all relevant points.

9.7   REFERENCES/FURTHER READING

Gastel B. and Day R. A. (2016) How to Write and Publish a Scientific Paper 8th*Ed., California,* Greenwood