Training Manual

Enhancing Research Competencies

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Enhancing Research Competencies

for

Academic Staff

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Preface

Human Resource Development of the University System is one of the statutory responsibilities of the University Grants Commission (UGC) and also a key component of the Higher Education for the Twenty First Century (HETC) Project (2011-2016), the second phase of World Bank assistance provided for higher education sector in Sri Lanka. The UGC being the apex body of the university system bears the responsibility of providing opportunities for growth and career development to as many as possible through in-service training. In-service training for all categories of staff is vitally important not only to impart specific knowledge and skills required to perform in the employee's assigned tasks but also to promote right attitudes and behavioral attributes such as allegiance, commitment, initiative, compliance with codes of practices and ethics, which are indispensible elements required for improving the productivity of employees and that of the entire system.

In executing its mandatory role, the UGC has established Staff Development Centers through the Commission Circulars No. 820 of 20th February 2003 and expanded and strengthened the role of SDCs through the UGC Circular 937 of 10th November 2010. The UGC is providing additional funds beginning from 2011 for improving physical and human resources and expanding the scope of continuing education programmes. This initiative has been assisted by the WB-HETC Project (2011-2015) commencing from 2011.The -HRD-ST sub-project under the direction of the Standing Committee on Staff Development of the UGC has developed a comprehensive programme aimed at human resources development of universities, covering academic and other staff (i.e. senior administrative staff, executive staff, technical staff, non-academic support staff, etc.).

The aim of the UGC-HETC joint endeavor is to design and develop a series of Training Programmes and Manuals on diverse topics relevant to the staff of higher management, academic, executive and non-academic categories. The Training programmes and manuals are developed by the identified resource persons in close liaison and consultation with Professor Harischandra Abeygunawardena, Chairman of the Standing Committee on Staff Development of the UGC and Professor Lalith Munasinghe, Consultant of the HETC Project. All manuals are approved by the UGC for the use in the Staff Development Centers of all Universities.

This **Training Manual on Enhancing Research Competencies (CPD/Academic/01)** was developed by Prof. Asoka Pathiratne, Prof. Mangalika Hettiaracachi, Dr. D.B. Nanadadeva of University of Kelaniya, Dr. D.S.P. Chandrakumara and Mr. P. Dias of University of Sri Jayewardenepura as a commissioned assignment and would provide details of the prescribed training course. They will also act as training guides for prospective trainers of all universities.

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MODULE 1: INTRODUCTION TO RESEARCH

1. Learning Outcomes

At the end of the sessions, the participants will be able to explain the need of research in their specific area of knowledge.

2. Lecture Outline

- What is research?
- Types of research: i. Fundamental or Pure research and ii. Applied research.
- Nature of scientific explanation.
- Distinctions between scientific and non-scientific explanations.
- Limits of scientific explanation.
- Qualities of a researcher

3. Learning/Teaching Resource

a. Lecture Notes

3.1 What is research?

Research is an activity that investigates in order to find a solution for an unambiguous problem. Broadly speaking, it is a process of enquiry and investigation which systematically, methodically and ethically helps solve theoretical or practical problems (Sekaran, 2009: 5; Adams et al, 2007: 19). Research contributes to enhance the knowledge of people which is, on ethical grounds, expected to be for betterment of all human beings. This may include data collection, analysis, interpretation of results, creation of theories, revision of existing theories, etc. related to any subject of inquiry. We need research for enhancing the existing knowledge so as to empower the quality of human lives.

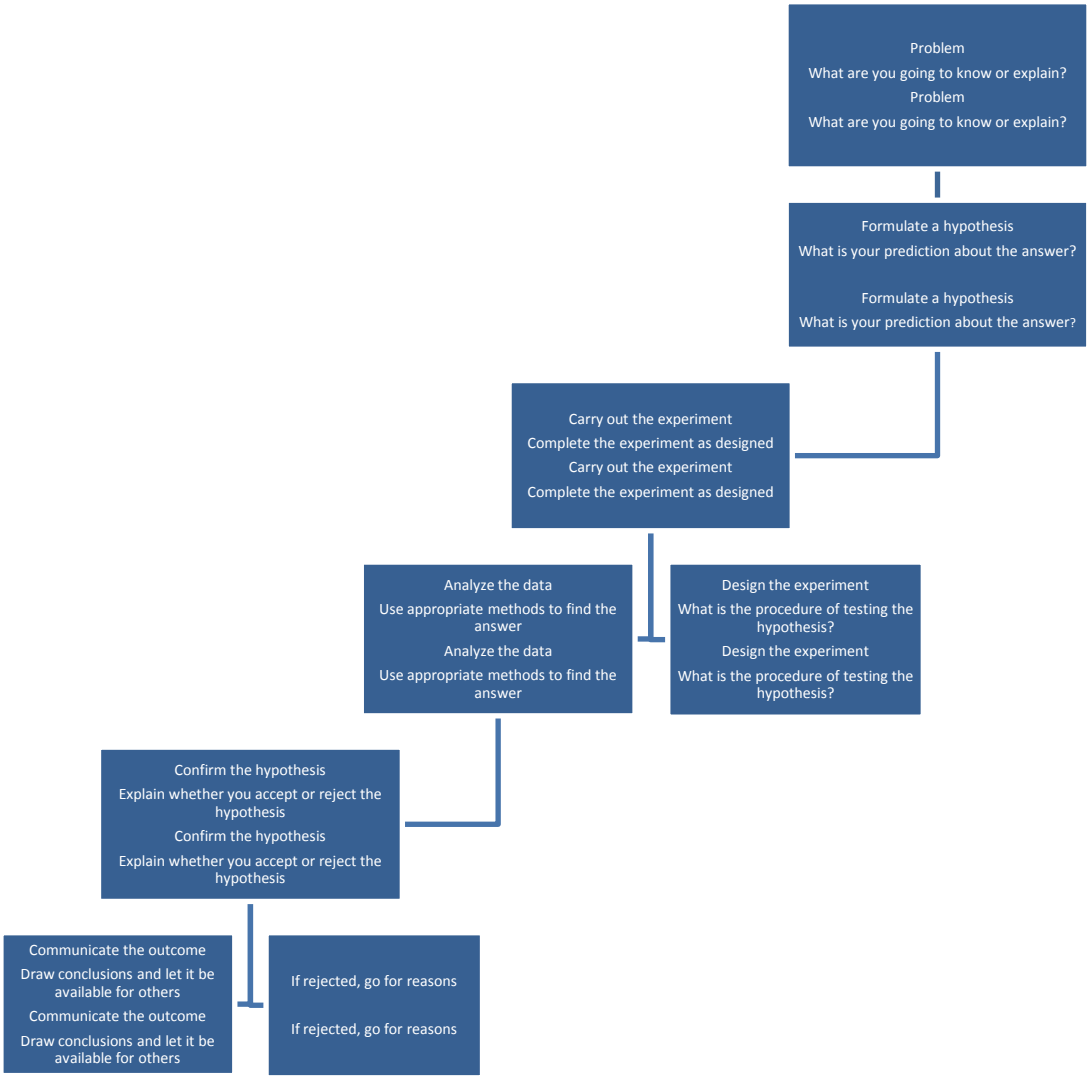
3.2 Types of research

Research may be either **pure or applied** in nature. **Pure research** which is also known as theoretical research expands the periphery of knowledge related to a specific subject or domain of subjects (Bordens and Abbot, 2006: 19). This type of research is used in enhancing the knowledge by examining and evaluating concepts and theories or other kinds of problems. Pure researches are not for the purpose of solving urgent current problems. Results of such researches may be important to use later on when policy decisions are made. **Applied research** deals with practical problems. For example, it may attempt to solve a practically urgent problem of an organization. If the Health Ministry wants to know why hospital registrations of kidney patients are high in one specific area compared to the other areas of the country, it needs a kind of applied research. Among various research methods, 'action research' is a widely used type of applied research.

3.3 Nature of Scientific Explanation

Science is a process of learning to know things in the material world. Things which are not seen in material form, for instance, gods, ghosts, etc. are excluded. Scientific method is a process used to find answers to questions about the universe using observation and investigation. It begins with a problem, base on observations and end with conclusions. Hence, the steps of the scientific method can be summarized as follows;

Steps of the Scientific Method

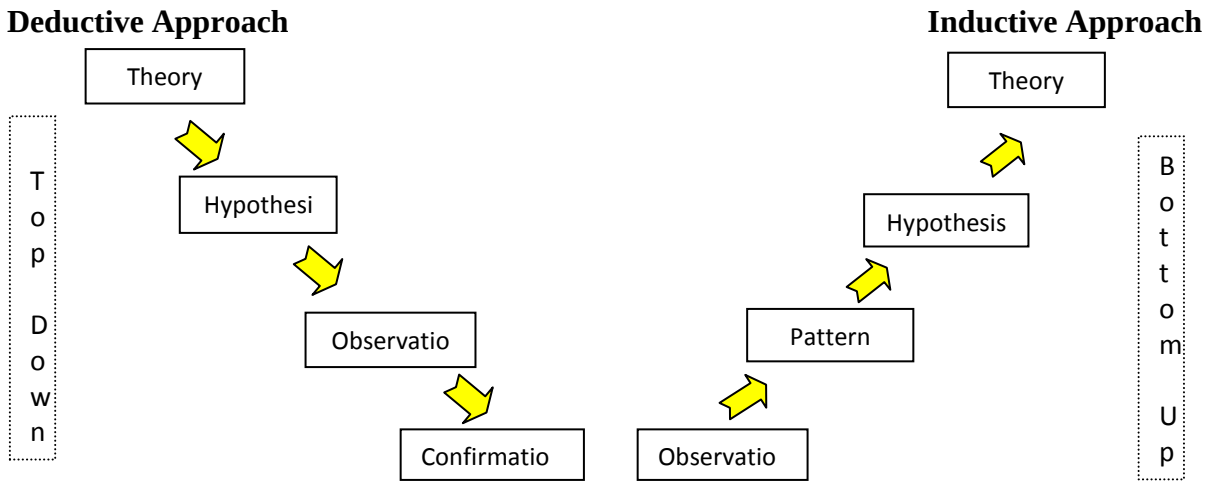


Using scientific method, we can solve research problems and add to the knowledge related to pure, applied and social sciences for the benefit of the society.

Induction and deduction are the two main logical paths to knowledge or the two broad methods of positivist reasoning (Dancy, 1985: 197). Deductive reasoning works from the general to the specific. This is, therefore, called a 'top-down' or 'knowledge-driven' approach. Inductive reasoning works from specific to general (Taylor et al, 2007: 14; Sharma and Sharma, 1986: 56). It is, therefore, called a 'bottom-up' or 'feature-detecting' approach. The selection of the approach for a certain research depends on a number of factors such as

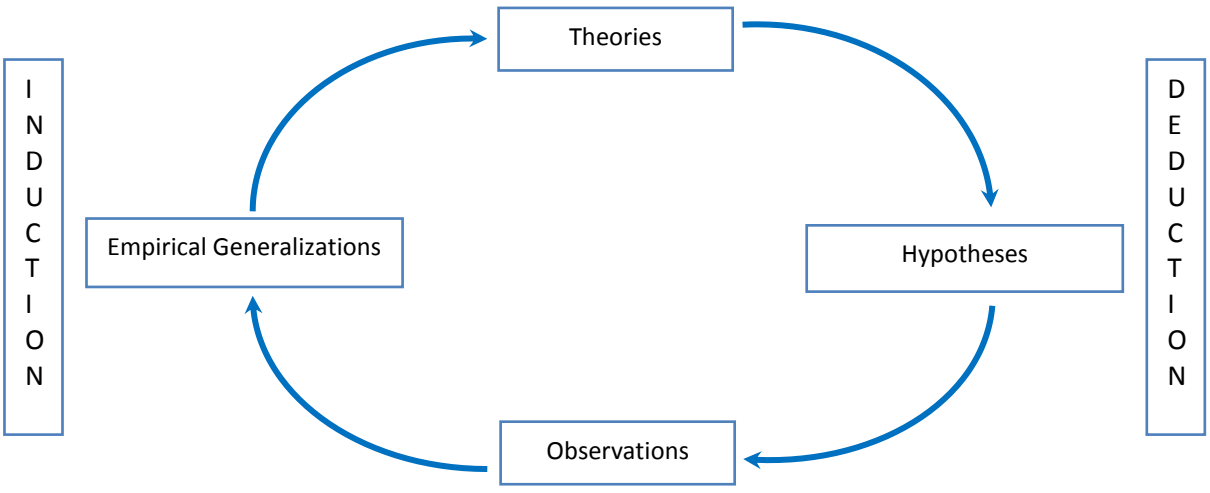
the nature of the epistemological or theoretical concerns, the kind of research problem, the kind of the available data set, etc.

The following figure helps understand the kind of the inductive and deductive approaches:



Difference between deductive and inductive approaches

However, it is not suggested that only one kind of process inevitably occurs in research. Instead, both processes may involve in a circular manner; theory leads to observations and in turn observations lead to discover new patterns which cause the development of new theories as given in the picture below.



Incorporation of the two approaches in research

Source: Walter Walace, 1971, cited in Babbie, 1986: 34.

According to the above explanation, theories formulate hypotheses, hypotheses determine observations, observations produce generalizations and generalizations give rise to adjustments or modifications of the theory (Babbie, 1986: 34). This process can again go ahead. The modified theory formulates modified hypotheses and it will be again followed by the other actions of the circle. This Thus, being a circle, there are no beginning and ending points in finding out or improving the knowledge.

3.3 Distinctions between scientific and non-scientific explanations

The following differences can be observed between scientific and non-scientific explanations.

a. The scientific explanation is a way of explaining something based on a **systematic process of inquiry** while non-scientific explanations are based on beliefs, attitudes, etc.
b. Conclusions of the scientific explanation are based on **evidence** while non-scientific explanations are based on beliefs, attitudes, etc.
c. The method of scientific explanation is based on **objectivity principle** so that results are replicable if the same study is conducted by the same person or any other scientists under the same conditions whereas the non-scientific explanation is not such.
d. The scientific explanation is **realistic** and based on **facts** whereas the non-scientific explanation is not such.

However, there may be non-scientific explanations where some of the above characteristics can be possessed.

3.4 Limitations of scientific explanation

Scientific explanation has its own limitations:

1. Subjective things such as pleasure or utility, pain, etc. cannot be explained objectively
2. Analyzability of qualitative data is limited
3. Attitudes, values or value judgments of people are not taken into consideration
4. Unrealistic assumptions are used
5. Exploration is limited only for the problems where the hypotheses are testable through evidence

3.5 Qualities of a researcher

Qualities that a researcher should have can vary attributable to domain of subjects or paradigm of research. However, some of the main and important qualities of a good researcher can be given as follows.

a. **Attitude related to the selected research paradigm**: If the research is conducted within the positivist paradigm, the researcher should have clarity about the paradigm including its relevance to the problem compared to other paradigms, and confidence and the good attitude towards it.
b. **Determination**: A good researcher should have enthusiasm to achieve the aim of research. He should have patience to continue the research until the problem is solved.
c. **Sensitivity of relationships**: A researcher should have theoretical sensitivity and a sensitivity about the cause and effect relationships which is a problem related to the reasoning part or the epistemology of research.
d. **Personal taste**: A research to be successfully completed, he should have a personal interest towards the scope and the problem of research that he is assigned to act upon.
e. **Appropriate techniques**: A researcher should know about different methods, techniques, tools, instruments, measures and formulas available for the work he is going to accomplish.

4. Essential Reading

- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Bordens, K.S, and Abbott, B.B. (2006). *Research Design and methods* (sixth ed,). New Delhi: Tata McGraw Hill Publishing Company Limited.
- Kumar, R. (2005). *Research Methodology: A step by step guide for beginners* (Second Edition). Delhi: Pearson Education.
- Sekaran, U. (2009). *Research Methods for Business: A Skill Building Approach* (Fourth Edition). New Delhi: WILEY-INDIA.

5. Supplementary Reading

- Babbie, E. (1986). *The Practice of Social Research* (Fourth Edition). California: Wadsworth Publishing Co.
- Briman, A.B. (2007). *Business Research Methods* (Second Edition), Oxford: Oxford University Press.
- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Dancy, J. (1985). *Introduction to Contemporary Epistemology*. New York: Basil Blackwell.
- Heath, P. and Lachs, J. (1982). *Science of Knowledge*. Cambridge: Cambridge Iniversity Press.
- Hawkins, C. and Sorgo, M. (1985). *Research: How to Plan, Speak and Write about It*. New Delhi: Narosa publishing House.

6. References

- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Babbie, E. (1986). *The Practice of Social Research* (Fourth Edition). California: Wadsworth Publishing Co.
- Bordens, K.S, and Abbott, B.B. (2006). *Research Design and methods* (sixth ed,). New Delhi: Tata McGraw Hill Publishing Company Limited.
- Dancy, J. (1985). *Introduction to Contemporary Epistemology*. New York: Basil Blackwell.
- Sekaran, U. (2009). *Research Methods for Business: A Skill Building Approach* (Fourth Edition). New Delhi: WILEY-INDIA.
- Taylor, B., Sinha, G., Ghoshal, T. (2007). *Research Methodology: A Guide for Researchers in Management and Social Sciences.* New Delhi: Prentice-Hall of India Private Limited.

MODULE 2: RESEARCH PARADIGMS

1. Learning Outcomes

At the end of the sessions, the participant will be able to decide what paradigm they should they adopt in their specific area of knowledge.

2. Lecture Outline

- Place of Research in Philosophy
- What is a Paradigm?
- Positivist Paradigm
- Interpretive Paradigm
- Critical Social Theory
- Criteria for Evaluating Research

3. Learning/Teaching Resource

a. Lecture Notes

Place of Research in Philosophy

Research clearly links with three interconnected concepts of Philosophy: Ontology, Epistemology and Methodology. **Ontology** is the study about what kinds of things exist or what entities are there in the universe (Bryman and Bell, 2007: 22). This is a branch of **Metaphysics** where 'first principles' or 'essence of things' are studied. In the usage, ontology is a set of concepts such as things, events and relations which are specified in someway in order to show what is existent. For instance, in pure, applied or social sciences we study concepts or theories, or relationships between variables or things/events. The fundamental question is concerned with what is in existence now. Thus, it is a philosophical study of reality and being. Basically, Ontology is the exploration of the fundamental kinds of things that exist in the world. **Epistemology** is the science of knowledge or study of how people know things and how they know they know things (Taylor, 2007: 1; Trochim, 2006: 18). In other words, this is the branch of philosophy deals with knowledge and how it is attained. It is thus concerned with nature, sources, limits and forms of knowledge.

Methodology is a system or organization of practices, techniques, procedures, measures and rules used by those who work in a discipline or an inquiry or research. This can also be called the science of 'finding out'. It bases on the researcher's ontological and epistemological manner and the standpoint. Research methodology includes three dimensions,

1. Research strategies: case studies, surveys, action research, experimental design, etc.
2. Research methods: interviews, observations, etc.
3. Data: qualitative, quantitative and mixed, primary and secondary, etc.

Methodology differs from method. Method is mostly related to techniques for gathering evidence while methodology is the whole organizational framework that includes the theory and analysis of how research should proceed. Thus, methodology refers to a theory or organizational structure of producing knowledge through research and includes a rationale for a researcher to conduct the research. It provides appropriate techniques or measures for every necessary part of the research and lays a solid foundation for the validity of the findings of the research. Further, methodology provides reasons or justifications for using such techniques in relation to the kind of new knowledge the researcher is going to add to the existing knowledge. A probationary lecturer should have a sufficient knowledge on the philosophy of research before he/she formulate the research proposal.

What is a Paradigm?

When studying a problem the researcher does so within a certain framework of defined ideas or a pattern of thinking. This is often called a paradigm. Determining an appropriate research paradigm to solve the research problem is the first step of the researcher. There are three different types of research paradigms or approaches which can be employed by researchers. They are,

1. Positivist approach
2. Interpretive approach
3. Critical social theory approach

Positivist approach to research is used in pure or hard sciences while the all three approaches are used in social or soft sciences. However, even in social sciences, choice of a method is dependant on the type of research question, previous research findings set out in the literature review, and as a whole on the nature of study. The basic form of these three research approaches is discussed in detail in 3.2.

Positivist Paradigm

Positivism which is an epistemological perspective is the philosophy of science. It says that reality is objectively given and real knowledge is based on experience, positive verification or observation. Hence, positivist researchers are such that they reach a full understanding based on experiment and observation. Reality can be described by measurable properties independently from the observer and his instruments rather than depending on subjective sensations. This is known as the objectivity principle of the scientific inquiry. Both quantitative and qualitative research can come under the positivist paradigm (Kumar, 2007, 13). However, more opportunities are granted to quantitative data and functional or cause-effect relationships under this paradigm since variables and relationships are to be identified and measured using mathematics, statistics or other quantitative techniques.

Interpretive Paradigm

In contrast to positivism, interpretive approach is aware of context and more concerned with an understanding of human behavior. The reality in this approach is socially constructed rather than objectively determined. Interpretive researchers attempt to understand phenomena all the way through accessing the meanings that participants or informants assign to them. In contrast to positivist approach, interpretive researchers reject the possibility of an 'objective'

nature of events and situations. Instead they expect a relativistic understanding of phenomena. Studying texts gives rise to subjective interpretation and therefore many meanings may be discovered in one text. According to this approach, generalizations of a situation, from a small number of case studies to a large population is not sought. By thorough understanding the nature of a phenomenon in a certain setting, it is expected to use to enlighten other settings. Hence, the role of the researcher who conducts research within the framework of this paradigm do not collect facts and analyze for results, but search for different structures and meanings that people place based on experience of their cultural society . However, this approach is often criticized as being subjective. Grounded theory is very popular under this approach.

Critical Social Theory

This approach attempts to overcome the criticism over the subjectivity problem of the interpretive research. According to this approach, social reality is historically constituted and it is produced and reproduced by people. This rejects many elements of positivism while attempting to be less subjective. This approach is a critique of the present system, may be capitalism, and endows with a better understanding to present social conditions, how these conditions evolved, how they are transformed, how they interact and interrelated to each other, what rules and laws direct their change or transformation. The entire task is achieved through a cross-disciplinary approach that incorporates the perspectives drawn from many different fields of study. The goal of the Critical Theory is to transform the society into a rational, benevolent and humane society.

Critical research is easy to identify due to some special characteristics:

(i) Normative and aim to change reality: this is because there are injustices in the society
(ii) Intension to change reality is expressed in terms of emancipation
(iii) Critical on the way of applying rationality in capitalism: this becomes a cause of lack of attention to injustices and emancipation

In addition to above mentioned single paradigm research, it is appropriate to think of cross-paradigmatic research. For example, one can use positivist approach in identifying what is existent and then interpretive approach to know why is it so.

Criteria for Evaluating Research: Reliability and Validity

Reliability and validity are the two main criteria in evaluation research in any discipline. Reliability is related to repeatability and consistency. This means that whether the results of a research would be obtainable without any change with a consistency if the research is repeated (Babbie, 1986: 109). If it is repeatable with same results, in that sense it would be a good research. The reliability criterion is especially important in quantitative research when the relationships between variables are to be measured. However, in order to obtain the same results, the researcher should repeat it exactly in the same way, with same method, instruments and other things including the controlling conditions. This criterion is easily fulfilled in physical sciences. However, in social sciences, discrepancies among research

results are high because the researches are repeated in different cultural societies. In such circumstances, doing the research within the interpretive paradigm is more meaningful.

Validity, being the most important criterion in research, refers to how far results of a research reflect the reality (Babbie, 1986:112). This may take into consideration in several forms (Bryman and Bell, 2007: 41):

1. Measurement validity: whether the measurement of a variable is stable.
2. Internal validity: how far can a researcher prove that his independent variables are responsible for the measured changes in the dependent variable? Whether the change is due to some other factors?
3. External validity: how far the results are generalizable to external situations.
4. Ecological validity: whether the results have validity in natural social environment.

Validity of a research can be reduced or adversely affected by the following three types of errors:

1. Methodological or practical errors
2. Sampling errors
3. Measurement errors

4. Essential Reading

- Bordens, K.S, and Abbott, B.B. (2006). *Research Design and methods* (sixth ed,). New Delhi: Tata McGraw Hill Publishing Company Limited.
- Kumar, R. (2005). *Research Methodology: A step by step guide for beginners* (Second Edition). Delhi: Pearson Education.
- Taylor, B., Sinha, G., Ghoshal, T. (2007). *Research Methodology: A Guide for Researchers in Management and Social Sciences.*New Delhi: Prentice-Hall of India Private Limited.
- Trochim, W.M.K. (2006). *Research Methods* (Second Edition). New Delhi: Biztantra.

5. Supplementary Reading

- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Cooper, D.R. and Schindler, P.S. (2006). *Business Research methods* (Ninth edition). New Deli: Tata McGraw Hill Publishing Company Limited.
- Dancy, J. (1985). *Introduction to Contemporary Epistemology*. New York: Basil Blackwell.

6. References

- Bryman, A. and Bell, E. (2007). *Business Research Methods*. Oxford: Oxford University Press.
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- Trochim, W.M.K. (2006). *Research Methods* (Second Edition). New Delhi: Biztantra.

MODULE 3: RESEARCH PROCESS

1. **Learning Outcomes**

   At the end of the sessions, the participant will be able to demonstrate knowledge of basic steps involved in the research process

2. **Lecture Outline**

   - Research task as a sequential process involving several steps and importance of literature review
   - Formulating a research problem and postulating hypotheses
   - Conceptualizing a research design, constructing an instrument for data collection and selecting samples
   - Writing a research proposal
   - Collecting data
   - Processing data and interpretation of results
   - Dissemination of research findings

3. **Learning/Teaching Resource**

   a. **Lecture Notes**

   Research involves systematic, controlled, valid and rigorous exploration and description of what is not known and establishment of associations and causations that permit the accurate prediction of outcomes under a given set of conditions. It also involves identifying gaps in knowledge, verification of what is already known, and identification of past errors and limitations.

   Research task can be treated as a sequential process involving several steps. Figure 1 illustrates the logical sequence of the research process in eight steps. The first five steps namely formulating a research problem, conceptualizing a research design, constructing an instrument for data collection (data collection design), selecting samples and writing research proposal are the planning part of a research study. The last three steps (data collection, data analysis and writing a research report) are the stages involved in conducting the research study. Depending on the nature of the research study, some steps may be omitted. However idea of sequence is useful for developing a research project.

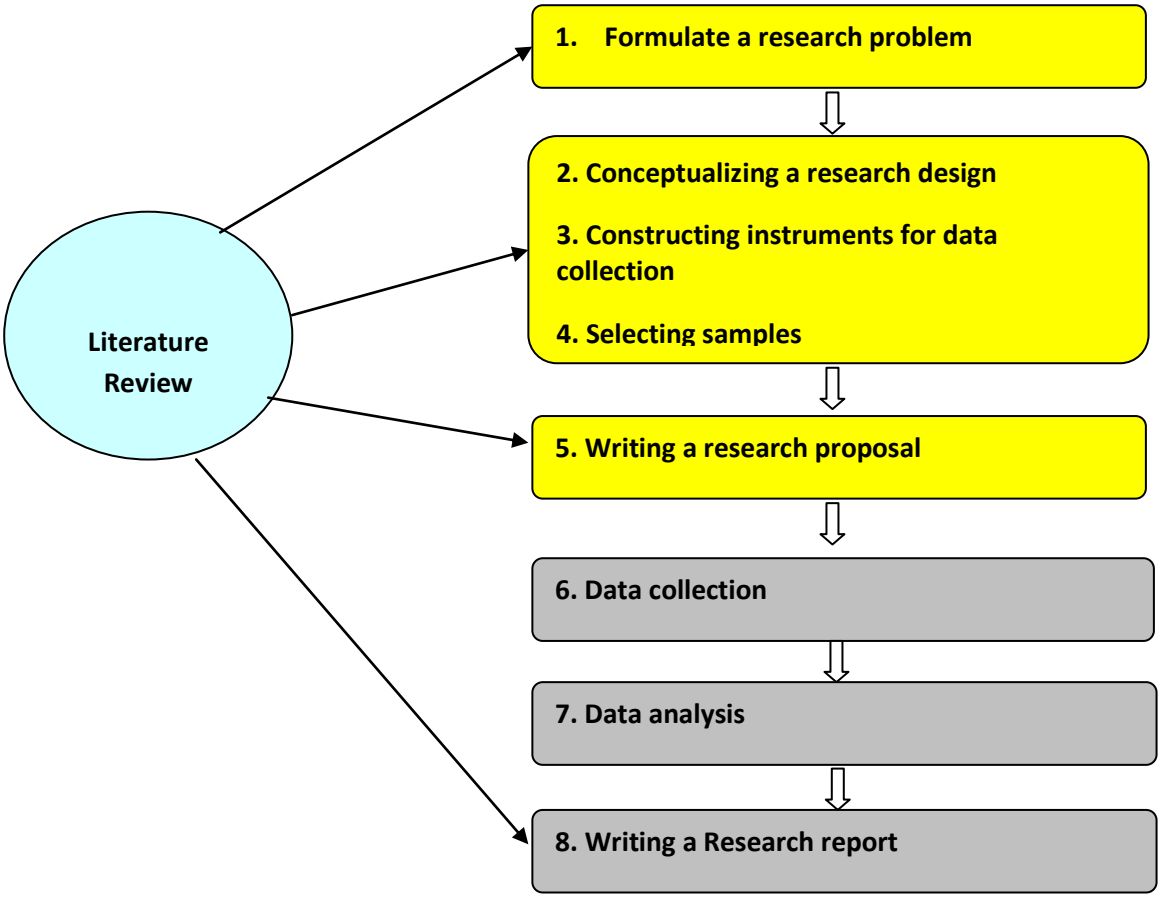


Figure 1. Steps in the research process

Literature Review

The literature review is an integral part of the research process. The literature review begins before a research problem is finalized and continues until the research report is finished. The literature review brings clarity and focuses to the identified research problem, improves the research methodology and broadens the knowledge base of the researcher in the research area and place the findings of the research undertaken in the context of what is already known in the field of inquiry. The main sources for identifying literature are books and journals. There are several sources which can provide information about locating relevant journals (i.e. Library catalogues, Indices of journals, abstracts of articles, citation indices). In addition, specially prepared electronic data bases (i.e. SCOPUS, ABI/INFORM, ERIC, HEALTHROM, MEDLINE) are available for literature search.

Step 1. Formulating a research problem

The formulation of a research problem is the most important step in the research process as it is the foundation on which the researcher builds the whole study. A research problem identifies the destination of the research and what the researcher intends to find out. The other steps in the research process are greatly influenced by the way in which the research problem is formulated. Therefore it is important to give considerable and careful thoughts at this stage; evaluate the research problem in the light of the work involved, financial and other resources available, the time availability of the researcher, researcher's interest, researcher's (and supervisors') technical expertise & knowledge in the field of study. Exploration of the research problem is accomplished through observations, familiarization with the available literature, and discussions with the experts/focus groups or some combination. Revision of the research problem is a desirable outcome of exploration and enhances the researcher's understanding of the option available for developing a successful design.

If a Specific Research Problem is not available….

You are expected to review the existing literature in your broad area of interest with the aim of gradually narrowing down the specific research problem. Identify the broad area interest to you and dissect the broad area into sub areas and select what is of most interest to you considering the time available to you, your level of expertise and other resources needed to undertake your study. Then use it to develop a theoretical framework from which your study emerges and use it to develop a conceptual framework which will become the basis of your investigation. But it can condition your thinking about your study and the methodology resulting a less innovative choice of research problem and methodology. Therefore you should try to conceptualize your research problem before undertaking a major literature review.

Once the research problem is selected, next step is to raise **research questions**. Within your chosen sub area list the questions you want to find answers to. Then formulate the **main objectives** and **sub objectives**. Objectives transform research questions into behavioral aims by using action oriented words such as "to determine", "to ascertain", "to evaluate". Objectives should be specific and free from ambiguity and each one should relate to only one aspect of the study. Once objectives are formulated, examine your objectives to ascertain the feasibility of achieving them through your research study. Some researchers are satisfied only with the

research question and do not formulate objectives. Keep in mind the requirements of your institution/funding source for research proposals.

In the process of formulating a research problem, there are two important considerations.: (i) The use of concepts and **identifying variables** (ii) the c**onstruction of hypotheses**. **Concepts** are highly subjective as their understanding varies from person to person and may not be measurable. In a research study, it is important to operationalise the concepts in measurable terms. Knowledge of the different types of variables and the way they are measured are important in fine tuning the research problem. Variables are important in bringing clarity and specificity to the conceptualizaton of the research problem, to the formulation of the hypotheses and to the development of a research instrument. They affect how the data can be analysed, what statistical tests can be applied to the data, what interpretations can be made, how the data can be presented and what conclusions can be drawn.

Construction of hypotheses

Hypotheses are important for bringing clarity, specificity and focus to the research study. **A hypothesis is a speculative statement that is subjected to verification through a research study.** In formulating hypothesis it is important to ensure that is simple, specific, conceptually clear; is able to be verified ; is rooted in an existing body of knowledge; and able to be operationalized. The testing of hypotheses become meaningless if any one of the aspects of your research study-design, sampling procedure, data collection method, data analysis, statistical procedure applied or conclusions drawn is faulty or inappropriate. Hypotheses although are important, are not essential for a study. Some research studies may be conducted without constructing hypotheses.

Step 2. Conceptualizing a research design

The main purpose of a research design is to explain how the researcher will find answers to the identified research questions. The research design sets out the logic of the inquiry of the researcher. The strength of findings of a research study largely rests on how it was found. The research design relates to the identification and/or development of procedures and logistical arrangements required to undertake a study. It also emphasizes the importance of quality in these procedures to ensure their validity, objectivity and accuracy. Through a research design, the researcher conceptualize an operational plan to undertake the various procedures and tasks needed to complete his/her study and ensure that these procedures are sufficient to obtain valid,

objective and accurate answers to the research questions. A research design should include the following:

- The study design *per se* and the logistical arrangements that are proposed to undertake
- The measurement procedures
- The sampling strategy
- The frame of analysis
- Time frame.

For a research study, selection of an appropriate research design is crucial in enabling the researcher to arrive at valid findings, comparisons and conclusions. When selecting a research design it is important to ensure that it is valid, workable and manageable. Some of the commonly used study designs are outlined in Figure 2. It is important to select or develop the research design that is most suited to the identified research study. The researcher must have strong reasons for selecting a particular design; must be able to justify the selection. The researcher should be aware of its strengths, weaknesses and limitations. In addition the researcher is expected to explain the logistical details required to implement the suggested design.

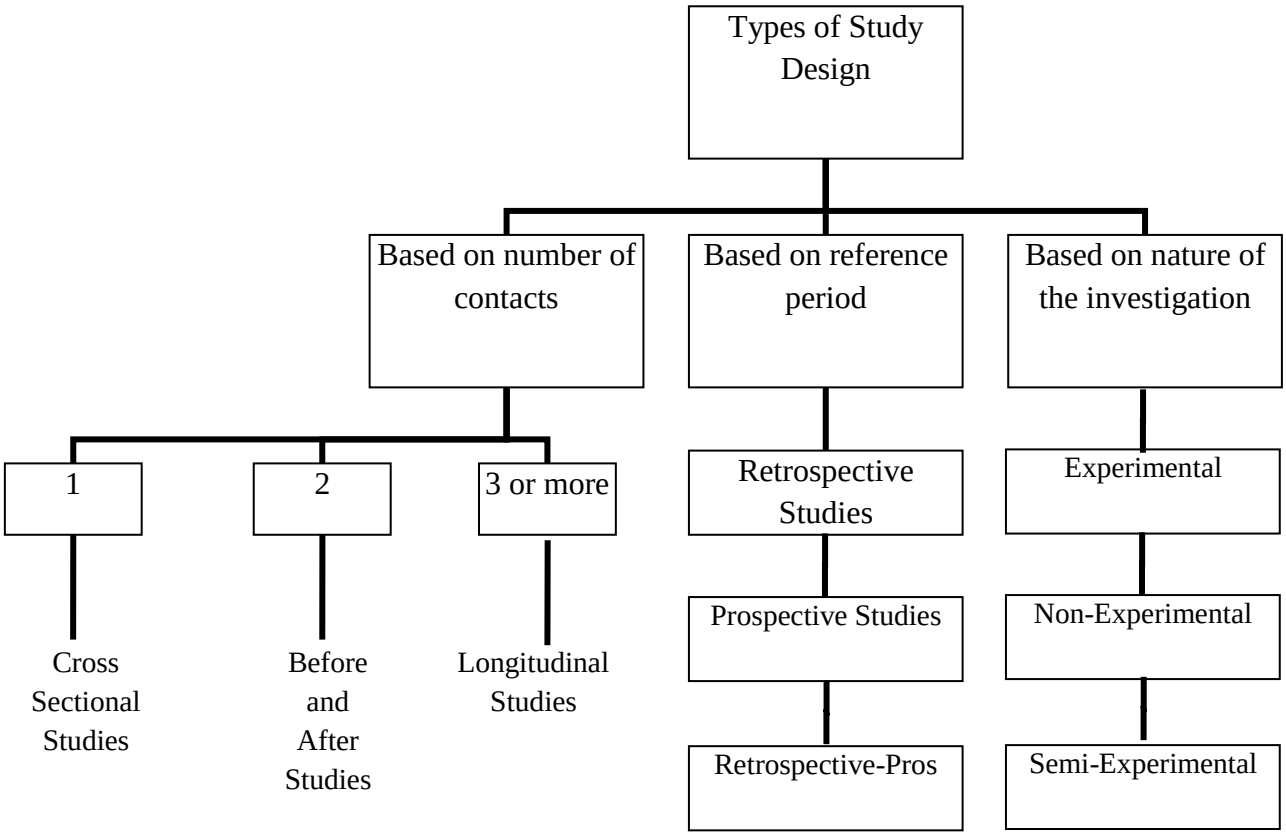


Figure 2. Types of Study Design

Step 3. Constructing an instrument for data collection

The construction of a research instrument is the most important aspect of any research endeavor as it determines the nature and quality of the information. A research instrument must be developed in the light of the objectives of the proposed study. Research instrument or research tool is anything that becomes a means of collecting information for your research study (i.e. observation forms, interview schedules, questionnaires etc). The researcher should decide how to collect data for the proposed study and construct a method for data collection. The methods used to collect information about a situation, phenomenon, issue or group of people can be classified as *primary sources* and *secondary sources*. Observations, interviewing, and use of questionnaires are three main methods under primary sources. The sources where the information required is already available are called secondary sources.

The choice of particular method of collecting data depends on the purpose of collecting information, the type of information being collected, the resources available to you, your skills in the use of a particular method of data collection and the socioeconomic-demographic characteristics of the study population. Each method has its own advantages and disadvantages and each is appropriate for certain situations. The choice of a particular method for collecting data is important for ensuring the quality of the information. The validity and reliability of the research instruments should also be taken into consideration.

Step 4. Selecting a sample

The accuracy of the findings of the proposed study largely depends on the way the samples are selected. The basic objective of the sampling design is to minimize within the limitation of cost, the gap between the values obtained from the samples of the research study and those prevalent in the population. The sampling designs will be discussed in another session of this training course. In qualitative research the issue of sampling in general has little significance as the main aim of the most qualitative inquiries is either to explore or describe the diversity in situation, phenomenon or issue.

Step 5. Writing a Research Proposal

The research proposal is the overall operational plan of you research study which tells the reader about your research problem and how you are planning to investigate to obtain answers to the research problem. The purpose is to ensure and reassure the readers of the validity of the methodology to obtain answers accurately and objectively. Requirements regarding the style and content of the research proposal may vary depending on the institution/funding agency and even within an institution, and discipline to discipline. However the research proposal should tell your supervisor and other reviewers the following information about the study.

- What you are proposing to do.
- How you plan to proceed
- Why you selected the proposed strategy.

Step 6. Data Collection

At this stage the researcher actually collects data. Many methods are available to gather required information. Depending on the research plan, the researcher might make observations, carry out interviews, send questionnaires or/and conduct focus group discussions etc. As a part of the research design, the researcher should decide upon the procedure (s) that should be adopted to collect data to address the research problem.

Step 7. Data Analysis

Analysis of the information collected (at the step 6) depends on the type of the information (descriptive, quantitative, qualitative, attitudinal etc.) and the way the researcher needs to communicate the results to the readers. If the study is descriptive, write the research report based on manual analysis of the contents of field notes, use appropriate computer programmes available, or Ethnograph. For quantitative data statistical analysis could be used.

Step 8. Writing a Research Report

The research report informs the world what has been done, what has been discovered by the researcher and conclusions drawn from the study. The research report should be written in an academic style. The report should be divided in several sections and/or chapters based on the main themes of the study and the means by which the research is communicated to the world.

4. Further reading

- Lecture notes prepared for this session
- Kumar R. (2005) Research Methodology., Pearson Education, Australia (pages 15-25, 30-53)

5. Supplementary Reading

- Cohen L, Manon L and Morrison K (2007) Research methods in Education, Routledge.
- Cooper D R and Schindler (2006) Business Research Methods , McGraw Hill Companies
- Creswell J. W. (2009) Research Design. Sage Publications Inc. California. (Pages 1-47)

6. References

- Creswell J. W. (2009) Research Design. Sage Publications Inc. California
- Kumar R. (2005) Research Methodology., Pearson Education, Australia

MODULE 4: QUALITATIVE, QUANTITATIVE AND MIXED METHODS

1. **Learning Outcomes**

   At the end of the sessions, the participants will be able to explain how they can join the two methods in solving a research problem.

2. **Lecture Outline**

- Quantitative Research
  - What is Quantitative Research?
  - The Cause of Action in Quantitative Research
  - The Forms of Relationships
  - Quantification of Qualitative Variables and Concepts
  - Quantitative Research Strategies
  - Data and Sampling in Quantitative Research
  - Data Analysis in Quantitative Research

- Qualitative Research
  - What is Qualitative Research?
  - Qualitative Research Strategies:
  - Ethnography, Action Research, Participant Observation, Focus groups, Grounded Theory
  - Sampling in Qualitative Research

- Mixed methods

3. **Learning/Teaching Resource**

a) Lecture Notes

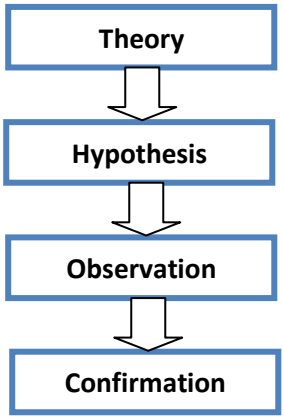
3.1 What is Quantitative Research?

Research becomes quantitative if mainly due to the nature of data and the analysis. If you completely depend on quantitative data such as numerical facts and mathematical and statistical calculations and techniques, it would be a quantitative research. This type of research mostly gets going with positivist paradigm and the scientific method which are mainly used in physical sciences and to some extent in social sciences and managerial studies.

3.2 The Course of Action in Quantitative Research

Quantitative research mostly uses the deductive approach and starts with a theory. The problem is viewed in the theoretical standpoint and the hypothesis is deduced related to that theoretical position. In experimental research, the hypothesis comes after theory as a general rule. However, formulating a hypothesis is not essential in social science and business research. Instead, the researcher concentrates on the aim and objectives and carries out the study without going off from the central task.

Main Steps



You can refer to **chapter/section 2** of this module for more details with regard to the course of action in quantitative research.

3.3 The Forms of Relationships between Variables

Relationships that can be existed among variables can be divided into two main types (Bordens and Abbott, 2006: 98).

1. Causal relationships
2. Correlational relationships

Causal relationships exhibit a kind of cause-effect relationship that can come about between variables. For examples: cutting a tree causes to fall it and damage your car if it was near it. This type of relationships usually shows a single a directional relationship. This way, a change in one variable causes to change in another variable. Although cutting a tree causes to fall it and damage your car, damage to your car, on the other direction, does not cause the tree to fall and so forth.

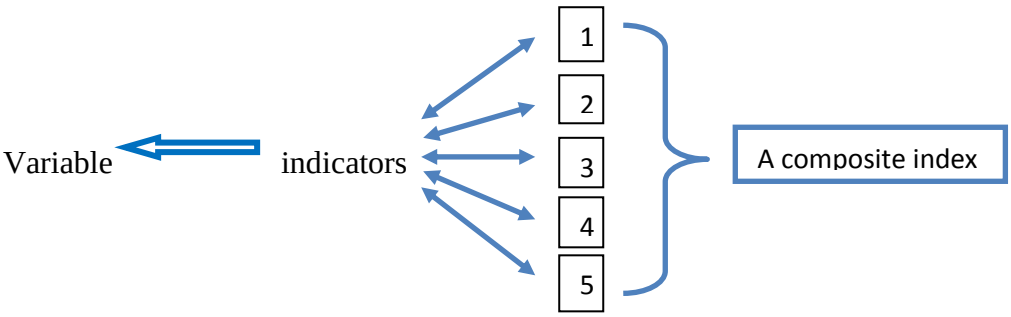
The second type, **correlational relationships**, does not mean that a change in one variable necessarily cause a change in another variable. Instead, a change in one variable covaries either with or without any influence of the other variable. For instance, demand for umbrellas increases and supply of fish declines during the rainy season. Hence, a negative correlation

exists between the supply of fish and the demand for umbrellas. This does not mean that that increase in the demand for umbrellas is a cause of the decrease in decline in the supply of fish or vice versa. However, both happen in the same season and hence there is a correlation. Therefore, without any influence of one variable on the other, there may have correlations between variables. This does not mean that in correlations variables do not have unidirectional or bidirectional influences among them by any means. It may have, but it is not such causal relationships expected in correlations.

It should be further mentioned that a researcher should distinguish between causal and correlationships among the variables he found to be significant. Differentiation between these two is an important part of research because especially in policy recommendations correlational relationships cannot be recommended as policy variables to influence another variable.

3.4 Quantification of qualitative variables and concepts

Most of the ideas, concepts, categories, etc. we appear in subject disciplines should be quantified for measurement purpose in quantitative research. The researcher should check whether the variables which are going to be involved in the research are in the type of quantifiable. Even if a variable can not be quantified and measured in its direct form, one can quantify and measure it through its indicators. For example, 'mothers love' is a concept and cannot be directly quantified and measured. However, if you can find some indicators for her love to child, you can measure her love and even compare it with that of others. In this case, you can use indicators such as the time, money, labor, etc. mother allocate for her child, the number of kisses she gives per day for her child or more realistic indicators. You can use the most suitable indicator (this should be justified) as the representative indicator for the variable or few most important indicators as per the requirement. You can even build composite indexes when you want to make it more realistic and generalizable.



Views of informants can also be quantified using ordinal measures of variables such as scales and typologies.

Scaling: Scaling has been introduced in research for the purpose quantifying qualitative variables or concepts in Psychology and Education (Trochim, 2006: 132). Scales are used in showing the degree, magnitude or difference of a thing or person when it is determined in terms of views of people. This method of measurement is often used in social sciences and business research as this lies in between subjective and objective ends. However, there is a possibility of using scales in pure and applied science research depending on problem to be analyzed. Scales have been divided by different authors in different ways. For example it may be worthwhile to mention some popular types of scales used in research (Kumar, 2006: 67, Trochim, 2006: 132, Babbie, 1986):

a) Nominal scales
b) Ordinal scales
c) Interval scales
d) Ratio scales

In nominal scales, we can classify informants, individuals, population or objects according to basic or main characteristics that bring into line with the aim and objectives of the research. For example, you can classify people in an area according to their occupation as given below:

- Teachers
- Doctors
- Engineers
- Unskilled laborers, etc.

In ordinal scales, we not only classify informants, individuals, population or objects according to their basic or main characteristics but also arrange in ascending or descending order. For example, you can classify families according to their income level as given below:

- Low
- Middle
- High

In interval scales we classify individuals, objects, etc. based on equal or different intervals. For example, individuals can be grouped depending on age intervals as given below.

- Age 10 and below
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50 and so forth.

In ratio scales, we measure the actual amount or value of a variable starting from zero. In all areas of research, we have to use this type of ratios.

Likert scaling: Likert scales, differently from above scales, measure response of individuals or objects in dichotomous or interval basis. For example, dichotomous responses are as follows:

- Yes/No ☐
- True/False ☐
- Agree/Disagree, etc. ☐

Interval based response of an individual to a question on his English knowledge can take, for example, one of the following levels of scale:

- Very poor ☐
- Poor ☐
- Average ☐
- Good ☐
- Very good ☐

Information collected through this method can be used for further statistical calculations if the scale rates are arranged from 1 to 5 or 1 to 7 so that the numbered scales have a middle scale (as 'Average' above scale rates) that divides the lower and upper scales equally.

Typologies: Typology means a system of dividing things, views of people, etc, into different groups or types depending on their characteristics. The division can be performed in the forms of tables, matrices, lists, etc. However, typologies are used in qualitative research as well.

Researcher/ Author	Year	Country	Relationship between farm scale and average cost	Type
Ajantha	*2008*	*Sri Lanka*	*Positive*	*A*
Aswan & Anton	*2002*	*India*	*No relationship*	*C*
Manoj	*2010*	*93 countries*	*Positive*	*A*
Lionel et al	*2004*	*U.K. and developed western countries*	*Negative*	*B*
Diunugala	*2007*	*U.S.A.*	*Positive at the beginning and then becomes negative*	*D*

**Names and other information given in the table are hypothetical.*

You may find some other techniques in constructing quantitative variables.

3.5 Quantitative Research Strategies

Quantitative researches are mainly two types:

1. Experimental research
2. Non-experimental observational research

Experimental research is one main popular method in quantitative research which is conducted within the positivist paradigm in pure and applied sciences. This can be seen in two main types (Sekaran, 2009: 144):

1. Lab experiments: under highly controlled conditions
2. Field experiments

In lab and field experiments we control and manipulate variables so as to establish a causal relationship (cause-effect relationship) between two or more variables. This method is mainly used in pure and applied sciences and to some extent in social sciences and business studies. According to this method, a variable related to the research problem is selected and manipulate it under controlled conditions in order to identify causal relationships.

In addition, some non-experimental observational methods are also used in quantitative research.

3.6 Data in quantitative research

Data can be divided into two main parts such as primary data and secondary data. Primary data is the data collected by the researcher himself for the first time for the purpose of his research. Secondary data is the data which are used in one's research, obtaining from another survey or study. This is obtainable from two main sources such as institutional and non-institutional sources.

When the quantitative research is of experimental type which comes under the positivist paradigm, only random sampling is used for collecting data.

3.7 Data Analysis in Quantitative Research

A large body of techniques has been developed as analytical tools in quantitative research. These techniques can be divided into several groups:

1. Simple numerals
2. Mathematical measures
3. Statistical techniques

Statistical software such as SPSS, MINITAB, can be used in statistical analysis.

The above techniques are discussed in detail in the data analysis and presentation section of this module.

3.8 Qualitative Research

3.8.1 What is Qualitative Research?

Qualitative research technique mostly comes under the interpretive research paradigm. However, there is a possibility to use this under the other research paradigms as well. A research technique is known as qualitative depending on the **type of data, type of analysis** and **the purpose of research**. Data can be obtained either in the form of quantitative or qualitative. When a research is based on qualitative data, it is known as a qualitative study or research. Qualitative data is such that it exists only in the form of statements, expressions or views of people expressed or written in sentences or paragraphs with no any numerals. When a researcher's purpose is to understand the meanings people assign on a certain thing or event based on their attitudes, motivations that come under their own value judgments, he/she needs to obtain data in the qualitative form. This means that qualitative researchers study things in their natural settings, attempting to understand, or interpret, phenomena in terms of the meanings people bring to them.

3.8.2 Qualitative Research Strategies

Qualitative research incorporates a number of strategies which come under the interpretive paradigm. However, some of the techniques can be used in positivist and critical social theory approaches as well. These techniques turn into qualitative mainly in the way of collecting and analyzing data. The strategies commonly used in the qualitative way are as follows:

1. Case studies
2. Ethnography
3. Action research
4. Grounded theory
5. Focus groups, and
6. Individual in-depth interviews

The above methods can be explained in some detail to the extent you can choose the suitable technique for your research.

1. Case Studies

We know that in most of quantitative strategies a wide range of data representing all characteristics of population is used and therefore the results of the study are more generalizable. In contrast, similar to most of other qualitative techniques, case study technique takes into account a problem related to an individual or very small number of units which are specific to a certain person, family, area, institution, group, culture, community, etc. Hence, this takes the form of interpretive over the selected unit/s or the case of the study. Validity of the results of the study is also focused on the same case and not generalizable away from the investigated case. However, there is a possibility of generalization if the researcher can reanalyze a further number of such cases which have been studied representing different types of units of a wider population.

In order to achieve the aim, the researcher systematically employs all appropriate techniques in all parts of the study. The data sources of the case study can be divided into two main parts such as,

1. Personal documents, and
2. Case history.

Personal documents may include diaries, confessions, autobiographies, etc. or any document that provides necessary information for the analysis. An investigation of the 'case history' relevant to the problem is also important in making clear the background of the case.

Case studies which make an in-depth understanding of an individual or unit are used different purposes in a wider range of disciplines. A case study can be used in formulating hypotheses when designing a more generalizable research. However, this technique has some defects and limitations:

- If the 'unit' is too small, its conclusions are not valuable for the remaining units or community.
- Time consuming
- Incorrect conclusions due to selection errors are unavoidable

2. Ethnography

Ethnographic research is applied in understanding the functioning of cultures and social interactions and expressions of and between people and different groups (Bordens and Abbot, 2006: 209). In ethnographic research, the researcher becomes a partner of the culture or social system he is going to study. He studies every important action or pattern of actions with the idea of achieving the aim.

Ethnographic research is applied in Sociology, Social Anthropology and Psychology in order to identify behavioral patterns. In observing behavioral patterns, two types of observations are used:

1. Participatory observations
2. Non-participatory observations

In participatory method you become an actor of the cultural group you are studying and collect qualitative data through observations. However, in non-participatory method, researcher does not become a partner of that culture and observe it as an external person who wants to study it.

Data analysis in ethnographic research is to some extent similar to that of the grounded theory. It takes several steps:

Step 1: Read the field notes and notice important parts, points, themes, etc.

Step 2: Read the field notes again and assign different codes for different parts, points, or themes.

Step 3: Classify parts, points, themes, etc. of the field notes according to the codes which has been assigned.

Step 4: Identify important patterns, interactions, etc. of the cultural group/s and systematically arrange it.

Step 5: Write down the report/paper/thesis.

3. Action research

Action research is a continuous investigation on the results of an action or series of actions taken as a solution to a practical problem of an organization. The results of this research are needed and important for the manager/s of that organization in order to achieve his/their aim. However, for a successfulness of an action research, both academics and managers should work together.

For example, suppose that there is a problem of destroying the medicinal plants of the Ritigala Strict Reserve Forest by the people in the surrounding villages. An attempt to provide a solution to this problem was taken by the relevant government authority in collaboration with an NGO involved in this connection. An academic researcher was also appointed to investigate the problem and suggest necessary actions. The academic visited the

forest with relevant officials and discussed with villagers, Grama Niladari and village elite for several days and an action was suggested. However, results of that action were observed and suggestions for remedial actions for pitfalls or drawbacks were again and again introduced until they achieved the aim. The following is how this process carried out by the academic and the authorized people.

Step 1:

In order to prevent destroying forest collecting medicinal plants, their action was to persuade villagers to grow medicinal plants in their own home gardens. The researcher, observing what is happening, takes written records in all developments.

Step 2:

The first action was partly failed because some villagers were reluctant to do it. The next action was to motivate such villagers to grow medicinal plants by providing necessary instructions and material. The researcher continued recording everything.

Step 3:

The second action was successful and nearly 80 per cent of villagers started growing medicinal plants in their home gardens. Destroying the forest gradually reduced. The researcher with others had identified the problem of selling medicinal plants in a regular basis. As a solution to this problem, Ayurvedic Institute was linked with the village to purchase the produce.

This way until the aim was achieved the researcher, the NGO and the government officials observed the results of every action and suggested remedial actions. The researcher's role was to observe, document, analyze and suggest actions until it happen to be successful.

The above example shows that in action research, the researcher plays a 'helping role' in diagnosing problems, action planning, action implementing and evaluating outcomes. Evaluation leads to a new diagnosis. Although action research is main considered as a qualitative interpretive technique, it may also be used in critical paradigm also.

4. Grounded Theory

Grounded Theory is a purely qualitative method of research that uses a systematic set of procedures to develop an inductively derived theory about a phenomenon. The purpose of grounded theory method is to build a theory or illuminate the area under study. The theories built under this methodology will ultimately be valid to other similar situations. Further, the theory's implications will have useful applications.

The basic idea of the grounded theory approach is to read and re-read a textual database such as a corpus of field-notes and to discover or label variables and their relationships. The ability to identify variables and relationships is termed 'theoretical sensitivity' (Glasser and Strauss, 1967). This method attempts to tie social science data more closely to beliefs and concerns of participants so that researchers would find in theory a more congenial guide to the problems exist in practice. Its procedures force the researcher to break through assumptions and to create a new order out of the old.

Suppose our research topic is '*the rural infrastructure determination*'. Having no any theory has been created on this topic, the researcher is going to develop a theory grounded on data. According to the grounded theory technique, there are three basic elements namely concepts, categories and propositions. Concepts are the basic units of analysis. For instance, suppose, there are five factors such as A, B, C, D and E for determining utilization of rural infrastructure. Further, suppose, there are indicators under each factor - the factor A has a_1, a_2, and a_3. The term 'indicator' in the quantitative method is the term 'concept' under this method. Likewise there are concepts for each factor. The categories are A, B, C, D and E. Hence, categories are another name for variables that comes under quantitative method. The third element of the grounded theory which is known as propositions indicates generalized relationships between a category and its concepts. Thus, instead of testing hypotheses in the quantitative method, propositions are built for indicating generalized relationships. Therefore, concepts, categories and propositions indicate theoretical relationships that are required to saturate theory or solving the problem. After saturating a theory from data, the analysis reaches closure.

FIELD OF STUDY :Rural infrastructure

PROBLEM :How to determine the utilization of infrastructure resources by rural households.

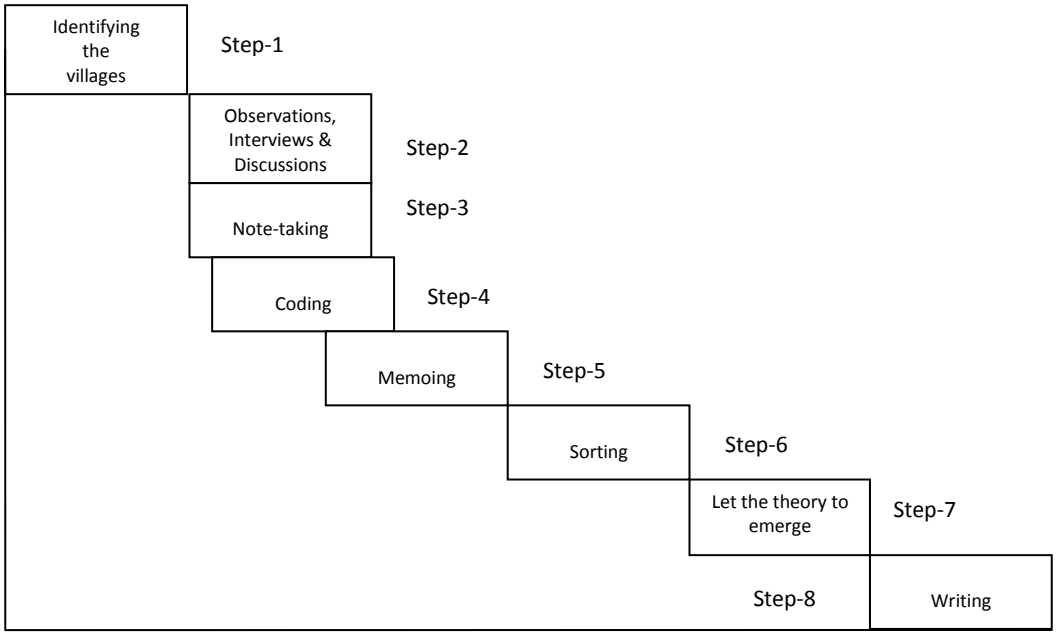
CONCEPTS :Determining factors; A, B, C, D and E (variables)

CATEGORIES :Indicators of each factor; for instance, under the factor A;a_1, a_2 and a_3

PROPOSITIONS :Generalized relationships between a category and its concepts.

The way of using grounded theory, as a qualitative method to theory building, can be well explained according to the overlapping steps over time indicated in the following figure.

Overlapping steps over time

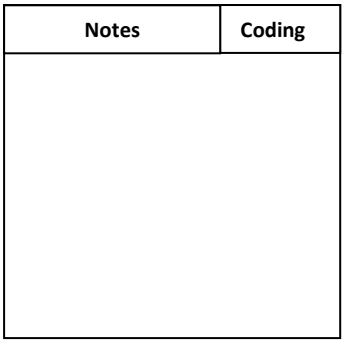


Grounded Theory approach produces conceptual and not measured relationships. Hence, instead of hypothesis testing, propositions are built for indicating generalized relationships. The researcher does not begin with a theory, and then prove it. Rather, the researcher begins with an area of study, namely determination of the infrastructure utilization and a theory of utilization of rural infrastructure is allowed to emerge. By introducing the Grounded theory, Glaser (1992) explains that the Grounded Theory is to discover the theory implicit in the data. The nine steps of the study which is indicated in the figure can be briefly explained.

Some important points come under this method can further be explained:

- **Note-taking**: According to the grounded theory, taking notes during an interview is not the appropriate method. Instead, key-word notes are taken during the interviews and convert them into themes afterwards. By that time the investigator will get a more understanding through extra interviews and deliberate thinking.

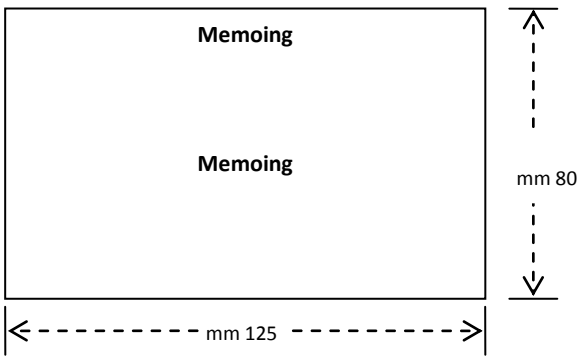
- As the investigator uses pieces of papers for interview notes, the notes can be written in the left hand two-thirds of the page. The remaining one-third can be used for coding purpose.



- **Coding** starts from the second interview with first interview in mind. Coding is continued in subsequent interviews or data obtained from other sources with the emerging theory in mind. The coding will make the easier to compare data set to data set initially and data set to theory later.

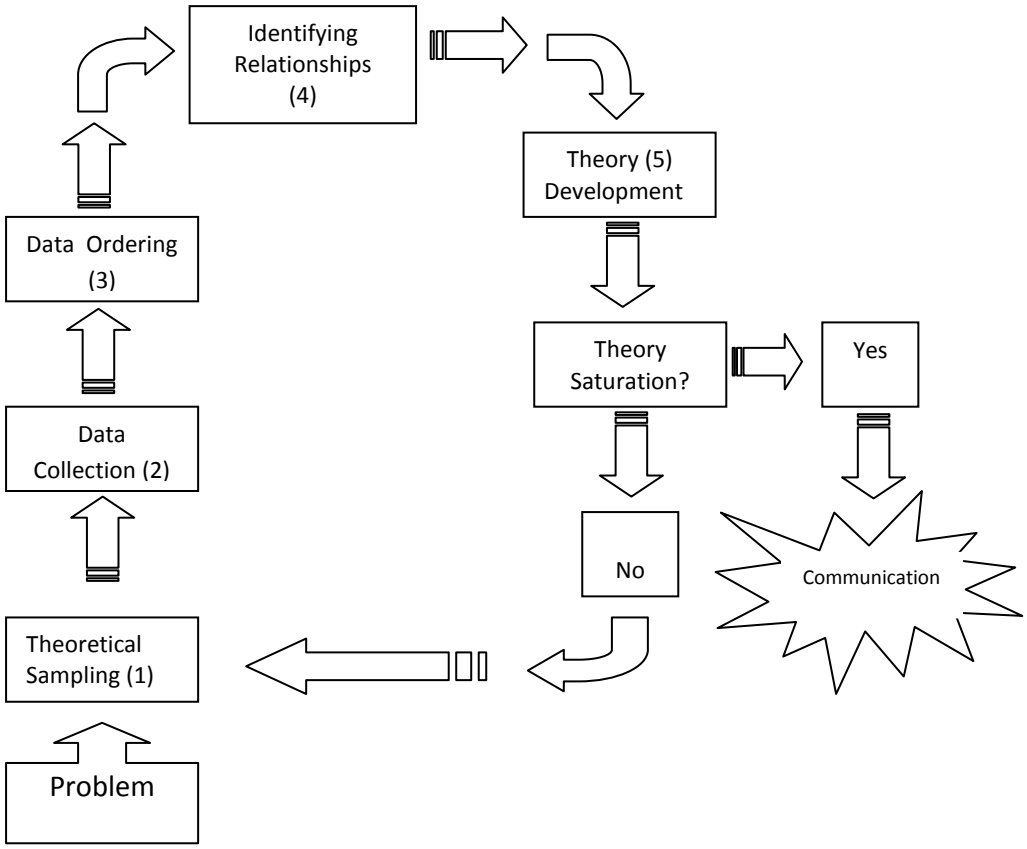
- **Memoing** is the sixth step of the study. This continues in parallel with data collection, note-taking and coding. Memo is a note to the researcher about some proposition on a category or property and relationships between categories. The researcher would accumulate a large number of memos at the fourth step. These memos will provide different aspects of the theory which emerges from the data. A memoing card can take the following form;

A memoing card



- Relationship between utilization of resources and its determinants are to be extracted not from the raw data, but from deliberate theoretical sensitivity of the researcher. Memo-cards are used for easy classification of such relationships. Further, the impact due to the utilization of infrastructure is to be identified through the Memo-cards.
- Step seven of the study consists of **sorting**. Use of memoing cards makes sorting easier. Memoing cards can be grouped on the basis of the similar categories.
- **Identifying the relationships** between the infrastructure services and its determinants is to be completed in the eighth step. By the end of this step the theory would be saturated.
- Collection of **literature** pertinent to the literature emerged from the data is to be done at this step. Thus, contrast to the traditional method of research, literature that has been contributed to concerned problem is used for comparison of the literature emerged through the primary data. This method avoids the possible imposing of irrelevant theories to the specific situation of the country.

The following figure shows the process of theory building under the Grounded Theory method:



The Process of Theory Building

Source: Based on Dick (2002), Kelle (1997), Pandit (1996), Glasser (1967)

3.8.3 Sampling in Qualitative Research

Sampling in qualitative studies has two main features:

1) **Non-probability sampling**: Qualitative research is accompanied with non-probability sampling so that there is no possibility to use statistical techniques for a data set of this type.

2) **Sample size is small**: Being an in-depth study, qualitative research uses only a limited number of individuals, families or focus groups. However, the researcher takes all details which are relevant to the study taking a lengthier time. He or his investigators may collect data for several times from the same informants.

The following are some popular methods of sampling which come under qualitative research:

1) **Purposive or judgmental sampling**: Researcher selects sampling units using his knowledge experience, and requirement.
2) **Convenience sampling**: Researcher gives the priority for convenience in selecting sampling units.
3) **Snowball sampling**: A snowball develops to be larger while it is rolling from a higher level of a hill of snow to the plain. Similarly, according to this sampling method the size of the sample develops to be larger between the starting point and the ending point of choosing sampling units. For example, suppose, a researcher starts data collection in a village in an isolated area on a certain topic. At the beginning he meets Grama Niladari of that G.N. division discuss about the matter. Grama Niladari tells the researcher to meet chief priest of the temple and the head master of the school. Accordingly the researcher meets them and gets data from them. They suggest the researcher to meet few more villagers to have a discussion about the matter. This way, the sample or the number of sampling units expands more and more, in the same way as a rolling snow ball, until the researcher collects all necessary data. The researcher stops collecting data when he cannot additional points into the stock of collected data by interviewing more and more informant. In other words, marginal points to the researcher's data basket become zero at this stage.

Focus groups and Individual In-depth Interviews are quite similar. The only difference, in individual in-depth interviews, the researcher interviews informants one by one while in focus groups he interviews a group of people and record their expressions and ideas manually or in an electronic recorder and then analyze.

3.8 Mixed methods

There is a possibility to design purely qualitative researches or purely quantitative researches. At the same time, researches can be designed mixing these two methods in a suitable way. In such researches, apart of research becomes qualitative while the other part is quantitative. These two methods can be merged mainly in three ways as given below:

1. Qualitative analysis followed by a quantitative analysis: This method is followed by a researcher when he needs to identify the relevant variables related to the problem of the study. Qualitative study first makes clear the variables and then the quantitative study is carried out using the variables identified through the qualitative analysis. For example, suppose, a researcher can first qualitatively identify the factors affecting the education of children at family level, and then he can identify the statistically significant factors from the qualitatively identified factors using Statistics. This is the most popular method of merging the two methods.

2. Quantitative analysis followed by a qualitative analysis: This method is followed by a researcher when he needs to make clear or clarify the reasoning or meaning of quantitatively measured results or when he needs to interpret the results accurately. Especially, when a researcher finds new issues, he needs such interpretations. For example, suppose, a researcher identifies positive factors, negative factors, stronger factors and weekly significant factors affecting the education of children at family level through a statistical analysis. However, he still needs clarification for why some factors happened to be negative while some other factors are positive, why some factors are stronger while some other factors are weak. For this clarification he has to conduct a qualitative analysis focusing on data for the specific issues.

3. Analysis of quantitative and qualitative data simultaneously: In some researches, both quantitative and qualitative data are simultaneously collected and analyzed. This method is mostly used when a research is based on descriptive statistics and qualitative data.

4. Essential Reading

- Babbie, E. (1986). *The Practice of Social Research* (Fourth Edition). California: Wadsworth Publishing Co.
- Bordens, K.S, and Abbott, B.B. (2006). *Research Design and methods* (sixth ed,). New Delhi: Tata McGraw Hill Publishing Company Limited.
- Kumar, R. (2005). *Research Methodology: A step by step guide for beginners* (Second Edition). Delhi: Pearson Education.
- Sekaran, U. (2009). *Research Methods for Business: A Skill Building Approach* (Fourth Edition). New Delhi: WILEY-INDIA

5. Supplementary Reading

- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Bryman, A. and Bell, E. (2007). *Business Research Methods* (Second Edition). Oxford: Oxford University Press.
- Davis, D and Cosenza, R.M. (1985). *Business Research for Decision Making*. California: Kent Publishing Company.
- Green, P.E., Tull, D.S. and Albaum, G. (2002). *Research for Marketing Decisions* (Fifth Edition), New Delhi: Prentice Hall of India.
- Hawkins, C. and Sorgi, M. (Eds)(1985). *Research: How to Plan, Speak and Write about it*. New Delhi: Narosa Publishing House.
- Taylor, B., Sinha, G., Ghoshal, T. (2007). *Research Methodology: A Guide for Researchers in Management and Social Sciences.* New Delhi: Prentice-Hall of India Private Limited.
- Trochim, W.M.K. (2006). *Research Methods* (Second Edition). New Delhi: Biztantra.

6. References

- Babbie, E. (1986). *The Practice of Social Research* (Fourth Edition). California: Wadsworth Publishing Co.
- Bordens, K.S, and Abbott, B.B. (2006). *Research Design and methods* (sixth ed,). New Delhi: Tata McGraw Hill Publishing Company Limited.
- Glaser, B. (1992). *Basics of Grounded Theory Analysis: emergence vs forcing.* Mill Valley, Calif: Sociology Press.
- Glaser, B. and Strauss, A. (1967). *The Discovery of Grounded Theory*. Chicago: Aldine.
- Kelle, U (1997) Theory Building in Qualitative Research and Computer Programs for Management of Textual Data, *Sociological Research Online*, Vol. 2 (2), Available from: www.socresonline.org.uk/socresonline/2/2/1.html: 14.02.2004.
- Pandit, N. R (1996). The Creation of Theory: A Recent Application of the Grounded Method, *The Qualitative Report*, Vol.2 (4), Available from: http://www.nova.edu/ssss/QR/QR2-4/pandit.html: 12.02.2004.
- Sekaran, U. (2009). *Research Methods for Business: A Skill Building Approach* (Fourth Edition). New Delhi: WILEY-INDIA.
- Trochim, W.M.K. (2006). *Research Methods* (Second Edition). New Delhi: Biztantra.

MODULE 5: RESEARCH METHODS IN PURE AND APPLIED SCIENCES

1. Learning Outcomes

At the end of the sessions, the participant will be able to

- demonstrate knowledge of the research methods used in pure and applied sciences
- discuss and reflect the applicability of various scientific approaches and techniques in his/her own field of research.

2. Lecture Outline

- Nature of scientific research
- Scientific method
- Experiments
- Descriptions as a scientific research method
- Comparative studies as a scientific research method
- Modeling as a scientific research method
- Surveys, Case studies, Meta-analysis
- The real practice of science

3. Lecture Notes

3.1 Nature of Scientific research

Scientific research is a robust and dynamic practice by which answers are pursued to the questions that can be approached scientifically. Even though the techniques that are used to conduct research may differ between various disciplines in science, the underlying principles and objectives are similar. The body of knowledge that is built through these disciplines is based on the collection of data which are then analyzed and interpreted in light of other research findings.

Scientific research can be carried out with several objectives in mind: explorations, descriptions, explanations.

- **Explorative studies**: An observation may arouse curiosity of a researcher & make him/her want to find out more about them.

Alternatively, the researcher may wish to carry out a preliminary study to test the feasibility of undertaking a more detail study later. Such studies are called explorative research.

- **Descriptive studies** are on descriptions of phenomena or characteristics associated with a subject population, estimates of the proportions of a population that have such characteristics and discovery of associations among different variables etc.
- **Explanatory studies**: In these studies. experiments are carried out with a view to determine or explain its causes.

Scientific research employs multiple methods toward investigating phenomena. These methods can be categorized broadly to **experiments** and **non-experimental methods**. Non-experimental methods include descriptions, comparisons, and modeling. In scientific research, some of these methods are used in combination. For example, a scientific research study can have some aspects of descriptive research and some aspects of experimental research. In applied sciences, non-experimental research methods such as surveys, case studies, and meta-analyses are also used.

Many scientific investigations largely employ one method, but different methods may be combined in a single study, or a single study may have characteristics of more than one method. The choice of which research method to use is personal and depends on the experiences of the scientists conducting the research and the nature of the question they are seeking to address.

Scientific research methods are complementary. When multiple lines of evidence independently support one another, hypotheses are strengthened and confidence in scientific conclusions improves. The structure of the deoxyribonucleic acid (DNA, the heredity material) was not revealed by chance, but through the work of many scientists collecting data, evaluating the results, and putting together a comprehensive theory that explained their observations.

3.2 Scientific method

Scientific method is a standard sequence of steps normally followed by scientists in investigating particular events or research problems in nature. It refers to the philosophy that is common to all research methods irrespective of the branch of the study**.** Its primary goal is the pursuit of truth as determined by logical considerations.

Inductive reasoning and **deductive reasoning**

Logical thinking(reasoning) is the basic tool that is used by researchers in the disciplines of sciences to construct scientific principles/rules and theories as well as to understand the scientific principles and apply them to predict specific results. **Inductive reasoning** uses specific observations and experiments to construct scientific principles, more general rules and theories (e.g Isaac Newton constructed the Law of Gravitation-"*All objects fall towards the centre of earth*" through inductive reasoning). Through inductive reasoning general models are built from specific observations and then the models are tested to see how they work**. Deductive reasoning** applies general principles to predict specific results, understand particular situations and answer to specific observations. (e.g. Circumference of the earth was estimated by Greek Eratosthenes using principles of geometry).

Scientific method is the **testing of a hypothesis** formulated after the systematic collection of data. Hypothesis is an educated guess and a potential explanation for certain observations. It is a testable statement which gives a tentative answer to the question raised from observations. It can be considered as a proposition that might be true. A good hypothesis is reasonably consistent with well established facts. It should generate **definite predictions**. Moreover the test results should be **repeatable** by independent observers.

Research in natural sciences is generally carried out based on the **positivistic approach** where a researcher would commence the research study using a relevant theory and the hypotheses to be tested will be derived based on the theory. This type of research considers that there is truth (reality) in the world. Hence the reality can be understood in an objective manner and ultimately it should be the same for the every observer.

Scientific method can be explained by several sequential steps.

1. **Identification of the problem & make careful observations**

   Observations can be obtained by our senses directly or indirectly by instruments (e.g: telescope, electron microscope, cathode ray oscilloscope etc.). Scientific problems can also be identified after studying data of previous research studies.

2 **Development of a question**

   Next step is to develop a research question (about cause and effect) based on observations and/or previous studies.

3 **Formulation of a hypothesis (or hypotheses) through inductive generalization from the observations**

4. **Carry out experiments to test the hypothesis/hypotheses.**

   Based on the results of the experiments, one or more hypotheses may be rejected if they are inconsistent with experimental results and observations. Then further experiments are carried out to test the remaining possible hypotheses. If a hypothesis is supported by the new data, the next step is to make predictions **(Step 5).**

   If the remaining hypotheses are not supported by the data obtained from the experiments, those hypotheses also have to be rejected as untrue. If all postulated hypotheses were found to be untrue, **new hypotheses have to be formulated** (or hypothesis has to be revised) based on new data for further testing through experiments **(Back to the Step 3).**

5. **Selection of the most likely hypothesis and make predictions (**derive consequences) of the hypothesis through deductive reasoning & **carry out further experiments to test the predictions and the hypothesis it self.**

6. **Conditionally accept the hypothesis that is consistent with the available data and confirming predictions supported by evidence/observations. Then the results are disseminated to the community through scientific reports**

7. **Formulating a theory**

   If a conditionally accepted hypothesis is validated by a large number of experiments by various researchers over a considerable period of time, the hypothesis may eventually be considered a theory.

   As knowledge increases & techniques of investigation improve, conditionally accepted hypotheses & even well established theories may be challenged, modified, or rejected **(Back to step 3).**

Scientific method is illustrated in the Figure 1. The method is a linear process if formulated hypotheses for a particular question are accepted by the scientific community and established as a theory. Alternatively it could be a circular process if hypotheses have to be rejected and reformulated at any stage.

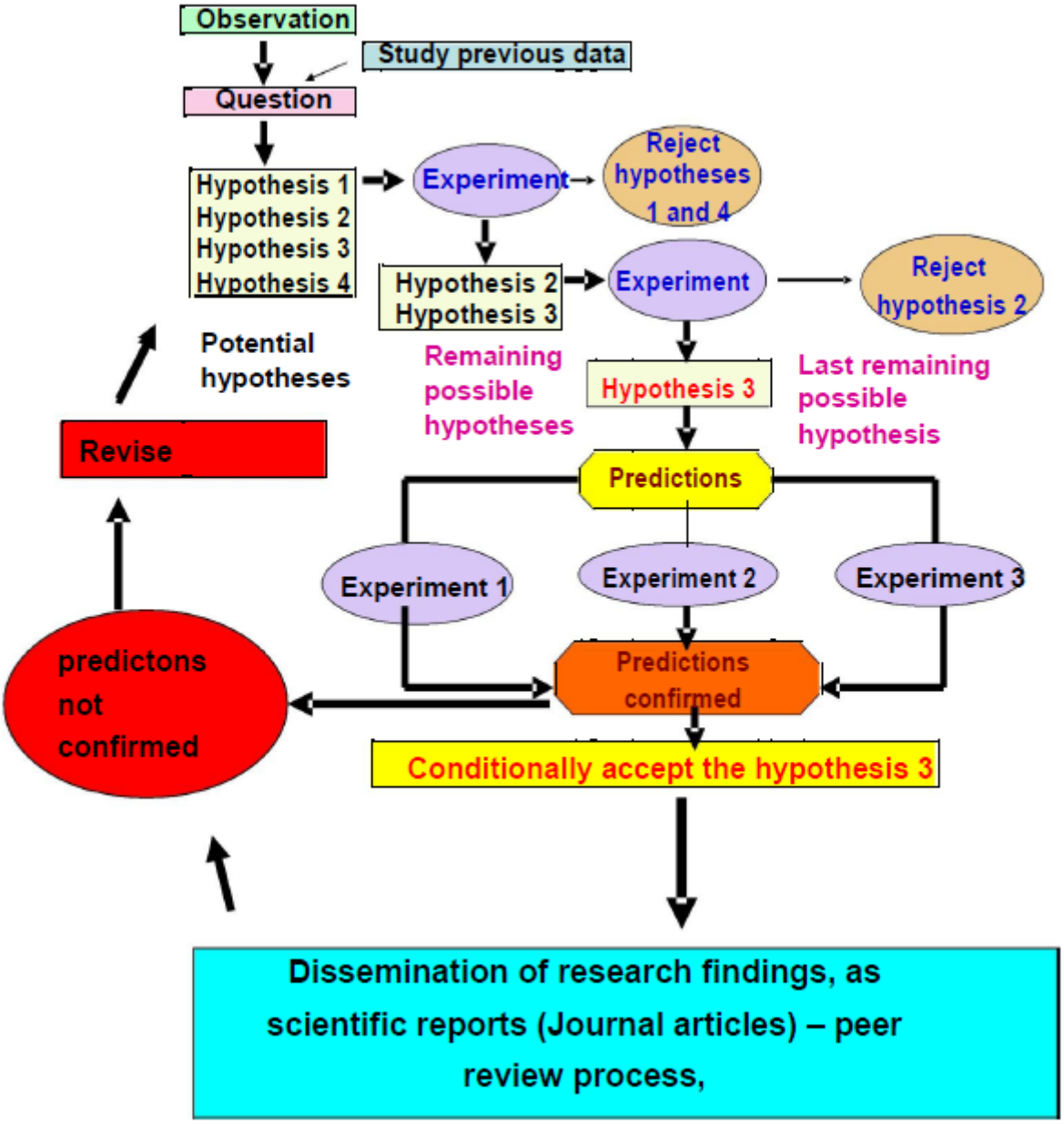


Figure 1. Scientific Method :The method is a linear process if formulated hypotheses for a particular question are accepted by the scientific community. Alternatively it could be a circular process if hypotheses have to be rejected and reformulated.

3.3 Experiments

This is the research method that is commonly used in pure and applied sciences. Experiments involve relatively limited and well defined concepts and propositions. It is usually associated with laboratory work. Experiments can also be conducted in the field situations where variables are isolated, controlled and manipulated.

The purpose of the experiments is to test a hypothesis (hypotheses) and provide explanations. It is aimed at producing new observations which would support or contradict the hypothesis. The experimental design should be selected in such a way so that it would not favour acceptance of hypothesis or rejection of the hypothesis. Design is critical to the success or failure of an experiment. Slight variations in the experimental set-up could strongly affect the outcome being measured.

The essential feature of experimental research is that researchers deliberately control and manipulate the conditions which determine the events, in which they are interested, introduce interventions and measure the difference that it makes. Experimental methods are used to investigate the relationship(s) between two or more variables when at least one of those variables can be intentionally controlled or manipulated. The resulting effect of that manipulation (often called a treatment) can then be measured on another variable or variables. The essential components of the experiments include **independent and dependent variables, experimental and control groups, pre testing and post testing stages.**

An experiment is designed to examine the effects of an independent variable on a dependent variable. The **independent variable i**s the phenomenon which is hypothesized to be the input or antecedent variable. It is the input/factor that is presumed to cause the changes in the dependent variable and is manipulated, measured or selected prior to measuring the outcome or the dependent variable. In contrast to this, the **dependant variable** is the characteristic hypothesized to be the outcome of some input variable. Use of **control groups** is considered to be mandatory in such experiments in order to minimize the potential effects of other variables which might affect the research results and to ensure that the results reflect the experimental conditions rather than intervening factors. In the

experimental design, all conditions/factors should be similar except the variable/factor that is tested. Usually two (or several) experiments are run in parallel and one variable is altered to test the hypothesis in the experimental groups whereas in the control group the variable is unaltered. In all other aspects two experiments are identical. Therefore any difference in outcome of the two experiments is due to the influence of the changed variable.

In testing new drugs medical researchers frequently administer the drug to an experimental group and a **placebo** to a control group. The control group patients believe that they are receiving the same drug as the experimental group. If the drug is effective, those patients receiving the drug will show better improvement than those in the control groups. Here the experiments are blind or double blind. In **blind experiments**, the participants are not told whether they are in the control group or an experimental group though which they are known to the researcher. In a **double blind experiment** not even the researcher knows whether a participant is in the control group or an experimental group- that knowledge is with the third party. Some experimental designs also make use of **positive controls**. A positive control is run as a parallel experiment and generally involves the use of an alternative treatment that the researcher knows will have an effect on the dependent variable. For example, when testing the effectiveness of a new drug for pain relief, a scientist might administer treatment placebo to one group of patients as a negative control, and a known treatment like aspirin to a separate group of individuals as a positive control since the pain-relieving aspects of aspirin are well documented. In both cases, the controls allow scientists to quantify background variability and reject alternative hypotheses that might otherwise explain the effect of the treatment on the dependent variable.

In the simplest experimental design group, subjects are initially measured in terms of a dependent variable (Pre-tested). They are then subjected to an intervention (Stimulus), which represent the independent variable and measured again. The differences between the two are then considered to be the consequence of the influence of the independent variable.

Different kinds of experimental designs

- The pretest-post test, control and experimental group design
- The two control groups and one experimental group, pretest-post-test design
- The post –test, control and experimental group design
- The post-test, two experimental groups design
- The pretest-post- test, two treatment design
- The matched pair design
- The factorial design
- The parametric design
- Repeated measure designs.

A true experiment includes several key features:

- One or more control groups
- One or more experimental groups
- Random allocation of subjects to control and experimental groups
- Control of order and sequence effects within subjects
- Pretest of the groups to ensure parity
- Post test of the groups to see the effect on the dependent variable.
- One or more interventions to the experimental group(s)
- Isolation, control and manipulation of independent variables
- Non-contamination between the control and experimental groups

Scientists prefer quantitative data because such data lends itself to objectivity. Data collected from control and experimental groups/ pre-testing and post testing stages are analyzed in comparison to controls /pre-testing stage using appropriate statistical methods for data interpretations and draw conclusions. Like all scientific research, the results of experiments are shared with the scientific community, are built upon, and inspire additional experiments and research.

Although scientific experiments provide invaluable data regarding causal relationships, they do have limitations. One criticism of experiments is that they do not necessarily represent real-world situations. In order to clearly identify the relationship between an independent variable and a dependent variable, experiments are designed so that many other contributing variables are fixed or eliminated. Experimental research still, is an excellent way of determining relationships between variables that can be later validated in real world settings through descriptive or comparative research studies. Scientists also have an obligation to adhere to ethical limits in designing and conducting experiments.

3.4 Description as a scientific research method

Description is commonly used as a research method in various disciplines of science to explain unique natural systems (e.g. in Ecology), large scale phenomena (e.g. in Astronomy), or past events (e.g. in Epidemiology, Geology, Forensic science etc.). Descriptive research studies are used to gather data regarding natural phenomena and natural relationships and include observations and measurements of behaviours. Description involves the systematic observation and cataloging of components of a natural system in a manner that can be utilized and replicated by other scientists. In contrast with experimentation, sometimes the main goal of the descriptive method is explicitly to avoid manipulating any variables, such as in some ecological studies that seek to describe the natural interactions between organisms in the environment.

Descriptive research method also involves data gathering and hypothesis development and testing. This method usually involves an initial observation and detailed description of some phenomenon (e.g. behavior of chimpanzees in the wild, the frequency of lunar eclipses). Then a hypothesis or multiple working hypotheses are developed by scientists to explain the phenomenon. Additional observations are made to test the hypothesis or to determine the most likely of the competing hypotheses. Eventually, a scientist can develop an explanatory theory that fits the observations. This is an iterative process. The entire process may happen within a short duration for one scientist, or over many decades/centuries involving the contributions of many scientists, sometimes from many fields of science. Descriptive studies can also be exploratory rather than driven by hypothesis testing. For example, records of a well designed systematic river quality monitoring programme which take regular observations of water quality may be useful in addressing questions about water pollution and other watershed-related questions.

Description is a very useful research method for research questions where experimentation is impossible, such as determining events in earth history. Despite the wide applicability of this research method in science, it is challenging to establish "cause and effect relationships" through description alone. Instead, descriptive studies lead most often to information about the function or form of phenomena and the establishment of physical, spatial, and temporal relationships.

Although, descriptions can stand alone as a research method, systematic description is often a component of other types of scientific research. Scientists who conduct experiments must first study and describe the system with which they experiment, researchers who initiate comparative studies need descriptive data regarding the population they are investigating, and scientists who build models must have an accurate representation of the system they are modeling. For example, ongoing measurements of Carbon dioxide concentrations in the atmosphere are a quantitative description of the composition of the atmosphere over time. These daily, worldwide measurements have allowed the scientists to develop hypotheses about the atmospheric response to volcanic eruptions, pollutants, and the steadily increasing emissions of greenhouse gases. Based on these findings, the scientists can develop models to assess the possible impacts of a continued increase in Carbon dioxide concentration in the atmosphere.

3.5 Comparisons as a scientific research method

Comparison is used to determine and quantify relationships between two or more variables by observing different groups that (either by choice or circumstance) are exposed to different treatments. Importantly, the simple comparison of two variables or objects is not comparative research. Instead, comparative research involves the systematic cataloging of the nature and/or behavior of two or more variables, and the quantification of the relationship between them. Comparative studies are used in different scientific disciplines including comparative biology, chemistry, epidemiology, psychology, toxicology and forensic science.

Examples of comparative research are the studies that were initiated in the past to investigate the relationship between cigarette smoking and lung cancer in which scientists compared individuals who had chosen to smoke of their own accord with non-smokers and correlated the decision to smoke (the treatment) with various health problems including lung cancer. Comparisons include both retrospective studies that look events that have already occurred and prospective studies that examine variables from the present forward. DNA fingerprinting, a technique used to incriminate or exonerate a suspect using biological evidence, is based on comparative science. Comparative methods are also commonly used in studies involving humans due to the ethical limits of experimental treatment.

Comparative research is similar to experimentation as the comparison seeks to interpret the relationship between two or more variables by documenting observed differences and similarities between two or more subjects or groups. In contrast to experimentation, the comparative researcher does not subject one of those groups to a treatment, but rather observes a group that either by choice or circumstance has been subject to a treatment. Therefore the differences in these groups are observed rather than being consciously imposed the treatment to the selected groups due to ethical reasons, or because it is not possible such as in a retrospective study. Thus comparison involves observation in a more “natural” setting, not subject to experimental confines, and in this way evokes similarities with the research method, description.

Comparative research method may be the primary choice for conducting certain types of scientific research……..

- If the researcher, tries to understand the similarities and differences between two subjects but not to measure a response to change caused by experimental treatment.

- When the physical scale or timeline of a question may prevent experimentation. For example, in the field of paleoclimatology, researchers have compared cores taken from sediments deposited millions of years ago in the world's oceans to see if the sedimentary composition is similar across all oceans or differs according to geographic location. Because the sediments in these cores were deposited millions of years ago, it would be impossible to obtain these results through the experimental method. Research designed to look at past events such as sediment cores deposited millions of years ago is referred to as **retrospective research**.

- When the ethical implications of an experimental treatment preclude an experimental design. Researchers who study the toxicity of environmental pollutants or the spread of disease in humans are precluded from purposefully exposing a group of individuals to the toxin or disease for ethical reasons. In these situations, researchers would set up a comparative study by identifying individuals who have been accidentally exposed to the pollutant or disease and comparing their symptoms to those of a control group of people who were not exposed. Research designed to look at events from the present into the future, such as a study looking at the development of symptoms in individuals exposed to a pollutant, is referred to as **prospective research.**

Comparative studies are a critical part of the spectrum of research methods currently used in science. They allow scientists to apply a treatment-control design in settings that preclude experimentation, and they can provide invaluable information about the relationships between variables. The intense scrutiny that comparison has undergone in the public arena due to cases involving cigarettes and climate change have actually strengthened the method by clarifying its role in science and emphasizing the reliability of data obtained from these studies. The utility of comparative science was significantly strengthened with the invention and popularization of modern statistical methods for quantifying the association between variables. Today, these statistical methods are critical for quantifying the nature of relationships examined in many comparative research studies. The outcome of comparative research is often presented as a probability, statement of statistical significance, or declaration of risk (Refer module component 2.7). One of the primary limitations of comparative methods is the control of other variables that might influence a study. As a result, comparative researchers often go to great lengths to choose two different study groups that are similar in almost all respects except for the treatment in question. Many comparative studies in humans are carried out on identical twins for this exact reason.

3.6 Modeling as a scientific research method

In some scientific research (e.g. Physics, Engineering, Chemistry, Meteorology, Geology, Computer science, Environmental Science), models are built to replicate systems in the real world through simplification, to perform an experiment that cannot be carried out in the real world or to assemble several known ideas into a coherent whole to build and test hypotheses. Modeling involves developing physical, conceptual, or computer-based representations of systems.

Physical models are used in scientific research. For example, a group of engineers and geologists at the University of Minnesota have built a room-sized physical replica of a river delta similar to model a real one like the Mississippi River delta in the Gulf of Mexico. These researchers have successfully incorporated into their model the key processes that control river deltas (like the variability of water flow, the deposition of sediments transported by the river, and the compaction and subsidence of the coastline under the pressure of constant sediment additions) in order to better understand how those processes interact. With their physical model, they can mimic the general setting of the Mississippi River delta and then do things they can't do in the real world, like take a slice through the resulting sedimentary deposits to analyze the layers within the sediments.

Some models used in scientific research are conceptual models which involve assembling all of the known components of a system into a coherent whole (e. g. evolution of the model of the atom as our knowledge about subatomic particles increased).

Computer modeling is a relatively new scientific research method, but it is based on the same principles as physical and conceptual modeling. Many scientists now build models mathematically through computer programming. These computer-based models serve many of the same purposes as physical models, but are determined entirely by mathematical relationships between variables that are defined numerically. Both physical and computer-based models are built to mimic natural systems and then used to conduct experiments or make observations. Computer models are based on exactly the same principles as conceptual and physical models, however, they take advantage of relatively recent advances in computing power to mimic real systems(Global climatic model has been developed using computer based modellng).

Whether developing a conceptual model like the atomic model, a physical model like a miniature river delta, or a computer model like a global climate model, the first step is to define the system that is to be modeled and the goals for the model. "System" is a generic term that can apply to something

very small (like a single atom), something very large (the Earth's atmosphere), or something in between, like the distribution of nutrients in a local stream. So defining the system generally involves drawing the boundaries (literally or figuratively) around what you want to model, and then determining the key variables and the relationships between those variables. Though this initial step may seem straightforward, it can be quite complicated. Inevitably, there are many more variables within a system than can be realistically included in a model, so scientists need to simplify. To do this, they make assumptions about which variables are most important. Once a model is built (either in concept, physical space or in a computer), it can be tested using a given set of conditions. The results of these tests can then be compared against reality in order to validate the model. If the model shows something really different than what the scientists expect, the relationships between variables may need to be redefined or the scientists may have oversimplified the system. Then the model is revised, improved, tested again, and compared to observations again in an ongoing, iterative process. All models are also limited by the availability of data from the real system. As the amount of data from a system increases, so will the accuracy of the model. For climate modeling, that is why scientists continue to gather data about climate in the geologic past and monitor things like ocean temperatures with satellites – all that data helps define parameters within the model. The various types of modeling play important roles in virtually every scientific discipline, from ecology to analytical chemistry and from population dynamics to geology. The accessibility of modeling as a research method allows it to be easily combined with other scientific research methods, and scientists often incorporate modeling into experimental, descriptive, and comparative studies.

3.7 Some other non-experimental research methods used in scientific research

3.7.1 Surveys

Survey research is used as a mode of investigation in some applied science disciplines. e.g. Nutrition & Health Sciences, Agriculture, Environmental Science, Fisheries Sciences etc. Surveys are normally used in studies which have individuals as units of analysis. They are particularly important in measuring people's attitudes on particular questions, in determining the effect of some natural event, or looking for patterns of cause and effect among many variables. Survey research can be used to test a hypothesis (hypotheses). Data collected from the surveys could be analyzed using appropriate statistical methods for data interpretations and draw conclusions. Surveys can be used as an appropriate mode in gathering data for certain descriptive and comparative research methods.

Designing a survey is a complex procedure that shares components of research design and

written communication. The main tool that is used in survey research in applied sciences is the questionnaire. The first step in designing a questionnaire is to determine its purpose. The questions may be open ended or close ended. Each has advantages and disadvantages. Questions should address a single issue per tem, avoid bias, offer clear alternatives and take into account the tendency toward social desirability and consent. Common response formats are the visual analog scale, the Likert scale, and the general labeled magnitude scale, each of
which asks for ratings of the level of sensation or of agreement with the statement. Before collecting data the researcher should decide how the data will be analyzed. Methods of survey administration includes face to face, written, computerized and by telephone. Each has advantages and disadvantages. Written surveys may be administered in groups, dropped off for individual completion or mailed. Most researchers require at least a 50% return rate before they consider a survey representative. Survey should use appropriate sampling designs to sample the large populations.

3.7.2 Case studies

Case study method is an approach to study a scientific problem through a thorough analysis of an individual case. The case may be a person, group, community or any other group of social life. All data relevant to the case are gathered and organized logically in terms of the case. It provides an opportunity for the intensive analysis of many specific details often overlooked by other research methods. This approach rests on the assumption that the case being studied is typical of cases of a certain types so that, through intensive analysis, generalizations may be made that will be applicable to other cases of the same type. Case studies are commonly used in medical research.

3.7.3 Meta-analysis

Meta-analysis is used in some areas of applied science research. Meta–analysis is simply **the analysis of other analysis**. It involves aggregating and combining the results of comparable studies into a coherent account to discover main effects. This is often carried out statistically. Method requires preparation of a proper research design. It must have a hypothesis to be tested against the extant data.

A five step model has been proposed (Cook et al 1992: 7-12, cited by Cohen et al. 2007) for an integrative review as a research process.

1. **Problem formulation**, where high quality meta-analysis must be rigorous in its attention to the design, conduct and analysis of the review.
2. **Data collection**, where sampling of studies for review has to demonstrate fitness for purpose.
3. **Data retrieval and analysi**s, where threats to validity in non-experimental research are addressed. Validity here must demonstrate quality, reliability in coding the study characteristics, methodological aspects of the original research that is used for meta-analysis.
4. **Analysis and interpretation**, where the accumulated findings of several pieces of research should be regarded as complex data points that have to be interpreted by statistical analysis.

3.8 The real practice of science

Scientific research methods are part of the practice through which questions can be addressed scientifically. These methods all produce data that are subject to analysis and interpretation and lead to ideas in science such as hypotheses, theories, and laws. Scientific ideas are developed and disseminated through the literature (mainly as journal articles), where individuals and groups may debate the interpretations and significance of the results. Eventually, as multiple lines of evidence add weight to an idea it becomes an integral part of the body of knowledge that exists in science and feeds back into the research process.

All scientific research methods are interconnected and are often used in combination to fully understand complex phenomenon. Modeling and experimentation are ways of simplifying systems towards understanding causality and future events. However, both rely on assumptions and knowledge of existing systems that can be provided by descriptive studies or other experiments. Description and comparison are used to understand existing systems and are used to examine the application of experimental and modeling results in real-world systems. Results from descriptive and comparative studies are often used to confirm causal relationships identified by models and experiments. While some questions lend themselves to one or another strategy due to the scope or nature of the problem under investigation, most areas of scientific research employ all of these methods as a means of complementing one another towards clarifying a specific hypothesis, theory, or idea in science. Scientific theories are clarified and strengthened through the collection of data from more than one method that generate multiple lines of evidence. For example, the various research methods have been used to investigate what came to be known as the “ozone hole.”

4 . Essential Reading

Lecture note given to the participants

5. Supplementary Reading

- Creswell J. W. (2009) Research Design. Sage Publications Inc. California
- Cohen L, Manion L and Morrison K (2007) Research Methods in Education , Routledge, Oxon (pages 272-296)
- Kumar R. (2005) Research Methodology, Pearson Education, Australia (pages 54-79, 83-142)
- http://visionlearnng.com: Research methods

6. References

- Creswell J. W. (2009) Research Design. Sage Publications Inc. California
- Cohen L, Manion L and Morrison K (2007) Research Methods in Education , Routledge, Oxon (pages 272-296)
- Kumar R. (2005) Research Methodology., Pearson Education, Australia (pages 54-79, 83-142)
  (http://visionlearnng.com) Research methods

1. **Learning Outcomes**

   At the end of the sessions, the participants will be able to explain how they transform a social or business problem into a research problem and design and carry out the next steps in social science or business research.

2. **Lecture Outline**

   Introduction
   Single paradigm-single strategy methodologies
   Single paradigm-multiple strategy methodologies
   Cross paradigm-multiple strategy methodologies
   Data collection methods
   Analytical methods
   Communication of results

3. **Learning/Teaching Resource**

   a) Lecture Notes

6.1 Introduction

There is a large body of theoretical literature on research methods used in social sciences and commerce and management and it exceeds the methods available in physical sciences. Further, the researcher can mix or merge paradigms, methods, procedures, etc. according to the need. However, he has to justify the methods and methodology he uses in research. The same researcher may mix paradigms, methods, procedures, etc. in different ways in different researches. Thus, one cannot say about a methodology which can be constantly used in all researches. It should change depending on the nature and need of research. The aim of these two sessions is to give a basic knowledge and guidance on the ways of forming or designing a methodology in social science and business research.

3.2 Single paradigm-single strategy methodologies

Any of the following strategies can be independently, without mixing and merging, used in social science and business research. The way of using these strategies was in detail discussed in the section 2.3 of the module.

Experimental research
Case studies
Ethnography
Action research
Grounded theory
Focus groups, and
Individual in-depth interviews

Experimental research is the pure strategy comes under the positivist paradigm. Relationships existing in the world can be mainly divided into two: causal and correlation relationships

(Bordens and Abbott, 2007: 98). This strategy using scientific method controls variables and attempt to find causal relationships among variables. Thus, the same procedure discussed in sections 1, 2 and 2.3 is relevant in this regard.

Case study strategy is also used as an independent strategy in social sciences and business research. This strategy limits the validity of conclusions to an individual unit or smaller group of the people, firms, etc (Young and Schmid, 1992). However, the researcher has the generalizability of findings to a wider population, if he can increase the number of cases include in the study.

Ethnographic research is more related to the interpretive research that focuses on specific socio-cultural behavior of people. This method can solely used without mixing with other strategies in social and business research.

Action research, grounded theory, focus groups and individual in-depth interviews can also be used, without mixing strategies, in socio-economic research. These four types mostly fall into the paradigm of interpretive research.

3.3 Single paradigm-multiple strategy methodologies

A methodology for social science or business research can be designed within a single paradigm, using different research strategies. The following is an example of designing a methodology:

Research Problem/topic		Urban Consumer Behavior
Paradigm		Positivist (The above topic/problem is to be solved within the positivist paradigm)
Research strategy/strategies		The research is divided into two parts. The first part is to be completed through **individual in-depth interview strategy (IIIS)**. A hypothesis for further study/analysis is formulated through this strategy and then the **experimental strategy (ES)** will be used to test the hypothesis.
Data type	**The first part: IIIS**	Qualitative: textual data with no numerals; expressions of individuals
	The second part: ES	Quantitative measurable data
Data collection	**The first part: IIIS**	Random sampling method to select individuals (consumers)
	The second part: ES	Random sampling method to select consumers
Instruments to collect data	**The first part: IIIS**	Discussions with individual consumers
	The second part: ES	Questionnaire survey
Analysis	**The first part: IIIS**	Qualitative analysis of consumers' individuals' expressions and behaviours
	The second part: ES	Quantitative: analysis through descriptive statistics and an estimating a model
Presentation of findings		Report type

The above study stays in the positivist paradigm throughout the entire study. However, within the same paradigm, the first part of the study uses qualitative individual in-depth study approach whereas the second part uses the experimental strategy.

Data type of the first part of the study is qualitative though it is quantitative in the second part.

Both first and second parts of the study use the random sampling method. However, the first part uses notes taken down through discussions with individuals while the second part uses a questionnaire survey to collect measurable data.

The first part of the analysis is a purely qualitative while the second part of the study is quantitative. The first part analyses expressions of individuals while the second part uses descriptive and inferential techniques of statistics.

Finally, the presentation of findings is a research report on the urban consumer behavior.

3.4 Cross-paradigm-multiple strategy methodologies

The following is an example for cross-paradigm-multiple strategy methodology.

Research Problem/topic		Impact of Internal Displacement on Social Behavior
Paradigm	**The first part:**	Interpretive paradigm
	The second part:	Positivist paradigm
Research strategy/ strategies	**The first part:**	Grounded theory strategy
	The second part:	Experimental strategy
Data type	**The first part:**	Qualitative: textual data with no numerals
	The second part:	Quantitative
Data collection	**The first part:**	Through discussions, interviews, observations
	The second part:	Random sampling method
Analysis	**The first part:**	Qualitative analysis of consumers' expressions and behaviors: identify causal relationships and formulate a hypothesis
	The second part:	Test the validity of the hypothesis formulated in the first part through the experimental strategy: quantitative analysis through descriptive statistics and an estimating a model social behavior.
Presentation of findings		Report type

Suppose, the research topic, 'impact of internal displacement on social behavior' has not been ever studied and no theoretical literature has been created yet. The research does not have information as to formulate a hypothesis and apply the experimental strategy. Thus, he, for the first time, in history starts exploring the social behavior of internally displaced people and illuminates the areas under study using the **grounded theory strategy** within the **interpretive paradigm**. He identifies concepts, categories and relationships related to this category of people. Secondly, as now the researcher has sufficient knowledge to formulate a hypothesis on the 'impact of internal displacement on social behavior of people', he formulates a hypothesis based on that knowledge. He finally tests the hypothesis using **experimental strategy** which comes under the **positivist paradigm**. This way a researcher can mix or merge paradigms and strategies and solve the research problems more effectively.

The following is another example for a research design based on cross-paradigm-multiple-strategy methodology.

Research Problem/topic		Diffusion of Innovative Farming Methods in the Rural Sector
Paradigm	**The first part:**	Positivist paradigm
	The second part:	Interpretive paradigm
Research strategy/ strategies	**The first part:**	Experimental strategy
	The second part:	Individual in-depth interviews
Data type	**The first part:**	Quantitative
	The second part:	Qualitative: textual data with no numerals
Data collection	**The first part:**	Random sampling method
	The second part:	Judgment sampling
Analysis	**The first part:**	Testing a hypothesis; quantitative analysis; using statistics; using analytical software such as SPSS and MINITAB.
	The second part:	Identification of reasoning for the results obtained through quantitative analysis in the first part
Presentation of findings		Report type

The above design is such that the first part of the study is carried out through experimental strategy that comes under the positivist paradigm and results are obtained through statistical techniques. Reasons for these quantitative results are identified through qualitative analysis in the second part of the study.

For example, suppose, at the first step,
the above study took into consideration twelve factors into account and identified the following four factors determining diffusion of innovative farming practices through the experimental method using statistical analysis. The other eight factors were rejected as not significant in the diffusion of innovations. Three of the significant factors are positively affected with the diffusion of innovative methods while the remaining factor is negatively associated.

- Education level of owner farmers : positive
- Relative price of the farming product : positive
- Average cost of input : negative
- Relative price of the farm product : positive

At the second step, the study identifies the reasoning behind these relationships through qualitative method by interviewing owner farmers. The reasoning is provided for the following questions through this strategy:

- Why the diffusion of innovative farming methods is positively associated with the education level of owner farmers positive?
- Why the diffusion of innovative farming methods is positively associated with relative price of the farming product?
- Why the diffusion of innovative farming methods is negatively associated with average cost of inputs?
- Why the diffusion of innovative farming methods is positively associated with the relative price of the farm product?

- Why the eight factors were rejected as not significant.

The reader can think of alternative ways of mixing paradigms and research strategies.

3.5 Data Collection Methods in Social and Business Research

3.5.1 Types of data

Data, being the main raw material of research, can be divided into two parts such as qualitative data and quantitative data. In social and business research either on or both types of data can be used. However, when the experimental strategy used, availability of quantitative data is essential. Even qualitative data can be quantified through various methods depending on the need of the researcher.

3.5.2 Sources of data

A social science or business research can be divided into three main categories based of the main source of data:

1. Researches completely based on primary data
2. Researches completely based on secondary data
3. Researches based on both primary and secondary data

Secondary data can again be divided into two parts such as,

1. Institutional data
2. Non-institutional data

Examples for institutional sources are data obtained from IMF, World Bank, ADB, WTO, World Health Organization and Central Bank of Sri Lanka, Hector Kobbekaduwa Agrarian Research and Training Institute, etc. Research reports of university academics are an example of non-institutional sources. Both institutional and non-institutional sources are used in most of the social and business researches.

The main forms of primary data collection in social sciences are as follows:

1. Face to face informal/formal discussions and taking down notes, videotaping, audio recording, etc.
2. Face to face interviews using a formal organized questionnaire
3. Directing questionnaires without personally interviewing: through telephones, ICT based methods, etc.
4. Observing individuals, people or phenomena
5. Offering reaction activities to informants: e.g. ask tem show a cultural dance, conducting a test for children to know their knowledge in something

The reader should have knowledge on what are the merits and demerits each of the above methods so that he can choose the best method depending on the circumstances.

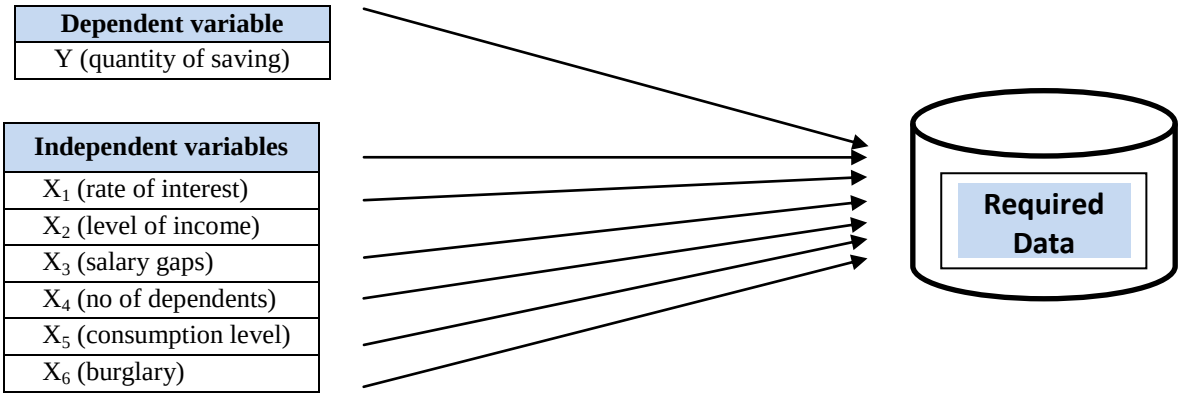
It is also important to have knowledge about the **types of questionnaires**. Questionnaires can be prepared in different forms:

1. **Structured questionnaires**: These are prepared with predetermined questions based on the requirement and the existing knowledge about it. This form of questionnaires may include '**closed-form**' or/and '**open-ended**' questions (Kumar, 2005: 132).

Closed for questions are offered when the researcher needs to get the answer in a certain classified form that can easily match with his methodology. When the researcher does not have an idea about the possible exact forms of answers, the question should be kept in open-ended form so that he can later on classify it according to the answers given by the informants. The reader can think of examples for closed-form and open-ended questions.

2. **Unstructured questionnaires**: these are frequently used as interview or discussion guides (Bryman and Bell, 2007: 283). This form of questionnaires is appropriate to obtain opinions, attitudes, ideas, and normative expressions of informants.

The researcher should make clear whether he has included all necessary questions in the questionnaire. For example, if he is going to construct a model to explain the saving behavior of rural peasants within the positivist paradigm, he should first determine the independent and dependant variables and then design the questions with the aim of constructing the variables using the answers obtained for those questions.



Y is quantity of family savings, variables from X_1 to X_6 are the independent variables you are going to test their significance in order to include them in the model. At this attempt you have to construct all these variables in order to build the model. However, you would not be able construct variables if you have not collected data for each and every variable shown in the above figure. As a solution to this problem, the researcher can first carry out a **pilot survey** and test whether it successfully gathers the necessary data.

In addition, while designing a questionnaire, the researcher should take some more points into consideration:

- Questions should be given numbers and set properly so that preparing the data base would not be difficult.
- Instead of seeking long answers to questions, a standard codes should be given.
- The tithe of the study or survey should be given on the top of the front page of the questionnaire.
- The authority or the basis for collecting information should be clearly stated next to the title of the questionnaire.
- The confidentiality of information collected through survey should be made clear to the informants so that they feel that they would be safe.
- Questions should be clear and unbiased.

The reader should add extra points to the above list depending on the nature of study and questionnaire he is going to use for collecting data.

Finally, the researcher should know that the data collection method differs between research strategies. The structured or semi-structured questionnaires can be used when the study is carried out through positivist approach. Most of the qualitative researchers who collect data from the field take down notes instead of filling questionnaires or schedules so that their data happens to be 'field notes'.

3.5.3 Sampling

Sampling is a process of selecting observations with regard to a certain problem (Babbie, 1986:138). Sampling allows us to draw conclusions for a wider population based on a smaller number of observations. To the extent that the sample represents all types of individuals or objects, the results of the research would be generalizable. Sampling is of two types:

1. Probability sampling
2. Non-probability sampling

Probability sampling is necessary for research that applies scientific method within the positivist paradigm. Samples are drawn for the calculation of estimates for the following purposes:

(a) Estimating population parameters from sample data, or

(b) Testing hypotheses about population parameters using statistical methods.

For the accuracy of the above estimates it is necessary to employ probability sampling in research. As this sampling method offers a known and non-zero chance of being selected as a sample unit, it represents all individuals, units or objects of the target population. Thus, employing probability sampling is essential in quantitative research.

Probability sampling can take different types:

1. Simple random sampling
2. Systematic sampling
3. Multistage random sampling
4. Stratified random sampling
5. Simple cluster sampling
6. Stratified cluster sampling

All these types have their merits and demerits. The reader has to refer to sampling text books for more knowledge on each of the above sampling method.

Non-probability sampling can not be used in quantitative research where population estimates becomes important. This is used only in qualitative research. There are three main types of qualitative sampling methods.

1) Purposive or judgmental sampling: Researcher decides what units he has to select as sampling units using his knowledge experience, and requirement. **Quota sampling** is also a method that can be included in the same category. This method classifies the population based on their differences in characteristics and assign quotas (Adams et al, 2007: 90).

2) Convenience sampling: Researcher gives the priority for convenience in selecting sampling units.
3) Snowball sampling: An explanation with an example about this sampling method has been provided in section 2.3.

Sample size in all types of qualitative research is less than that of quantitative research.

The researcher in social and business studies should choose the appropriate sampling design depending on the cost, time and resource availability and other requirements.

3.6 Data Analysis in Social and Business Research

Data analysis in social and business can be divided into two categories as follows:

1. Data analysis in quantitative research
2. Data analysis of qualitative research

Data analysis in quantitative research: Data analysis in quantitative social and business research is much more complex than in physical sciences. This is for the reason that most of the variables which remains in the form of qualitative variables or concepts and categories have to be transformed into a measurable form. Hence, the researcher, before he enters the serious analysis, should arrange data and construct variables so that he can use it in an advanced statistical, mathematical or other type of quantitative analysis. For this purpose, the reader should refer to relevant methods in standard books depending on his requirement. For example, when a researcher is in need of measuring relative poverty among families, taking only family income is not realistic. The income may not be properly revealed by the informants. Further, non-pecuniary income and the other assets of families are not properly represented by income. As a solution to this problem, the researcher can construct a **composite index** to measure assets level of families through which he can identify the relative poverty level of families. The researcher should refer to method of constructing composite indexes in standard books in such a situation.

After arranging and constructing variables, there is a large box of tools for a quantitative analyst to select from it for his analysis. The following table presents some of the tools available in statistics. Usually, quantitative analyst divides his analysis into two main parts:

1. Analysis based on descriptive statistics
2. Analysis based on advanced statistical techniques including inferential statistics

The analysis starts from descriptive statistics continues to advance techniques. The researcher can get an idea through the analysis of descriptive statistics on what advanced methods he should choose in the second step. The analytical tools of the research based upon the characteristics of data, behavior of variables, etc.

At present, using statistical software is the usual way of quantitative analysis. SPSS, MINITAB, STRATA, etc. are widely used in data analysis in social and business research.

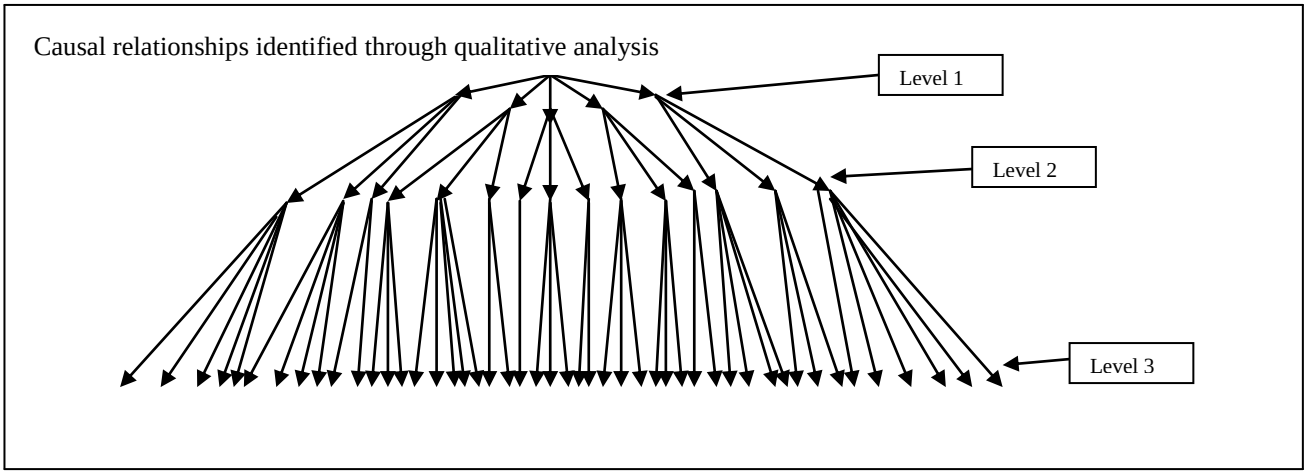
Statistical Tools		
Graphs		
	Bar graphs	
	Line graphs	
	Scatter plots	
	Pie charts	
Frequency distribution		
	Histogram	
	Stem plot	
Descriptive statistics		
	Measures of central tendency	Mode
		Median
		Mean
	Measures of dispersion	Range
		Inter-quartile range
		Variance
		Standard deviation
	Box-plots	
Measures of association and regression		
	Pearson correlation coefficient	
	Spearman correlation coefficient	
	Other correlation measures	
	Linear regression	
	Multivariate correlation techniques	
Inferential statistics		
	Parametric statistics	
	Non-parametric statistics	

Data analysis in qualitative research: Data analysis in qualitative research is completely different from that of the quantitative. Researcher can do this manually or using computer software such as N_6, NVIVO.

For example, the following is a manual method of a researcher who applies qualitative in his analysis.

Steps of Qualitative Analysis	
Step 1	Gather all field notes relevant to the study.
Step 2	Read for the first time and identify what sort of facts and points are available.
Step 3	Read for the second time and use different codes (e.g. A, B, C, D, etc.) for different ideas or points and equal codes for equal ideas.
Step 4	Classify the notes according to the codes and prepare nodes (a node consists of parts of notes which come under the same code). Since this is just a classification of notes just by seeing, it is known as free node. You will prepare a few or more number of free nodes using all field notes.
Step 5	A tree node is prepared using free nodes. This will be just like a flow chart.
Step 6	You will see that you have picked up all necessary points from your field notes and classified it in a systematic way so that you can easily and clearly identify causal relationships.
Step 7	Write the report using identified causal relationships. Quote expressions of people whenever you feel it is necessary to prove something.
Step 8	Include topologies as evidence tables in the appendix.

The researcher will finally get causal relationships in the following manner:



Thus, qualitative analysis is a classification of data based on codes given by the researcher for his field notes. This method is a relief for the researcher since he can drop all unnecessary data and take only necessary data in point form. At the time of writing the report, the researcher can suitably quote the expressions of people so that what you say is proved. If it is real qualitative analysis you will not use any numerals in the report.

3.7 Communication of Results

Results of research should be communicated to others scientifically. The two main forms of scientific communication are as follows:

1. Oral presentations: this can be assisted by Power-point presentations, etc.
2. Written documents: reports, dissertations or theses, research papers, conference papers, etc.

In oral presentations, the researcher should well organize the presentation. It should at least contain the following themes:

1. Who you are
2. Introduction
3. Research problem and its significance
4. Aim and objectives
5. Methodology
6. Data
7. Findings
8. Conclusion and recommendations

A maximum of 45 minutes presentation should be followed by a discussion. Write down the points obtain from the audience.

Write documents should be scientifically prepared with uniformity throughout the document. The research should follow the given or standard methods of referencing and other writing methods and styles.

4. Essential Reading

- Babbie, E. (1986). *The Practice of Social Research* (Fourth Edition). California: Wadsworth Publishing Co.
- Bordens, K.S, and Abbott, B.B. (2006). *Research Design and methods* (sixth ed,). New Delhi: Tata McGraw Hill Publishing Company Limited.
- Kumar, R. (2005). *Research Methodology: A step by step guide for beginners* (Second Edition). Delhi: Pearson Education.
- Sekaran, U. (2009). *Research Methods for Business: A Skill Building Approach* (Fourth Edition). New Delhi: WILEY-INDIA.

5. Supplementary Reading

- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Briman, A.B. (2007). *Business Research Methods* (Second Edition). Oxford: Oxford University Press.
- Davis, D and Cosenza, R.M. (1985). *Business Research for Decision Making*. California: Kent Publishing Company.
- Green, P.E., Tull, D.S. and Albaum, G. (2002). *Research for Marketing Decisions* (Fifth Edition), New Delhi: Prentice Hall of India.
- Hawkins, C. and Sorgi, M. (Eds)(1985). *Research: How to Plan, Speak and Write about it*. New Delhi: Narosa Publishing House.
- Taylor, B., Sinha, G., Ghoshal, T. (2007). *Research Methodology: A Guide for Researchers in Management and Social Sciences.* New Delhi: Prentice-Hall of India Private Limited.
- Trochim, W.M.K. (2006). *Research Methods* (Second Edition). New Delhi: Biztantra.

6. References

- Adams, J., Khan, H.T.A., Raeside, R. and White, D. (2007). *Research Methods for Graduate Business and Social Science Students*. New Delhi: Response Books.
- Babbie, E. (1986). *The Practice of Social Research* (Fourth Edition). California: Wadsworth Publishing Co.
- Bordens, K.S, and Abbott, B.B. (2006). *Research Design and methods* (sixth ed,). New Delhi: Tata McGraw Hill Publishing Company Limited.
- Bryman, A. and Bell, E. (2007). *Business Research Methods* (Second Edition). Oxford: Oxford University Press.
- Kumar, R. (2005). *Research Methodology: A step by step guide for beginners* (Second Edition). Delhi: Pearson Education
- Young, V.P. (1992). *Scientific Social Surveys and Research* (ed). New Delhi: Prentice Hall of India Private Limited.

MODULE 7: RESEARCH METHODS IN HUMANITIES

1. **Learning Outcomes**

   At the end of the sessions, the participant will be able to demonstrate knowledge of the research methods used in Humanities

2. **Lecture Outline**

   - Significance of humanities research in understanding the human existence.
   - Purpose of humanities research; examining the past to understand the future.
   - Humanities research questions, study design, and emphasis on thinking critically and theoretically.
   - Different perspectives in humanities research; historical, interpretive, analytical, reflective, and the postmodern.
   - Different approaches in humanities research; critical discourse analysis, comparative studies, critical readings of texts, religious studies, ethnographic studies etc.

3. **Learning/Teaching Resource**

   a. **Lecture Notes**

Session 01

3.1 Introduction

The present module consists of two training sessions. In the first session, the nature of humanities as a broad domain of human cognition, significance of research in the humanities, and different approaches in humanities research will be discussed. In the second session, the methods of knowledge production in some major branches of humanities will be introduced.

Unlike the other two major domains of human cognition; *i.e.* the natural sciences or the social sciences, due to the complex nature of its constituent disciplines, defining humanities in clear-cut terms is somewhat difficult. Humanities can be broadly described as the study of the myriad ways in which people, from every period of history and from every corner of the globe, process and document the human experience. Since early beginnings of the human race, we have used art, music, dance, literature, philosophy, religion, history, and language etc. to understand and record our experiences. These modes of expression have become some of the subjects that traditionally fall under the humanities umbrella.

Subject Areas in the Humanities
Fine Arts, Art History, Classics, Drama and Theater, English, History, Linguistics, Performing arts, Philosophy, Religious Studies, Literature, Cultural Studies, Languages, Linguistics.

3.2 Significance of Humanities Education and Research

It is well known that humanities education does not directly or seemingly contribute to scientific or technological advancement, social or economic development, poverty alleviation or growth in business or commerce. It is often asked why governments should support or encourage humanities education or research in the humanities if the study of or research in the humanities do not contribute to the material development of the society.

Knowledge of those records of human experience documented in the form of art, music, dance, literature, philosophy, religion, history, and language etc. gives us the opportunity to feel a sense of connection to those who have come before us, as well as to our contemporaries. Such knowledge gives us insights into everything. Through exploration of the humanities we learn how to think creatively and critically, to reason, and to ask questions. This is because these skills allow us to gain new insights into everything from poetry and paintings to business models and politics. We may remember that humanistic subjects have been at the heart of a liberal arts education since the ancient Greeks first used them to educate their citizens.

Study of humanities helps us understand our world. Through the work of humanities scholars, we learn about the values of different cultures, about what goes into making a work of art, about how history is made. Their efforts preserve the great accomplishments of the past, and help us understand the world we live in, and give us tools to imagine the future. Research into the human experience adds to our knowledge about our world.

Proper understanding of humanities brings clarity to the future. Today, humanistic knowledge continues to provide the ideal foundation for exploring and understanding the human experience. Investigating a branch of philosophy might get a person to think about ethical questions. Learning another language might help one gain an appreciation for the similarities in different cultures.

Bringing Clarity to the Future through Humanities

Contemplating art:	affect creative decisions of the viewer
Reading a book:	think about meaning of democracy
Listening to history:	better understanding about the past

Bringing clarity to the future can be further explained. Contemplating a sculpture might make the viewer think about how artist's life affected her creative decisions. Reading a book from another region of the world might help the reader think about the meaning of democracy. Listening to history course might help the student to have a better understanding of the past, while at the same time giving him or her a clearer picture of what the future holds.

Humanities research therefore, can be described as an examination of the past to understand the future. Humanities research often involves an individual professor researching in a library in order to write a book. The books that result from this study are part of an ongoing dialogue about the

meaning and possibilities of human existence that reaches back to ancient times and looks forward to our common future.

3.3 Approaches to Humanities Research

A hallmark of humanistic study is that research is approached differently than in the natural and social sciences, where data and hard evidence are required to draw conclusions. Because the human experience cannot be adequately captured by facts and figures alone, humanities research employs methods that are historical, interpretive and analytical in nature. Professors who engage in humanities research often pose questions about common assumptions, uncover new meanings in artistic works, or find new ways to understand cultural interactions.

This type of inquiry can;

produce clearer pictures of the past,

uncover the many insights that we can draw from our forbears, and in turn, help us better prepare for the future.

3.4 Interdisciplinary Collaboration in Humanities Research

There is a widespread mis-belief that humanities research is essentially centered on a single discipline and is carried out in isolation. Although this may be true with certain researchers and certain disciplines, in many cases, humanities research also draws from other sources and often requires alternative methods of investigation. A professor may collaborate with a colleague in another area of study to gain alternative perspectives on a topic. Other projects require the gathering of original information by doing fieldwork which could entail interviewing people, unearthing artifacts or documenting the history behind an archive of photographs.

Typical Research Methodology Course in English Literature Provides training in;

Methodological and theoretical issues
Comparative analysis of anthologies
Compiling academic bibliographies
Working with archives, manuscripts, and early texts
Bibliography and literature searching

3.5 Research in Natural Sciences and Humanities

Scientific research is often described as "… a systematic search or investigation directed to the discovery of some fact by careful consideration or study of a subject; a course of critical inquiry." Can we apply the same description for humanities research? The "… discovery of some fact…" may be true in history or textual editing, but not in literary criticism. The very concepts of fact is debunked in the 1980's (postmodernist approach). Can we compare scientific research with humanities research?

Research in Science and Humanities compared;

Research in science: Basic (BSR) or Applied (ASR)

BSR: Motivated by curiosity rather than by a particular goal,
Outcomes tend to be theoretical rather than practical.

ASR: Usually grows out of basic research, and
Usually has practical goals in view from the beginning.

Can we consider humanities research in terms of basic or applied**?**

One would say that all humanities research is basic research, because it never aims at having a practical application. On the other hand, if understanding is a practical outcome, then all humanities research is applied, as it aims directly at producing a practical outcome, namely changing the way we understand that part of the human record it has in view. Probably the truth is that in the humanities, as in science, both are done.

3.6 Scientific and Humanities Methods Compared

In science, one doesn't prove a hypothesis, any more than one does in cultural studies. All one can do is to offer a hypothesis that withstands being disproved for some period of time, until contradictory evidence or a better account of the evidence comes along. This self-correcting mechanism is the basis of progress in scientific research. Such mechanism is not so obvious in humanities research.

Scientific Method Vs Humanities Method (One School of Thinking)

Sci. Meth: Quantifiability -- objective data
Hum Meth: Non-quantifiability – subjective data

Sci. Meth: Percentage of times turning heads or tails - objective
Hum Meth: Percentage of people who believe the coin might land on its side – subjective

Then, how does a problem in literary criticism differ from a problem in scientific research? Literary-critical 'problems' are not for solving. The object of the literary researcher is not to settle questions, but to open and explore them. Words such as 'problem,' 'experiment,' 'fact,' 'truth,' and 'hypothesis' all mean something very different in a humanistic context than they do in the sciences.

End of Session 01

Session 02

3.7 Methods in Traditional Humanities Research

Dissertations in Humanities sometimes have chapters on methodology. Such a chapter often contained a description on the methods of information collection. In the past, research methods in humanities essentially meant the methods of; collecting information, doing library research, using quotations, writing citations & foot notes, and writing the bibliography.

3.8 Nature of Humanities Research Questions

One may raise a question such as, 'how much patriotic Piyadasa Sirisena's novels?' To find answers to this question, can we take objective measurements of his novels? Can we count the number of appearance of patriotic words or phrases in his novels? Can we ask the readers of their reactions to his novels? Either way, it is going to be subjective.

Can we avoid subjectivity by changing the research question? The real originating question may be re-stated as; 'what makes Sirisena's writing patriotic? Then we can use a'data-mining' software to measure 'non-quantifiable' information. One such tool is NORA software for literary criticism.

Nora is a text-analysis software that enables users to determine the frequency with which words or phrases are used, create concordances, view words in context, and otherwise study patterns in texts. (Nora stands for 'no one recognizes acronyms').

3.9 What is data-mining?

Data-mining is a new research tool that can be used to measure non-quantifiable information such as expressions, feelings, ideas, values etc. Data-mining delivers a new kind of evidence into the scene of reading, writing, and reflection, and although it is not easy to figure out sensible ways of applying this new research method (new, at least, to the humanities). It check our sense against the myriad details of the text, and sometimes in that process we will find our assumptions checked and altered, almost in the way that evidence sometimes alters assumptions in science.

3.10 Humanities Research Methods 01: Critical Discourse Analysis (CDA)

This is an interdisciplinary approach to the study of 'discourse'. The method is used in several disciplines in humanities and social sciences. It is a way of approaching and thinking about a problem. Therefore, it is neither qualitative, nor quantitative. This can be explained as a manner of questioning the basic assumptions of quantitative and qualitative methods

CDA does not provide a tangible answer to problems based on scientific research. It only enables access to knowledge-based assumptions behind a discourse (project, text, art, statement etc…). It enables to reveal the hidden motivations behind a discourse to interpret that discourse.

Thus, CDA does not provide absolute answers to a specific problem. It only enables us to understand the conditions behind a specific "problem" and makes us realize that the essence of that "problem" (and its resolution) that lie in its assumptions; the very assumptions that enable the existence of that "problem".

CDA: Reliability and Validity

CDA is a matter of interpretation.

As no hard data provided through CDA, the reliability and validity of one's research/findings depends on the force and logic of one's arguments.

Even the best constructed arguments are subjected to their own deconstructive reading and counter-interpretation.

Validity of CDA depends on the quality of the rhetoric.

Despite this fact, well-founded arguments remain authoritative over time and have concrete applications.

3.11 Advantages and Disadvantages of Critical Discourse Analysis (CDA)

CDA is applicable to every situation and every subject. New perspectives provided by CDA allow personal growth and a high-level of creative fulfillment. No technology or funds are necessary to carry out a research based on CDA. Authoritative CDA can lead to fundamental changes in the practice of an institution, the profession, and society. However, it does not provide definitive answers; so not a hard science, but an insight/knowledge based on continuous debate.

3.12 Humanities Research Methods 02: Religious Studies

Religious Studies is essentially an interdisciplinary field. It encompasses disciplines such as Anthropology, Area Studies, Art, Classics, Comparative literature, Cultural Studies, Ecology, Economics, Folklore, History, International Studies, Linguistics, Management, Music Philosophy, Political Science, Psychology, Sociology etc. etc…

There is a vast difference between the study of religion (SR) and religious studies (RS). RS takes place within a secular and academic environment, rather than in a faith-oriented community where SR takes place. Goal of any research in RS should not be to demonstrate or refute provocative religious concepts such as the existence of God, the idea of reincarnation, or the possibility burning in hell. Such issues are supernatural and/or metaphysical and thus not open to rational inquiry.

On such issues, a researcher may contextualize such questions. One can examine a particular Buddhist conception of reincarnation, or Nietzsche's questioning of the existence of God. Reader will be interested in what a particular historical figure, community, or text will reveal about such issues than what you actually believe

In Religious Studies, the researcher analyzes evidence. Personal beliefs do not influence to predetermine conclusions. Reasoned evidence rather than personal opinion is needed. Material should not be evaluated in light of researcher's religious convictions. Such analysis is inappropriate in any scholarly work.

It is ineffective as one cannot anticipate that the reader will share the researcher's assumptions

3.13 Common Approaches in Religious Studies 01: Comparative Studies

Comparative studies are used to discuss both similarities and difference between the things to be compared. The research should produce more than a list of similarities and differences. It must support some larger theoretical point or issue that is larger than any of the items in the comparison.

A good comparative study should describe each thing that the researcher compares in terms of the social, historical, and cultural environments to which it belongs. He/she should explain the larger theoretical point or issue that is at the analytical core of your thesis. It is necessary to compare each thing with the others at the descriptive level to identify their similarities and differences, and individually compare each thing with the larger theoretical point or issue of one's thesis. The researcher should conclude the thesis by explaining what the comparisons at both the descriptive and the theoretical levels demonstrate about the value of the theoretical issue or point that is at the analytical core of the thesis.

3.14 Common Approaches in Religious Studies 02: Critical Readings of Religious Texts

Critical examination of sacred and/or traditionally authoritative texts: an important part of religious studies. The same methods used in literary analysis can be utilized to critically read a religious text. In this approach of research, the researcher evaluates the genre of a particular text – its interpretation.

The researcher will examine the issues related to authorship, source material, historical context, and common themes and motifs. He/she may do character analysis. One very popular approach in religious studies involves the comparison of multiple texts.

3.15 Common Approaches in Religious Studies 03: Ethnographic Studies

Ethnographic approach of religious studies has become a popular form of research method in recent years. In this method, the researcher observes religious actions and interviews its participants.

3.16 Common Approaches in Religious Studies 04: Historical Analysis

In the historical approach of religious studies, the researcher analyzes political or social history of religion in a given society

4. Essential Reading

- Unsworth, John. *New Methods for Humanities Research***:** the 2005 Lyman Award Lecture. National Humanities Center, Research Triangle Park, NC. November 11, 2005. Accessible at http://www3.isrl.illinois.edu/~unsworth/lyman.htm

5. Supplementary Reading

- Willie van Peer, Frank Hakemulder and Sonia Zyngier**.** 2007. *Muses and Measures: Empirical Research Methods for the Humanities.* ISBN 13: 9781847181701
- P, Michael and G. Griffin (ed.) *Research Methods for Cultural Studies*. 2008. Edinburgh: Edinburgh University Press. ISBN 978 0 7486 2577

End of Session 02

MODULE 8: DATA COLLECTION AND ANALYSIS

1. Learning Outcomes

At the end of the module the participants will be able to:

- Identify the role of statistics in research
- Appreciate the importance of planning data analysis at the initial stage of the research
- Identify the methods of data collection and apply them where appropriate
- Apply random and non-random sampling techniques
- Design and conduct experiments
- Design data entry formats and use them effectively in data entry
- Explore data sets using descriptive measures, graphs and charts
- Formulate statistical hypothesis and test them using appropriate statistical techniques
- Present findings of a research effectively using tables, graphs and charts
- Evaluate statistical arguments

2. Lecture Outline

- Introduction:
  The relationship between statistics and research, Branches of statistics, Role of probability in statistics, Terminology, scope and limitations of statistics
- Formulating statistical hypothesis:
  Objectives of the study, response and independent variables, scales of measurements
- Data collection:
  Methods of data collection (censuses, sample surveys and planned experiments), Primary and secondary data, Random and non-random sampling techniques, Experimental designs, Pilot studies, Questionnaires and schedules
- Exploring data:
  Tables, histograms, stem-and leaf plots, box plots, scatter plots, Descriptive measures (Mean, median, standard errors, correlations)
- Confirmatory analysis:
  Point estimates and confidence intervals, Type I and Type II errors, Level of significance, P-value
- Communicating statistical results:
- Evaluating statistical arguments:

3. Learning/Teaching Resource

a. Lecture Notes

Session 1

Learning Outcomes

At the end of this session you will be able to:

- Identify the role of statistics in research
- Identify the importance of planning data analysis at the initial stage of the research
- Identify the methods of data collection and apply them where appropriate

3.1 The role of statistics in research:

Statistics plays a major role especially in quantitative research. It is evident from the following definition of statistics.

> **Statistics** is the official science of making effective use of numerical data relating to groups of individuals or experiments. It deals with all aspects of this, including not only the collection, analysis and interpretation of such data, but also the planning of the collection of data, in terms of the design of surveys and experiments.
>
> -Dodge, Y. (2003) *The Oxford Dictionary of Statistical Terms*, Oxford University Press. ISBN 0199206139

Statistics helps the researcher to plan the data collection process and to derive information from the data (i.e. making conclusions based on data).

Data are plain facts. When data are processed, organized, structured or presented in a given context so as to make them useful, they are called information.

It is not enough to have data (such as statistics on the economy). Data in themselves are fairly useless. But when these data are *interpreted* and processed to determine its true meaning, they become useful and can be called information.

1. Data is the lowest level of knowledge and information is the second level.
2. Data by itself alone is not significant. Information is significant by itself.
3. Observations and recordings are done to obtain data, while analysis is done to obtain information.

Eg.

Data: Birth weights of the babies born at a particular hospital during last week

Information: Average birth weight of a baby born at that hospital during last week

3.2 Branches of statistics

Identification of the branches of statistics is important since it will help the researcher to select the correct branch of statistics in making conclusions.

Classical versus Bayesian

In classical statistics only the data are used in making conclusions. However, in Bayesian statistics, in addition to the data, the prior information (the subjective knowledge about the scenario under study, before collecting data) is also used in making conclusions. Famous Bayes' theorem (Introduced by Rev. Thomas Bayes 1702-1761) is used to combine prior knowledge with the data. There are arguments pro and against Baysian and classical. Earlier there were two school of thoughts Frequentists (who use classical statistics) and Bayesians (Who use Bayesian statistics). In classical statistics, conclusions are objective but prior knowledge of the researcher is neglected. Contrary to that, Baysian statistics recognizes the importance of the prior knowledge of the researcher but loses its objectivity. After some deliberation over the matter, we may select one of the branches, depending on the situation.

Eg.

Classical: Passing rate of a particular course unit can be calculated using the last semester results of the course unit.

Bayesian: If we combine the information obtained under classical approach with the personal belief about the passing rate of the person who makes the conclusion then it is Bayesian.

Descriptive versus Inferential

Descriptive statistics describes the data at hand using graphs, charts and summary measures. However, it will not generalize the conclusion to the population on which the sample has been taken. The later is done by inferential statistics. Therefore, it is sufficient to use descriptive statistics only if we have collected data from the whole population (no sampling has been done). However, very often we do sampling due to its economy, efficiency and reliability. In such a case, both descriptive and inferential statistics are useful.

Parametric versus nonparametric

If we know the form of the distribution (more frequently the normal distribution) of the random variable/s under study we can use parametric statistical methods. Nonparametric statistics is used when the form of the random variable/s are unknown.

Univariate and Multivariate

If the study is limited to one dependent variable or set of unrelated response variables then we can confine to univariate statistics. If the response variables are inter-related then we have to use multivariate statistics.

Eg.

If we are targeting only on the durability of a product then it is a uni-variate study. However, if we consider colour, shape, etc. about the product in addition to the durability then it is termed as multivariate study.

3.3 The role of probability in statistics

Measuring the uncertainty of a conclusion given is vital in statistics. Therefore, probability (as a measure of uncertainty) has an essential role to play in statistics, especially in inferential statistics.

3.4 Terminology

Observational and experimental studies

In an observational study, the researcher merely observes what is happening or what has happened in the past and tries to draw conclusions based on these observations. However, in an experimental study, the researcher manipulates on of the variables and tries to determine how the manipulation influences other variables.

Eg.

If we record gender, age, income etc. on several people without imposing any condition on them in a study then it is an observational study. However, if we record the blood pressure of several people by dividing them into two parts and giving two different treatments to the groups then it is an experimental study.

Population and sample

A population is any entire collection of people, animals, plants or things from which we may collect data. It is the entire group we are interested in, which we wish to describe or draw conclusions about. A sample is a subset of a population.

Eg.

In a study of job satisfaction of the employees of a company if we consider all the employees then it is the population. However, if we select a group of employees to represent all the employees of the company then it is known as a sample.

Qualitative and quantitative data

If the data are expressed in numerical terms they are known as quantitative data whereas the the data that are not quantifiable are known as qualitative data.

Eg.

Gender, level of education (which are non-quantifiable) are examples for qualitative variables. Weight, height are examples for quantitative variables.

Scales of measurements (Nominal, Ordinal, Interval and Ratio)

Qualitative data can further be divided into two parts, namely nominal and ordinal. In nominal data there is no ordering such as gender, the colour. However in ordinal data there is an ordering though they are not numerical (such as level of formal education, the satisfaction)

Primary and secondary data

Primary data are the specific data collected for a particular objective. If the same data are used for another objective then they are known as secondary data for that objective.

If we collect family income data from several households in a city for a particular study then that data are primary to us. If we obtain the same from the GS of the area then that data are secondary to us since they have been collected for some other purpose by the GS.

Activity 1

Why statistics is important in research? (List of reason)

3.5 Significance of statistics in research

Statistics helps the researcher to obtain objective conclusions from data. However, conclusions are somewhat subjective where the Bayesian statistical techniques are used. This is the most important aspect of statistics. Statistical conclusions are not 100% true. However, confidence of each conclusion is also given along with all conclusions (usually as the level of significance). This might be considered as the most important aspect of statistics. The other significance of statistics in research is that it helps to achieve the objectives of the research in a more efficient and effective manner. This leads to the reduction of time and other resources in achieving conclusions.

'Scientific research is a process of guided learning. The object of statistical methods is to make that process as efficient as possible.' (Box, Hunter, & Hunter, 1978)

3.6 Frequently used statistical concepts/tools/techniques in research

Following are the frequently used statistical concepts/tools/techniques.

- Estimation of population mean/ proportion/variance (along with their standard errors & confidence intervals)
- Testing hypotheses on population mean/proportion/variance
- Comparing two population means/proportions/variances (for both independent and related populations)
- Measuring and testing the significance of the association between two variables
- Establishing relationships between variables (Regression)
- Comparing means of several populations (ANOVA/MANOVA)
- Forecasting (Time series analysis)
- Clustering observations/ variables (Cluster analysis)
- Identifying hidden factors (Factor analysis)

Activity 02

Find one example each for the statistical concepts/tools/techniques (Provide few on each)

3.7 Statistics and planning the research

It is essential to seriously think about the statistical concepts/tools/ techniques at the planning stage of research. However, many researchers think about statistics at the data analysis stage of research. If you do not plan the study incorporating the relevant statistical concepts/tools/techniques, you will not be able to achieve the objectives of the research in the most efficient way. Some or all of the following might happen.

- Irrelevant data collection (inability to meet the objectives of the study, time and resources are wasted)
- Insufficient data collection (inability to meet the objectives of the study)
- Lack of desired precision (inability to meet the objectives of the study
- Assumptions behind the statistical technique/s may not be satisfied
  (This may lead invalid conclusions)

3.8 Steps to be taken before collecting data

For a successful study, following steps are essential before collecting data.

- Review the relevant literature
- Clearly state the objectives of study
- Determine exactly what data are required
  - -Dependent & independent variables
  - -Primary and/or secondary data
  - -Scales of measurements
- Identify the target population
- Specify the method of sampling
- Decide the sample size (depending on the precision required and the resources available)
- Specify the method/s of data collection
- Decide on the method of data entry (software to be used and the format)
- Determine the statistical techniques to be applied
- Be familiarize with those techniques (especially about the underlying assumptions of the technique/s and the interpretations of results obtained from a statistical software)
- Be familiarize with a suitable statistical software (Ability to use a statistical software is recommended. Minitab and SPSS are commonly used. However, non-statistical software Microsoft Excel can perform many of the basic analyses.)
- Analyze a mock data set (wherever possible) Data on a pilot/ previous study can be used as mock data
- Perform a pilot study especially if you are new to the field. Not only it will improve the quality of data but it will save lot of your recourses and effort. Pilot study will help you to get a real flavor of the data to be obtained. These data will also be useful in determining the sample size, etc.

3.9 Modes of data collection

Basically, the data can be collected through three modes. Namely censuses, sample surveys and designed experiments. In censuses, we collect data from each and every

individual of the population. The analysis of data is straight forward and no inference is needed. Descriptive statistics itself will provide the answers to the research questions.

Whole population cannot be considered in many practical situations due to resource limitations etc. Therefore, censuses are replaced by sample surveys. In sample surveys, only a subset of the population will be considered for collecting data. As a result, conclusions depend on the sample selected. Application of a proper sampling method is essential. Also, inferential statistics is needed to make conclusions.

Both of the previous modes fall into the category of observational studies where we do not control anything related to the population. However, there are studies where we control or impose conditions on the experimental units and observe the response. These kinds of studies are known as experimental studies. More details will be given in session 2.

3.10 Methods of data collection

There are various methods of data collection. A suitable method or a set of methods has to be determined depending on the background of the situation. Knowing the relative merits and demerits is essential in selecting a method.

Commonly used methods of data collection

1. Direct observation

   We can collect some data just by observing them directly. Eg. Counting the number of vehicles passing through a particular junction.
2. Mailed questionnaires

   We can also collect data by mailing a questionnaire to the relevant respondents.
3. Personal interviews

   Another method of collecting data is interviewing people.
4. Participative observations

   There are two types of observations: objective and involved. In the first, you try to keep separate, watching and hearing what occurs--as if you were a camera or microphone trying to record. An involved or participative observation lets you take part in the place, event, or behavior (although a part of you might want to remain objective, watching yourself as well as the event).

   Eg.

   Let's say you wanted to research the ways salespeople react to college students. An objective observation would have you standing in a store (perhaps pretending to shop) and watching as a college student came into the store. An involved or participative observation would have you (a college student) go into the store and interact with the salesperson.

Activity 03 (Group, 5 minutes)

List the advantages and disadvantages of the above data collection methods and list two situations where you may apply each of those methods in your field of study.

Session 2

Learning Outcomes

At the end of this session you will be able to:

- Apply random and non-random sampling techniques
- Design and conduct experiments

3.11 Random and Non-random sampling

Basically sampling is divided into two groups viz. random and non random. In random sampling, all the elements in the population have some chance (not necessarily equal) for being selected to the sample. However it is not there in non-random sampling. Sampling frame (a list or map of all elements of the population) is a must for random sampling. Sampling error (error due to using a sample instead of the whole population) can only be estimated through random sampling. Therefore, non-random sampling is used only when random sampling is impractical (not possible to construct a sampling frame)

3.12 Simple Random sampling

In simple random sampling, each and every element in the population have an equal chance for being selected to the sample. Simple random sampling is appropriate only when the population is homogeneous with respect to the intended purpose of study.

Lottery method or random number table or random number generator can be used to select the sample.

Activity 1 (Group, 2 minutes)

- Write down the steps of selecting a simple random sample of the participants
- List one situation where this sample is appropriate

3.13 Stratified random sampling

Stratified random sampling could be used in a situation where the population itself is not homogeneous but it can be split into homogeneous (with respect to the objective/s of the study) parts (Strata). The method is to select simple random samples from each stratum separately. Note that stratification is not an easy task since the information related to stratification may not be available.

Activity 2 (Individual, 2 minutes)

- List one situation where stratified random sampling could be used from your field of study

  Justify your answer

3.14 Systematic (random) sampling

In systematic random sampling, one item is randomly selected from the first sampling interval and then corresponding ones from all other sampling intervals are selected. Here, the sampling interval is formally defined as,

Sampling interval =Size of the population/size of the sample.

However, it is really the proportion/percentage of items are selected to the sample.

Eg. If 10 percent of the items are selected, then one in every $10^{th,}$ will be selected. However, only the first one will be selected randomly. Assume that 3^{rd} item was selected randomly then corresponding item (3^{rd} from all other 10 items) are selected.

Activity 3 (Individual, 2 minutes)

- List one situation where Systematic sampling could be used from your field of study Justify your answer

3.15 Cluster sampling

Cluster sampling could be used in a situation where elements of the population are gathered in clusters and a frame of clusters is available (Sampling frame may not be available/ convenient). The method is to select a sample of clusters at the first stage and to select samples from selected clusters at the second stage. In selecting clusters, probability proportional to the size technique could be applied. i.e. Higher chance for the clusters having larger no. of elements.

Activity 4 (Group, 2 minutes)

- List one situation where Cluster sampling could be used from your field of study. Justify your answer

3.16 Absolute and comparative experiments

In absolute experiments the objective is to estimate a parameter or a set of parameters of the population.

Eg.: Average CO% of the atmosphere in Colombo city during 7-8 a.m. in the morning

In this situation, point estimates and interval estimates (confidence intervals) are important.

The objective of a comparative experiment is to compare parameters of several populations.

Eg.: Tire brand A is better than brand B with respect to wear and tear

Background conditions should be kept at constant level to perform a comparison of this nature (e.g. type of the road, driver, speed, etc.)

3.17 Terminology used in experimental design

Treatment

A treatment is the condition applied to experimental unit. It may be a

- Levels of a single factor (simple experiment)
- Level combinations of several factors (factorial experiment, to investigate interaction between factors)

Eg. If we want to investigate the effect of temperature on the yield of a particular product then levels of the temperatures (say t1, t2, t3,….)that we want to get measurements on the yield can be considered as treatments.

If we want to investigate the effects of temperature and the pressure on the yield of the product simultaneously then temperature-pressure combinations say (t1p1, t1p2, …) will be the treatments.

Replication

Application of one treatment more than once is known as the replication and it is important to estimate the average and to increase the precision (lesser variability) of the estimate.

Randomization

Application of the treatments in a random manner is known as randomization and it is essential to obtain unbiased (valid) estimates.

Eg. Suppose we have 12 plots and 4 treatments (T1, T2, T3, and T4) are to be applied. Then each treatment has to be applied to 3 plots. We apply the treatments to plots in such a way that each plot has equal chance of getting any treatment. This can simply be done by using the lottery method.

Completely randomized design

If sufficient number of homogeneous experimental units is available, then we can apply treatments to experimental units in a completely random manner. This design is known as completely randomized design.

Activity 5 (Individual, 2 minutes)

Identify a situation where completely randomized design could be applied

Randomized complete design

We apply randomized complete block design in a situation where

- all experimental units are not homogeneous but they can be split into homogeneous groups (blocks).
- block size is enough to apply all treatments

Under the above conditions, we apply treatments onto the units in a block in a completely random manner band we repeat the same for all blocks.

Activity 6 (Individual, 2 minutes)

Identify a situation where randomized complete design could be applied

Randomized incomplete block design

Randomized incomplete block design is applied when the block size is not enough to apply all treatments. In this situation, we select a set of treatments and apply them onto the units in a block randomly depending on the block size. We repeat the same for all blocks. In this case, the selection of treatments has to be done carefully.

Activity 7 (Individual, 2 minutes)

Identify a situation where randomized incomplete design could be applied.

3.18 Selecting a design

Note that there are many different types of designs in addition to the 3 that we discussed. Selection of the design has to be done carefully. In selecting a design following concepts are also useful.

-Latin square design
-Split-plot design
-Lattice design
-Strip plot design
-Confounding and fractional replication

Session 3

Learning Outcomes

At the end of this session you will be able to:

- Design data entry formats and use them effectively in data entry
- Explore data sets using descriptive measures, graphs and charts

3.19 Data entry formats

Entering data into a spread sheet such as Excel, SPSS, Minitab is convenient. If data entry operators are used Excel is preferred. The data entered in an Excel sheet can easily be transferred into a statistical software. Text files can also be used, especially when data are taken from different databases.

It is the practice to have variables in columns and cases in rows. One column for one variable and one row for one case is a useful. Missing values have to be handled with care. Special unique coding should be given to them. Labels for variables and values could be given after transferring data to statistical software.

3.20 Data validation

Data validation is a must before analyzing data. Following tips may be useful in identifying unusual observations.

Acceptable values for a variable can be identified through

- One way table if the variable is qualitative or has a smaller no of values
- Finding the minimum and maximum value of the variable if the variable is quantitative

Eg.

Gender	Count
Male	26
Female	33
Fale	1
Total	60

It is clear that Gender=Fale is not acceptable

For human body temperature, we know that 125F is not acceptable.

Form of the distribution of the variable under discussion is important in selecting a suitable statistical technique. Form of the distribution of the variable can be identified through

Histogram
Boxplot
Stem and leaf plot
Normal probability plot
.

Histogram drawn for the length of a bear (in inches) for 143 bears is given below. The distribution seems to be quite symmetric.

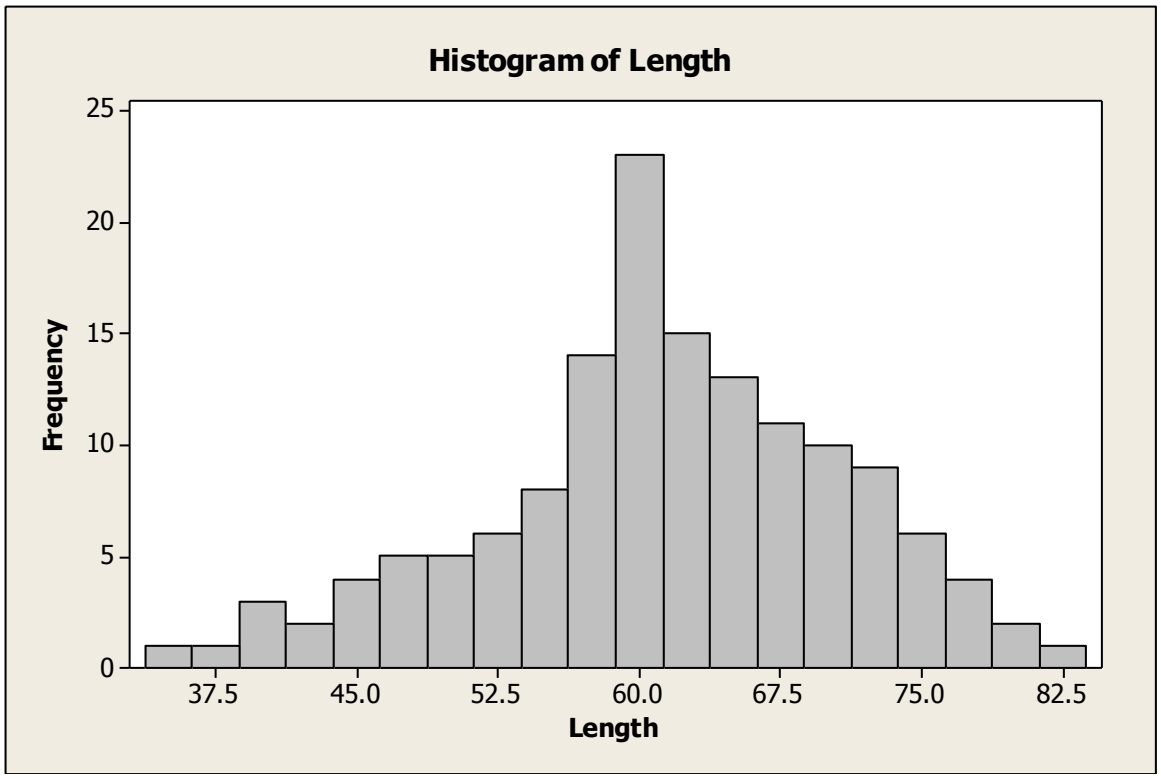


Figure 1: Histogram for the length of a bear

Dot plot, stem and leaf plot, and the normal probability plot for the same variable are given below.

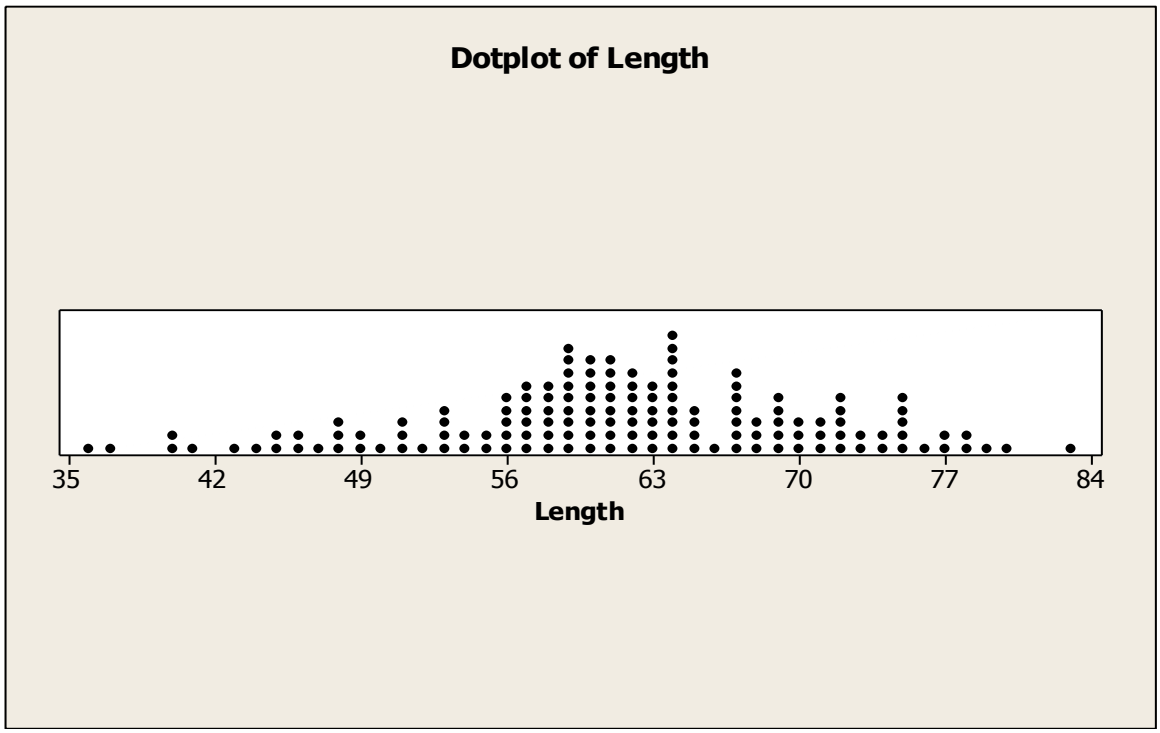


Figure 2: Dot plot for the length of a bear

Stem-and-Leaf Display: Length

```
Stem-and-leaf of Length  N  = 143
Leaf Unit = 1.0


LO 36, 37, 40, 40, 41


 7    4  33
 17   4  5566778889
 29   5  000122233344
 58   5  55566677777777888888999999999
(37)  6
00000000111111111222233333333444444444
 48   6  55556666667777789999
 28   7  000001222223333
 13   7  555556678899


HI 83
```

Figure 3: Stem-and-leaf plot for the length of a bear

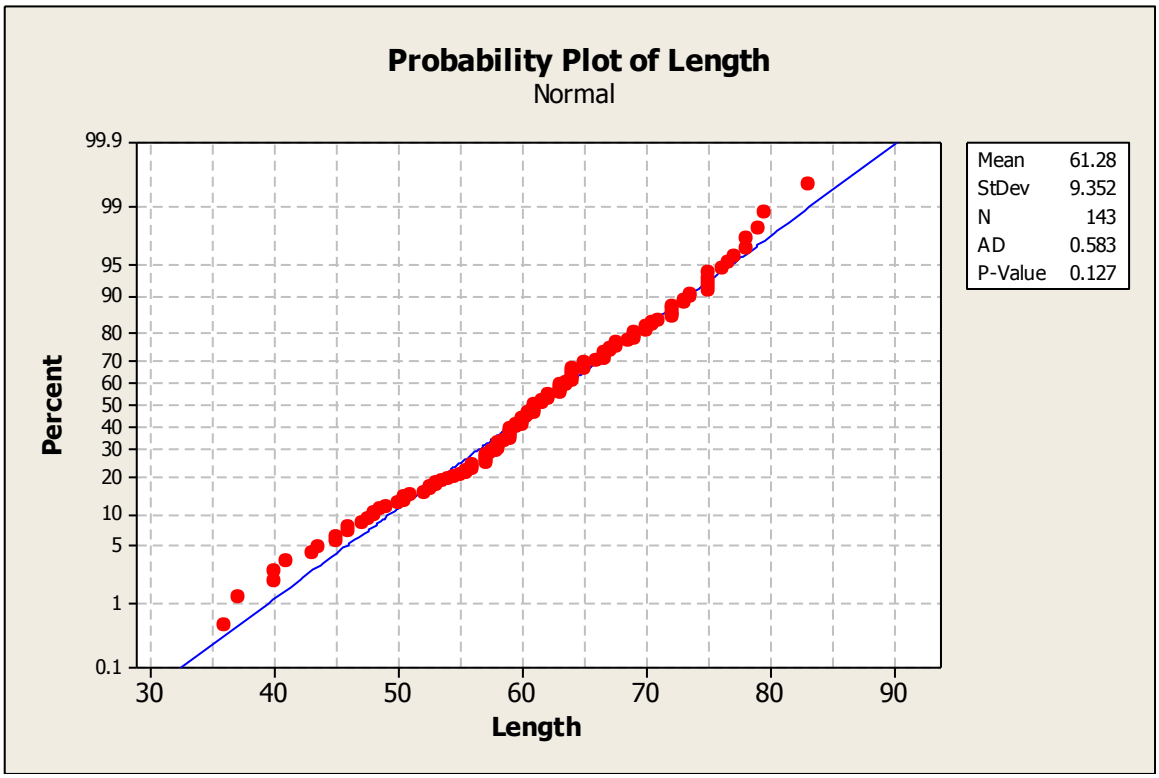


Figure 4: Normal probability plot for length of a bear

Normal probability plot shows that the data points are very closer to the straight line. Therefore it is reasonable to assume the normality for the length of a bear. (Formal statistical test result is also given there. It will be discussed in the next session.)

Consistency with the rest of the variables can be verified through

-Two-way tables

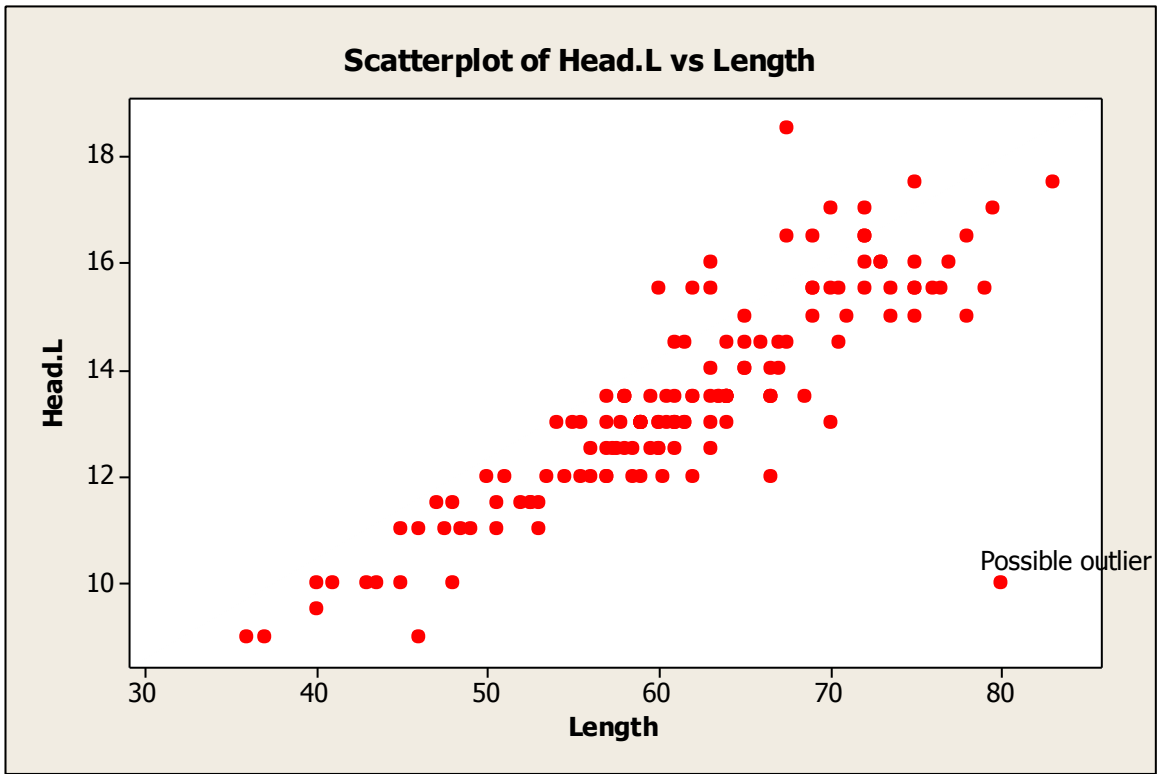
-Scatter plots

-Descriptive measures for each group

Following two-way table on smoking habits and the gender shows two female smokers. In Sri Lankan context this may be doubtful.

	Smoker	Non-smoker	Total
Male	21	75	86
Female	2	56	58
Total	23	131	144

The following scatter plot shows that the data point (80, 10) is not consistent with the rest of the data.



3.21 Description of Data: Selecting a suitable descriptive summary measure

Many measures are available for central tendency (Centre of the data set), dispersion (deviation from the centre), skewness (asymmetry of the data set) etc. of a variable. Following are the desirable properties of a summary measure.

Easy to calculate, easy to understand, unique, not affected by extreme values, based on all observations, suitable for further mathematical treatments.

3.22 Measures of central tendency

Mean is the most commonly used summary measure of central tendency. However, it is not the only measure available. Median, Mode, Weighted mean, Geometric mean, Harmonic mean, Quadratic mean (Would it be better to define or make them prerequisites? (Notes to participants to read before the session)?? And examples) are some of the alternatives. Therefore in selecting a measure we have to be very careful. Mean is suitable when the data are quantitative, no extreme value and the distribution is roughly symmetric (Eg. See figure 1). Median can also be used with ordinal data. It is not affected by extreme values and it is a good measure when the distribution is not symmetric (Eg. See figure 5 and 6).

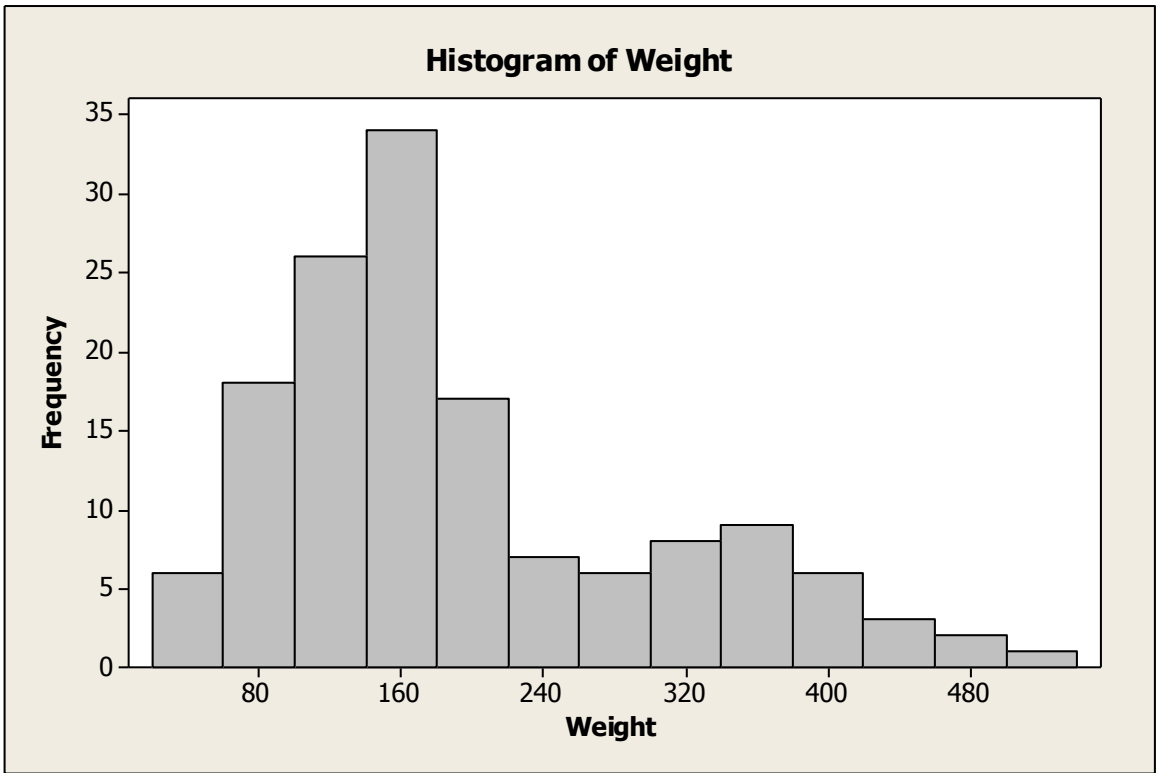


Figure 5: Histogram for the weight of a bear

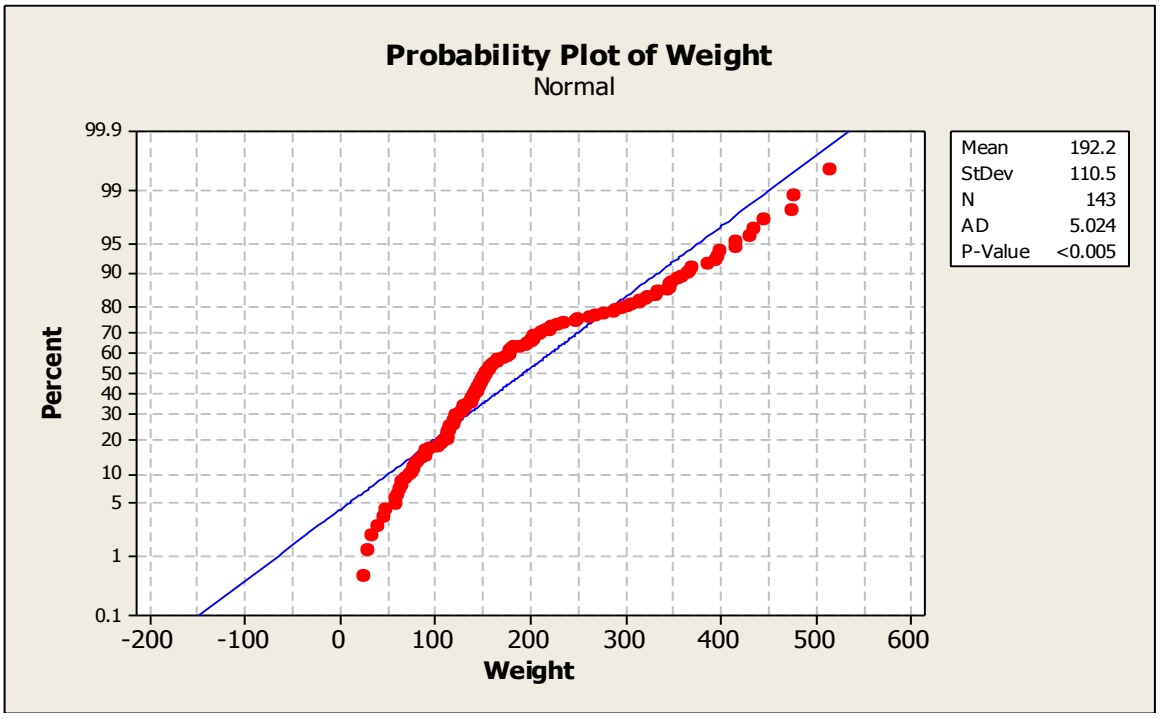


Figure 6: Normal probability plot for the weight of a bear

Interpretation of the measure is also important. Mode is the only measure that can be used with nominal data.

3.23 Measures of dispersion

Briefly describe what is meant by dispersion?

Usually variance and standard deviation (Definition) are used as measures of dispersion when mean is used as the measure of central tendency. When median is used as the measure of central tendency, inter quartile range and quartile deviation (Definition) are used as the measures of dispersion. Coefficient of variation (Definition) is a units free measure of dispersion which could be used for comparisons.

3.24 Measures of association

Briefly describe what is meant by association?

If both variables are quantitative and the association is linear then the Pearson's product moment correlation coefficient (very often shortened as the correlation coefficient) can be used to measure the strength of the association. If the relationship is not linear by transforming variables we might get the linearity. But without linearity correlation coefficient is meaningless. Examples

Spearman's rank correlation coefficient (simply the rank correlation coefficient) can be used to measure the association between two ordinal variables. (Note that quantitative variables can easily convert into ordinal variables by taking the rank.) Examples

Charts for presentation of data (Slide 57)

- Simple bar charts
- Multiple bar charts
- Stacked (component) bar charts
- Percentage component bar charts
- Pie-charts

Tables for presentation of data (Slide 58)

- One-way frequency tables
- Two-way frequency tables
- Tables with descriptive measures

Session 4

Learning Outcomes

At the end of this session you will be able to:

- Formulate statistical hypothesis and test them using appropriate statistical techniques
- Present findings of a research effectively using tables, graphs and charts
- Evaluate statistical arguments

3.25 Statistical Hypothesis and hypothesis testing

A statistical hypothesis is a straight forward statement about a population parameter or about a set of population parameters.

Eg. Mean birth weight of a Sri Lankan baby is 2.5kg

The hypothesis may or may not be true. In testing hypothesis we test whether the claim of the hypothesis is true under the light of data.

3.26 Null and alternative hypothesis

Usually the null hypothesis (usually denoted by H_0) is the one that the researcher wants to reject and claim his alternative (usually denoted by H_1 or H_a).

Eg. Ten years ago the average pH of a particular river is known to be 7. However, a researcher believes that due to the influx of chemical substances now it should be more acidic. (i.e. average pH <7). He wants to test his claim. Here H_0: average pH=7, and H_1: average pH<7. After collecting data, the researcher can test his hypothesis. If H_0 is rejected (based on data) he can statistically prove his claim. However, there is a possibility that the data he collects might not prove his claim.

3.27 Type I and Type II errors

Type I error is the one that we reject the null hypothesis when it is really true. Note that we do not really know whether the null hypothesis is true or not. What we do is accept or reject it based on the information extracted from the data.

Type II error is the one that we accept the null hypothesis when it is really false.

In testing hypothesis, type I error is considered to be the most serious out of these two. This condition has to be taken into account in identifying null and alternative hypotheses.

3.28 Consumer's risk and producer's risk (in Business terminology)

In a particular hypothesis testing problem, the probability of type I error is known as producer's risk and the probability of type II error is known as consumer's risk.

Examples…

3.29 Level of significance (α)and p-value

Level of significance is the maximum value that we allow for the probability of type I error in testing a particular hypothesis. Recall that type I error has been taken as the most serious error in testing hypothesis. Depending on the outcome of the conclusion we have to assign a value for the level of significance. P-value is the observed level of significance. We reject H_0 and accept H_1 if p-value is less than α. However if p-value is greater than or equal to α we accept H_0 and say that we have no evidence to claim H_1.

4. Essential Reading

- Chapter 8 (Quantitative methods) of Research Design (Qualitative, Quantitative and Mixed Methods Approaches), 3rd ed. By John W. Creswell
- Chapter 24 (Quantitative data analysis) Research methods in education by Louis Cohen, Lawrence Manion and Keith Morrison
- Chapter 25 (Multidimensional measurements) Research methods in education by Louis Cohen, Lawrence Manion and Keith Morrison
- Chapter 7 (Dealing with quantitative data) of Research methods for the social sciences by Jerry Wellington and Marcin Szczerbinski

5. Supplementary Reading

- Box, G. E. P., Hunter, W. G., and Hunter, J. S., (1978), Statistics for Experiments: An Introduction to Design, Data Analysis and Model Building, John Wiley, New York.
- Cochran, W. G., and Cox, G. M., (1957), Experimental Designs, (2nd ed.), John Wiley & Sons Inc., New York.
- Johnson, R. A., (1995), Miller & Freund's Probability and Statistics for Engineers, (5th ed.), Prentice Hall of India Pvt. Ltd, New Delhi.
- Mathews, P. (2005), Design of experiments with Minitab, Pearson Education, New Delhi.
- Montgomery, D. C., (1991), Design and analysis of experiments, 3rd ed., John Wiley, New York.
- Business Statistics-A First Course (4th Ed.) by David M Levine, Timothy C, Krehbiel, Mark L Berenson and P. K. Viswanathan, Pearson Education (2008)
- Complete Business Statistics, Amir D Aczel & Jayavel Sounderpandian, 6th Ed.

MODULE 9: COMPILING A RESEARCH PROPOSAL

1. Learning Outcomes

At the end of the session, the participant will be able to compile a research proposal for his/her higher degree, or write a grant proposal for a research project

2. Lecture Outline

- Significance of higher degree research proposals and proposals for research grants.
- Components of a research proposal:
  introduction, problem statement, background, purpose statement, significance of the study, literature review, hypothesis statement, definition of terms, assumptions of the study, scope and limitations, research procedure (study design/ experimental design), estimated budget, time-frame, long-range consequences, plans for dissemination of results.
- Applying for research grants.
- Searching for foundations or grant-awarding institutions.

3. Learning/Teaching Resource

a. Lecture Notes

3.1 What is a Research / Grant Proposal and why it is Important

When you apply for placement as a research degree student, you are asked to submit a research proposal. Your application will be reviewed by a selection committee to determine whether they should be accepted to their institution as a research degree student. Your proposal tells the reviewer what research you expect to do, why it is important, how you would do it, what methods or tools you will employ, what will be the expected outcomes of your study, and what long-range consequences it may have on the society. Based on the strengths of your proposal, the university/ institution will decide whether you should be admitted as a research degree student or not.

You may also need to apply to a grant awarding foundation to obtain a research grant. The foundation will need to determine whether your proposed research is worth of spending the amount of money that you have applied for. You will be required to submit a grant proposal along with your application for funding support. A team of reviewers will look at the same aspects of your research as mentioned above. On the strengths of your grant proposal, the foundation will decide whether you should be awarded the research grant.

3.2 Components of a Research/ Grant Proposal

The present module has identified fifteen components as necessary ingredients of a proposal. However, it is not mandatory that every proposal should include all fifteen components. Depending on the nature of the study, you may combine two or more components into one. Similarly, you may add new components if your study requires such. Secondly, the components need not to be sequenced in the same order given in the module. Based on the nature of the study, you may change the order to suite the special nature of your study.

- **3.2.1 Introduction:** In this section, you emphasize the need for the study, and set the stage for the study. The introduction orients the reader to your approach. You must try to catch the attention and the interest of the reviewer.

- **3.2.2 Problem Statement:** This is the heart of any research proposal. It provides major motivation for the study. You describe the present state/ current theory/

current event / current program that you intend to address. This section will be a very brief one, but there is much to think.

- **3.2.3 Background or Need for the Study:** Describe why the problem is of pressing societal concern/ theoretical interest/ need for advancement of knowledge. You may use opinions of knowledgeable persons that the problem is worth addressing, powerful public opinion or public statistics showing the pressing nature of the problem. You must make the reader as interested in the study as you are, and make him/ her convinced of its importance.

- **3.2.4 Purpose Statement**: This is very different from Problem Statement. This is a statement of your study; *i.e.* what you hope to DO about the PROBLEM by carrying out your STUDY. Mention only the essentials of the study, and what it intends to accomplish.

- **3.2.5 Significance of the Study**: This section elaborates the PURPOSE part of the proposal. You describe the importance of your study [PURPOSE] (as distinct from any and all other studies that address the same topic). This is the justification for your study [PURPOSE] to address the problem. This section shows what makes this study worth pursuing. You must establish clearly that your study is an appropriate approach to the PROBLEM, and that some important benefit will occur if it is done.

- **3.2.6 Nature of the Study (Methodology):** It is the broad perspective from which you view the problem, make the investigation, and draw inferences. Methodology is different form Research Technique or Procedure or Research Method.

- **3.2.7 Literature Review**: This is a review of current knowledge of the event/ theoretical issue/ program. It should cover material that contributes to PURPOSE, BACKGROUND, and DESIGN of the study. Helps place your study in the context of similar studies that have addressed the problem. You must show that you have already read the most important literature on the subject. You must be aware of the most crucial

background research and developments. Knowledge of most basic publications and previous research are needed to properly develop a project for extending that research in a new, innovative way and not be inadvertently duplicating past work.

Must remember that the literature review in the proposal is very different from the chapter in the dissertation, which describes the results of that review.

- **3.2.8 Hypothesis:** State the hypothesis/ hypotheses that you have postulated and intend to examine in the study.

End of Session 01

Session 02

- **3.2.9 Definition of Terms:** You have to define the terms that are specific to the field, that have everyday-language counterparts, or that relate to the study. You need to define any term that might confuse the reader. If the list too long, place the 5 or 6 most important ones here, and the rest in an appendix.

- **3.2.10 Assumptions of the Study:** In every study, the researcher makes Assumptions. They show your 'PERSPECTIVE'. There are two kinds of assumptions; Ideological and Methodological. Ideological Assumptions are untested and untestable assumptions, basic values, world views, beliefs about the problem, hypothesis, research design, political ideologies that are assumed in the study. So, you have to make the reader to review your proposal from your perspective.

- **3.2.11 Scope and Limitations**: You need to define and delimit the study to show the specific angle [your frame of reference or conceptual framework] from which you approach the PROBLEM, and provide rationale for choosing that angle. A problem can be approached from many different angles, and no dissertation can cover all or even most of those angles. But defining the scope is not simply saying that, *"... the study will deal only aspects A and B of the total problem*. Limitations are conceptual and methodological shortcomings which will characterize the study and which you cannot overcome. You should make rigorous attempts to REDUCE or OVERCOME the limitations. Then, why should we mention them in the proposal? After considering all possible improvements, pointing out the remaining limitations in advance shows that you are aware of them.

- **3.2.12 Procedure of the Study/ Research Method/ Study Design/ Research Design**: State the specific activities you will carryout to fulfill the PURPOSE (your study). This is a step-by-step guide to how you will gather evidence, analyze it, and draw conclusions. Major sub-sections would be; Subjects (sources of data), Data gathering, Variables, and Data analysis, and Hypothesis.

- **3.2.13 Long-range Consequences**: Try to assess the impact of your work (whatever its outcome) upon society or theory; and by relating that impact to your problem & purpose,

describe what the likely consequences of your having done the study will be, regardless of how the results turn out.

- **3.2.14 Time Frame**: Show in the form of a chart, how you have planned the period of research to carryout each of the major tasks of the study. You may divide the time period in terms of months or quarters, depending on the nature of the research tasks.

- **3.2.15 Suitability of the Investigator**: Some universities and foundations would like to know whether you have the necessary background knowledge and skills to carryout the research tasks.

- **3.2.16 Estimated Budget**: This is mandatory for a research grant proposal as the grant awarding foundation needs to know how much money is requested and what the justifications are. However, higher degree institutions may or may not require an estimate of the cost of the project.

4.0 Grant Awarding Foundations: There are national foundations and international foundations from where a research grant can be obtained. National Science Foundation and the National Center for Advanced Studies in Humanities and Social Sciences (NCAS) that function under the University Grants Commission are two good foundations that one may apply for funding. At international level, there are hundreds of foundations that provide research funding to international applicants. Internet is the best source to find out details about such foundations, application procedures, deadlines, etc. etc.

7. Supplementary Reading

- http://www.medcol.mw/comrec/res.prop.4mat.php
- http://www.nmmu.ac.za/robert/resprop.htm

MODULE 10: WRITING OF RESEARCH REPORTS: THESIS, RESEARCH PAPERS, ABSTRACTS

1. Learning Outcomes

At the end of the sessions, the participant will be able to demonstrate knowledge of writing a thesis, research papers, research abstracts and extended abstracts in accordance with the stipulated requirements.

2. Lecture Outline

- Research writing : Research reports as means of disseminating research findings, academic writing, formatting requirements, referencing requirements
- Layout of a thesis: Guidelines for writing a thesis
- Journal articles: Guidelines for writing a research paper
- Research abstracts: Guidelines for preparation of abstracts and extended abstracts of conference papers

3. Learning/Teaching Resource

a. Lecture Notes

4. 1Research writing

The last step of the research process is dissemination of research findings by research reports. Through various types of research reports, the findings of the research study and the implications are communicated to the public especially to the academic/professional community. Therefore this step of the research process is the most crucial step. The quality of the research report depends on written communication skills of the researcher, clarity of thought, ability to express the thoughts in a sequential and logical manner, and the researcher's knowledge base on the subject area. If the report is not well written, the amount and quality of the hard work done by the researcher(s) would not be duly recognized.

The research findings can be made available to the public/professionals in different forms which include theses, journal articles and conference papers. The report could be written by the author as a thesis to submit to the university in support of his/her candidature for a higher degree. The thesis may be accessible to the professionals at a later stage. The findings of the research study can also be communicated to the academic/professional community by publishing research articles in journals and presenting the research papers at conferences/professional meetings/seminars. For presenting research papers orally or by posters at the academic/professional gatherings, abstract or extended abstract of the research report should be written and sent to the organizers for evaluation by peers for suitability for the presentation.

The research report should be written in an academic style. **Academic writing** is different from personal writing, commercial writing or creative writing. The main difference between academic writing and other writing is in the degree of control, rigorousness and caution required. In research writing, the writer has to be extremely careful about what to write, the selection of words, the way ideas are expressed, and the validity and verifiability of the bases

for the conclusions drawn by the researcher. For research writing a high degree of intellectual rigor is needed. Research writing must be absolutely accurate, logical, concise, clear and free of ambiguity. The writer(s) of the research report must be able to defend the things written in the report if anyone challenges it.

The research reports can be written in different formats. The **formatting requirements** vary depending on the type of the report, university and academic discipline. The writer should follow the prescribed format and stipulated guidelines when writing the research report. In writing the research report, it is a good practice to develop an outline. If the report is to be presented as a thesis, the writer should decide how to divide the report into different chapters and plan what should be written in each chapter. The research report could be divided into different chapters and /or sections based upon the main themes of your study. In developing chapterization, the sub-objectives (Specific objectives) of the research study provide guidance. Depending on the importance of the theme, a complete chapter could be devoted or related themes could be combined to form one chapter.

The report should follow an **academic style of referencing.** There are different ways of referencing and writing bibliography. Of different referencing systems available (e.g. the author-date system, the author- number system, the reference by number system, the short-title system), the writer of the research report should adopt the one that is acceptable to the university/academic discipline/journal depending on the nature of the research report. In general the author – date system is mainly used in research reports. In some disciplines, the author- number system or the reference by number system are also used. There are different systems for writing a reference list/ bibliography and the choice of the writer is dependent on the preference of the discipline and the university. The style of writing a reference list/bibliography includes the Harvard System, the American Psychological Association system (APA system), the American Medical Association system, the Modern Languages Association system (MLA system) and the foot note system.

3.2 Layout of a Thesis

Presentation style of the thesis should conform to the specific rules and guidelines issued by the university to which thesis is submitted. In general, a thesis consists of three main parts: (i). Preliminaries, (ii). Text of the thesis, (iii) Reference materials. Each part may consist of several sections. All these sections may not be found in all theses; but prescribed format should be followed irrespective of what is omitted.

(i). Preliminaries

Title page
Declaration page/ Approval page
Abstract
Preface and/or acknowledgements
Table of contents
List of Tables
List of Figures
List of Symbols/List of Abbreviations

(ii). Text of the thesis

Introduction
Body of the thesis
Conclusions

(iii). Reference materials

References/Work Cited/Bibliography
Appendices

(i). Preliminaries

Title page

Title page contains three main parts: The materials of the title page should be arranged in such a way that a well balanced page results. The first part of the title page states the exact title of the thesis. Title should be indicative of originality and innovativeness in the subject or method. The title of the thesis should be informative, comprehensive, concise and accurate with the meaning clear at a glance. The words should contribute specific information of practical use in title lists, indexing and information retrieval. The second part is the full name of the candidate with the degrees he/she has already received. Some universities also require the name(s) of the university/universities which granted the previous degree(s) to the candidate and the year the degree(s) was awarded. The third part of the title page is the submission statement that indicates that the work is submitted in partial fulfillment of degree requirements and also the month and the year when the thesis is submitted.

Declaration Page/Approval Page

The title page is followed by a declaration/approval page where the candidate declare that the work embodied in the thesis has been carried out by the candidate and the work has not been submitted earlier or concurrently for awarding any other degree or academic qualification. The statement is certified by the research supervisors (research advisors). On this page, the supervisor's name and designation and the official address should be given.

Abstract

The approval page is followed by the abstract page. The abstract is a condensed statement of the essential ideas of the work done. The abstract of the thesis enables the reader to identify the basic content of a document quickly and accurately, determine its relevance to their interests and decide whether they need to read the whole document. The abstract should include a statement of the research problem, an explanation of the methods/procedures used to gather data, summary of main results and interpretation of results (significance and possible implications). It should not be a summary statement of each chapter of the thesis. Normally the abstract must not exceed 600 words in length but the writer should conform to the guidelines specified by the relevant university/institute. An abstract is objective. Hence personal thoughts and feelings of the author are not expected. Normally the abstract is written in past tense as it refers to the work already done.

Acknowledgement page(s)

In this page, the writer formally recognizes his/her indebtedness for guidance and assistance of the thesis supervisors/advisors and other members of the Department/Faculty/Institution and other significant help from organizations and people.

Table of Contents

This is a chronological list of major headings and sub headings or subjects together with the corresponding page numbers. It should not be too detailed to confuse the reader. The table of contents lists the chapter titles with the subdivisions in each, the bibliography/references, and appendices. All titles in the table of contents should correspond exactly with the chapter titles as they appear in the body of the main text. There should not be missing words or any deviation from the wordings. The page references should be correct. The preliminaries can also be listed under table of contents. However under the table of contents, tables and figures are not listed as they are listed separately as list of tables and list of figures respectively.

List of Tables

Table of Contents is followed by the "List of Tables" which begins on a new page. The arrangement should be the same as in the table of contents. For each table, the table number, its exact caption and the number of page on which it appears should be given.

List of Figures

The "List of Figures" follows the list of tables and is arranged in the same general format. If any graphs, maps, or illustrations are used they are listed under List of Figures. If photographs are included in the thesis, normally they are listed as "List of Plates" which follows the list of figures, beginning on a new page. However in some theses they are listed together with the other figures under the List of Figures. The writer should consult the research advisor in relation to the accepted form.

List of Abbreviations/List of Symbols

The "List of Abbreviations" follows the list of figures (or list of plates if it is included). The list is a valuable support to the reader if the thesis contains a number of symbols/ abbreviations.

(ii) Text of the Thesis

The main body of the thesis is divided into chapters based upon the main themes of the research study. Each chapter has a title and begins on a new page. In developing chapterization, the sub-objectives of the research study provide guidance. Depending on the importance of the theme, a complete chapter could be devoted or related themes could be combined to form one chapter. The title of the each chapter should be descriptive of the main theme, but be clear and concise. When providing specific information about a variable, the report should integrate the rationale for studying the variable, the literature review, the hypotheses, if any, findings, conclusions drawn, and possible implications of the findings.

The arrangement of the chapters may vary and the writer should follow the format specified by the relevant Department/Faculty/ University (see the sample formats provided).

- Usually, the first division of the main text (Chapter 1) is the **Introduction.** The introduction should provide adequate background information in connection with the research problem, justification of the problem, critical review of relevant literature on previous investigations to relate the thesis to previous research in the field, and indicate where this study fits in relation to previous studies. Introduction should contain logic leading to work and hypotheses and the aims and objectives of the study. In the theses of some disciplines (e.g. Social Sciences) it may also indicate the limitations of the study, a preview of the organization of the thesis, a statement of the source of data, the procedures and the treatment of the findings. In some theses, the literature review is a separate chapter (see the sample format 2) which contains a review of the relevant literature to relate the thesis to previous research in the field. It should focus on the ideas, issues, arguments & findings in the literature from multiple sources and indicate where this study fits in relation to previous studies.

- In science disciplines (see the sample format 1) the other divisions of the main text (Chapters 2 - 4) are usually Chapter 2: Methodology, Chapter 3. Results (including analysis) and Chapter 4. Discussion.

- **Chapter 2. Methodology** should contain the materials used, sites selected, methodology adopted to obtain results including selection of samples and statistical design used in sampling, experimental plan, methods and techniques used in data collection and data analysis. This chapter should provide enough details for another researcher to repeat your study, because scientific method requires reproducibility. If the researcher had selected a method that has been successfully used by many other researchers, the method should be mentioned briefly giving references. If it is a new (unpublished) method all the needed details should be provided.

- **Chapter 3. Results.** This is the most important section as it contains the new knowledge generated by the researcher to disseminate to the world. This chapter includes tables and/or figures relevant to the data collected from the study. The text should contain a reference to each figure and table together with an outline of what they are intended to present. Usually the analyses of results are also described under this chapter.

- **Chapter 4. Discussion** should contain the facts found by the researcher, his/her comments on the facts and theoretical implications of the facts. In this chapter the results of the study should be interpreted logically in relation to the formulated hypotheses and in relation to previous work by others. The validity of the findings should also be assessed and recommendations should be given. Under conclusions and recommendations, a description of the conclusions arrived from the study and theoretical implications relevance to present conditions should be given. New lines of study – possible avenues of further work should also be discussed.

  "The sample format 3" provided with the lecture notes is increasingly preferred by most foreign universities for the thesis written in science based research compared to the conventional formats. According to this format, except the Chapter 1 (Introduction) and the

last chapter (General discussion and conclusions), all other chapters contain different themes which are written as research papers of the journals.

As in the sample format 4, a chapter could be devoted to one theme. The title of the each chapter should be descriptive of the main theme, but be clear and concise. In addition related themes could be combined to form one chapter. This format is usually used in preparation of theses in non-science disciplines.

(iii) Notes and reference materials

Notes

The notes section is a device for giving credit where credit is due or supplying needed definitions or explanations without cluttering the text. It may follow the text of the thesis as endnotes or appear at the bottom of the page as footnotes. Most footnotes cite the source of a quotation, fact or idea in compact form.

References/Bibliography

This section precedes the appendices. **References** are the list of sources used in the preparation of the thesis: the sources that are used directly by way of extracting ideas, data and other content. The **bibliography** comprises the sources that the writer found relevant but were not directly used in the preparation. According to the prescribed requirements by the University/Faculty, the reference list/bibliography could be included in the thesis. Style manuals provide guidelines on form, section and alphabetical arrangement and annotation of references/bibliography. The style of writing a reference list/bibliography includes the Harvard System, the American Psychological Association system (APA system), the American Medical Association system, the Modern Languages Association system (MLA system) and the foot note system. Requirement of the style is specific to the institution/ programme/discipline. Usually, when reference is made to the work of others, it should be indicated in the text at the appropriate place and full details of the reference is given at the end of the thesis under the references. Long bibliographies may be divided in to sections according to the books, journal articles and electronic references or primary and secondary sources where entries are arranged alphabetically by the author's last name within each section. Bibliographic retrieval software allows researchers to locate and save references from online services and translate them into database record. Entities can be further searched, sorted, indexed and formatted into bibliographies of any style.

Appendices

An appendix to a thesis contains the material too detailed for inclusion in the body of the thesis. Information that do not directly fit into the text such as raw data sets, questionnaires used for data gathering, detail descriptions of methodology, tables, figures, which are not presented in the text, any other information which may be useful for the reader/a second researcher can be included under appendices. When diverse materials are included, each type starts on a new page under different heading. The different sections are classified as 'Appendix A", "Appendix B" etc.

Curriculum Vitae

Inclusion of the CV of the author in the thesis is optional. This is a biographical sketch of the author which provides information on the degrees obtained with the dates and the awarding institutes, and other personal information of scholarly nature. Publications of the author are not included.

Sample Formats of Theses

Sample Format 1

- Title page
- Abstract
- Declaration
- Acknowledgements
- Table of Contents
- List of Tables
- List of Figures
- List of Abbreviations
- **Chapter 1 Introduction**
- **Chapter 2 Materials and Methods**
- **Chapter 3 Results**
- **Chapter 4 Discussion**
- References
- Appendices

Sample Format 2

- Title page
- Abstract
- Declaration
- Acknowledgements
- Table of Contents
- List of Tables
- List of Figures
- List of Abbreviations
- **Chapter 1 Introduction**
- **Chapter 2 Review of Literature**
- **Chapter 3 Methodology**
- **Chapter 4 Results**
- **Chapter 5 Analysis**
- **Chapter 6 Discussion and Arguments**
- **Chapter 7 Conclusions and Recommendations**
- References
- Appendices

Sample Format 3

- Title page
- Declaration
- Abstract
- Acknowledgements
- Table of Contents
- List of Tables
- List of Figures
- **Chapter 1 General Introduction**
- **Chapter 2 Subtitle 1**
  - **2.1 Abstract**
  - **2.2 Introduction**
  - **2.3 Materials and Methods**
  - **2.4 Results**
  - **2.5 Discussion**
- **Chapter 3 Subtitle 2**
  - **3.1 Abstract**
  - **3.2 Introduction**
  - **3.3 Materials and Methods**
  - **3.4 Results**
  - **3.5 Discussion**
- **Chapter 4 Subtitle 3**
  - **4.1 Abstract**
  - **4.2 Introduction**
  - **4.3 Materials and Methods**
  - **4.4 Results**
  - **4.5 Discussion**
- **Chapter 5 General discussion**
- References

- Appendices

Sample Format 4

- Title page
- Abstract
- Declaration
- Acknowledgements
- Table of Contents
- List of Tables
- List of Figures
- **Chapter 1 Introduction**
- **Chapter 2 Title of a main theme**
- **Chapter 3 Title of a main theme**
- **Chapter 4 Title of a main theme**
- **Chapter 6 Conclusion**
- Bibliography
- Appendices

3. 3 Journal articles: Guidelines for writing a research paper

Before writing the research paper, you should select the journal for which you plan to send your article. The choice of the journal will influence the format and style of the article. The writer should follow guidelines to authors (information to contributors) published by the journal. The information is available on-line in the journal web sites or hard copies of the journals. The guidelines for authors can also be obtained from the journal editors. You may find the following guidelines useful for any scholarly writing.

General format of a research article

- Title, name(s) of author(s) and the address of the place where the research was carried out/authors' affiliations, address of the corresponding author including the e-mal address
- Abstract
- Keywords
- Introduction
- Materials and Methods/Methodology
- Results
- Discussion
- Acknowledgements(if any)
- References

Title of a research paper

The title should be concise, accurate and informative. It can be a description or a statement. Usually the most important phrase is written first. Some journals specify the maximum number of characters in the title of the article.

Abstract of a research paper

Abstract of the paper should clearly summarize the important findings of the paper. It should be brief but should contain hard facts. The length of the abstract – depends on the word counts specified by the journal (usually 150-250 words). The abstract should contain the objectives & methods (briefly), main results (not vague adjectives), interpretation of results, significance and possible implications.

Introduction section of a research paper

Introduction should be short (about 1 - 1 1/2 A4 size page). It should contain background to the research work, a very brief review of relevant literature, logic leading to the work/ hypothesis, statement of objectives of the study.

Methodology section of a research paper

Methodology adopted to obtain results is described in this section. It may contain a description of the selection of samples, statistical design used in sampling, research design, methods and techniques used in data collection, methods used in data analysis (e.g. statistical tests). The writer is expected to provide enough details for another researcher to repeat the study, because scientific method requires reproducibility. If a method that has been

successfully used by many other researchers was used, the method could be mentioned briefly giving references. If a new (unpublished) method was used in the research study, all the needed details should be provided.

Results section of a research paper

This section can be written as in thesis but in a more concise form. The sub sections should be arranged in a logical order. Tables, figures and outline of what the researcher intended to present should be included. A brief description of overall results is expected. However, description of each individual value in the table or figure is not expected. Usually the tables and figures are given in separate sheets and appended after the reference list. The tables/figures should be numbered consecutively with Arabic numerals.

Discussion section of a research paper

In this section interpret results in relation to the formulate hypothesis and in relation to the previous work by others are required. It should include conclusions & theoretical implications of the study and possible avenues of future research.

References

In this section only the important references that have been used in the body of the text are included. It is important to follow the guidelines given in the journal (for which you are going to submit) in relation to the style of referencing. It is necessary to type the entry exactly as it is given in the journal (note the use of commas, brackets, full stops, abbreviations etc.). All citations in the body of the text should appear in the reference list and vice versa. In the reference list, some journals require journal names in full where as some journals need the international abbreviation for the journal name. The abbreviations of the journals can be obtained from the following websites.

http://library.caltech.edu/reference/abbreviations

http://in-cites.cm/journal-list/index.html

Note: *Editors and publishers of the journals consider that there are fundamental principles underlying scholarly or professional publishing including publication of research articles. These fundamental principles with respect to the authors' paper are that the paper should be the authors' own original work, which has not been previously published elsewhere, reflect the authors' own research and analysis and do so in a truthful and complete manner, and properly credit the meaningful contributions of co-authors and co-researchers. The research paper should not be submitted to more than one journal for consideration (ensuring it is not under redundant simultaneous peer review) and be appropriately placed in the context of prior and existing research.*

3.4 Research abstracts/extended abstracts of conference papers

Research findings can be made available to the public as conference papers. It is a useful tool when the researcher wants to test his/her ideas and present his/her findings amongst professional gatherings quickly. In many cases, it can become the start point for future publication of the full research paper. However the paper must adhere to the theme of the research conference/seminar/forum. In most cases abstracts and extended abstracts have to prepared and sent to the organizers for consideration for presentation at the conference. The guidelines provided by the organizers (in relation to the format/style/word count/page size etc.) should be followed when preparing the abstracts/extended abstracts. In an extended abstract, a more detailed description of the research work including introduction, methods, results, discussion and references is usually required within the stipulated page limit. Extended abstracts can be considered as the condensed form of a full research paper. In most conference proceedings, only the abstract will be published but the extended abstract is required for the peer review process to evaluate the suitability of the research work for presentation at the academic gathering.

5. Essential Reading

- Lecture notes provided for this module component

6. Supplementary Reading

- American Psychological Association (2001) Publication Manual of the American Psychological Association Washington, DC.
- Kumar R (2005) Research Methodology. Pearson Education, Australia. (pages 265-271)
- Rahim F. A. (1996) Thesis Writing. A Manual for Researchers. New Age International (P) Ltd. New Delhi. (1-139)
- Wilkinson A. M. (1991) The Scientist's Handbook for Writing Papers and Dissertations. Englewood Cliffs, NJ:Prentice Hall

MODULE 11: ORAL, POSTER AND OTHER FORMS OF PRESENTATION

1. Learning Outcomes

At the end of the session, the participant will be able to demonstrate knowledge and acquire skills in presenting research findings in the form of oral/poster presentations in an effective manner.

2. Lecture Outline

- Oral/poster presentations as means of disseminating research findings
- Procedure of developing contents for oral/poster presentations
- Arranging the presentation on paper
- Presenting your poster effectively
- Preparing for an oral presentation
- Delivering an oral presentation effectively

3. Learning/Teaching Resource

a. Lecture Notes

Oral/poster presentations as means of disseminating research findings

Research findings could be disseminated in a conference or in a research symposium as a poster presentation, oral presentation or as an electronic presentation. Presentation should be done in a way that it would stand out among hundreds of other presentations. Usually, best presentations make just one point loudly & clearly. Tested hypotheses should revolve around the same single point.

If you are nervous at presenting a paper orally or feel uncomfortable with the official language of the symposium you could opt to present your work as a poster. However, the best reason for selecting poster mode of presentation should be the contents; if the methods or results are complicated & best communicated graphically or if the work is a bit esoteric and intended for a particular group, it is better to present it as a poster.

Poster will do most of the "talking" and be on view. Plan (poor or excellent) is displayed throughout the conference.

Today, poster presentations are considered as more efficient means of presenting research results as they allow more interaction. A poster is especially desirable, if a researcher is terrible at giving talks. Sometimes due to limited time for oral presentations, organizers could request you to present your research as a poster presentation.

A poster which would be sandwiched between other posters would eventually be viewed in a congested room filled with people. In such a situation, your poster must be interesting and visually slick if you hope to attract viewers. An effective poster presentation would provide minimum text, work presented must be complete & Should be understood solely on what is

presented. Viewer should be able to read it completely under 10 minutes and should think that he/she has learned something new.

Oral presentations give an opportunity to provide clear & complete picture of your contribution to the audience lively. Information is communicated orally within 15 - 20 minutes. Listeners have one chance to hear the talk (can't "re-read"). Your talk should be simple and clear for the audience to understand, your points should be highlighted by vocal characteristics. An oral presentation would be over in a short period of time some "ultra-smooth speakers" could divert the attention from a poorly planned presentation.

Procedure of developing contents for oral/poster presentations

The presentation generally follows the guidelines (format) of a published research paper, but to present in much less space (poster)or within much less time(oral). Therefore, one should spend time thinking about his/her own research, prepare a summary, giving the central message. You have to summarize your main work using most appropriate words in finding the central message of your work. Are you with a new discovery, better technology or new information, write it with 25 words and then find the most suitable title for your work.

Use key words which highlight the main content, be as descriptive as possible using specific terms & be accurate. Format the title in "sentence case"; do not use "title case" or "all caps". Latter two styles obscure useful naming conventions that depend on font formatting (e.g., Latin binomials). In addition, science has proved that brain requires few extra milliseconds to interpret sentences formatted in title case and all caps. Titles with colons are longer than a normal title and take longer time to read. Coloned titles are devised to provide humor into otherwise mind-numbing poster topic or to provide greater detail about the general & vague topic introduced by the first clause in order to attract wider viewership. Although humor and clarity are great it is better to have a clear & short title without unnecessary colons.

Write a short Introduction to the burning question as supportive Information. Practice 25 words exercise (in finding the central message of the introduction you may have to recognize your research; is it a deductive or inductive research?).
Lengthy background information and definitions chase the readers away, specially when they are standing ; attention of listeners also would be lost if you are delivering a lengthy introduction orally. Could use a photograph or illustration to communicate some aspect of your research question. State why you did the work in the context of published , primary literature. Briefly describe the experimental approach and justify. Give a clear hypothesis. Please, remember that "A" has never been studied before is a lame reason for doing it. Practice 25 words exercise to have approximately 200 words finally.

Materials and methods should be brief but the viewer/listener should be able to clearly figure out how you did it. Give the bare essentials, provide an overview of the trendy experimental

approach, State and justify any assumption. Use figures & tables to illustrate experimental design, use flow charts, to show reaction steps or timing of experimental procedures. Limit to approximately, 200 words.

Central message of the results should state, what did you find? Did the test come out in the way you expected? Briefly give qualitative & descriptive results. Present analyzed data to address hypothesis. Highlight the amazing results. Refer to supporting Figures & Tables. Provide figure legends that could stand on their own (i.e., could convey some points to the reader, even when the figure only is viewed). Tables with legends, but opt for Figures whenever possible. Do not include all results superficially. Illustrate only the main results by figures, tables, graphs, drawings, etc, with little text. Maximum 200 words approximately. Keep the other results handy (could refer whenever required). This is the main & largest section, except you have no data to present. One could save space/ time from other sections if more space/time is required to present the amazing, controversial and important results.

Discussion and conclusion is the most important section. Remind the hypothesis and results without sounding like you are reminding, state whether your results support the hypothesis. Provide an insightful discussion of aforementioned results. Convince the reader/listener that your results are conclusive and interesting. Point out the dramatic finding/s. Indicate why the finding/s is/are significant. Show the relevance to other published work and to the real world. Recommend future work. Provide a take home message. Maximum 200 words approximately.

Literature cited & acknowledgement in a poster presentation should be under auxiliary sections and be placed at the lower left corner of the poster. Use journal articles that support the facts stated. Web sites are undesirable sources. Also, if you have read only the abstract of a journal article, it is better not to cite it. About 4 to 6 main references (maximum 10) are sufficient. Acknowledge the funding agencies (approximately 40 words). Your e-mail address & URL, where a reader could download a PDF version of the poster could be given under further information. Maximum 20 words approximately.

In an oral presentation, you are identified by the listeners in relation to the work you have presented and therefore listeners would contact you (over lunch or tea) if they need to know details of literature you have used or to get further information.

Arranging the presentation on paper

Size of the poster is given by organizers. You should Plan to make full use of the space (without cramping any section). QuarkXPress, InDesign, and LaTeX are considered as best programmes for designing large-format posters. Graphics packages such as Illustrator, CorelDraw, Freehand, Omnigraffle and Inkspace also could be used to prepare posters. PosterGenius is a recently introduced, advanced software for scientific poster preparation. Poster template files for some of the above programmes can be found on the internet and "Poweroipnt" could be applied to those templates.

On average a text box should have 11 words per line (width of a text box should be approximately 40 characters) .Lines that are longer or shorter are found to be difficult to read. A block of text should not contain more than 10 sentences. If numbers & acronyms are used (e.g., 214, DNA) within the body of text, scale down the font size by couple of points so that their sizes would not be large compared to the lowercase text. Paragraphs should be indented using the ruler (do not use the tab; default is usually too big). Spaces within & between words should be corrected, especially before and after italicized text. You could maintain single space between sentences.

Use serif font (e.g., New Times Roman) for body text as they are much easier to read at smaller font sizes. If you wish non-serif font (e.g., Arial) could be used for title and headings. For scientific names use italics instead of underlining. Use of a larger font size for headers (sub-titles) is sufficient for demarcating sections; use of bullet is not necessary.

It is important to design the template of your poster to possess a good amount of white space which makes the poster readable. Do not use dark backgrounds. It is difficult to design graphics work on a dark background. Use symbols and patterns instead of colours to show differences as some viewers may have a certain degree of colour-vision deficiencies (without your knowledge, you yourself may be suffering from colour sensitivity deficiencies and might design a poster that is difficult to interpret).

Details on photographs and diagrams should be comfortably viewed from 6 feet away. Do not overpower the image with a thick border; select a line colour which is subtly pleasing but barely noticeable to the viewer. Logos of institutes undermine the visual impact of the images of your research. If it is essential, make sure it is small and appear on the auxiliary section. If photographs were taken at higher resolution, use matte finishes to minimize glare for viewers.
Clip art will only distract attention, use only if they add interest to the display & complement the subject matter (you may waste time).

Titles on graphs are not used in manuscripts, however, short informative titles on graphs help the viewer to go through your poster easily. Details on graphs should be comfortably viewed from 6 feet away. Don't try to use keys that come with most graphing applications; it may be difficult to interpret. Backgrounds, grid lines that come with graphing programmes should be deleted. Three dimensional graphs obscure true difference among bar heights, and therefore should not be used.

Do not put up large Tables of numbers. Prepare Tables with summarized data. Numbers in a Table should be large enough & legible.

Keep Equations to a minimum. Equations should be large enough with nomenclature.

Format the literature cited according to inflexible rules. References that are carelessly formatted mark you & your poster as unprofessional. Same font size, used for text should be used in arranging the list of references.

Style chosen for the poster should be consistent not to have interruptions to the flow & to give impression of harmony. Head lines should appear in the same position on all sections. If bold lettering is used to emphasize in one section do not use italics on the other. Captions of graphs, drawings, tables, etc. should be either at the top or at the bottom.

It is advisable to **produce a rough draft at least one month before it is due** and ask about six persons, including one senior researcher to look at it when you are not present. Request them to leave their suggestions on word count, prose style, idea flow, figure clarity, font size, spelling, etc. on small 'stick-on' papers you provide for them.
Check for mistakes, legibility & inconsistency in style. Try different lay out arrangement. Be critical of your own poster. Check for spelling errors. Mistakes give the impression that you are careless, not bothered and you have not put in the effort and therefore, not worthy in assessing. Common mistake is making the poster too long; densely packed posters with high word-count are not attractive. Edit your poster to reduce text, and to remove unimportant Tables & Figures.

If you are creating images on the computer, remember that screen colour (RGB mode)is different from mix-ink mode (CYMK); change the RGB mode to CYMK mode in photoshop to see the correct image. Complete the poster on a single platform; some image files may be lost during switching from Mac to PC or from PC to Mac. In addition it could create problems in printing too.

You could prepare a small version of your poster with copies to be distributed.

Presenting your poster

Speak to the viewers & explain. Start by giving an overview of why your research is interesting and relevant in 1-sentence. Use a relevant Figure in delivering this 1-sentence. If viewers show interest, continue on to other Figures & give concrete facts. Vagueness such as" this Figure illustrates our main results" is not accepted. Keep a correction fluid and a pen in case a viewer discovers an embarrassing error. Complete explanation started for the viewers who came first, even if some others join halfway.
Glue a coin envelope, to the auxiliary section of the poster containing your visiting card. **If the visitors stayed with your poster listening to you for more than 4 minutes you have succeeded. If a viewer say "Your work seems really interesting, I will definitely come back later" you have failed.**

Preparing for an oral presentation

Speaking rate should not exceed 100 to 150 words per minute therefore a 20 minutes presentation limits you to about 2000 to 3000 words. Under these conditions, if you are to communicate effectively you must plan carefully. First, decide on how long are you planning to talk, and then decide on the type of audiovisuals that will be used and the role they will play in the presentation.

You have to rule out impromptu speaking, as it may jeopardized your reputation and the research effort.

Memorization is risky and time-consuming. Any memory slip during presentation would be a catastrophe. Memorization precludes establishing rapport with the members of the audience and adapting to their reactions while speaking. It produces a self- or speaker-centered approach and is not recommended.

Reading a manuscript sounds dull & lifeless. Presenter focus on the manuscript excluding the audience; this head-down preoccupation with the text is inappropriate.

The extemporaneous presentation is audience-centered and made from minimal notes or an outline. It permits the speaker to be natural, conversational and flexible. Preparation of extemporaneous presentation consists of writing a draft along with a complete outline and converting the main points to notes. It will allow the presenter to try lines of argument, experiment with various ways of expressing thoughts and develop phraseology. Meanwhile, the main points are fixed sequentially in your mind and supporting connections are made. Audience accept speaker notes and they help to reduce speaker fears. Even if the presenter never use them, they provide psychological support. Use of 5-by-8-inch cards for briefing notes is popular. Sequentially number your cards, place title & preliminary remarks on the first card. Have a card for each major section of the presentation (amount of detail in them depends on the need). Key phrases, illustrations, statistics, dates and pronunciation guide could be included. Instructions such as emphasize, slow, use the Figure 2, etc. cold be placed along the margin of a card.

Having a second laptop and projection system, as well as multi-prong power cords and spare computer connection cords should be in the high-tech insurance plan.

Rehearsal is a prerequisite for effective presentation; however it is too often slighted, especially by inexperienced speakers. Rehearsal efforts should first concentrate on the parts that are awkward or poorly developed. After the problem areas have been worked out, there should be at least a few full-scale practices under simulated presentation conditions. Presentation should be timed & edited until the time target is met; a video recorder is an excellent diagnostic tool for the presenter to know his/her weaknesses & strengths.

Electronic presenter should practice with the equipment so that movement between files, hyperlinks and your Power Point presentation would appear effortless.

Research audience knows why it is assembled, has a high level of interest and therefore does not need to be entertained. Even so the **speaker has a real challenge in communicating effectively.**

The fear of public speaking ranks up with the fear of death and/or public nudity. Whether you have enough experience or this is your first speech, stage fright, the illogical fear of facing an audience can be a paralyzing emotion.
According to Patricia Fripp, an award- winning Keynote speaker, one needs to anticipate one's speech mentally, logistically and physically. Mental preparation is the key: **invest 3 hours of preparation for 30 minutes speech (6:1 ratio).** Spend time memorizing your opening and closing 3 or 4 sentences each. Knowing the opening increases your fluency, allows you to make the rapport with the audience when you are likely to be most nervous. Logistically, know the meeting room. Go there early to be familiar & comfortable in the environment. Check the equipment and review your visual aids quickly. This will allow you to focus effectively on the audience during presentation.

In a small group, shake hands, exchange greetings & make eye contact beforehand. In a larger meeting at least connect with the people in the front row. Do it sincerely & they will be cheering for your success. Audience is there to listen to you; they are not waiting for you to fail. If your anxiety level is still high, then you need an outlet for your energy. Patricia Fripp says "find a private spot, wave your hands in the air, relax your jaw, shakes your head from side to side, then shakes your legs one at a time". Remember you are to release enough nervous energy in order to calm your anxieties; **you are not supposed to be stress-free to a level that you forget your purpose.**

Delivering an oral presentation

Speak ,don't read as an essay, if you read, the audience will understand very little & lose concentration. You should not read word to word from your slides. Use simple language, emphasize the key points; repeat them using different phrases. **If you speak so softly, arrange someone in the back of the room who would signal if your voice is not reaching there**. If you speak too rapidly, remind yourself to slowdown. Make deliberate pauses before starting a sentence. Speak words with precision without exaggerating. If you talk too slow, practice to increase the speed so that the audience will not become restless.

Don't let the words trail off at the completion of a sentence. Don't repeat pet phrases (e.g.,uhs, you know, in other words)

Do not rock back & forth, roll or twist from side to side. Do not lean too much on the lectern. Do not hitch or tug on clothing, or fiddle with pocket change, keys, pencils or other devices. Do not stare into space. Lack of eye contact is common with inexperienced speakers; many seems to choose a spot above the heads of the audience and continue to stare except when looking at notes which is bothersome, particularly to listeners. Eye contact is important.

Audience need to feel that you are looking at them. Pick out three people from left, right and center and practice looking at them successively while talking.

Use your natural expressions with face, hand & body to add to your verbal communication But don't become an actor. Be aware of the reactions. Questions indicate that audience was listening with interest. Be ready to get the discussion going after your presentation (have some provocative questions). Have answers ready to expected questions on a slide.

Whether poster, oral or electronic (using high tech audiovisuals) poor presentations do a grave injustice what might otherwise be an excellent research.

4. Essential Reading

- Cooper, D.R. and P.S. Schindler (2005). Business Research Methods, ninth edition. Tata McGraw- Hill Publishing Company Limited, New Delhi.
- Briscoe, M.H.(1996). Preparing Scientific Illustrations: A Guide to Better Posters, Presentations and Publications, 2nd ed. Springer-Verlag, New York.

5. Supplementary Reading

- Block, S.(1996). The DOs and DON'Ts of poster presentation. Biophysical Journal 71:3527-3529

MODULE 12: PUBLICATION OF RESEARCH

1. **Learning Outcomes**

   At the end of the session, the participant will be able to demonstrate knowledge of different means to publish his/her own research.

2. **Lecture Outline**

   - Different audiences and their needs.
   - Different forms of publication.
   - Academic forums for research publication
   - Writing for academic forums
   - Finding conference funding

3. **Learning/Teaching Resource**

   a. **Lecture Notes**

   3.1 Introduction (slide 02)

   Publication of research results can be considered as the zenith of the research process. Until the findings of your research enter the public domain, the course of your research cannot be considered complete. Publishing means that you expose or open-up your research findings to various segments of the society.

   3.2 Why Publish? (slide 03)

   Research is done with the hope that the findings are going to be used by someone with authority and resources such as the governments, non-governmental organizations, other researchers, students etc. for the benefit of the society -the humankind at large. In order to achieve this humane goal, we need to disseminate the results of our research to the relevant audiences or the target groups. Hence, publication of research allows the public to know about your findings and have access to the new knowledge you have produced.

   The community of researchers in one's own discipline is not the only audience that would be interested in the findings of research. There may be many signets of society including the researchers in other disciplines, government agencies, non-government organizations, the industry, the media, and students etc. who would need to know the results and who would be benefited from it.

   As research is mostly done using public funds, the public has a right to know the results of one's research. The researcher, therefore, has a moral obligation to let the public know the findings of his/her research.

   3.3 Knowing the Audience and their Needs (slide 04)

Diverse audiences have diverse needs. Each audience would need to know the results of the researcher's findings at different levels for different purposes. This requires different ways of presenting the findings. Therefore, it is very necessary to know which audience the researcher is communicating with. This helps the researcher determine what form of publication he/she is going to choose for dissemination of research findings

3.4 Different forms of Publication (slides 05, 06)

There is a range of possibilities for dissemination and presenting research findings to meet the needs of the diverse audiences, serving different purposes, as follows;

- For the academic/scientific community
- Refereed journals, non-refereed journals, and e-journals
- Research communications at academic forums: presentations at conferences, seminars, workshops, research symposia, etc. with abstracts
- Published and circulated during the event, or full-paper published in pre-conference or post-conference proceedings.
- Monographs, books or book chapters
- Publishing a higher degree thesis or dissertation
- Newspapers
- For the government, charity, NGO, industry etc.
- Commissioned scientific reports
- For internal distribution within an organization or between organizations
- Technical reports
- For the general public
- News briefs, booklets, books, leaflets, newsletters, news magazines

3.5 Research Communications for the academic Community (slide 07, 08, 09)

a). Conferences, seminars, and symposia organized by learned societies or professional organizations in Sri Lanka and abroad remain as popular forums among researchers for academic communication. Research finding can be presented in the form of an oral presentation or a poster. The paper may be printed as an abstract or as a full-paper in the conference proceedings. Oral presentation to a live audience allows the researcher to get valuable feedback soon after the presentation.

b). Publishing in refereed journals (peer-reviewed journals), is perhaps the supreme achievement for a researcher. Papers submitted for publication in such journals are subjected to scrutiny by an independent expert in the field of research before being published. The expert may either, recommends the paper without revision, suggests revisions for improvement, or rejects the paper from publishing while giving his/her reasons for such decision.

Researchers must be aware of the refereed journals published in one's own discipline. Format and style requirements of papers may differ from journal to journal and details pertaining to such matters are often given by the editors. Most journals have imposed maximum page or word limits and limits on the number and size of illustrations.

One may also publish research findings in non-refereed journals. Such journals are not considered as prestigious as refereed journals as the paper does not go through a rigorous process of review for quality.

National Science Foundation provides information about journals on its website; www.nsf.ac.lk

c). Research can also be published in the form of a monograph, book or a chapter of a book that will be edited by an editorial board. The writer will have to submit a book-proposal to an academic publisher explaining the contents of the book, its relevance to the target audience, and convincing that the publisher would be able to sell the product within a reasonable time-frame.

d). Theses/dissertations submitted for research degrees can be published. There is a popular notion that once a research degree is awarded, the thesis/dissertation has to be published. The format of a book is very different from that of a thesis/dissertation. Therefore, one has to re-arrange the material in ther thesis to fit into the book form, and this can be time consuming. One also has to consider whether the contents of the thesis/dissertation are going to attract a reasonably significant readership.

However, what many researchers do is to select few sections of the thesis/dissertation and publish them in peer-reviewed journals. In fact, most well-known publishers discourage young researchers attempting to publish their theses/dissertations as theses/dissertations often have a limited readership.

e). A researcher may write a 'feature article' for a major newspaper. The writer has to be mindful about the length, the language, and also the format of it as the readership of such an article can be quite diverse. The language also should be free of unnecessary use of technical terms and jargon.

3.6 Research Communications for the government, charity, NGO, industry etc. (slide 10)

Outcome of research commissioned by a government agency, a charity, a non-governmental organization, or the industry will be communicated in the form of a commissioned scientific report. The report format may be different from that of a journal article, but certain rules regarding the contents applied to a journal article may apply to a commissioned scientific report as well. The length of such a report may depend on the nature of the problem that was investigated.

Depending on the nature of the agency or the issue investigated, the report may be classified as restricted circulation.

3.7 Research Communications for internal distribution within an organization or between organizations

You may have been contracted by an organization to conduct a research study to address an issue related to the interests of that organization or a group of organizations. You will write a technical report based on the findings of your study and submit the same to the organization that

contracted you. In such cases, you are not supposed to disseminate the outcome of your study outside such organization, unless the organization has unambiguously granted you permission to do so (something that can be very rare). Such technical reports will be read only by a very small number of high ranking managers or executives, and often, not by ordinary employees of the organization.

3.8 Research Communications for the General Public

A researcher may write news briefs for newspapers, publish books or booklets, posters, prepare leaflets to be distributed among the public through an appropriate agency, write to newsletters or news magazines that have a significant circulations among the expected readership. In such writings, it is necessary to be mindful about the language, the format, the length, and even the font type and its size.

The internet provides so many alternative opportunities for disseminating your research findings. One positive aspect of such e-publication is that it is cheaper, quicker, and accessible to an almost limitless readership.

3.9 Academic Forums within Sri Lanka (slide 11)

The Sri Lanka Association for the Advancement of Science (SLAAS), the apex academic body for the pure and applied sciences in the country. The SLAAS holds its annual sessions to which most of the scientists of Sri Lanka present the results of their research. Scientists also communicate the findings of their research to; the Sri Lanka Institute of Biology, the Sri Lanka Institute of Chemistry, the Sri Lanka Institute of Physics, and the Sri Lanka Association for Fisheries and Aquatic Resources.

Additionally, scientists also can present papers to the Annual research congress of the Postgraduate Institute of Agriculture of the University of Peradeniya, Forestry symposium of the University of Sri Jayawardenepura, and the Aggricultural Research Symposium of the University of Wayamba. Those universities with faculties of graduate studies also hold annual research symposiums, and for the most of such symposiums, submissions from any researcher are welcomed.

3.10 International Academic Forums (slide 12)

Browsing the internet is an effective way of finding information about academic or professional forums in Sri Lanka or abroad. Signing-up with such organizations for e-news updates also is a good way to obtain information. There are some websites that provide information about conferences held across the globe. Three such web sites are;

www.allconferences.com
www.conferencealert.com
www.natureevents.com

A search engine can be useful to find information on such websites. Information on some international conferences and seminars are sent to Vice Chancellors and Deans too.

3.11 Writing for Academic Forums (slide 13)

Conference organizers provide guidelines for the preparation of papers, abstracts, and posters. Paper proposals may be rejected if guidelines were not followed. If the submission is up to the expected standard, it will be accepted for presentation at the conference. Some conference organizers provide travel grants to participants from developing countries.

3.12 Funding to attend Conference: finding Travel Grants (slide 14, 15)

Cost of attending a forum held abroad can be costly unless the researcher holds a research grant that includes travel money for conference attendance. Costs may involve registration fee, air-fare, hotel accommodation, food, and miscellaneous expenses such as local transport etc. Travel grants can be obtained from various international foundations and NGO's, and information about such grants are published in their websites. Universities also have some schemes to provide travel grants. National Science Foundation and the National Center for Advanced Studies in Humanities and Social Sciences also are two good sources to obtain travel grants.

3.13 Benefits to the Researcher (slide 16)

Publication of research findings will bring immense benefits to the researcher. One important benefit is that he/she will be recognized at both nationally and internationally. Fellow researchers around the world come to know about his/her capabilities, strengths, and experience as a researcher. This is very important for his/her career development, and initiating networks with other researchers worldwide for future research collaboration.

4. Essential Reading

- Day, Robert A. 1998. *How to Write and Publish a Scientific Paper* (5th ed.) Orix Press. (**ISBN-13:** 978-1573561655)
- Katz, Michael J. xxxx *From Research to Manuscript: A Guide to Scientific Writing*. (2nd ed.) Springer **ISBN-13:** 978-1402094668

5. Supplementary Reading

- http://www.rin.ac.uk/our-work/communicating-and-disseminating-research/communicating-knowledge-how-and-why-researchers-pu
- http://library.wur.nl/frontis/landscape_research/18_publishing.pdf
- http://www.drtonygeorge.com/study_howtopublishpaper.htm

MODULE 13: PROBLEMS ENCOUNTERED BY RESEARCHERS

1. **Learning Outcomes**

   At the end of the session, the participant will be able to demonstrate the knowledge of the role and responsibilities of the supervisor and the postgraduate research student.

2. **Lecture Outline**
   - Institutional regulations on supervision; supervisor as a mentor.
   - Scheduling meetings.
   - Ethical conduct of supervisors.
   - Commitment and motivation of the student.
   - Academic honesty and professional integrity

3. **Learning/Teaching Resource**
   a. **Lecture Notes**

3.1 Introduction

A healthy relationship between the supervisor and the research degree (RD) student is crucial for the successful completion of a research degree program. Higher degree institutions (HDI), therefore, have established regulations to compel both the supervisor and the student to maintain such relationship. Institutional policy frameworks define the role of the supervisor and the responsibilities of the student. It is necessary that RD students be familiar with such regulations that would help him/her to maintain a working professional relationship with the supervisor. The student must bear in mind that effective relationship with the supervisor is integral to the quality of his/her educational experience.

3.2 Institutional Responsibilities: General

Taking care of all matters pertaining to r**egistration and records management of RD students is the responsibility of the HDI. The relevant office** must provide the student with information about registration dates etc. Further, the office must update the student's record with all relevant details relating to the student's supervision, progress, research degree registered for, and other relevant management information.

The office must ensure that training and guidance on thesis writing and formatting are available to all students. It is the duty of the office to ensure that procedures for submission and examination are clear, well publicized, and accessible. It is also a responsibility of the office to maintain a record of any concerns notified by the student or the supervisor to the Graduate School ahead of the examination.

3.3 Institutional Responsibilities on Supervision and Research Progress

The HDI has a responsibility to ensure that candidates for higher degrees work in an appropriate intellectual and academic environment and receive appropriate supervision during their candidature. Therefore, the office must ensure that supervisors regularly update their skills through training and development. Excellence in supervision will be acknowledged and rewarded across the institution and enhanced through training and support.

It is the responsibility of the office to inform external organizations where a student is undertaking research if there is a change in their registration status where appropriate. The office is responsible for monitoring of the progress of the student. Therefore, it should make arrangements to review the students' progress reports. The office should also provide advice and guidance to students and supervisors where serious concerns about progress arise .

It is also necessary to keep a record of annual progress reports of the student's work. The office can retain a written and signed record of any progress files referred to the Graduate School.

3.4 Supervisor's Responsibility

Research supervision is a subtle and complex form of teaching. The quality of the RD graduate is related to the quality of supervision provided. A good quality RD graduate should have an understanding of current research based knowledge in the field, its methodologies for creating new knowledge, and can create, critique, and appraise new and significant knowledge. The input of the supervisor is crucial in producing a RD graduate of such quality.

Supervisor holds prime responsibility for overseeing the student's progress. He/she should have the expertise, time, and resources to provide ongoing support to the RD student.

3.5 Eligibility Requirements to be a Supervisor

The supervisor must be a member of the academic staff of the University at Senior Lecturer/ Associate Professor or above; or be considered appropriate by the Dean of the Faculty on a case by case basis. He/she should hold a qualification at a level above that for which the candidate seeks to be supervised, or hold a qualification at the same level as that for which the candidate seeks to be supervised and demonstrate a record of scholarly achievement; or have demonstrated current and active involvement in research appropriate to the field of study and a record of scholarly achievement to the satisfaction of the Dean of the Faculty on a case by case basis.

3.6 Supervisor-Student Relationship

Relationship between the supervisor and the student will change, as the candidature progresses. Although substantive responsibilities will not change, the student should become more independent of the supervisor. This is essential if the student is to graduate as an independent researcher.

As the student becomes more involved in his/her research, his/her expertise could, and probably should, surpass that of the supervisor, at least in the area of the immediate topic.

Any differences in opinion should be discussed openly and frankly, and tensions dealt with as soon as possible. Regular meetings and the reviews of progress can be used to discuss changes in research direction.

Contact with Supervisors

- Face-to-face meetings,
- Mail,
- Telephone,
- Email, or
- A combination of these.

Research practices in different fields of study may require a variety of supervisory arrangements

3.7 Supervisor-Student Meetings

There are clear expectations on both sides on such matters as regularity and structure of meetings, and the standard of work required to achieve the degree. Students must be provided with information about important procedures, regulations, services and support, including authorship, intellectual property, copyright requirements and information on plagiarism.

Supervisor must be supportive of the student, and encourages open and constructive communication. Student's development as an independent researcher must be facilitated so that the student can have control over his/her own research program.

3.8 Role of the Supervisor

The main role of the supervisor is to direct the student's work so that it is executed in a competent, scholarly manner. He/she should guide the student in the right direction, and assist the student to meet set milestones and complete the study within set timeframes. The supervisor must abide by the Code of Good Practices for supervision. Accordingly, the supervisor must;

- Be familiar with, abide by, and guide students in relation to the university's policies, procedures, regulations, guidelines and codes relevant to higher degrees by research. These include intellectual property, ethics and safety, authorship arrangements, and copyright and plagiarism;
- Remain aware of current supervisory practices and the policy environment by participating in supervisor development and awareness programs;
- Maintain and develop supervisory skills through continuous professional development;
- Ensure to the best of his/her ability that the candidate is capable of undertaking the project and that the supervisor is both suitably qualified to carry out the supervision and has sufficient time available, before undertaking the supervision;
- Establish with the student and review as necessary the mutual expectations and obligations including supervision style, before undertaking the supervision;
- Agree on the appropriate level of support for the student within reasonable limits and be available for scheduled meetings;
- Be clear in the provision of guidance and instruction; and
- Ensure that the facilities are available to enable the project to succeed, and provide information on sources of research expertise, institutional administration and policy information etc.

Inability to Supervise: If the supervisor is not confident at this stage that the research proposal is likely to succeed or that the facilities are available or has any doubts about his or her ability for any reason to supervise the candidate he or she must raise this with the head of department, postgraduate coordinator and/or faculty.

Meeting Commitments: The supervisor has a responsibility especially over the initial phase of candidature; to ensure that facilities identified as necessary do eventuate; to encourage the candidate to extend his or her contacts within the department and elsewhere; to encourage the candidate to make productive use of his or her time; and to ensure that commitments made in respect of availability and contact are met by both parties.

Providing Feedback: Supervisors will provide internal feedback to research students through reviews of progress, regular meetings, and presentations within the school. This feedback will enable research students to make appropriate modifications to their research proposal which will form the framework for the thesis. (Students need to allow time for the supervisor(s) to critically read their work when seeking feedback on drafts of the thesis.)

Constructive Criticism and Monitoring: Supervisor must comment critically and constructively, and in reasonable time, on the content of drafts of the thesis. Must monitor the student's writing style to help avoid plagiarism and to ensure appropriate presentation of written material. He/she will refer the student to appropriate resources and assist with preparation of the thesis.

Supervisor must monitor the student's performance and ensure the student is promptly made aware of inadequate progress or insufficient work by providing detailed feedback that identifies problems, establishing agreed timelines and milestones by which to measure performance, and conducting additional reviews of progress as required.

Supervisor has to identify the various degree and other administrative requirements and advise the candidate as necessary.

Advising on Government and Institutional Guidelines: Supervisor must advise the student of applicable government and institutional guidelines for the conduct of research, including requirements relating to ethical approvals for studies on human or animal subjects, and the use of potentially hazardous agents. As far as possible, research supervisors should ensure that the work submitted by candidates is their own and that data are valid.

Responding to Critical Reviews: Supervisor must advise the student on how to deal constructively and appropriately on critical reviews that include examiners' comments and recommendations. Supervisor must recommend to the Dept. appropriate responses to the examiners' recommendations, including a proposed resolution of conflicting examiners' reports to the Examinations Panel, where necessary.

3.9 Responsibilities of Students

Common Problems faced by RD Students

- Supervisor too busy
- Poor feedback
- Supervisor's lack of commitment & interest
- Tensions or conflicting perspectives from within the supervisory panel
- Poor communications and disagreements about the project
- Conflicting or unrealistic expectations between parties
- Supervisor being selfish or disrespectful
- Supervisor not up-to-date with the field
- Supervisor lacking experience in research or supervision
- Personality clashes

Rules and Regulations: The student must be familiar with and abide by the regulations, policies, and procedures for higher degrees by research and other relevant policies and procedures pertaining to intellectual property rights, copyright, plagiarism etc.

Meetings with the Supervisor: Supervision is a negotiated process. The student and supervisor/s will need to establish:

- How often and when you meet
- Whether you meet face-to-face or by distance media
- How long you spend in supervision sessions
- An agenda and goals for the supervision sessions.

Skills Development: Your supervisor/s may direct you to courses that can assist you to develop necessary research skills. Research education support is provided by the University, although you may need to enroll in outside courses

Ethics and compliance: If the research requires approval from various committees concerning human research ethics or the animal research ethics, the student must get the principal supervisor to sign off the protocols on the front page of the submission before it is sent to the relevant ethics committee. You must obtain ethics and safety approvals for the research program as necessary, and prior to data collection.

Developing a Research Plan: Together with the supervisors, you must develop and agree a detailed, realistic, time-bound, research plan for the research degree, including significant milestones and maintain progress towards its achievement**.** You must play an informed part in planning a research project in order to complete the thesis and degree within the allocated time of scholarship and/or funded candidature. Maintain the progress of work according to milestones agreed with supervisors.

Planning and Reviewing Progress: You must participate with supervisors and the research degree coordinator in planning and reviewing progress, and monitor achievement.

Ethical and safe working practices: You must adopt ethical and safe working practices in places of study and work and be familiar with occupational health, safety and welfare guidelines of the institution.

Review of Progress: You are required to undertake planning and review meetings with their supervisor/s at least *twice per year* and it is the student's responsibility to initiate the review process. A formal report of these meetings is required at least once per year where the principal supervisor, associate supervisor and research degree coordinator write a report and recommendations regarding the student's progress, in consultation with the student.

You must present written material regularly as required to supervisors. Take initiative in obtaining more clarity and resolving misunderstanding in communication with supervisors. Review progress with supervisory team and raise any issues relating to progress as appropriate. Take responsibility for seeking resolution to unsatisfactory progress.

Appointment of Examiners: Participate in discussions relating to the appointment of examiners and, while not having a right to nominate or veto the choice, raise any concerns or objections about potential examiners.

Making Supervising Appointments: Make regular supervising appointments in advance. Both you and your supervisors are busy people.

Giving advance notice includes providing your supervisor with any readings which may form the background to the session. This may be simply giving references to published writing or providing copies of your own or others' writing. It also includes giving notice, either orally or in writing, of any specific questions or issues you wish to raise.

Preparation for Supervisory Sessions: Prepare for supervisory sessions. It is student's responsibility to set the agenda for supervisory sessions. It will make those sessions infinitely more useful if you give your supervisor some written material and advance notice of your agenda. Supervision is generally more productive and effective if you and your supervisor are adequately prepared.

Record Keeping of Supervisory Sessions: Keep a record of supervisory sessions. What form this takes is up to you. Even more important is to keep a record of agreements reached in supervisory sessions. Ideally, before you conclude a session, you and your supervisor should spend about 10 minutes recording in writing any consensus decisions that have a direct bearing on your research. These may include the time and date of the next supervisory session, any tasks you have agreed to complete before the next supervisory session, and any tasks your supervisor will undertake before the next supervisory session.

Making Supervisory Meetings Successful: Keep in regular contact. Try not to get too far out of touch with your supervisor, especially in the early stages of your candidature. You should meet in person or by teleconference, email or other means regularly, and submit regular progress reports and drafts of your work. Try to submit draft material that is at an advanced and relatively 'polished' stage of development so your supervisor can focus on the content rather than correcting grammatical and typographic errors. Also, avoid resubmitting the same draft material several times.

Be Open with Supervisor: Discuss your working relationship. Let your supervisor know, quite openly, how the supervisory relationship is working for you. If you feel your supervisor is being too 'laid back' and non-directive, say so. If you feel your supervisor is being too dominating and directive, say so. If you want more or less support than you are getting, ask for it. Don't make your supervisor second-guess your needs.

Inform Supervisor your Progress: Keep both your supervisors informed of your progress. They are there to support you in your research, and will be unable to fulfill this role unless they are regularly informed of your progress.

Meeting Deadlines: Be diligent, meet agreed deadlines and respect the multiple demands on your supervisor's time.

Editing the Thesis: You should assume responsibility for editing your work. You may or employ an editor for that purpose. Your supervisor is not responsible for editing your work.

Personal Development: Draw up a personal development plan with supervisors. Undertake appropriate training as agreed with the supervisors. Review and update the personal development plan regularly to ensure continuing relevance. Undertake approximately two weeks' per year training and development activity.

Submission of Thesis: Ensure familiarity with University, Graduate School and funder terms and conditions regarding submission, examination, extensions etc. Seek advice from the supervisory team on standards specific to the individual thesis. Set an anticipated submission date taking into account University requirements.

Take the decision to submit following advice from the supervisory team. Notify the Graduate School within two weeks of receiving a list of the Exam Committee members if a conflict of interest exists with an examiner.

Corrections to the thesis: After examination, promptly make required corrections to the thesis within the allocated time and ensure enrolment is active in the case of major amendments.

Publications arising from Research: Ensure familiarity with Faculty/Graduate School policies regarding the supervisor's rights and responsibilities when considering publication. Provide up-to-date contact details to the supervisor if subsequent publication is likely following graduation.

Research Misconduct: Research misconduct is a serious offence. It includes: Fabrication or falsification of data

- Plagiarism
- Misleading ascription of authorship
- Misuse of funds
- Unethical conduct of research involving humans or animal subjects
- Other practices which deviate from those commonly accepted within the research community for proposing, conducting or reporting research.

Misconduct does not include inadvertent errors or differences in the interpretation of or judgments about data.

4. Essential Reading

- http://www.gla.ac.uk/services/postgraduateresearch/pgrcodeofpractice/section12rolesandresponsibilitiesataglance
- http://www.unisa.edu.au/resdegrees/candidates/responsibilities.asp

5. Supplementary Reading

- Delamont S., P. Atkinson, and O. Parry. 1997. *Supervising the Phd: a guide to success*. London: The Society for Research into Higher Education