
(FTCIA)

Online Collaborative Learning Project (OCLP)

Study Materials.

Farook Training College Innovative Academia (FTCIA)
Online Collaborative Learning Project (OCLP)

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The entire materials are prepared by the Research scholars of Farook Training College, Calicut, Kerala.

It is expected that this will be a support for those who need simplified, concise but comprehensive study materials for their examination preparation. It is a smart footstep to self learning and peer learning.

A note of appreciation to all research scholars who are the workforce behind this great endeavor.

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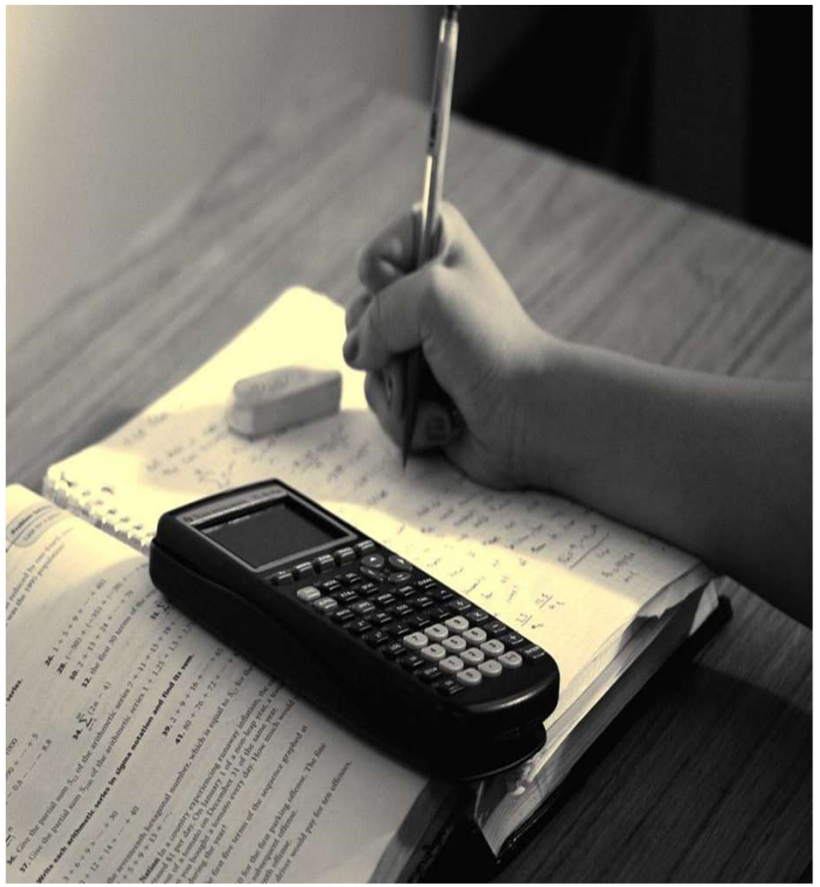

Paper I- Research Methodology and Educational Statistics

UNIT I

Fundamental Principles of Educational Research

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Educational research: Meaning

- Educational research refers to a systematic attempt to gain a better understanding of educational process with a view to improve its efficiency.
- It is the application of scientific methods to the study of educational problems.
- Research conducted in the field of education, solving problems in the field of education In order to reach a conclusion.
- Education is an interdisciplinary subject
- Subject expertise is not needed in the case of educational research

Continue..

- Scientific and educational research is done in a systematic way.
- Science uses mostly inductive reasoning and educational research uses both inductive and deductive.
- Science is more precise, educational research may not have that much precision.
- It is too expensive to conduct scientific research, but an educational research is economical.
- Educational research is the systematic attempt to obtain answers to meaningful questions about a phenomenon or an event of education through the application of scientific method.
- It uses systematic collection and analysis of data related to the field of education.

Characteristics of Educational research

- Based on sound philosophy of education
- Needs imagination and insight as much as scientific attitude
- Requires an interdisciplinary approach
- It usually employs deductive reasoning more
- It is not exact as research in physical science
- Generally require inexpensive material
- Cannot be a mechanical process
- It is based on interdependence of causes and effect

Aims and purpose of educational research

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- Unfold truth by systematic method
- New generalization with old ideas
- Verify old conclusions with new data
- Put forward an original idea or theory
- Educational reconstruction in intelligent way
- Helps to solve educational problems
- Provide innovations in curriculum.

Scope and areas of Educational Research

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- Levels of education
- Subject matter: deep route with many subjects
- Methodology used
- Based on time
- Based on purpose/function

Functions of Educational Research

- Examine experience of past as an aid to study the present situation in education- for this uses historical research-a descriptive technique which gives factual information
- To canvas present practices in education-normative survey method to used to understand educational progress
- To indicate casual relation among conditions to determine effectiveness of procedure-experimental design.
- Analyze causal complex relationship-through manipulations of statistical data and correlational and genetic studies

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- To improve educational procedure through the reinforcement and extension of knowledge
- To aid educational administration to improve the educational system
- To make a decision concerning the reinforcement or extension of knowledge to a particular area.
- It develops and evaluates methods that text concepts, practices and theories in education.

Methods of acquiring knowledge

The primitive methods or non-scientific ways of knowing are

- Tenacity
- Intuition
- Authority
- Traditions and customs
- Personal Experience

Scientific approach to gaining knowledge

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- ★ Research as a scientific process concerned with the objective verification of generalization and logical analysis of problems as well as designing appropriate methodologies for obtaining evidence.
- ★ Way of looking at the world in terms of reason and empirical evidence
- ★ A combination of rationalism and empiricism is the scientific approach to gaining of knowledge

Rationalism

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- ★ Way of thinking in which knowledge is developed through reasoning process alone.
- ★ Logical rules are followed to arrive at acceptable conclusion.
- ★ Rationalism involves deductive reasoning ,inductive reasoning or combination of both.

Deductive reasoning (Aristotle)

A valid conclusion can be derived from a valid premise through a sequence of formal steps of logic moving from general to particular

Inductive reasoning : Francis Bacon

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- Observation were made on particular events in a class
- Reverse process of deductive reasoning

Empiricism

- A way of gaining knowledge through observation of real events, knowing through experiencing our senses such as see, hear, touch, taste and smell
- I won’t believe until I see it “ is empirical motto

Positivism

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- ★ Modern period science freed from clutch of religion and began to dominate in the process of knowledge generalization
- ★ Thus human beings turned more to observation and experimentation for establishing truth.

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Auguste Comte believed that human mind, society and knowledge went through a process of development and change, from non-scientific, authoritarian metaphysical to a state of rational scientific knowledge which he called positivism and which could be applied to the solution of social problem.

According to Comte three stages in Positivism

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- Theoretical stage: most primitive attempt are made to explain behavior in terms of spiritual and supernatural entities.
- Metaphysical stage : Modified version of theological stage and explained in terms of spiritual abstractions and forces.
- Positive stage : Dispenses theological and metaphysical concepts and turns to observation and reason as means of understanding behavior more simply.

Limitations of positivism

- A mechanistic and reductionist view of nature.
- Quantification of human behavior and experience.
- Fail to take into account unique ability of human beings- interpret our own experience.

MODULE 2

Designs and Methods

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Research Problem

- A Research Problem is a statement about an area of concern, a condition to be improved, a difficulty to be eliminated, or a troubling question that exists in scholarly literature, in theory, or in practice that points to the need for meaningful understanding and deliberate investigation.
- A research problem is a general educational issue, concern, or controversy addressed in research that narrows the research topic.
- It is formulated during the initial stages of study.

The purpose of a problem statement is to:

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- Introduce the reader to the importance of the topic being studied
- Places the problem into a particular context
- Provides the framework for reporting the results

There are four general conceptualizations of research problem

1. **Casuist Research Problem** -- this type of problem relates to the determination of right and wrong in questions of conduct or conscience by analyzing moral dilemmas through the application of general rules and the careful distinction of special cases.
2. **Difference Research Problem** -- typically asks the question, “Is there a difference between two or more groups or treatments?” This type of problem statement is used when the researcher compares or contrasts two or more phenomena.
3. **Descriptive Research Problem --** typically asks the question, "what is...?" with the underlying purpose to describe a situation, state, or existence of a specific phenomenon.
4. **Relational Research Problem** -- suggests a relationship of some sort between two or more variables to be investigated. The underlying purpose is to investigate qualities/characteristics that are connected in some way.

Statement of research problem

An adequate statement of the research problem is one of the most important parts of the research. Different researchers are likely to generate a variety of researchable problems from the same situation since there are many research issues that can arise out of a general problem situation. Your research will be able to pursue only one in depth.

For a problem statement to be effective in the planning of applied research it should have the following characteristics (Andrew and Hildebrand 1982).

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1. The problem reflects felt needs
2. The problem is non-hypothetical, ie it must be based on factual evidence
3. It should suggest meaningful and testable hypotheses - to avoid answers that are of little or no use to the alleviation of the problem
4. The problems should be relevant and manageable

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Formulating the research problem allows you to make clear, both to yourself and the reader, what the purpose of your research is. Subsequent elaboration of method should be oriented to providing information to address that problem. The problem statement is therefore a very important device for keeping you on track with your research. It is also one means by which your research will be evaluated - does the research address the problem as stated.

Quantitative research problem

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- Explains or predicts the connections, relations or comparisons between variables
- Contains independent and dependent variables
- Measures variables for getting quantified data
- Tests theories or broad explanations
- Generalizes results to a large number of people

Formulating the research problem in Quantitative research

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Once the general topic or problem has been identified, this should then be stated as a clear research problem, that is, taken from just a statement about a problematic situation to a clearly defined researchable problem that identifies the issues you are trying to address.

It is not always easy to formulate the research problem simply and clearly. In some areas of scientific research the investigator might spend years exploring, thinking, and researching before they are clear about what research questions they are seeking to answer. Many topics may prove too wide-ranging to provide a researchable problem. Choosing to study, for instance a social issue such as child poverty, does not in itself provide a researchable problem. The problem is too wide-ranging for one researcher to address. Time and resources would make this unfeasible and the results from such a study would consequently lack depth and focus.

Ways to formulate a problem

- Specify research objectives
- Review its context or environment
- Explore its nature
- Determine variable relationships
- Anticipate the possible consequences of alternative approaches

Research Design

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- ★ A research design is an arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.
- ★ Research design is the conceptual structure with in which research is conducted.
- ★ It contributes the blueprint for the collection,measurement and analysis of data.
- ★ It includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data.

Research design must contains

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(a)Clear statement of the research problem

(b)Procedures and techniques to be used for gathering information

(c)The population to be studied

(d)Methods to be used in processing and analysing data

A researcher attempting to solve his problem should necessarily prepare a plan which will help him to attain his ultimate goal. Without such plan of study no scientific study is possible.

Need for Research design

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- Research design is needed because it facilitates the smooth sailing of the various research operations ,thereby making research as efficient as possible yielding maximum information with minimal expenditure of effort,time and money.
- We need a research design or a plan in advance of data collection and analysis for our research proposal.Research design stands for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objective of the research and availability of staff,time and money.

Features of a good design

The design which minimises bias and maximises the reliability of the data collected and analysed is considered a good design.A research design appropriate for a particular research problem,involves the consideration of the following factors.

(1) The means of obtaining information
(2) The availability and skills of the researcher
(3) The objective of the problem to be studied
(4) The nature of the problem to be studied
(5) The availability of time and money for the research work

Selection of Research designs for Quantitative Research

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Quantitative research is a means for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures. The final written report has a set structure consisting of introduction, literature and theory, methods, results, and discussion (Creswell, 2008). Like qualitative researchers, those who engage in this form of inquiry have assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations, and being able to generalize and replicate the findings.

The overall decision involves which design should be used to study a topic. Informing this decision should be the worldview assumptions the researcher brings to the study; procedures of inquiry (called strategies); and specific methods of data collection, analysis, and interpretation. The selection of a research design is also based on the nature of the research problem or issue being addressed, the researchers' personal experiences, and the audiences for the study.

Descriptive Research

- Descriptive research is a type of research that describes a population, situation, or phenomenon that is being studied.
- It is used to describe characteristics of a population or phenomenon being studied.
- It focuses on answering the how, what, when, and where questions rather than the why.
- Descriptive research means observing and measuring without manipulating variables.

- It can identify characteristics, trends and correlations.
- It provides a descriptive analysis of a given population or sample. Any inferences are left to the readers.
- Qualitative, quantitative or a combination of both types of data can be presented.
- Hypotheses or broad research questions are used.

Data Sources

- Persons such as teachers, students, parents, administrators, etc.
- Documents such as policy statements, curricular guidelines.
- Records such as student transcripts.

Research Tools

- Structured interviews.
- Structured questionnaires and surveys
- Standardized tests.

Ex Post-Facto Research

- The ex-post facto research is a kind of research in which the researcher predicts the possible causes behind an effect that has already occurred.
- The researcher predicts a cause on the basis of a controlled effect .
- For example, if a child is delinquent (that is, one who indulges in criminal activities), then in order to find the basic reason behind such delinquency, the researcher would try to find out the various events that have occurred and the many possibilities that could have contributed to the concerned delinquent behaviour. The expected possibilities may be lack of discipline at school/ family history/ peer effect/neighbourhood or socialisation.

Causal-Comparative Research

- Causal comparative research attempts to identify a causative relationship between an independent variable and a dependent variable.
- Causal comparative design is used to determine the cause for or consequences of existing differences in groups of individuals.
- Not as powerful as experimental designs
- Used when independent variables cannot or should not be examined using controlled experiments

Correlational Research

- The relationships among two or more variables are studied without any attempt to influence them.
- Investigate the possibility of relationships between only two variables,although investigations of more than two variables are common.
- A form of descriptive research because it describes an existing relationship between variables

Experimental Research

- Sets out to determine the cause and effect of two or more variables
- Manipulates the independent variable
- Compares the groups in terms of dependent variable
- Minimises confounding variables
- Uses randomisation

EXPERIMENTAL DESIGNS

- Research design is the framework or guide used for the planning, implementation, and analysis of a study.
- It is a systematic plan of what is to be done, how it will be done, and how the data will be analysed.
- Experimentation is the most scientifically sophisticated research method.
- It is observation under controlled conditions.
- In experimental design researcher is an active agent rather than passive observer.

Definition

- Research design: It can be defined as a blueprint of research study, which enables the researcher to know on whom, what, when, where, and how the study will be conducted.
- Experimental research design: Experimental research designs are concerned with examination of the effect of independent variable on the dependent variable, where the independent variable is manipulated through treatment or intervention(s), and the effect of these interventions is observed on the dependent variable.
- According to Riley, experimental research design is a powerful design for testing hypotheses of causal relationship among variables.

There are various types of experimental designs:

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- Pre-experimental designs
- True experimental designs
- Factorial designs
- Quasi -experimental designs

The selection of a particular design depends upon factors like:

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- Nature and purpose of the experiment
- The type of the variables to be manipulated
- The nature of the data
- The facilities for carrying out the experiment
- The competence of the experimenter

PRE – EXPERIMENTAL DESIGNS

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- This designs provide little or no control of extraneous or situation variables.
- Very simple & convenient to conduct these studies in natural setting
- Most suitable design for the beginners in the field of experimental research.
- They are considered “pre-,” indicating they are preparatory or prerequisite to true experimental designs.
- In pre-experimental designs, either a single group of participants or multiple groups are observed after some intervention or treatment presumed to cause change.
- Although they do follow some basic steps used in experiments, pre-experimental designs either fail to include a pre-test, a control or comparison group, or both; in addition, no randomization procedures are used to control for extraneous variables.

One Group Pretest Posttest Design

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- In this design , an experimenter measures dependent variable before the independent variable is applied or withdrawn and then takes its measurement again afterwards.

- The difference in the measurements of dependent variable is computed and is taken as the amount of change as a result of application of independent variable

Pre -test T1	Independent variable X	Post -test T2
Mean of the criterion test	Teaching through programmed instruction	Mean of the criterion test

- It is the simplest type of pre-experimental design, where only the experimental group is selected as the study subjects.

- A pre-test observation of the dependant variables is made before implementation of the treatment to the selected group, the treatment is administered, & finally a post test observation of dependant variables is carried out to assess the effect of treatment on the group.

Limitations

- This design does not use any control group therefore the experimenter cannot assume the difference between pre test mean and post test mean was brought about by experimental treatment or by some extraneous variable .
- Extraneous variables like history and maturation are no controlled.
- This design does not provide any procedure for evaluating the effect of post test itself.

True Experimental Designs

- True experimental research designs are those where researchers have complete control over the extraneous variables & can predict confidently that the observed effect on the dependable variable is only due to the manipulation of the independent variable.
- It provide full experimental control through the randomisation procedure.

Main Characteristics

- Manipulation: It refers to conscious control of the independent variable by the researcher through treatment or intervention(s) to observe its effect on dependent variable.
- Control: It refers to the use of control group and controlling the effects of extraneous variable in which researcher is interested.
- Randomization: It means that every subject has and equal chance of being assigned to experimental or control group. Randomization is used in true experimental research designs to minimize the threat of internal validity of the study and to eliminate the effect of extraneous variables on dependent variable.

Randomized Groups, Pre- Test Post -test Designs

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- Subjects are assigned to the experimental group and control group by random procedures.
- Administered a pre test T1 as a measure of dependent variable.
- The treatment is carried out only on experimental group.
- At the end of the experiment the experimental and control groups are administered a post test T2 as a measure of dependent variable.
- The difference between means of T1 and T2 is found for each group.
- These mean difference scores are compared with appropriate statistical test in order to ascertain whether the experimental treatment produced a significant effect than the control condition.

Randomly Assigned	Pre-Test	Independent Variable	Post Test
Control Group	T1	Teaching Through Traditional Method	T2
Experimental Group	T1	Teaching Through Structured Approach	T2

- ✔ In this research designs, subjects are randomly assigned to either the experimental or the control group.
- ✔ The effect of the dependent variable on both the groups is seen before the treatment (pre test).
- ✔ Later, the treatment is carried out on experimental group only.
- ✔ After-treatment observation of dependant variable is made on both the groups to examine the effect of the manipulation of independent variable on dependant variable.

The Randomized Solomon Four Group Design

- In this design subjects are assigned at random to the four groups.
- The experimental and one of the control group are administered a pre-test.
- The other two control groups are not pretested.
- The design enable the experimenter to control and measure both the main and interaction effects of testing.

Randomly assigned	Pre test	Independent variable	Post test
Control group(C1)	T1C1	Teaching through conventional method	T2C1
Control group (C2)	NO PRE-TEST	Teaching through structural approach	T2C2
Control group (C3)	NO PRE- TEST	Teaching through conventional method	T2C3
Experimental group(E)	T1E	Teaching through structural approach	T2E

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- The randomization assure equivalence between the groups prior to experimentation.
- It controls most of the extraneous variables.
- The second control group provides control over the interactive effect of pretesting and the experimental treatment.
- It provides control over any possible contemporary effects that may occur between pretesting and post testing.

Quasi- Experimental Designs

- his design is used in situations in which it is not possible for the experimenter to assign subjects randomly to groups or exercise full control over the scheduling of experimental conditions.
- This design provide as much control as possible under the existing condition.
- The prefix *quasi* means “resembling.”
- Thus quasi-experimental research is research that resembles experimental research but is not true experimental research.
- Although the independent variable is manipulated, participants are not randomly assigned to conditions or orders of conditions (Cook & Campbell, 1979)

Non Randomized Control Group Pretest Posttest Design

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- Is also known as “non equivalent control group design”. •
- This design is identical to the pre test- post test group design, except there is no random assignment of the study subjects in experimental and control groups.
- In this design experimental and control groups are selected without randomization.
- Dependent variables are observed in experimental as well as control groups before the intervention.
- Later the experimental group receives treatment, following which the post test observation of dependent variable is carried out for both the groups to assess the effect of the intervention or treatment on experimental group.

Group	Pre test	Independent variable	Post test
Experimental	T1	Experimental treatment	T2
Control	T1	Controlled condition	T2

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- Quasi experimental designs are more frequently used because they are more practical and feasible to conduct research.
- Where the sample size is small, and where randomization & availability of control group is not possible, this design is preferred.
- Quasi experimental design is more suitable for real natural world setting than true experimental designs.
- This design allows the researchers to evaluate the impact of quasi independent variables under naturally occurring conditions.

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- In some cases hypotheses are practically answered through this design.
- In this design there is no control over extraneous variables influencing the dependent variable.
- The absence of a control group and absence of control over the research setting makes the result of this design less reliable and weak for the establishment of causal relationship between independent & dependent variable.

UNIT 03

Qualitative Research Designs and Methods

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Qualitative research

- Qualitative research basically inductive or spiral in nature and has a very different structure .the researcher start with a tentative idea or question and these question become more specific with progress in research
- In qualitative research one start with observation and end with a theoretical position
- Inductive in nature ie,the research moves from specific to theory

Characteristics

- Aims to study real world situation
- Use inductive approach
- Give depth knowledge of the phenomenon
- Behaviour of the subject is not regular and predictable
- Doesn't perform in control situation
- Dominant strategy to collect data is purposive sampling
- A holistic perspective is needed

Major types

- **Historical Research**
- **Phenomenology**
- **Ethnography**
- **Grounded Theory**
- **Case Study**

HISTORICAL RESEARCH

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- Historical research to attempt establish fact so as to arrive at conclusion concerning past events
- Historical research is used to compare the records of the historical events and the activities surrounding them.it helps the organise historical events sequentially ,and the preserve historical data
- It is the critical investigation of historical events
- Analyse the past events and develop the present concept and conclusion

- Data collection

___ Primary source and secondary source

Data evaluation

External criticism and internal criticism

Primary sources: primary sources are eye witness accounts of data.in primary sources of data the observer his direct physical relationship with data

Secondary source: secondary source of data is indirectly observed constructs example:text books,periodicals,research journal etc

Data evaluation

- External criticism:it is called lower order criticism.it check the genuineness and authenticity of the data source

- Internal criticism
  Called higher order criticism.it is concerned with the validity and credibility of the data sources

Types of Historical Research

- Bibliographic research
- Legal research
- Studying the history of ideas
- Studying the history of institution

Steps of Historical Research

- Selection of the problem
- Formulation of hypotheses
- Collection of data
- Criticism of data
- Interpretation of data
- Writing of research report

Phenomenology

- The disciplinary origin of phenomenology is philosophy
- It is the descriptive study of how individual experience a phenomena
- Focuses on the experiences of people regarding a phenomenon and how they interpret these experiences

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- Phenomenology is way of thinking about ourselves instead of asking about what we are ,it focus on phenomena
- Ex.interviewing the wives of 10 prisoners of war and asking them to describe their experiences

Ethnography

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- It is disciplinary origin anthropology
- Ethnography the process of studying and describing a culture (a culture is a shared attitude,Norms,practices, language and materials things of a group of people)
- It research is an in depth forms of research where people are observed in their natural environment without any changes

Grounded theory

- Origin sociology
- Two sociologist -Barney G.Glaser and Anselm L.Strauss developed theory late 1960 ‘s
- It is a general methodology for developing theory that is grounded in data systematically gathered and analysed remarked

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Analytical and interpretive procedures are used for analysing and conceptualising data through coding(open coding,external coding,and selection coding)non statistical sampling writing of memos,diagramming of conceptual relationship,written and verbal report

Case study

- Case study research is mostly used to study an organisation or an entity.this research method has evolved over the years as one of the most valuable qualitative research method
- It is undertaken to examine a social unit as a whole

Types of case study

- Intrinsic case study: the objective is to understand the particulars of the case
- Instrumental case study: the objective to understand something more general than the case
- Collective case study:the objective the study and compare multiple cases in single research study

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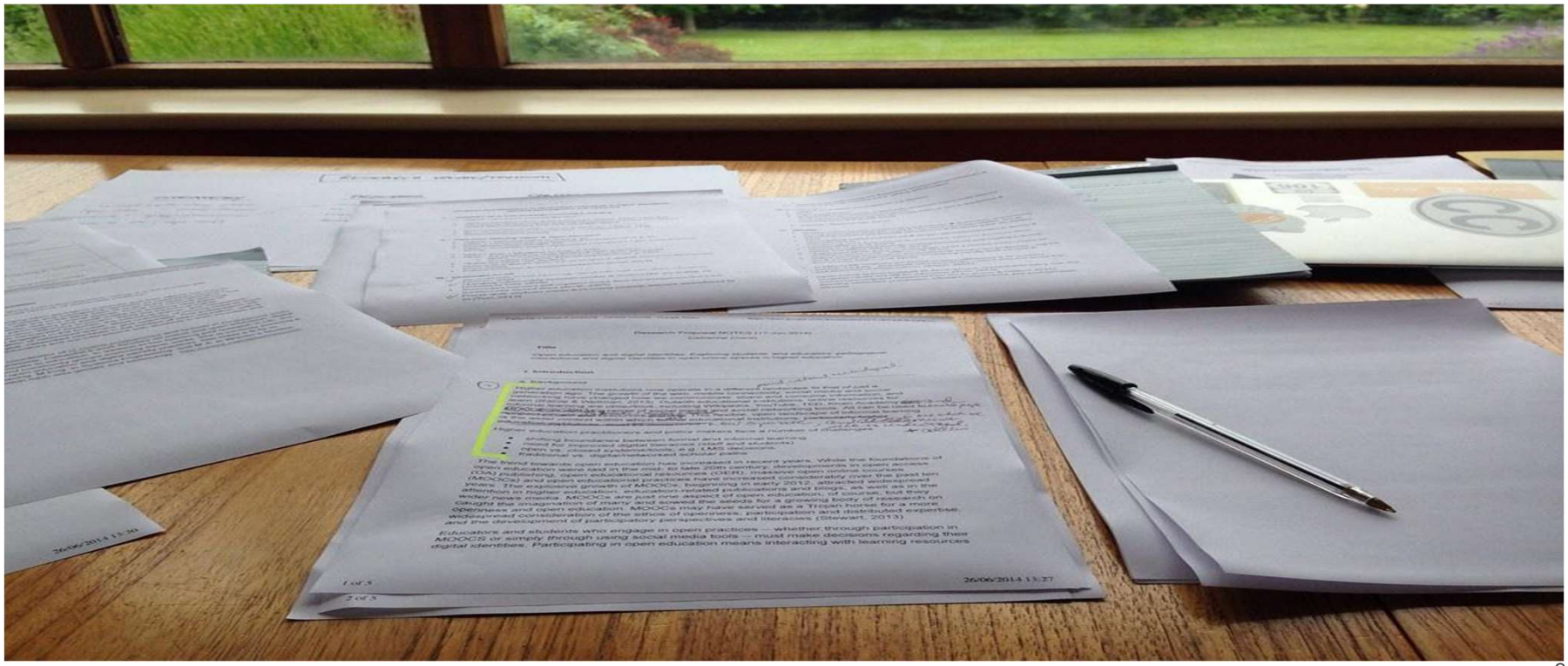
In the educational context ,case study may be used to study typical individuals(like, drug addicts,juvenile delinquents,school dropout,slow learners,gifted children etc.)

UNIT IV
Evaluation and Communication of Educational Research

Fousiya (FT)

Preparation and criticisms of Research Proposals



Definition

The goal of a research proposal is twofold: to present and justify the need to study a research problem and to present the practical ways in which the proposed study should be conducted. The design elements and procedures for conducting research are governed by standards of the predominant discipline in which the problem resides, therefore, the guidelines for research proposals are more exacting and less formal than a general project proposal. Research proposals contain extensive literature reviews. They must provide persuasive evidence that a need exists for the proposed study. In addition to providing a rationale, a proposal describes detailed methodology for conducting the research consistent with requirements of the professional or academic field and a statement on anticipated outcomes and/or benefits derived from the study's completion.

Krathwohl, David R. *How to Prepare a Dissertation Proposal: Suggestions for Students in Education and the Social and Behavioral Sciences*. Syracuse, NY: Syracuse University Press, 2005.

How to Approach Writing a Research Proposal

A proposal should contain all the key elements involved in designing a completed research study, with sufficient information that allows readers to assess the validity and usefulness of your proposed study. The only elements missing from a research proposal are the findings of the study and your analysis of those findings. Finally, an effective proposal is judged on the quality of your writing and, therefore, it is important that your proposal is coherent, clear, and compelling.

All research proposals must address the following questions:

1. **What do you plan to accomplish?** Be clear and succinct in defining the research problem and what it is you are proposing to research.
2. **Why do you want to do the research?** In addition to detailing your research design, you also must conduct a thorough review of the literature and provide convincing evidence that it is a topic worthy of in-depth investigation. Be sure to answer the "So What?" question.
3. **How are you going to conduct the research?** Be sure that what you propose is doable. If you're having difficulty formulating a research problem to propose investigating, **go here** for strategies in developing a problem to study.

Common Mistakes to Avoid

- **Failure to be concise**. A research proposal must be focused and not be "all over the map" or diverge into on unrelated tangents without a clear sense of purpose.
- **Failure to cite landmark works in your literature review**. Proposals should be grounded in foundational research that lays a foundation for understanding the development and scope of the issue.
- **Failure to delimit the contextual boundaries of your research** [e.g., time, place, people, etc.]. As with any research paper, your proposed study must inform the reader how and in what ways the study will examine the problem.
- **Failure to develop a coherent and persuasive argument for the proposed research**. This is critical. In many workplace settings, the research proposal is intended to argue for why a study should be funded.
- **Sloppy or imprecise writing, or poor grammar**. Although a research proposal does not represent a completed research study, there is still an expectation that it is well-written and follows the style and rules of good academic writing.
- **Too much detail on minor issues, but not enough detail on major issues**. Your proposal should focus on only a few key research questions in order to support the argument that the research needs to be conducted. Minor issues, even if valid, can be mentioned but they should not dominate the overall narrative.

Structure and Writing Style

Beginning the Proposal Process

As with writing most college-level academic papers, research proposals are generally organized the same way throughout most social science disciplines. The text of proposals generally vary in length between ten and thirty-five pages, followed by the list of references. However, before you begin, read the assignment carefully and, if anything seems unclear, ask your professor whether there are any specific requirements for organizing and writing the proposal.

A good place to begin is to ask yourself a series of questions:

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- What do I want to study?
- Why is the topic important?
- How is it significant within the subject areas covered in my class?
- What problems will it help solve?
- How does it build upon [and hopefully go beyond] research already conducted on the topic?
- What exactly should I plan to do, and can I get it done in the time available?

Most proposals should include the following sections

I. Introduction

II. Background and Significance

III. Literature Review

IV. Research Design and Methods

V. Preliminary Suppositions and Implications

VI. Time schedule

VII. Conclusion

VIII. Citations

Introduction

In the real world of higher education, a research proposal is most often written by scholars seeking grant funding for a research project or it's the first step in getting approval to write a doctoral dissertation. Even if this is just a course assignment, treat your introduction as the initial pitch of an idea or a thorough examination of the significance of a research problem. After reading the introduction, your readers should not only have an understanding of what you want to do, but they should also be able to gain a sense of your passion for the topic and to be excited about the study's possible outcomes. Note that most proposals do not include an abstract [summary] before the introduction.

Think about your introduction as a narrative written in two to four paragraphs that succinctly answers the following four questions:

1. What is the central research problem?
2. What is the topic of study related to that research problem?
3. What methods should be used to analyze the research problem?
4. Why is this important research, what is its significance, and why should someone reading the proposal care about the outcomes of the proposed study?

Background and Significance

This is where you explain the context of your proposal and describe in detail why it's important. It can be melded into your introduction or you can create a separate section to help with the organization and narrative flow of your proposal. Approach writing this section with the thought that you can't assume your readers will know as much about the research problem as you do. Note that this section is not an essay going over everything you have learned about the topic; instead, you must choose what is most relevant in explaining the aims of your research.

To that end, while there are no prescribed rules for establishing the significance of your proposed study, you should attempt to address some or all of the following:

- State the research problem and give a more detailed explanation about the purpose of the study than what you stated in the introduction. This is particularly important if the problem is complex or multifaceted.
- Present the rationale of your proposed study and clearly indicate why it is worth doing; be sure to answer the "So What? question [i.e., why should anyone care].
- Describe the major issues or problems to be addressed by your research. This can be in the form of questions to be addressed. Be sure to note how your proposed study builds on previous assumptions about the research problem.
- Explain the methods you plan to use for conducting your research. Clearly identify the key sources you intend to use and explain how they will contribute to your analysis of the topic.
- Describe the boundaries of your proposed research in order to provide a clear focus. Where appropriate, state not only what you plan to study, but what aspects of the research problem will be excluded from the study.
- If necessary, provide definitions of key concepts or terms.

Literature Review

Connected to the background and significance of your study is a section of your proposal devoted to a more deliberate review and synthesis of prior studies related to the research problem under investigation. The purpose here is to place your project within the larger whole of what is currently being explored, while demonstrating to your readers that your work is original and innovative. Think about what questions other researchers have asked, what methods they have used, and what is your understanding of their

To help frame your proposal's review of prior research, consider the "five C's" of writing a literature review:

1. **Cite**, so as to keep the primary focus on the literature pertinent to your research problem.
2. **Compare** the various arguments, theories, methodologies, and findings expressed in the literature: what do the authors agree on? Who applies similar approaches to analyzing the research problem?
3. **Contrast** the various arguments, themes, methodologies, approaches, and controversies expressed in the literature: describe what are the major areas of disagreement, controversy, or debate among scholars?
4. **Critique** the literature: Which arguments are more persuasive, and why? Which approaches, findings, and methodologies seem most reliable, valid, or appropriate, and why? Pay attention to the verbs you use to describe what an author says/does [e.g., asserts, demonstrates, argues, etc.].
5. **Connect** the literature to your own area of research and investigation: how does your own work draw upon, depart from, synthesize, or add a new perspective to what has been said in the literature?

Research Design and Methods

This section must be well-written and logically organized because you are not actually doing the research, yet, your reader must have confidence that it is worth pursuing. The reader will never have a study outcome from which to evaluate whether your methodological choices were the correct ones. Thus, the objective here is to convince the reader that your overall research design and proposed methods of analysis will correctly address the problem and that the methods will provide the means to effectively interpret the potential results. Your design and methods should be unmistakably tied to the specific aims of your study.

Describe the overall research design by building upon and drawing examples from your review of the literature. Consider not only methods that other researchers have used but methods of data gathering that have not been used but perhaps could be. Be specific about the methodological approaches you plan to undertake to obtain information, the techniques you would use to analyze the data, and the tests of external validity to which you commit yourself [i.e., the trustworthiness by which you can generalize from your study to other people, places, events, and/or periods of time].

Preliminary Suppositions and Implications

Just because you don't have to actually conduct the study and analyze the results, doesn't mean you can skip talking about the analytical process and potential implications. The purpose of this section is to argue how and in what ways you believe your research will refine, revise, or extend existing knowledge in the subject area under investigation. Depending on the aims and objectives of your study, describe how the anticipated results will impact future scholarly research, theory, practice, forms of interventions, or policymaking. Note that such discussions may have either substantive [a potential new policy], theoretical [a potential new understanding], or methodological [a potential new way of analyzing] significance.

Time schedule

Time allocated for conducting the research is to be noted in specifically

It will be the plan of the study for smooth conduction of research

Conclusion

The conclusion reiterates the importance or significance of your proposal and provides a brief summary of the entire study. This section should be only one or two paragraphs long, emphasizing why the research problem is worth investigating, why your research study is unique, and how it should advance existing knowledge.

Someone reading this section should come away with an understanding of:

- Why the study should be done,
- The specific purpose of the study and the research questions it attempts to answer,
- The decision to why the research design and methods used where chosen over other options,
- The potential implications emerging from your proposed study of the research problem, and
- A sense of how your study fits within the broader scholarship about the research problem.

Citations

As with any scholarly research paper, you must cite the sources you used. In a standard research proposal, this section can take two forms, so consult with your professor about which one is preferred.

1. **References --** lists only the literature that you actually used or cited in your proposal.
2. **Bibliography --** lists everything you used or cited in your proposal, with additional citations to any key sources relevant to understanding the research problem.

Communication of Research

Defining communication is much harder than it sounds. Indeed, scholars have argued about the topic for years, typically differing on the following topics:

– – –

Breadth: How many behaviors and actions should or should not be considered communication.

Intentionality: Whether the definition includes an intention to communicate.

Success: Whether someone was able to effectively communicate a message, or merely attempted to without it being received or understood.

Most definitions discuss five main components, which include

– – –

- ★ Sender
- ★ Receiver
- ★ context/environment,
- ★ medium, and
- ★ message

Approach

- Conceptualize
- plan and design
- implement a methodology
- analyze and interpret
- reconceptualize.

Communication Research Methods

In the field of communication, there are three main research methodologies: **quantitative, qualitative, and rhetorical.** As communication students progress in their careers, they will likely find themselves using one of these far more often than the others.

Ethics of Educational research.

Research ethics involves all ethical issues conserning the scientific research from choosing the research object to social consequences of research. Research ethics deal with all forms unethical action in research including the design, conducting and reporting of research, involving human experimentation, animal experimentation, scientific misconduct such as fraud, fabrication of data, plagiarism, violation of regulation of research, using medical patent unethically... etc.

The Importance of Research Ethics

They promote the aims of research, such as expanding knowledge.

They support the values required for collaborative work, such as mutual respect and fairness. This is essential because scientific research depends on collaboration between researchers and groups.

They mean that researchers can be held accountable for their actions. Many researchers are supported by public money, and regulations on conflicts of interest, misconduct, and research involving humans or animals are necessary to ensure that money is spent appropriately.

They ensure that the public can trust research. For people to support and fund research, they have to be confident in it.

They support important social and moral values, such as the principle of doing no harm to others.

Codes of Ethics

This means that you need to report your research honestly, and that this applies to your methods (what you did), your data, your results, and whether you have previously published any of it. You should not make up any data, including extrapolating unreasonably from some of your results, or do anything which could be construed as trying to mislead anyone. It is better to undersell than over-exaggerate your findings.

When working with others, you should always keep to any agreements, and act sincerely.

Objectivity

You should aim to avoid bias in any aspect of your research, including design, data analysis, interpretation, and peer review. For example, you should never recommend as a peer reviewer someone you know, or who you have worked with, and you should try to ensure that no groups are inadvertently excluded from your research. This also means that you need to disclose any personal or financial interests that may affect your research.

Carefulness

Take care in carrying out your research to avoid careless ~~mis~~takes. You should also review your work carefully and critically to ensure that your results are credible. It is also important to keep full records of your research. If you are asked to act as a peer reviewer, you should take the time to do the job effectively and fully.

Openness

You should always be prepared to share your data and results, along with any new tools that you have developed, when you publish your findings, as this helps to further knowledge and advance science. You should also be open to criticism and new ideas.

Respect for Intellectual Property

You should never plagiarise, or copy, other people's work and try to pass it off as your own. You should always ask for permission before using other people's tools or methods, unpublished data or results. **Not doing so is plagiarism.** Obviously, you need to respect copyrights and patents, together with other forms of intellectual property, and always acknowledge contributions to your research. If in doubt, acknowledge, to avoid any risk of plagiarism.

Confidentiality

You should respect anything that has been provided in confidence. You should also follow guidelines on protection of sensitive information such as patient records.

Responsible Publication

You should publish to advance to state of research and knowledge, and not just to advance your career. This means, in essence, that you should not publish anything that is not new, or that duplicates someone else's work.

Legality

You should always be aware of laws and regulations that govern your work, and be sure that you conform to them

UNIT I
Inferential Statistics – Part I

SHABANATH
FASALUL ABID
PRIYA
RANJITHA

SAMPLING

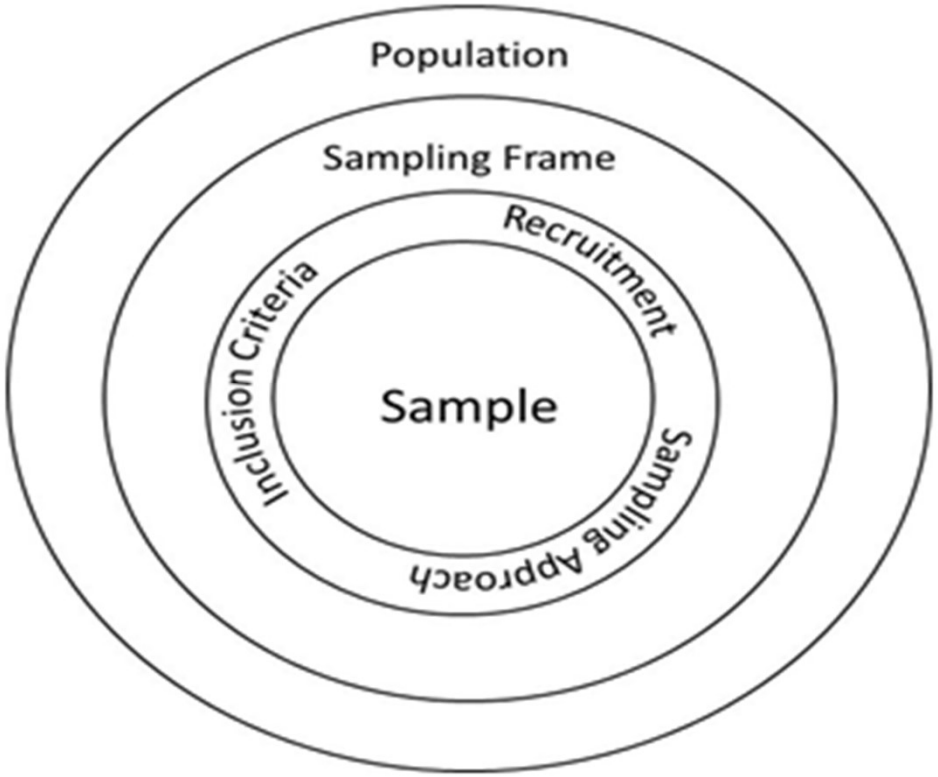
•Sampling is a process used in statistical analysis in which a predetermined number of observations are taken from a larger population.

•Sampling is a the process of selection of units (eg; people, organisation) from the population.

•The sample corresponds to the large population on the characteristics of interest. In that case , the researcher's conclusions from the sample are properly applicable to the entire population.

Population and Sample

- Population
  - Any group of individuals that have one or more characteristics in common
- Sample
  - A small proportion of population selected for observation and analysis
  - Can make inferences about the characteristics of population


Population
Sampling Frame
Recruitment
Sampling Approach
Inclusion Criteria
Sample

Steps in sampling

- Defining population
- Listing population
- Selecting a sample
- Obtain adequate sample

Types of sampling

Probability sampling

- Each has equal chance of being selected
- Possible when a list of population is available
- Population is relatively small

Non – probability sampling

§No equal chance

§When infinite number of population

§Population is relatively large/ spread in a large area

Sampling methods are divided into two main groups: **probability** and **non-probability sampling.**

- **Probability Sampling:**
- **Simple Random Sampling:**

selection at random by the researchers from a choice of subjects

- **Systematic Sampling:**

selecting by the researchers at numbered intervals, e.g. every one person in five in the target group

- **Non-probability Sampling**
- **Convenience Sampling:**

sampling those most convenient; those immediately available

- **Voluntary Sampling:**

the sample is self selecting; they come forward voluntarily in response to an appeal.

- **Stratified Sampling:**

  sampling within particular sections of the target groups,

  e.g. you target a specific number of people based on the percentage of the total group that share the same characteristics.

  So, for example, in a study of an organisation that had 50 supervisors & 800 labourers, a 10% representative sample of this population would target 5 supervisors & 80 labourers to interview.

- **Cluster Sampling:**

  surveying a particular cluster of the subject group.

- **Purposive Sampling:**

  enables you to use your judgement to choose people that are presented or are available that best meet your objectives or your target groups.

- **'Snowball' Sampling:**

  building up a sample through informants. You start with one person – who then suggests another & so on.

- **Event Sampling**

  using the opportunity presented by a particular event, e.g. a conference, to make contacts.

- **Time Sampling**
- Recognising that different times or days of the week or year may be significant and sampling at these times or days.

Sampling Error

•A sampling error is a statistical error that occurs when an analyst does not select a sample that represents the entire population of data. As a result, the results found in the sample do not represent the results that would be obtained from the entire population.

•Sampling error refers to the difference between the mean of the entire population and the mean obtained of the sample taken from the population.

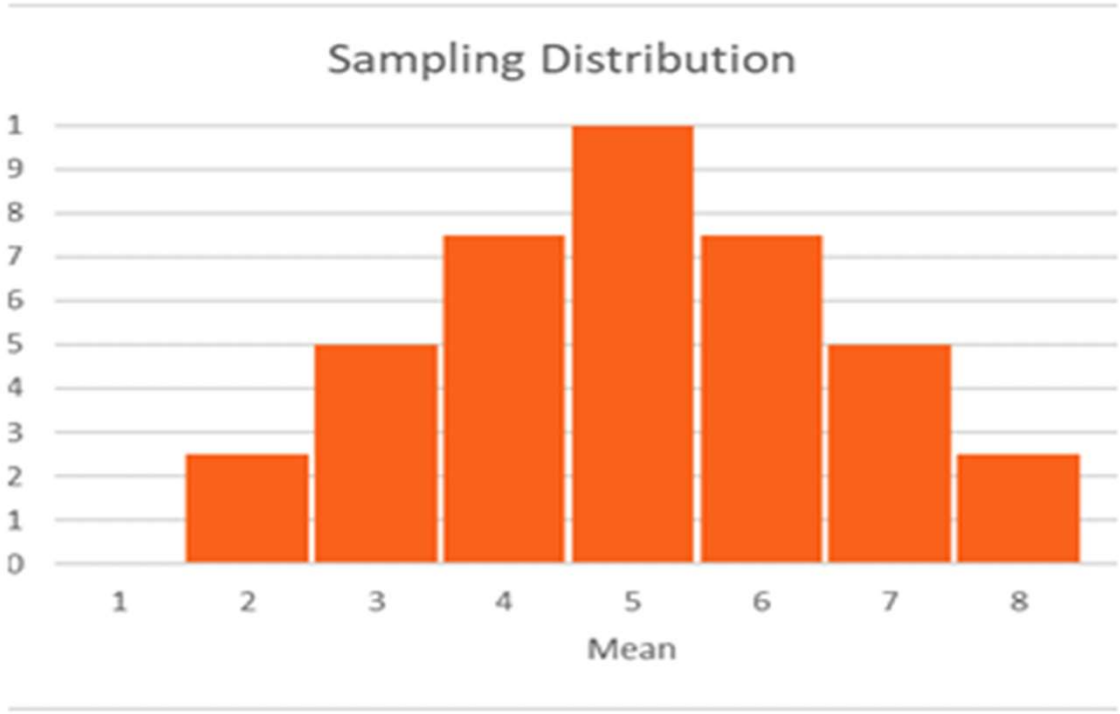
•A sampling error occurs when the sample used in the study is not representative ~~of the~~ whole population.

•Sampling is an analysis performed by selecting a number of observations from a larger population.

•Even randomized samples will have some degree of sampling error because a sample is only an approximation of the population from which it is drawn.

•The prevalence of sampling errors can be reduced by increasing the sample size.

•Random sampling is an additional way to minimize the occurrence of sampling errors.


Sampling Distribution
1
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
Mean

Sampling Distribution

• A sampling distribution is a probability distribution of a statistic obtained from a larger number of samples drawn from a specific population.

•The sampling distribution of a given population is the distribution of frequencies of a range of different outcomes that could possibly occur for a statistic of a population.

Standard error

– – –

•**Standard error** is the standard deviation of the sampling distribution of a statistic.

•The standard error (SE) of a statistic is the approximate standard deviation of a statistical sample population

•Standard error is nothing but the intra difference in the sample measurements of number of sample taken from a single population.

•Standard error plays a very crucial role in the large sample theory. It also may form the basis for the testing of a hypothesis. The statistical inference involved in the construction of the confidence interval is mainly based on standard error.

•The magnitude of the standard error gives an index of the precision of the ~~estim~~ate of the parameter. It is inversely proportional to the sample size, meaning that smaller samples tend to produce greater standard errors.

•The standard error can include the variation between the calculated mean of the population and one which is considered known, or accepted as accurate.

•The more data points involved in the calculations of the mean, the smaller the standard error tends to be.

•It can be abbreviated as S.E.

$$SE = \frac{\sigma}{\sqrt{n}}$$ — σ: standard deviation; n: number of samples

Directional and Non-directional Tests

•**Directional test** is a hypothesis test where a direction is specified.

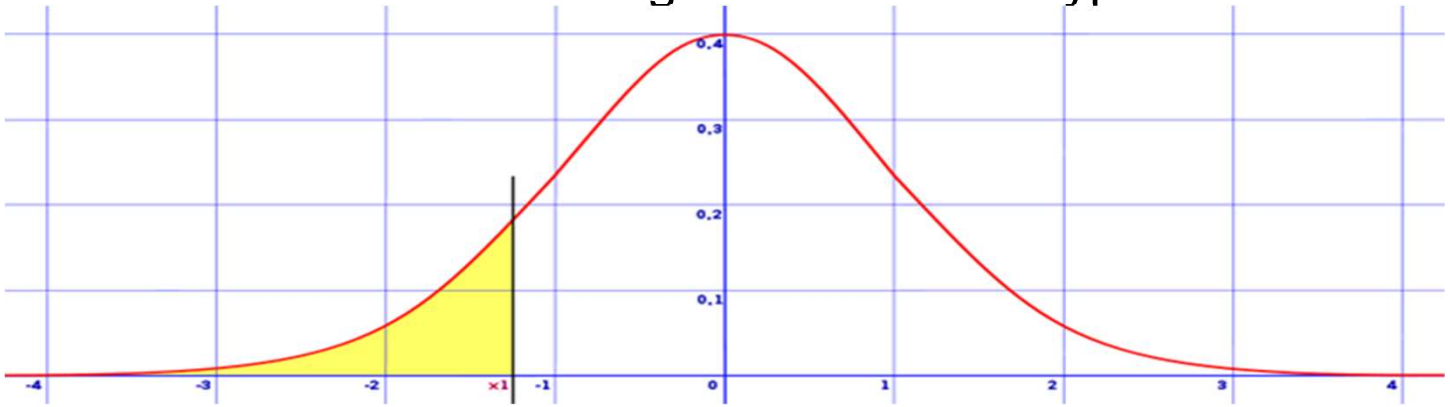
For example you might be interested in whether a hypothesized mean is greater than a certain number (you're testing in the positive direction on the number line), or you might want to know if the mean is less than that number (you're testing towards the negative direction).

•Directional tests are appropriate in situations where , expect a change that is either positive or negative, not both.

•Directional tests are also called one-tailed tests. This is because the critical region is in one tail and the error is all in one direction (either less than or greater than a central point, not both)

Directional test

•A **directional hypothesis** states not only that a null hypothesis is false, but also that the actual value of the parameter we're interested in is either greater than or less than the value given in the null hypothesis.



Non-directional Test

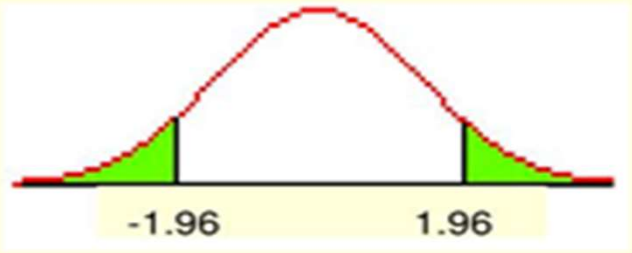
•Non-directional Hypothesis A two-tailed non-directional hypothesis predicts that the independent variable will have an effect on the dependent variable, but the direction of the effect is not specified.

E.g., there will be a difference in how many numbers are correctly recalled by children and adults.

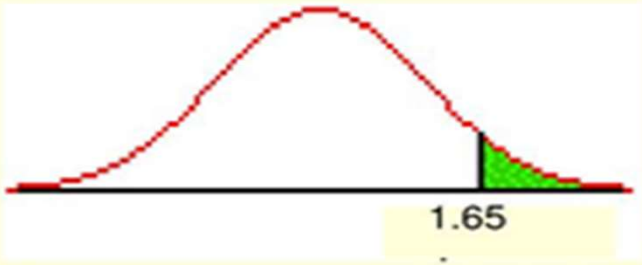
•The nondirectional alternative hypothesis states that there is a difference between the mean scores of two groups but does not specify which group is expected to be larger or smaller. If the calculated value for t exceeds the critical value at either tail of the distribution, than the null hypothesis can be rejected.

Non-Directional & Directional Hypotheses

- Nondirectional
  - H_o: there is no effect: $(\overline{X} = \mu)$
  - H_1: there IS an effect: $(\overline{X} \neq \mu)$
  - APPLY 2-TAILED TEST
    - 2.5% chance of error in each tail



- Directional
  - H_1: sample mean is larger than population mean $(\overline{X} > \mu)$
  - H_o $x \leq \mu$
  - APPLY 1-TAILED TEST
    - 5% chance of error in one tail



TYPE I ERROR AND TYPE II ERROR

In the context of testing hypotheses, there are basically two types of errors we make

- **Type I Error**
- **Type II Error**

Type I Error

*A type I error (false-positive) occurs if an investigator rejects a null hypothesis that is actually true in the population.

*A type I error, also known as an ***error of the first kind***,occurs when the null hypothesis (H) is true, but is rejected.

*A type I error may be compared with so called ***false positive.***

*A type I errors occurs when ***we believe a falsehood.***

***The rate of the type I error is called the size of the test and denoted by the **Greek letter α (alpha).**

* It usually equals the **significance level of a test.**

Type II Error

- Type II error, also known as an error of the **second kind**, occurs when the hypothesis is false, but erroneously fails to be rejected.
- Type II error means accepting the hypothesis which should have been rejected.
- A type II error may be compared with a so called **False Negative.**
- A type II error occurs when one rejects the alternative hypothesis(fails to rejects the null hypothesis) when the alternative hypothesis is true.
- The rate of the type II error is denoted by the Greek letter **β** (beta).

In the tabular form two error can be presented as follows:

	Null hypothesis (H_0) is true	Null hypothesis (H_0) is false
Reject null hypothesis	Type I error False positive	Correct outcome True positive
Fail to reject null hypothesis	Correct outcome True negative	Type II error False negative

Difference between Type I error and Type II error

Type I Error	Type II Error
a) Occurs when the null hypothesis (H0) is true, but is rejected.	a) Occurs when the null hypothesis is false, but erroneously fails to be rejected
b) •A type 1 error is called a false positive.	b) type 2 error is a false negative.
c) It denoted by the Greek letter α	c) It denoted by the *Beta β

Reducing Type I Errors•

Prescriptive testing is used to increase the level of confidence, which in turn reduces Type I errors. The chances of making a Type I error are reduced by increasing the level of confidence.

Reducing Type II Errors

Descriptive testing is used to better describe the test condition and acceptance criteria, which in turn reduces Type II errors. This increases the number of times we reject the Null hypothesis – ***with a resulting increase in the number of Type I errors*** (rejecting H0 when it was really true and should not have been rejected).

Test of significance

Test of significance is a formal procedure for comparing observed data with a claim (also called a hypothesis) whose truth we want to assess.

Test of significance is used to test a claim about an unknown population parameter.

A significance test uses data to evaluate a hypothesis by comparing sample point estimates of parameters to values predicted by the hypothesis.

A significance test or test of hypotheses is a method that uses sample data to decide between two competing claims.

The claim tested by a significance test is called the null hypotheses. Usually the null hypothesis is a statement about "no effect" or "no change." The claim that we are trying to gather evidence for – the researcher's point of view – is called the alternative hypothesis.

The alternative hypothesis is two-sided if it states that a parameter is different from the null hypothesis value. The alternative hypothesis is one-sided if it states that either a parameter is greater than or a parameter is less than the null hypothesis value.

UNIT II
Inferential Statistics – Part II

DEEPTHI
SHYMA

Parametric tests

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- Parametric tests are used for variables with distributions that fit certain criteria, such as symmetry and interval scales of measurement
- Parametric tests assume a normal distribution of values
- Parametric tests are in general more powerful (require a smaller sample size) than nonparametric tests.
- Typically, a parametric test is preferred because it has better ability to distinguish between the two arms. In other words, it is better at highlighting the weirdness of the distribution.
- Parametric tests most appropriate for Ratio data, interval data

t-test

- Goal: To ascertain if the difference in the means of two groups is significant
- Assumptions
  - Data are normally distributed (checked by looking at the histograms, reporting the mean/median/standard deviation, and by running Shapiro-Wilks)
  - If data come from different groups of people, then use Independent t-test (assumes scores are independent and variances in the populations are roughly equal)
  - If data come from same group of people, then use dependent t-test

T-test formula

The formula for the two-sample t-test (a.k.a. the Student's t-test) is shown below.

$$t = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\left(s^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)\right)}}$$

In this formula, t is the t-value, x_1 and x_2 are the means of the two groups being compared, s_2 is the pooled standard error of the two groups, and n_1 and n_2 are the number of observations in each of the groups.

A larger t-value shows that the difference between group means is greater than the pooled standard error, indicating a more significant difference between the groups.

Analysis of Variance

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- The analysis of variance (ANOVA) is the most widely used statistical test for hypothesis testing in factorial experiments
- Goal: To determine if an independent variable has a significant effect on a dependent variable
- An independent variable has at least two levels (test conditions)
- Goal (put another way): To determine if the test conditions yield different outcomes on the dependent variable (e.g., one of the test conditions is faster/slower than the other)

One-way ANOVA

- The one-way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups.
- The one-way ANOVA compares the means between the groups you are interested in and determines whether any of those means are statistically significantly different from each other. Specifically, it tests the null hypothesis:

$$H_0: \mu_1 = \mu_2 = \mu_3 = \cdots = \mu_k$$

where μ = group mean and k = number of groups. If, however, the one-way ANOVA returns a statistically significant result, we accept the alternative hypothesis (H_A), which is that there are at least two group means that are statistically significantly different from each other.

The Formula for ANOVA is:

$$F = \frac{\text{MST}}{\text{MSE}}$$

where:

$F = \text{ANOVA coefficient}$

$\text{MST} = \text{Mean sum of squares due to treatment}$

$\text{MSE} = \text{Mean sum of squares due to error}$

$$MST = \frac{\sum_{i=1}^{k}(T_i^2/n_i) - G^2/n}{k-1}$$

$$MSE = \frac{\sum_{i=1}^{k}\sum_{j=1}^{n_i} Y_{ij}^2 - \sum_{i=1}^{k}(T_i^2/n_i)}{n-k}$$

- where F is the variance ratio for the overall test, MST is the mean square due to treatments/groups (between groups), MSE is the mean square due to error (within groups, residual mean square), Y_{ij} is an observation, T_i is a group total, G is the grand total of all observations, n_i is the number in group i and n is the total number of observations.

TWO WAY ANOVA

The **two-way ANOVA** compares the mean differences between groups that have been split on **two** independent variables (called factors). The primary purpose of a **two-way ANOVA** is to understand if there is an interaction between the **two** independent variables on the dependent variable.

For example, you could use a two-way ANOVA to understand whether there is an interaction between gender and educational level on test anxiety amongst university students, where gender (males/females) and education level (undergraduate/postgraduate) are your independent variables, and test anxiety is your dependent variable.

The interaction term in a two-way ANOVA informs you whether the effect of one of your independent variables on the dependent variable is the same for all values of your other independent variable (and vice versa). For example, is the effect of gender (male/female) on test anxiety influenced by educational level (undergraduate/postgraduate)?

The F statistic depends on the term in the test. For factor A, the F-statistic is as follows:

$$F(A) = \frac{\text{MS}(A)}{\text{MS(Error)}}$$

For factor B, the F-statistic is as follows:

$$F(B) = \frac{\text{MS}(B)}{\text{MS(Error)}}$$

For the interaction between factor A and factor B, the F-statistic is as follows:

$$F(AB) = \frac{\text{MS}(AB)}{\text{MS(Error)}}$$

When the lack-of-fit test appears, the F-statistic is as follows:

$$F\left(\text{Lack-of-fit}\right) = \frac{MS(\text{Lack-of-fit})}{MS(\text{Pure error})}$$

The numerator and denominator degrees of freedom correspond to the degrees of freedom for the mean square.

ANCOVA

ANCOVA is a blend of analysis of variance (ANOVA) and regression. It is similar to factorial ANOVA, in that it can tell you what additional information you can get by considering one independent variable (factor) at a time, without the influence of the others.

Analysis of covariance is **used to test** the main and interaction effects of categorical variables on a continuous dependent variable, controlling for the effects of selected other continuous variables, which co-vary with the dependent. The control variables are called the "covariates."

ANCOVA is used in experimental studies when researchers want to remove the effects of some antecedent variable. For example: Pre-test scores are used as covariates in pre-test & post-test experimental designs.A

ANOVA is used to **compare** and contrast the means of two or more populations. ... **ANCOVA** is used to **compare** one variable in two or more populations while considering other variables.

In general terms, **covariates** are characteristics (excluding the actual treatment) of the participants in an experiment. ... **Covariates** may affect the outcome in a study. For **example**, you are running an experiment to see how corn plants tolerate drought.

UNIT III
Inferential Statistics – Part III

Radhika(PT)

Non parametric statistics of hypothesis testing

- Analysis of frequencies
- Chi- square test
- Sign test

Non parametric tests

- Statistical tests without parameters.
- Deliver accurate results even when the sample size is small
- More powerful than parametric tests even the assumptions of normality have been violated
- Suitable for all data type (nominal, ordinal, interval or the data which has outliers)
- Indifferent to population parameters
- Doesn’t mean any assumptions about the mean,Standard deviations etc of the parent population
- .

Non-parametric tests can be applied to situations when:

1. The data does not follow any probability distribution
2. The data constitutes of ordinal values or ranks
3. There are outliers in the data
4. The data has a limit of detection

Non parametric tests of hypothesis testing

Steps

- Set up hypothesis and opt a level of significance
- Set a test statistics
- Set decision rule
- Calculate test statistic
- Compare the test statistic to the decision rule

Set up hypothesis and opt a level of significance

★ Set up the null or alternative hypothesis

Level of significance :- Probability of making wrong decision

- Denoted by Alpha

★ Set a test statistics

The observed sample is converted into ranks and then ranks are treated as a test statistics.

★ Set decision rule :- Statement that tells when to reject the null hypothesis
★ Calculate test statistic :- Use the ranks to compute the test statistic
★ Compare the test statistic to the decision rule :- Accepting or rejecting the null hypothesis on the basis of comparison.

One-factor Chi-Square test

The chi-square test is sometimes called a "goodness-of-fit" test, because it asks whether there is a good fit between obtained data and theoretical data.
used to analyze nominal data

compares observed frequencies to frequencies that would be expected under the null hypothesis

The "levels" of the variable are discrete, mutually exclusive categories, and the data consist of frequencies or counts for each category.

Types

- 2 types: test of independence and test of goodness of fit

o In both cases, independence of observations is required.

- With the chi square, we are comparing data that we actually gather to what we would expect based

on a theory.

- Used with frequency counts in categories. Comparing

observed frequencies to expected frequencies. Uses a chi

square distribution of values.

Frequency counts - Comparing number of people in each category, rather than comparing means, variances, and other values

o Chi square distribution - Positively skewed curve, changes depending on df

o Observed frequencies (O) - Actual count of events in a category

o Expected frequencies (E) - Theoretical frequency

---

based on the null hypothesis. These are the values we'd expect to see if the null hypothesis is true

o We compare the observed and expected frequencies

using a chi square test

- Chi sq distribution

o Theoretical distribution, changes as df changes,

positively skewed (no negative values)

Test of Independence

- Tests whether two variables are independent of each other
  - Null hypothesis: there is no relationship between Variable A and Variable B
  - Alternative hypothesis: there is a relationship between Variable A and Variable B

Example

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o Two categorical variables (Variable A & Variable B): Gender & Favorite Food

o Main question: Are these variables related?

H0: There is no relationship between them

• By knowing a person's favorite food, you can predict whether they are male or female.

Ha: There is a relationship between them

• By knowing a person's favorite food, you can predict whether they are male or female.

Goodness of Fit

- Compares observed values to a theory

o Null hypothesis: there is no difference between the observed values and our theory (our theory

works!)

o Alternative hypothesis: there is a difference between the observed values and our theory (time to

rethink things!)

o This is opposite - usually we want to reject the null, but here we want to retain it.

- Example: I think that people become more inactive as they get older.

o I would collect data and compare this to some expected values, using the chi square test.

o Here, I want to retain the null hypothesis - this means my theory is possible

Using chi square

- Use when you have categories with counts, rather than scores
- Observations must be independent
  - Independence of observations, not variables
  - Subjects only appear in one cell of the table
- Conclusions only apply when a sample is representative of the population
  - Use random sampling

The Concept of Expected Frequencies

Expected frequencies fe : the cell frequencies that would be expected in a bivariate table if the two tables were statistically independent.

Observed frequencies fo: the cell frequencies actually observed in a bivariate table.

Calculating Expected Frequencies:

fe = (column marginal)(row marginal) / N

To obtain the expected frequencies for any cell in any cross-tabulation in which the two variables are assumed independent, multiply the row and column totals for that cell and divide the product by the total number of cases in the table.

Chi-Square (obtained):

The test statistic that summarizes the differences between the observed (fo) and the expected (fe)

frequencies in a bivariate table.

The calculation of the Chi-Square statistic is quite straight-forward and intuitive:

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}$$

where fo = the observed frequency (the observed counts in the cells)

and fe = the expected frequency if NO relationship existed between the variables

SIGN TEST

It is a non-parametric or “distribution free” test, which means the test doesn’t assume the data comes from a particular distribution, like the normal distribution. The sign test is an alternative to a one sample t test or a paired t test. It can also be used for ordered (ranked) categorical data.The sign test compares the sizes of two groups.It can also be used for ordered (ranked) categorical data.

The null hypothesis for the sign test is that the difference between medians is zero.For a one sample sign test, where the median for a single sample is analyzed, see: One Sample Median Tests.

Types of sign test

One sample: We set up the hypothesis so that + and - signs are the values of random variables having equal size.

Paired sample: This test is also called an alternative to the paired sample t-test. This test uses the + and - signs in paired sample tests or in before-after study. In this test, null hypothesis is set up so that the sign of + and - are of equal size, or the population means are equal to the sample mean.

Procedure:

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Calculate the + and – sign for the given distribution. Put a + sign for a value greater than the mean value, and put a – sign for a value less than the mean value. Put 0 as the value is equal to the mean value; pairs with 0 as the mean value are considered ties.

Denote the total number of signs by ‘n’ (ignore the zero sign) and the number of less frequent signs by ‘S.’

Obtain the critical value (K) at .05 of the significance level by using the following formula in case of small sampl

$$K = \frac{n-1}{2} - 0.98\sqrt{n}$$

Sign test in case of large sample

$$Z = \frac{S - np}{\sqrt{np(1-p)}}$$

binominal distribution formula (with p =½) =

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$$ {}^{n}C_{x}\, q^{n-x}, p_{x} $$

Compare the value of ‘S’ with the critical value (K). If the value of S is greater than the value of K, then the null hypothesis is accepted. If the value of the S is less than the critical value of K, then the null hypothesis is accepted. In the case of large samples, S is compared with the Z value.

Assumptions for the test

The data should be from two samples.

The two dependent samples should be paired or matched. For example, depression scores from before a medical procedure and after.

To set up the test, put your two sets of sample data into a table

This set of data represents test scores at the end of Spring and the beginning of the Fall semesters. The hypothesis is that the summer break means a significant drop in test scores.

H0: No difference in median of the signed differences.

H1: Median of the signed differences is less than zero.

Step 1: Subtract set 2 from set 1 and put the result in the third column.

#	Set 1	Set 2	Set 1 – Set 2	Sign
1	443	57	386	+
2	421	352	69	+
3	436	587	-151	-
4	376	415	-39	-
5	458	458	0	NA
6	408	424	-16	-
7	422	463	-41	-
8	431	583	-152	-
9	459	432	27	+
10	369	379	-10	-
11	360	370	-10	-
12	431	584	-153	-
13	403	422	-19	-
14	436	587	-151	-
15	376	415	-39	-
16	370	419	-49	-
17	443	57	386	+

Step 2: Add a fourth column indicating the sign of the number in column 3.

Step 3: Count the number of positives and negatives.

4 positives.

12 negatives.

12 negatives seems like a lot, but we can't say for sure that it's significant (i.e. that it didn't happen by chance) until we run the sign test.

Step 4: Add up the number of items in your sample and subtract any you had a difference of zero for (in column 3). The sample size in this question was 17, with one zero, so n = 16.

Step 5: Find the p-value using a binomial distribution table or use a binomial calculator. I used the calculator, putting in:

.5 for the probability. The null hypothesis is that there are an equal number of signs (i.e. 50/50). Therefore, the test is a simple binomial experiment with a .5 chance of the sign being negative and .5 of it being positive (assuming the null hypothesis is true).

16 for the number of trials.

4 for the number of successes. “Successes” here is the smaller of either the positive or negative signs from Step 2.

The p-value is 0.038, which is smaller than the alpha level of 0.05. We can reject the null hypothesis and say there is a significant difference.


thank
you