Introduction to Research

- Objectives:
- At the end of the topics in the learning guide the students are expected to:
- Explain the meaning of research
- Describe the characteristics of research
- List the competencies and skills needed in conducting research
- Describe briefly the research process
- Explain why research is important in TVET
- Describe some problems/situations demanding research in TVET.

1.1. Definition of Research

- **Research** is a systematic investigation of phenomena which includes collection, presentation, analysis, and interpretation of facts that links an individual's speculation with reality.

- **Research** is a systematic study of trend or event which involves careful collection, presentation, analysis, and interpretations of quantitative data or facts that relates man's thinking with reality.

Conti...

- **Research** is a systematic and refined technique of thinking, employing specialized tools, instruments and processes in order to obtain a more adequate solution to the problem.

- **Research** is searching for a clarifying explanation of an observed phenomenon or finding a solution to an existing problem in the workplace or environment.

Characteristics of Research

- It demands a clear statement of the problem
- It requires a plan (it is not aimlessly " looking" for something in the hope that you will come across a solution)
- It builds on existing data, using both positive and negative findings
- New data should be collected as required and be organized in such a way that they answer the research question(s)

Summarize: characteristics of research

1. The research should focus on priority problems.
2. The research should be systematic
3. The research should be logical.
4. The research should be reductive. This means that one researcher's findings should be made available to other researchers to prevent them from repeating the same research.
5. The research should be replicable. This asserts that there should be scope to confirm previous research findings in a new environment and different settings with a new group of subjects or at a different point in time.
6. The research should be generative. This is one of the valuable characteristics of research because answering one question leads to generating many other new questions.
7. The research should be action-oriented. In other words, it should be aimed at solving to implement its findings.
8. The research should follow an integrated multidisciplinary approach, i.e., research approaches from more than one discipline are needed.
9. The research must be relatively simple, timely, and time-bound, employing a comparatively simple design.
10. The research results should be presented in formats most useful for administrators, decision-makers, business managers, or community members.

Competence and Skill Needed in Research

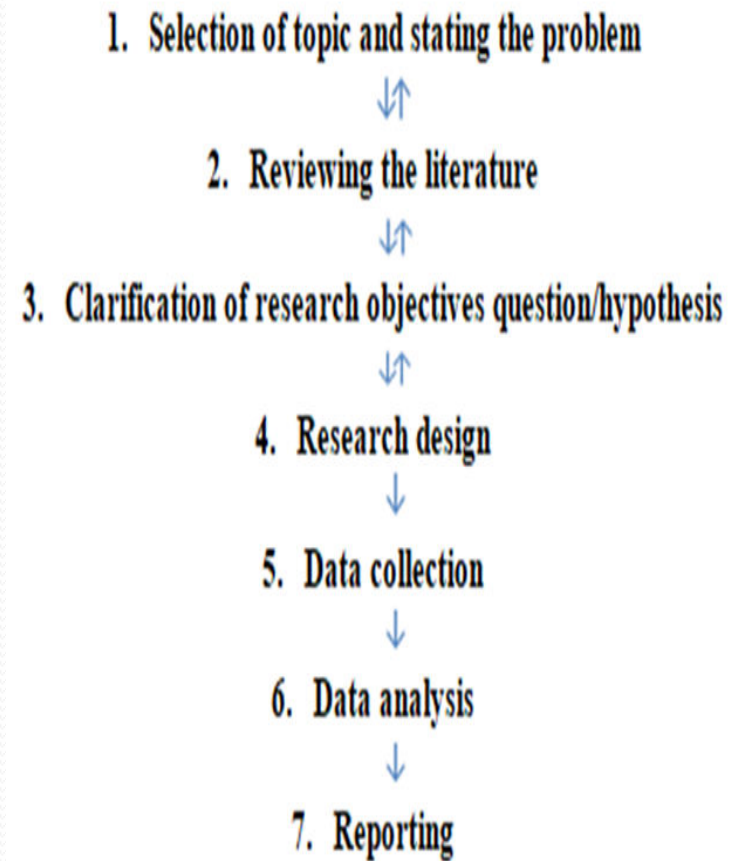**Competence in the use of library**

- Do you have the skill to use the library?
- Can you locate the necessary information you would need with the least time?
- Do you know how to use the card catalogue?
- Are you aware of the rules and regulations set by the library management?

The Research process

There are different stages in conducting research:

Selecting research problem

- Defining the research problem (research question, hypothesis).
- Conceptualizing the research from a theoretical framework (literature review)
- Determining the research design
- Gathering data;
- Analyzing and interpreting findings
- Making conclusions.
- Recommendation

1. Selection of topic and stating the problem
⇓⇑
2. Reviewing the literature
⇓⇑
3. Clarification of research objectives question/hypothesis
⇓⇑
4. Research design
↓
5. Data collection
↓
6. Data analysis
↓
7. Reporting

Research as source of knowledge

- **Experience**
  - Experience is a familiar and well-used source of knowledge.
- **Authority**
  - Authority is a quick and easy source of knowledge.
- **Deductive reasoning**
  - From theory and observation.
  - From general to specific

  For example, "All spiders have eight legs. A tarantula is a spider. Therefore, tarantulas have eight legs." For deductive reasoning

- **Inductive reasoning**
  - reverse of the deductive method or reason
  - To generalizing from the examples to the whole class.
  - Dogs A and B have fleas

  For example: ducks have always come to our pool. Therefore, the ducks will come to our pool this summer.

- **The scientific approach**
  - Scholars began to integrate the most important aspects of the inductive and deductive methods into a new technique, namely the inductive–deductive method, or the scientific approach.

Type of Research

- Descriptive research
- Survey
- Historical
- Explanatory
- Ex- post facto research
- Conceptual
- Exploratory
- Case study
- Tracer study
- Experimental
- Empirical
- Correlation

- Analytical Research
- Basic / pure/ Fundamental
- Applied
- Action
- Social impact assessment
- Evaluation
- Developmental
- Causal
- Qualitative
- Quantitative
- Online research

Type of Research

1. Descriptive research:-

- Describes the characteristics of the population or phenomenon that exist at present , define or explain picture of person , object , events and group by verbal or words.
- Not explain a new issues, events and so on
- Used for social science and business research
- It focus on **What , when , where, who and how** questions, If a research problem, rather than the why?

  Example questions: how something ,this or that has happened? Who is involved ?
  - What are the most popular online news sources among under-18s?
  - How prevalent is disease A in population B?
  - What is computer?
- It's concerned with:
  - Conditions and relationships that exists,
  - Practices that succeed ,
  - Beliefs or attitudes that are held,
  - Processes that are going on,
  - Effects that are being touched
- Descriptive methods
  - Some are **surveys, interviews, observations, case studies, and portfolios**.
  - The data collected methods can be either **quantitative or qualitative.**

2. Survey research:-

- Conducting gather data in many different fields
- Comprehensively and in detail survey
- Most commonly used survey is done to:
  - Describe the nature of existing conditions,
  - To identify standards against which existing conditions can be compared
  - To determine the relationship that exists b/n specific events
- Ask question for respondents :
  - Their attitudes/beliefs/opinions(problem of the organization)
  - Characteristics(married, single, divorced, age,etc)
  - Past and present behaviors
  - Expectation(what will happen as a result of some activities)
  - Self classification(social class, rich ,poor)
- There are survey methods:
  - **Questionnaire**
  - **Interview**
  - **Internet survey**
  - **Documents**

3. Historical Research:-

- Conducting to conclusions trends, causes and effects of past occurrences that may help explain present events and anticipating future events

- The data may include demographic records such as birth and death certification, newspapers articles and diaries and archive.

  - Example: Adwa victory (decribe how they got victory and etc)

- If a research problem, imposible why?

- Methods

  - **documentary, biographical, oral history, and archival methods**, in addition to many of the methods commonly used across the social sciences.

4. Explanatory

- Conducting to elaborates or explains not just the reasons behind the relationship of two factors, but also the ways by which such relationship exists.
- When you encounter an issue that is already known and have a description of it , you may begin to wonder why things are the way they are.
- It Desire to know "why" to explain and looks for cause and reasons
- It is responsible for finding the why of the events by establishing cause-effect relationships.
- In this sense, explanatory studies can deal with the determination of causes (post-facto research) and effects (experimental research) through hypothesis testing.
- **For example**, you might want to know why people buy certain products, why companies change their business processes, or what motivates people in the workplace. Explanatory research starts with a **theory or hypothesis** and then gathers evidence to prove or disprove the theory.
- **For example**: A *descriptive researchers*: may discover 10 percent of the parents abuse their children, where as The *explanatory researcher*: is more interested in learning why parents abuse their children
- It called as Causal Research and experimental research

- This research, Mostly the research starts from **<u>exploratory research</u>**, then descriptive research and then explanatory research.

What are the examples of explanatory research?

- Descriptive research can tell that 20% of the students are failed in the exam. Explanatory research can tell that what is the reason behind this failure.
- Descriptive research answers that a computer system with more RAM has more speed. Explanatory research answers the question that why a computer system with more RAM has more speed as compared to a computer system with less RAM.
- Descriptive research can tell that all of the male students have more crazy behavior as compared to female students. The explanatory research explains that what is the reason behind this failure.
- Some important methods of explanatory research design include the followings;
  - Depth Interview
  - Case Analysis Research/ case study
  - Tracer study
  - Focus Group Research
  - Literature Research

5. Exploratory

- It seeks to explore and investigate a problem that has not been clearly defined.

- The purpose of exploratory research is broken down into three main elements to gain a better understanding of topics or problems that are vague and not clearly defined, to form hypothesises to be examined and test the feasibility of ideas.

- Exploratory research is a methodology approach that explores research questions that have not previously been studied in depth. It is often used when the issue you're studying is new, or the data collection process is challenging in some way

- Exploratory research applications include case studies, field observations, focus groups, and interviews. Descriptive research applications include descriptive surveys, descriptive-normative surveys, descriptive analysis surveys, and correlative surveys.
- Exploratory research questions are designed to help you understand more about a particular topic of interest.
- It can help you connect ideas to understand the groundwork of your analysis without adding any assumptions yet.
- Some examples:
  - What effect does using a digital notebook have on the attention span of middle schoolers?
  - What factors influence mental health in undergraduates?
  - How can the use of a grocery delivery service reduce food waste in single-person households?

Some important methods

- Survey methodology
- Focus groups: (8-10)
- Interview
- Case study
- Literature review
- Online polls, surveys, blog posts, or interviews; social media:

6. Experimental Research

- Experimental research is a scientific approach to research, where one or more independent(cause) variables are manipulated/controlled by researcher and applied to one or more dependent(effect) variables to measure their effect on the latter.
- The effect of the independent variables on the dependent variables is usually observed and recorded over some time, to aid researchers in drawing a reasonable conclusion regarding the relationship between these 2 variable types.

Example:

- Imagine taking 2 samples of the same plant and exposing one of them to sunlight, while the other is kept away from sunlight. Let the plant exposed to sunlight be called **sample A**, while the latter is called **sample B.**
- If after the duration of the research, we find out that sample A grows and sample B dies, even though they are both regularly wetted /giving water and given the same treatment. Therefore, we can conclude that sunlight will aid growth in all similar plants.
- They are of 3 types, namely; pre-experimental, quasi-experimental, and true experimental research.

7. Ex post facto research

- **Ex post facto design**, also known as "**after-the-fact**" research, how an independent variable affects a dependent variable.
- 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
- Ex post facto attempts to determine a **cause-and-effect** relationship between an independent variable and a dependent variable.
- The independent variable, however, cannot be manipulated or altered, in which ex post facto studies will look at how a particular characteristic, trait, or past occurrence affects the dependent variable.

Example:

- If the researcher wants to examine the reason behind the occurrence of cancer in a person, then they may try to trace the possible reasons that might have led to cancer. The possibilities may be excess of smoking/ heredity/ diet habits and so on

- *In this Research* ,there can be two designs or forms of research and these are Prospective research design and Retrospective research design.
  - When the researcher tries to find out the future or potential results that is, the effect after treating the independent variable or the cause, then the researcher is actually trying to examine the prospective or the future results.
    - For example, if the researcher wants to examine the effects of excess of smoking, then the subject may be asked to smoke under varied conditions which may result in cancer.
  - The Retrospective research design on the other hand is one in which the researcher tries to trace the history in order to find out the basic reason behind an event.
    - For example, if the researcher wants to examine the reason behind the occurrence of cancer in a person, then they may try to trace the possible reasons that might have led to cancer. The possibilities may be excess of smoking/ heredity/ diet habits and so on.

8. Empirical research

- **Empirical research** is based on observed and measured phenomena and derives knowledge from actual experience rather than from theory or belief.

- Empirical research is defined as any research where conclusions of the study is strictly drawn from concretely empirical evidence, and therefore "verifiable" evidence.

- Empirical research can be conducted and analyzed using qualitative or quantitative methods.

- **For instance**, a study is being conducted to determine if working from home helps in reducing stress from highly-demanding jobs. An experiment is conducted using two groups of employees, one working at their homes, the other working at the office. Each group was observed. The outcomes derived from this research will provide empirical evidence if working from home does help **reduce stress or not.**

9. Correlational research

- Correlational research is a type of non-experimental research/ method in which a researcher measures two variables and understands and assesses the statistical relationship between them with no influence from any extraneous variable.

- Using statistically corresponding(by statistic formula B/n X and Y , on depend X variable to tell about Y)

- Correlational research is a type of research method that involves observing two variables in order to establish a statistically corresponding relationship between them. The aim of correlational research is to identify variables that have some sort of relationship do the extent that a change in one creates some change in the other.

- Example:- left foot or right measure , 100 sampling from student after all finished measured if correlated will 1 so left foot and right are equal (Left 25 and Right 25)

- If correlated will 0 , X and Y are not related , measure both X and Y

- If it will -1 , X opposite of Y , let say X max and Y Min shoes size.

Typically there are three types of correlational research:

- **Positive correlation**: A positive relationship between two variables is when an increase in one variable leads to a rise in the other variable. A decrease in one variable will see a reduction in the other variable.
  - *For example, the amount of money a person has might positively correlate with the number of cars the person owns.*
- **Negative correlation**: A negative correlation is quite literally the opposite of a positive relationship. If there is an increase in one variable, the second variable will show a decrease and vice versa.
  - *For example, being educated might negatively correlate with the crime rate when an increase in one variable leads to a decrease in another and vice versa. If a country's education level is improved, it can lower crime rates. Please note that this doesn't mean that lack of education leads to crimes. It only means that a lack of education and crime is believed to have a common reason – poverty.*
- *Zero / No correlation*: There is no correlation between the two variables in this third type. A change in one variable may not necessarily see a difference in the other variable.
  - *For example, being a millionaire and happiness are not correlated. An increase in money doesn't lead to happiness.*

10. Basic / pure/ Fundamental/ Theory Research

- Basic Research is a type of research used in the scientific field to understand and extend our knowledge about a specific phenomenon or field.
- It is also accepted as pure investigation or fundamental research
- It approach that is aimed at gaining a better understanding of a subject, phenomenon or basic law of nature.
- This type of research is primarily focused on the advancement of knowledge rather than solving a specific problem.
- Typically, basic research can be **exploratory, descriptive or explanatory;**
  - New theory
  - Add new K/dg
  - Universal scope
  - Theoretical than practical

Examples of basic research

- A study of how stress affects labor productivity.
- Studying the best factors of pricing strategies.
- The understanding of the leadership style of a particular company.
- How does the Language Acquisition Device work on children?
- How do teaching methods affect student's concentration in class?
- A research to discover the components of the human DNA.
- An investigation into the symptoms of Coronavirus.

11. Action Research

- Action research is a strategy that tries to find realistic solutions to organizations' difficulties and issues. It is similar to applied research.
- To solve immediate problems
- To enhance or improve of the existing system/ situation
- It applied in education sector
- Example:
  - *Imagine that you are interested in examining a specific problem that occurs in school. For this activity, you need to identify a problem (e.g., fewer girls are enrolling in advanced math courses after middle school), devise a plan (develop an intervention for teachers to help increase the interest of female students in advanced math), implement the plan (have the teachers conduct the intervention for two quarters), observe the outcome (circulate surveys questioning how the students rate their math and career interest), and reflect on the process (note whether the intervention was successful or not, and discuss possible areas of improvement). After writing down the five steps on paper, reflect on the process and how effective you think that action research was.*

Methods of Action Research

- There are many methods to conducting action research. Some of the methods include:
  - Observing individuals or groups
  - Using audio and video tape recording
  - Using structured or semi-structured interviews
  - Taking field notes
  - Using or taking photography
  - Distributing surveys or questionnaires

12. Applied Research

- Applied research is a type of examination looking to find practical solutions for existing problems.
- These can include challenges in the workplace, education and society.
- This research type uses empirical methodologies, such as experiments, to collect further data in an area of study. Findings are applicable and usually implemented upon completion of a study.
- Applied research focuses on answering one specific question for a client or sponsor.
- It's a type of research method for applying natural sciences to real life to improve the human condition.
- Start from Basic research , Apply the theories in practical / Activities
- To new application /technology of existing theories

Types of applied research

- **Action research:** Action research helps businesses find practical solutions to problems by guiding them.
- **Evaluation research:** In evaluation research, researchers analyze existing information to help clients make an informed decision.
- **Research and development:** Research and development focus on creating new products or services to meet a target market's needs.

Example:

- Applied study to understand the reach of online learning initiatives.
- Applied study to promote teacher-student classroom engagement.
- Applied study on the new math program.
- It can improve hiring.
- It improves work and policy.
- It identifies workplace skill gaps.
- Applied study to understand the reach of online learning initiatives.
- Applied study to promote teacher-student classroom engagement.
- Applied study on the new math program.
- The applied study is put into practice to cure a disease.
- The applied study is put into practice to improve agricultural practices.
- The applied study is applied to testing new laboratory equipment.

Type of Research	Primary Purposes	Characteristics
Basic/Fundamental	Broadening the knowledge and not the immediate solution of a problem.	• Directed towards evolving new or additional knowledge or enhancement of subject matter. • Involves developing and testing theories.
Applied	Aims at finding a solution to an observed practical problem.	• Directed towards practical application of knowledge. • It can also aims at testing a theory to evaluate its usefulness in education, business, management and the like.
Action	Primary purpose is to find an immediate solution to a situational problem.	• The findings are used to improve bothering current situations. • It is situational. • Findings are true for the specific situations only and cannot be used to generalize other situations.
Developmental	For producing new materials, products, and devices: installing new process, systems and service.	• For the substantial improvements of existing products, processes and devices.

13. Qualitative vs. Quantitative Research

- Quantitative researchQuantitative research is **expressed in numbers and graphs**. It is **used to test or confirm** theories and assumptions. This type of research can be used to establish **generalizable facts** about a topic.

- Common quantitative methods include experiments, observations recorded as numbers, and surveys with closed-ended questions.

- Quantitative research is at risk for research biases including information bias, omitted variable bias, sampling bias, or selection bias.

- Qualitative research : Qualitative research is **expressed in words**. It is **used to understand** concepts, thoughts or experiences. This type of research enables you to gather **in-depth insights** on topics that are not well understood.

- Common qualitative methods include interviews with open-ended questions, observations described in words, and literature reviews that explore concepts and theories.

- Qualitative research is also at risk for certain research biases including the Hawthorne effect, observer bias, recall bias, and social desirability bias.

14. Longitudinal vs cross-sectional

- The opposite of a longitudinal study is a cross-sectional study. While longitudinal studies repeatedly observe the same participants over a period of time, cross-sectional studies examine different samples (or a "cross-section") of the population at one point in time. They can be used to provide a snapshot of a group or society at a specific moment.

Chapter 3

RESEARCH PLANNING AND DEVELOPMENT

3.1 Identifying/selecting a topic

- Criteria for selecting a Research problem

- The main criteria in most of the research undertakings are:
  - **Personal factors**
    - Interest
    - Research capabilities
    - Economic capability
    - Size
  - **External factors**
    - Uniqueness
    - Importance or value of the problem
    - Critical mass: data and materials should be accessible to you.
    - Department or unit where the research is conducted

The process of selection criteria

Step1. Criteria for selecting a research topic

- Relevance
- Avoidance of duplication
- Feasibility: Resources available
- Political acceptability: interest and support of the authorities.
- Applicability
- Urgency
- Ethical acceptability

The process of selection criteria

Step2. Scales for rating research topics

Relevance

1 = Not relevant
2 = Relevant
3 = very relevant

Avoidance of duplication

1 = Sufficient information already available
2 = Some information available but major issues not covered
3 = No sound information available on which to base problem-solving

Feasibility

1 = Study not feasible considering available resources
2 = Study feasible considering available resources
3 = Study very feasible considering available resources

Political acceptability

1 = Topic not acceptable
2 = Topic somewhat acceptable
3 = Topic fully acceptable

Applicability

1 = No chance of recommendations being implemented
2 = Some chance of recommendations being implemented
3 = Good chance of recommendations being implemented

Urgency

1 = Information not urgently needed
2 = Information could be used but a delay of some months would be acceptable
3 = Data very urgently needed for decision-making

Ethical acceptability

1 = Major ethical problems
2 = Minor ethical problems
3 = No ethical problems

N.B. The above rating should be based on the existing data and not on mere assumptions.

Rating Sheet

Criteria for selecting a research topic	Proposed topic		
	Health problem I	Health problem II	Health problem III
Relevance			
Avoidance of duplication			
Feasibility			
Political acceptability			
Applicability			
Urgency of data needed			
Ethical acceptability			
Total			

Rating scale: 1 = low,   2 = medium,   3 = high

example1:

Problem situation:

In district " Y " a report showed that in the first month there were 500 children under one year old who started immunization, but at the end of the year it was found out that there were only 25 children who completed their vaccination.

Discrepancy:

All the 500 children at district "Y "should have completed their vaccination but only 5% out of those who started vaccination have completed.

Problem (research) question:

 why only 5% of the children completed their vaccination?

Definite answer:

Out of the 1 hospital, 2 health centers and 10 health stations found in district "Y" only 2 health stations were functioning, the rest were closed due to insecurity in the area. In the above example, assuming that all the given facts are true, there is   no need of undertaking a research, since definite answer is obtained to the problem situation. .

Example 2

Problem situation:

In district "Z" (population 150,000) there are 2 health centers, 1 hospital and 15 health stations and all of them function smoothly. However, at the end of the year it was found that the EPI coverage was only 25%.

Discrepancy:

Although district "Z" had 100% availability of health services and at least 80% of the children should have had full vaccinations the EPI coverage was only 25% as seen above.

Problem question:

What factors influence the low EPI coverage in district "Z"?

Possible answers:

- Mothers might have problems for not attending in the **Expanded Programme on Immunization (**EPI)sessions.
- The MCH, EPI, OPD, CDD, etc… programmes might not have been integrated; hence children might have missed opportunities in getting immunization.
- The follow up of defaulting children might not be effective and other reasons.

Thus, the above problem situation is researchable.

Excel analysis: frequency distribution and mean

Group Work   Problem Selection

Rating sheet for group work   Rating Scale 1 = low, 2 = medium, 3 = high

Proposed Topic	Criteria for selection of research topic							Total
	1. Relevance	2 Avoidance of duplication	3. Feasibility	4. Political acceptability	5. Applicability	6. Urgency of data needed	7. Ethical acceptability	
1								
2								
3								
4								
5								
6								
7								
8								

Sources of a research topic

- The three major sources of research topics are :
  - Conceptual / theoretical / theories/ ideas,
  - personal experiences, and
  - replications(doing again)

Tips on: characteristics of a good research topic

- **The topic is interesting**. It will hold the researcher's interest in the research process.
- **The topic is researchable**. It can be investigated through the collection and analysis of data and it is not started as a topic seeking to determine what should be done.
- **The topic is significant**. It contributes in some way to the improvement or understanding of education theory or practice.
- **The topic is manageable**. It fits the researchers' level or research skill, needed resources, and time restrictions.

Template of research part one

1. Introduction
   1.1. Background of the Study
   1.2. Statement of the Problem
   1.3. Research Questions
   1.4. Significance of the Study
   1.5. Objective of the study
     1.5.1. The general objective
   1.5.2. Specific Objectives
   1.6. Scope of the Study
   1.7. Limitation of the study
   1.8. Organization of the study

- Introduction /Background and Justification :
  - The evidence and relevance from the literature and published or archival data showing the problem exists. Include at least two references. You should also have a theoretical basis for the study.
- A research problem is an educational issue or problem in the study.
- A research topic is the broad subject matter being addressed in a study.
- research problem statement
- A purpose is the major intent or objective of the study.
- Research questions are those that the researcher would like answered or addressed in the study.

Introduction of research

- Begin by introducing your <u>research topic</u> and giving any necessary background information.(it set up the topic, purpose, and relevance of your thesis, as well as expectations for your reader.)

- How the problem differs from other parts of research

- It's important to contextualize your research and generate interest.

- You may want to mention a relevant news item, academic debate, or practical problem.

Topic and context

- Example topic
  - Attitudes of young people toward climate change.

- Example context
  - Share a recent news story about a children's climate strike, or the increasing importance of youth engagement in climate politics.

3.2.The Research Problem

- A research problem is the reason the research is being undertaken,

- In general it refers to some difficulty which a researcher experiences in the context of either a theoretical or practical situation and wants to obtain a solution for the same.

- In the social sciences, the research problem establishes the means by which you must answer the **"So What?"** question.

- It is very specific problem at which the objectives of the research are directed.

- It must be understood that all problems are not researchable.

Types of research problems

1. **Theoretical research problems**
   - *You might look for:*
     - A phenomenon or context that has not been closely studied
     - A contradiction between two or more perspectives
     - A situation or relationship that is not well understood
     - A troubling question that has yet to be resolved

2. **Practical research problems / Applied research problems /**
   - *You might look for:*
     - Issues with performance or efficiency
     - Processes that could be improved
     - Areas of concern among practitioners
     - Difficulties faced by specific groups of people

1. **All type of researches can be research problems**

- **Examples of practical research problems**
  - The HR department of a local chain of restaurants has a high staff turnover rate.
  - Voter attendance in New England has been decreasing, in contrast to the rest of the country.
  - A non-profit organization faces a funding gap that means some of its programs will have to be cut.
- **Examples of theoretical research problems**
  - The effects of long-term Vitamin D deficiency on cardiovascular / heart circulatory/ health are not well understood.
  - Historians of Scottish nationalism disagree about the role of the British Empire in the development of Scotland's national identity.
  - The relationship between gender, race, and income inequality has yet to be closely studied in the context of the millennial gig economy

Formulate a research problem

1. Identify a general area of interest
   - Aspects fill gaps (**type of researches / research problems)**
2. Learn more about the problem
   - **Context and background**
   - **Specificity and relevance**
3. Review the context of the information
4. Determine relationships between variables
5. Select and include important variables
6. Receive feedback and revise

Features of researchable problem

- **A researchable problem is not answerable by a yes or no**. Generally, yes or no- questions are merely superficial. Research goes beyond and it uses an in-depth inquiry.

- **A researchable problem implies relationship**. It is interested not only in observable phenomena in isolation but in reasons for, causes of, differences that distinguish one situation from another.

Conti…….

- **The problem is stated in clear, unambiguous manner**.

problem should be stated clearly, so that anyone who read it will understand and react to it the way you want to be.

- **A researchable problem must imply interpretation of data.**

Research seeks facts, and synthesizes the meaning of the facts leading to credible and rational conclusions.

Statement of the Problem

- A statement of problem refers to the critical issue that your research seeks to address.

- In other words, it captures the existing knowledge gap that your study aims to bridge using reliable results or outcomes.

- A problem statement can be as little as a few sentences or go all the way to several paragraphs—what matters is it communicates the central focus of your study.

Research Questions

- A **research question** pinpoints exactly what you want to find out in your work. A good research question is essential to guide your [research paper](), [dissertation](), or [thesis]().
- All research questions should be:
  - **Focused** on a single problem or issue
  - **Researchable** using [primary and/or secondary sources]()
  - **Feasible** to answer within the timeframe and practical constraints
  - **Specific** enough to answer thoroughly
  - **Complex** enough to develop the answer over the space of a paper or thesis
  - **Relevant** to your field of study and/or society more broadly

Research question can depend on method

Type of research	Example question
Qualitative research question	What are the experiences of the parents of children with Down syndrome enrolled in public preschools in the city? What are the perceptions of night-shift oncology nurses at the local hospital?
Quantitative research question	What is the demographic makeup of South Korea in 2020 compared to 2010? How has the average sea level changed on the Norwegian coast over the 25 years?

Research Sub problems/Questions

- Within researchable problems lie some sub problems or specific questions.

- The answer to these sub problems sometimes referred to as research questions

- These questions will lead to the resolution of main researchable problem.

EXAMPLE RESEARCH PROBLEM

- The teachers at school X do not have the skills to recognize or properly guide gifted children in the classroom.

- Under-30s increasingly engage in social media usage instead of regular work, but there is little research into young people's experiences of this type of trend.

EXAMPLE RESEARCH QUESTION

- What practical techniques can teachers at school X use to better identify and guide gifted children?

- What are the main factors that influence young people's decisions to use social media? What do users perceive as its advantages and disadvantages? Do age and education level have an effect on how people experience this type of practice?

Research problem: which of the following factors predict the employability of technician education graduates in terms of length of time waiting to get the first job and relevance of the job to technician program pursued?

- TVET graduate related factors/profile
  - Age, civil status and skills (communication, human, technical, and conceptual)
  - Grade point average upon graduation from TVET institution
  - Intelligence quotient
  - Type of technician education program attended
- TVET Institution-related factors
  - Adequacy of instructional materials
  - Effectiveness of the on- job training (OJT) program
  - Faculty competence
  - Adequacy of curriculum

Research Sub problems/Questions:

- What is the profile of technician graduate respondents?
- How do the respondents perceive the TVET institution in terms of its instructional facilities, effectiveness of OJT programs, faculty competence, and adequacy of technician curriculum?
- What is the mean length of waiting time of the graduates to land their first job?
- Do the following factors significantly predict the employability of technician graduates: graduate related factors or TVET institution related factors?

Hypothesis question or test

- A **hypothesis** is a statement that can be tested by scientific research. If you want to test a relationship between two or more variables, you need to write hypotheses before you start your [experiment] or [data collection].

- hypotheses always discusses **variables**, or the elements that you're testing. Variables can be objects, events,

- A hypothesis is a prediction about the relationship between two or more variables

- **Independent variables** are the ones that you change for your experiment

- **Dependent variables** are the ones that you can only observe.

Types of Hypotheses

- **Simple hypothesis**: This type of hypothesis suggests that there is a relationship between one independent variable and one dependent variable.

- **Complex hypothesis**: This type of hypothesis suggests a relationship between three or more variables, such as two independent variables and a dependent variable.

- **Null hypothesis(NH)**: This hypothesis suggests no relationship exists between two or more variables.

- **Alternative hypothesis(AH)**: This hypothesis states the opposite of the null hypothesis. It opposites of the null hypothesis

- **Statistical hypothesis**: This hypothesis uses statistical analysis to evaluate a representative sample of the population and then generalizes the findings to the larger group.

- **Logical hypothesis**: This hypothesis assumes a relationship between variables without collecting data or evidence.

Directional Hypothesis:

- A hypothesis that is built upon a certain directional relationship between two variables and constructed upon an already existing theory, is called a directional hypothesis.

  – example, *Girls perform better than boys* ('better than' shows the direction predicted)

Non-directional Hypothesis:

- It involves an open-ended non-directional hypothesis that predicts that the independent variable will influence the dependent variable; however, the nature or direction of a relationship between two subject variables is not defined or clear.

- For Example, there will be a difference in the performance of girls & boys (Not defining what kind of difference)

Inductive vs deductive hypothesis

- A deductive approach is concerned with "**developing a hypothesis (or hypotheses) based on existing theory, and then designing a research strategy to test the hypothesis**"

- **It reasoning involves using general premises to form a specific conclusion**

- In inductive reasoning, we begin with specific observations and measures, begin to detect patterns and regularities, formulate some tentative hypotheses that we can explore, and finally end up developing some general conclusions or theories.

- **It reasoning involves starting from specific premises and forming a general conclusion, while**

Simple hypotheses

- "Students who eat breakfast will perform better on a math exam than students who do not eat breakfast.

- Turning off your phone makes it charge faster.

Null hypothesis (abbreviated as H0)

- "There will be no difference in scores on a memory recall task between children and adults."

- There is no difference in plant growth when using either bottled water or tap water.

An alternative hypothesis(abbreviated as H1 or HA)

There is relation:

- "Adults will perform better on a memory task than children."

- "Plants grow better with bottled water than tap water".

Statistical hypothesis

- Approximately 2% of the world population has natural red hair.

- In humans, the birth-gender ratio of males to females is 1.05 to 1.00.

Formulation of hypothesis

The deductive hypothesis **(steps)**

1. **Start with an existing theory and create a problem statement**
   - Low cost airlines always have delays
   - All dogs have fleas
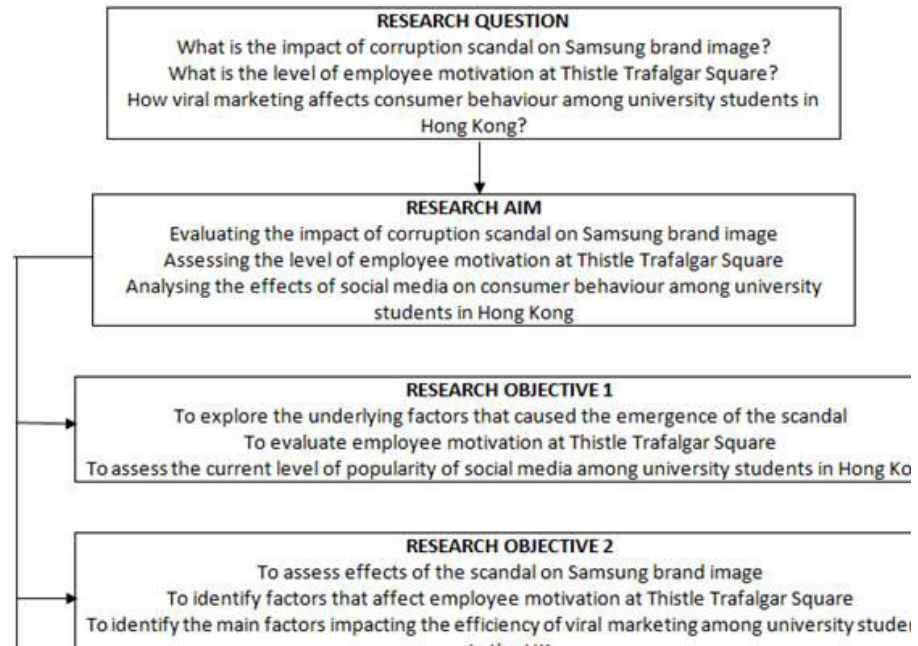   - All biological life depends on water to exist

2. **Formulate a falsifiable hypothesis, based on existing theory**
   - If passengers fly with a low cost airline, then they will always experience delays
   - All pet dogs in my apartment building have fleas
   - All land mammals depend on water to exist

3. **Collect data to test the hypothesis**
   - Collect flight data of low-cost airlines
   - Test all dogs in the building for fleas
   - Study all land mammal species to see if they depend on water

4. **Analyze and test the data**
   - 5 out of 100 flights of low-cost airlines are not delayed
   - 10 out of 20 dogs didn't have fleas
   - All land mammal species depend on water

5. **Decide whether you can reject the null hypothesis**
   - 5 out of 100 flights of low-cost airlines are not delayed = reject hypothesis
   - 10 out of 20 dogs didn't have fleas = reject hypothesis
   - All land mammal species depend on water = support hypothesis

Formulation of hypothesis

Inductive hypothesis (steps)

1. **Observation**
   - A low-cost airline flight is delayed
   - Dogs A and B have fleas
   - Elephants depend on water to exist

2. **Seeking patterns**
   - Another 20 flights from low-cost airlines are delayed
   - All observed dogs have fleas
   - All observed animals depend on water to exist

3. **Developing a theory or general (preliminary) conclusion**
   - Low cost airlines always have delays
   - All dogs have fleas
   - All biological life depends on water to exist

Objective of Research

- General Objective
  - To develop x web base system
- Specific Objective
  - Collect data
  - Analyze the existing system
  - Propose new system
  - Design new system
  - Develop and implement
  - Test
  - Maintain and review system

General objective of Research

- The research objectives are formulated in positive forms, which are derived from the major and basic questions already established by you before. It should be closely related to the statement of the problem or title

Formulating

research aims

and objectives:

RESEARCH QUESTION
What is the impact of corruption scandal on Samsung brand image?
What is the level of employee motivation at Thistle Trafalgar Square?
How viral marketing affects consumer behaviour among university students in Hong Kong?

RESEARCH AIM
Evaluating the impact of corruption scandal on Samsung brand image
Assessing the level of employee motivation at Thistle Trafalgar Square
Analysing the effects of social media on consumer behaviour among university students in Hong Kong

RESEARCH OBJECTIVE 1
To explore the underlying factors that caused the emergence of the scandal
To evaluate employee motivation at Thistle Trafalgar Square
To assess the current level of popularity of social media among university students in Hong Kong

RESEARCH OBJECTIVE 2
To assess effects of the scandal on Samsung brand image
To identify factors that affect employee motivation at Thistle Trafalgar Square
To identify the main factors impacting the efficiency of viral marketing among university students

Specific objectives

Specific objectives are **detailed objectives that describe what will be researched during the study**, whereas the general objective is a much broader statement about what the study aims to achieve overall.

- To Achieve the general objective

Example

Problem:

A research study designed to assess the accessibility and acceptability of the Voluntary Counselling and Testing (VCT) Services for HIV infection in *kebele* X had the following general and specific objectives:

- *General objective:* To identify factors that affects the acceptability of VCT services and to assess community attitudes towards comprehensive care and support for people living with HIV/AIDS.

- Specific objectives:
  - To assess the knowledge, attitude and practice of the community towards HIV/AIDS and VCT services.
  - To identify barriers and concerns related to VCT and its uptake.
  - To assess the awareness and perception of the study community regarding comprehensive care and support for people living with HIV/AIDS.

Significance of the study

- This section is concerned with addressing the contribution of your research either towards the world of knowledge or solving certain problems.
- It uses **to build knowledge and facilitate efficient learning,**
- **to understand various issues,**
- **to know the truth and prove lies, and**
- **to seek opportunities**, among others.
- It somehow answers your question.

Chapter 4

Research methodology, Methods and Design

4.1. Methodology vs Method

- Methodology
  - Study about the research tools
  - It's approach . Techniques and procedurals of research
  - It explain or analysis methods
  - It's the beginning research
  - Applied during later stage

- Method
  - It's tools of research
  - It helps find answers to the research question
  - It used to select a research techniques
  - It's the end of research
  - Applied during at initial stage

Methods	Methodology
The objective of methods is to find solution to the research problem.	The objective of methodology is to determine appropriateness of the methods applied with a view to ascertain solution.
Methods are just behavior or tools used to select a research technique.	Methodology is analysis of all the methods and procedures of the investigation.
Methods are applied during the later stage of the research study.	Methodologies are applied during the initial stage of the research process.
It comprises different investigation techniques of the study.	It is a systematic strategy to find solution to the research problem.
Methods encompasses of carrying out experiments, conducting surveys, tests, etc.	Methodology encompasses several techniques used while conducting these experiments, surveys, tests, etc.

RESEARCH METHOD	RESEARCH METHODOLOGY
Research methods are the methods used by researchers to collect data to conduct research on a particular research topic.	A Research methodology is systematic approach to solve the research problem and to reach a new conclusion.
The objective of the research method is to find the solution.	The objective of the research methodology is to determine the solution by applying correct procedures of research.
Research methods are useful to apply during the latter stage of the research process.	Research methodologies are applied in the initial stage of the research being conducted.
Research methods are small part of research methodology.	A Research methodology is a multi-dimensional concept.
Research methods consist of various techniques where various studies and experiments are used to conduct research and reach an appropriate conclusion.	Research methodologies are used applied during the initial stage of the research to explain the purpose of chosen methods and how they will serve its function.
Research methods consist of different investigation techniques.	Research methodologies is a systematic strategy to achieve the decided objective.
Research method encompasses of carrying out an experiment, survey, test and so on.	Research methodology encompasses different techniques which are used during the performance of the experiment, surveys, and test, etc.

4.2. Source of data / information

- Choose the samples for data
  - Subject
  - Representative sample from population
  - The basis of your selection

  Example: Students were chosen/selected on the basis of their grades and test scores.

4.3. Population and Sample

- Population
  - Large group
- Sample
  - Small group that extract from large group
  - Subset of population

Comparison	Population	Sample
Meaning	Collection of all the units or elements that possess common characteristics	A subgroup of the members of the population
Includes	Each and every element of a group	Only includes a handful of units of population
Characteristics	Parameter	Statistic
Data Collection	Complete enumeration or census	Sampling or sample survey
Focus on	Identification of the characteristics	Making inferences about the population

Types of population

- Finite Population:-
  - countable population
  - Example: Employees of a company
- Infinite Population
  - uncountable population
  - Example: The number of germs in the patient's body
- Existent Population
  - population of concrete individuals/ is available in solid
  - Examples are books, students
- Hypothetical Population
  - It is not available in solid
  - Example: The outcome of tossing a coin.

Population VS Sample

Population size
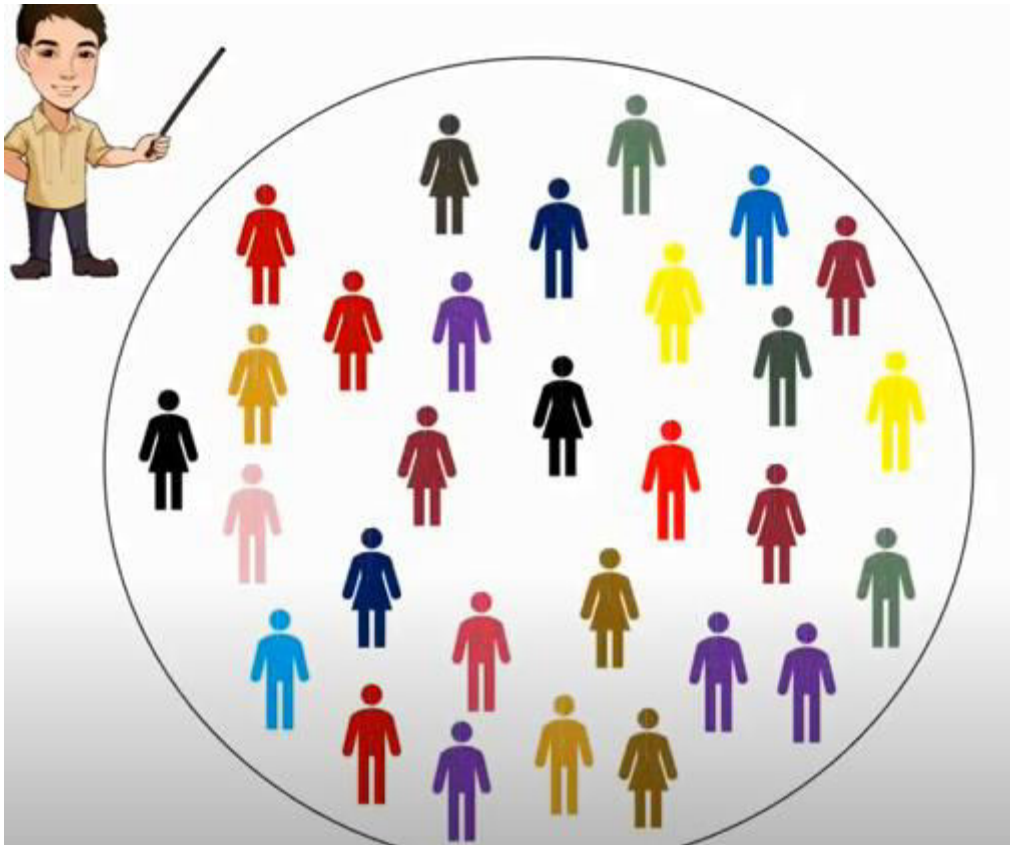
Sample size

Criteria /determine of Sample size
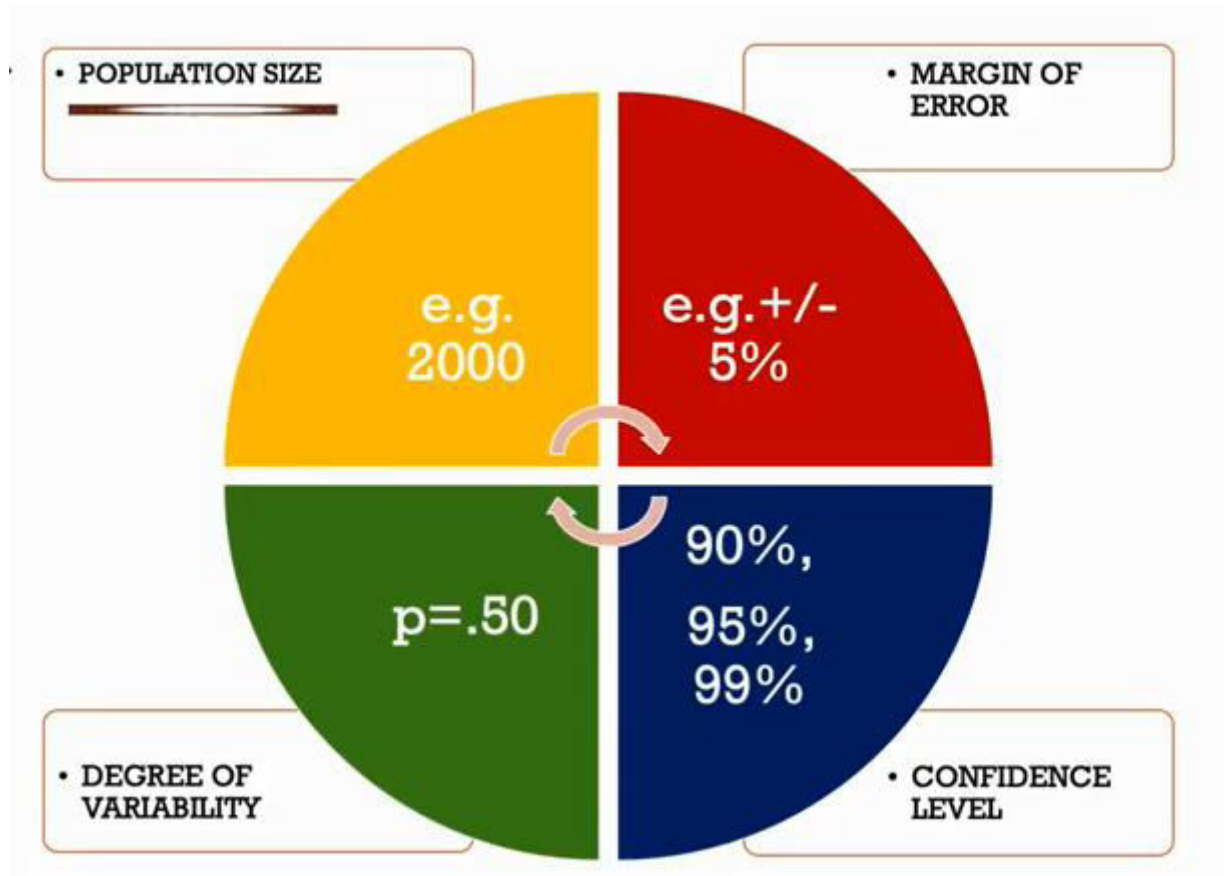
Criteria /determine of Sample size

- ## Population size(N):
  - **all the items that can be considered for the study**
  - **It's** how many people fit your demographic.
  - Don't worry! Your population size doesn't always have to be that big. Smaller population sizes can still give you accurate results as long as you know who you're trying to represent.
  - For good sampling
    - Representativeness
    - Reduce sample error and bais
    - Economical (resource and time)

MARGIN OF ERROR

Determines how much higher or lower than the population mean you are willing to let your sample mean fall.

± 5% OR .05

For example a researcher finds, that 70% of the students selected the modular learning approach with a margin of error of plus, minus 5 percen t .

Then the researcher can conclude that between 65% and 75% of the students in the population have selected modular learning approach.

Margin of error / level of precession / sample error:(e)

- **When it comes to surveys, there's no way to be 100% accurate.**
- Statistical inference about the confidence of what number shows actual reflection of the population
- It tell you how far off from the population means you're willing to allow your data to fall.
- It describes how close you can reasonably expect a survey result to fall relative to the real population value. .

CONFIDENCE LEVEL OR RISK LEVEL

How confident do you want to be that the actual mean falls within your confidence interval?

EXAMPLES: 90%   95%   99%

The key idea for confidence level tells the researcher that if the population is repeatedly sampled the average value of the attribute obtained by those samples is equal to the true population valu e .

- **Confidence level or risk level:** The actual means falls within a confidence intervals/margin error(90%,95% and 99%)
- **Confidence level tells** you how sure you can be that your data is accurate. It is expressed as a percentage and aligned to the confidence interval.

DEGREE OF VARIABILITY

How much variance do you expect in your response?

ASSUMED VALUE p=.5

Degree of variability or Standard deviation :

– it covers variance / variation in the survey a safe number is to be considered as 0.5 means sample has to be large
– It measures the absolute variability of a distribution

Types of Sample size formula

There are many formulas used for calculating sample size. One of the most common formulas used is **Yamane's** or **Slovin's** formula

1. Yamane's / Slovin's formula
2. Cochran formula
3. Mean formula

Cochran formula is use for large population that are heterogeneous in nature. For infinite population

Slovin's formula is better for population which little or nothing is known. For homogeneous and finite pouplation.

1. Yamane's / Slovin's formula
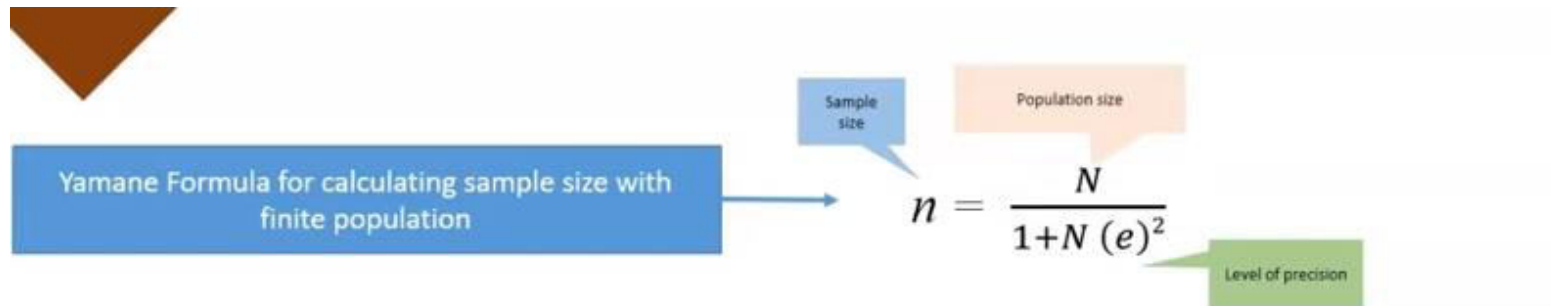
Yamane Formula for calculating sample size with finite population

$$n = \dfrac{N}{1+N\,(e)^2}$$

Sample size

Population size

Level of precision

Example: Assume our evaluation of students' adoption of the recommended practice will only affect 5,000 students

$$n = \dfrac{5000}{1+5000\,(0.05)^2} = 371\ students$$

In the study, the size of population is 2, 000. Find the sample size with 97% confidence level.

$N = 2,000$

$e = 3\% = 0.03$

Slovin's Formula:

$$n = \dfrac{N}{1+Ne^2}$$

$$n = \dfrac{2,000}{1 + 2,000(0.03)^2}$$

$$n = \dfrac{2,000}{2.8}$$

$$n = 714.2 \approx \boxed{714}$$

Example : we want to do a survey of employees of the TVTI, on how they use computer at work place.if the total population is 2500 and you want to work a 95% confidence level. What will be the sample size?

Example :

Solve for the sample size:

RESPONDENTS	POPULATION SIZE	SAMPLE SIZE
STEM	220	
HUMSS	330	
ABM	430	
GAS	170	
TVL-ICT	350	
TVL-HE	400	

Solve for the sample size:

RESPONDENTS	POPULATION SIZE	SAMPLE SIZE
STEM	220	
HUMSS	330	
ABM	430	
GAS	170	
TVL-ICT	350	
TVL-HE	400	
$N = 1,900$		$n = 330$

$e = 5\% = 0.05$

$$n = \frac{N}{1 + Ne^2}$$

$$n = \frac{1900}{1 + 1900 \, (0.05)^2}$$

$$n = \frac{1900}{5.75}$$

$$n = 330.4 \approx \boxed{330}$$

Solve for the sample size:

RESPONDENTS	POPULATION SIZE	SAMPLE SIZE
STEM	220	38
HUMSS	330	57
ABM	430	75
GAS	170	30
TVL-ICT	350	61
TVL-HE	400	69
	$N = 1,900$	$n = 330$

$$STEM = \frac{RPS}{N}(n) = \frac{220}{1900}(330) = 38.2 \approx 38$$

$$HUMSS = \frac{330}{1900}(330) = 57.3 \approx 57$$

$$ABM = \frac{430}{1900}(330) = 74.6 \approx 75$$

$$GAS = \frac{170}{1900}(330) = 29.5 \approx 30$$

$$ICT = \frac{350}{1900}(330) = 60.7 \approx 61$$

$$HE = \frac{400}{1900}(330) = 69.4 \approx 69$$

2. Cochran formula

sample size(n) = $\dfrac{\dfrac{Z^2 \cdot p(1-p)}{e^2}}{1 + \left(\dfrac{Z^2 \cdot p(1-p)}{e^2 N}\right)}$

WHERE,

N = POPULATION SIZE

p = PERCENTAGE/PROPORTION PICKING A CHOICE

e = SAMPLING ERROR (SE) / MARGIN OF ERROR (ME)

z = Z-SCORE (THE NUMBER OF STANDARD DEVIATIONS A GIVEN PROPORTION IS AWAY FROM THE MEAN)

Cochran formula for calculating a sample for proportions

$n_0 = \dfrac{Z^2 pq}{e^2}$

Sample size

Z vale found in the Z table at a given confidence level. Just do a square of that value

estimated proportion of an attribute that is present in the population

1-p

Desired level of precision

Example: Assume there is a large population and we do not know the variability in the proportion that will adopt the recommended practice; therefore, we assume p=.5 (maximum variability). Furthermore, suppose we desire a 95% confidence level and ±5% precision. The resulting sample size is:

$$n_0 = \frac{(1.96)^2(.5)(.5)}{(.05)^2} = 385 \; students$$

Step 2
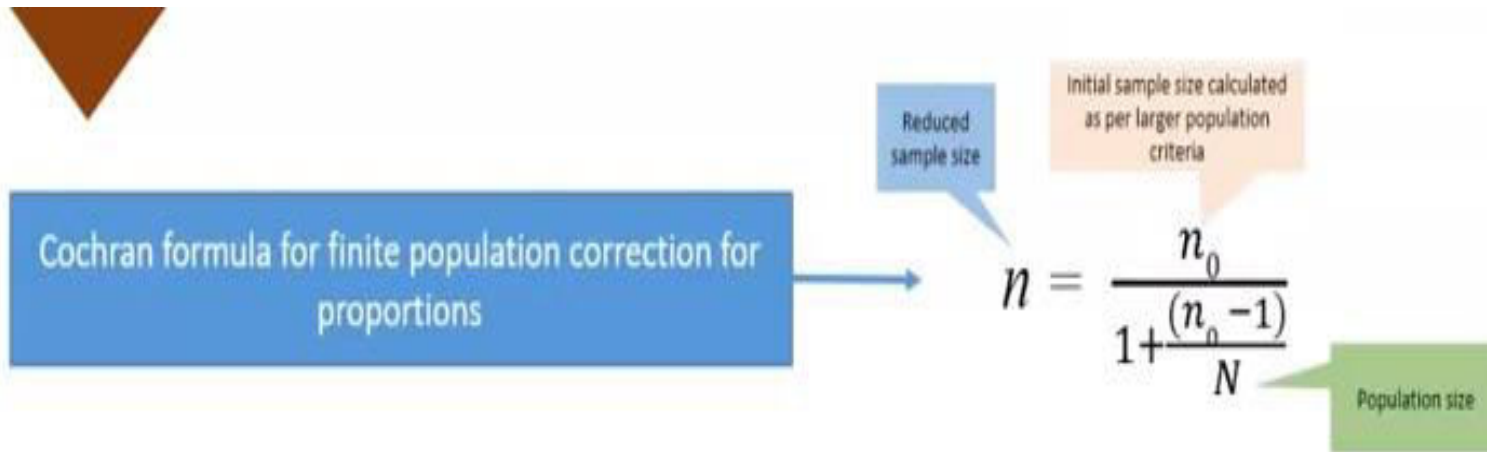
Cochran formula for finite population correction for proportions

Reduced sample size

Initial sample size calculated as per larger population criteria

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Population size

Example: Assume our evaluation of students' adoption of the recommended practice will only affect 5,000 students

$$n = \frac{385}{1 + \frac{(385 - 1)}{5000}} = 358 \; students$$

Z table

Confidence Level	z-score (±)
70% = 0.70	1.04
0.75	1.15
0.80	1.28
0.85	1.44
0.92	1.75
95%= 0.95	1.96
0.96	2.05
0.98	2.33
0.99	2.58

Example by one step

You need to decide between two different names for your new product. By your estimates there are 400,000 potential customers in your target market. Industry margin of error is 3% at a 95% confidence level. What is the sample size required to take an acceptable decision?

SOLUTION

N = POPULATION SIZE = 400,000
p = PROPORTION/PERCENTAGE PICKING A CHOICE = 0.5
e = SAMPLING ERROR (SE) / MARGIN OF ERROR (ME) = 3% = 0.03
z = Z-SCORE = 1.96

$$\text{Sample size} = \frac{\dfrac{z^2 \times p(1-p)}{e^2}}{\dfrac{z^2 \times p(1-p)}{e^2 N}} = \frac{((1.96)^2 * 0.5(1-0.5))/(0.03)^2}{1 + ((1.96)^2 * 0.5(1-0.5))/((0.03)^2 * 400000)} = 1064$$

3. Mean formula
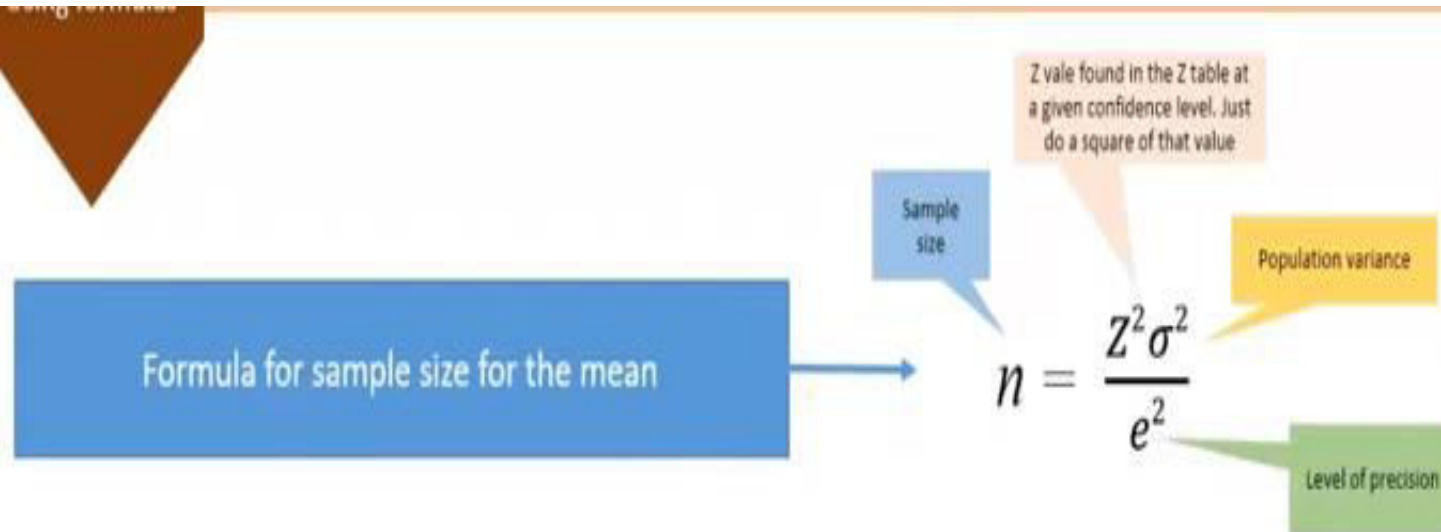
The disadvantage of the sample size based on the mean:

- Good estimate of the population variance is necessary. Often, an estimate is not available.
- Sample size can vary widely from one attribute to another because each is likely to have a different variance.
- Because of these problems, the sample size for the proportion is frequently preferred2

Sampling methods

- Basically, there are two types of sampling. They are:
  - Probability sampling
  - Non-probability sampling

Sampling methods

- Basically, there are two types of sampling. They are:
  - Probability sampling
  - Non-probability sampling

Types of Sampling Methods / Techniques
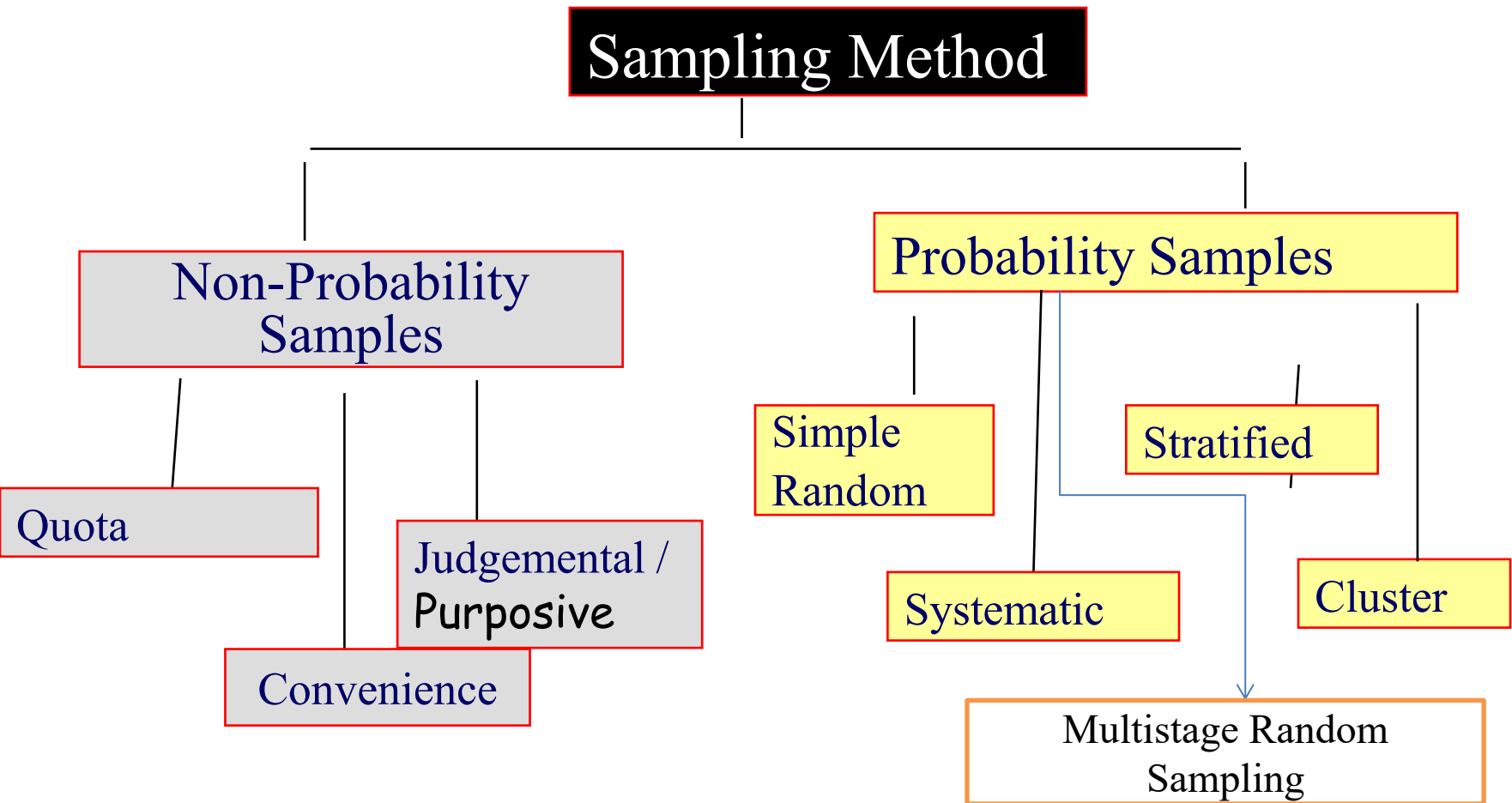
Technical Terminology

- A <u>population</u> is a collection of elements about which we wish to make an inference.

- <u>Target population (reference population</u>): Is that population about which an investigator wishes to draw a conclusion.

- <u>Study population (population sampled):</u> Population from which   the sample actually was drawn and about which a conclusion can be made. For Practical reasons the study population is often more limited than the target population. In some instances, the target population and the population sampled are identical.

- A <u>sampling frame</u> is a list of sampling units. The list of units from which the sample is to be selected

- **Sampling Frame:** is the list of people from which the sample is taken. It is the list from which the potential respondents are drawn.

- <u>Sampling units</u> are non-overlapping collections of elements from the population that cover the entire population. <u>Sampling units</u> :the unit of selection in the sampling process. For example, in a sample of districts, the sampling

- <u>Sampling units</u> :unit is a district; in a sample of persons, a person, etc.

- <u>Sampling units</u> :the unit on which the observations will be collected. For example, persons in a study of disease prevalence, or households, in a study of family size.

- <u>Sampling units:</u> the unit of selection in the sampling process

- <u>Sampling units</u> :study subjects that the unit on which information is collected or on which observations are made. E.g. Familiar examples are families, towns, litters, branches of a company, individual subjects or schools.

- <u>A sample </u>is a collection of sampling units drawn from a sampling frame.
  - It is "a smaller (but hopefully representative) collection of units from a population used to determine truths about that population

- <u>Sampling fraction (Sampling interval) - </u>the ratio of the number of units in the sample to the number of units in the reference population (N/n)

- **Parameter**: numerical characteristic of a population

- **Statistic:** numerical characteristic of a sample

Sampling…..

- Sampling is the process of selecting a representative sample from populations.

- It Selecting cases (elements)—or locating people (or other units of analysis)—from a target population in order to study the population.

Population Vs. Sample

Population of Interest

Sample
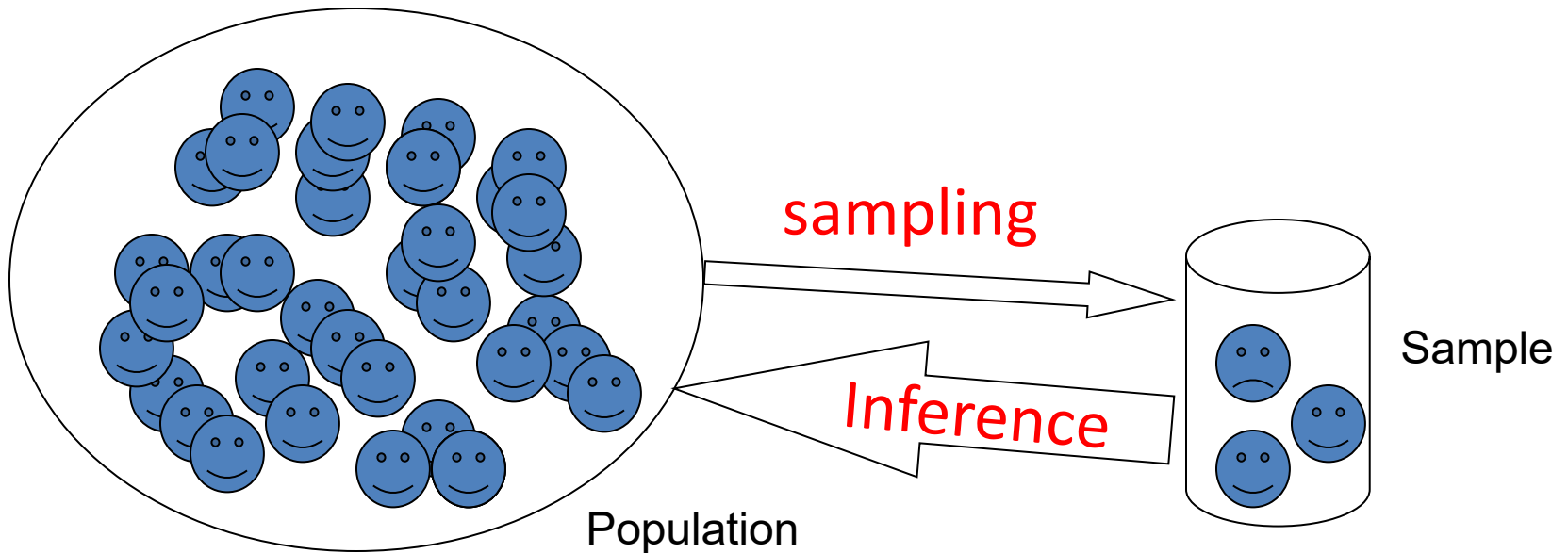
Population ← **Sample**

Parameter ← **Statistic**
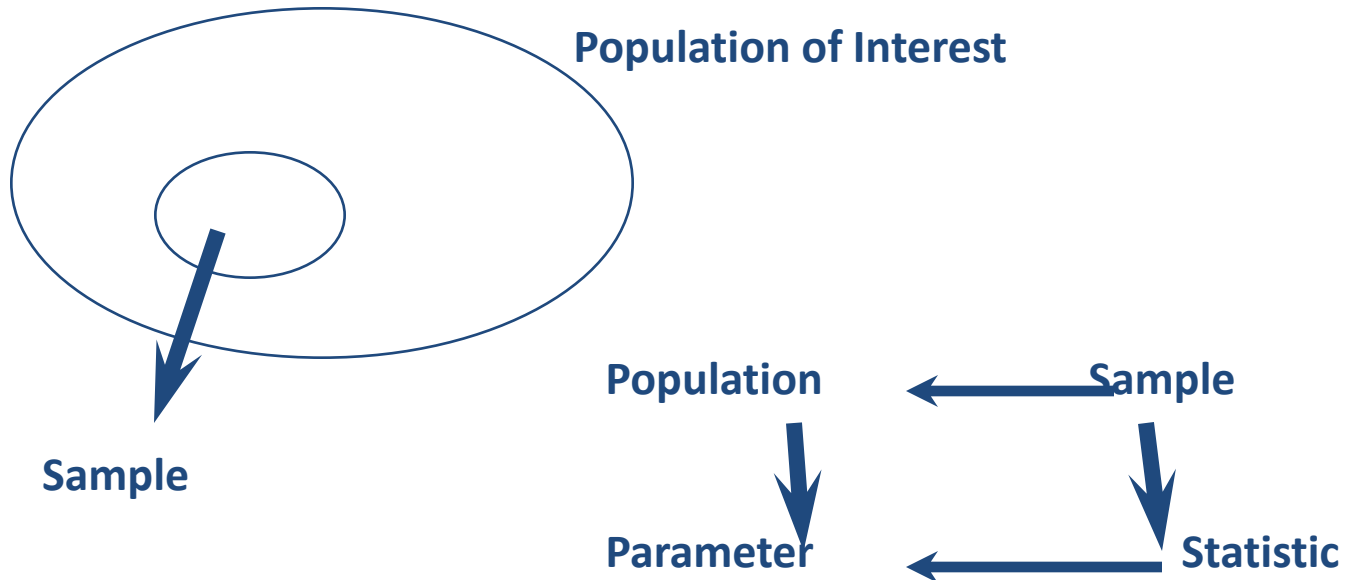
We measure the sample using statistics in order to draw inferences about the population and its parameters.

SAMPLING BREAKDOWN

Who do you want to generalize to? — The Theoretical Population

What population can you get access to? — The Study Population

How can you get access to them? — The Sampling Frame

Who is in your study? — The Sample
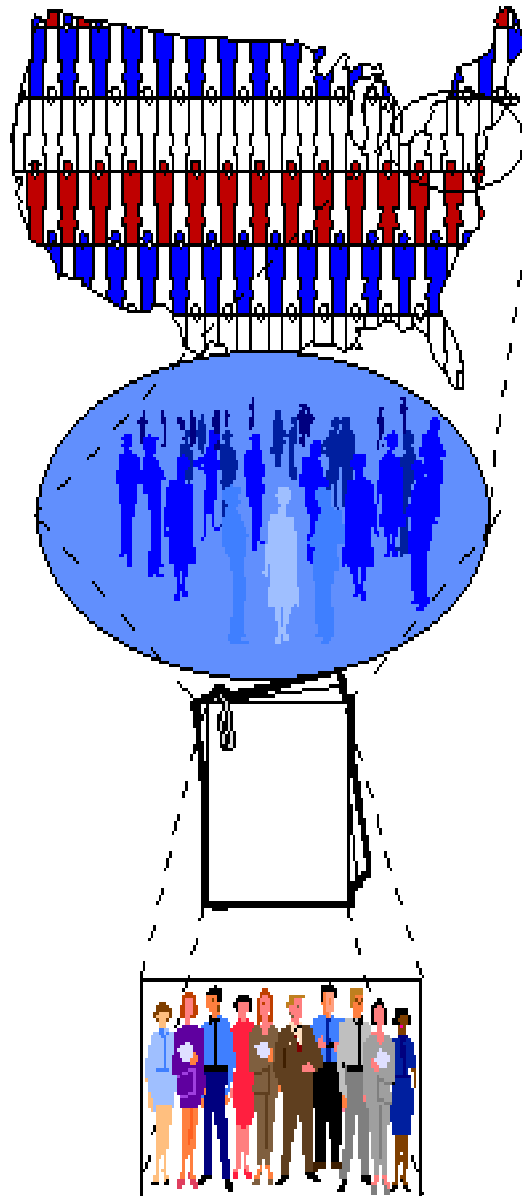
Census vs Survey Sample

- **Census:**
  - Obtained by collecting information about each member of a population.
  - Studying the whole population and requires a great deals of time, money and energy.
  - It is called a census sample because data is gathered on every member of the population.

- **Sample survey**:
  - study sample and draw conclusions about populations.
  - It is cheaper in terms of cost, practical & convenient in terms of technicalities, saves time & energy.

Advantage of sampling

▶ We obtain a sample rather than a complete enumeration (a census) of the population for many reasons.

➢Feasibility it may be the only feasible method of collecting data

➢Reduced cost sampling reduces demands on resource such as finance, personal and material

➢Greater accuracy sampling may lead to better accuracy of collecting data.

➢Greater speed data can be collected and summarized more quickly

Disadvantage of Sampling

▶ If sampling is biased, or not representative or too small the conclusion may not be valid and reliable

▶ If the population is very large and there are many sections and subsections, the sampling procedure becomes very complicated

▶ If the researcher does not possess the necessary skill and technical knowledge in sampling procedure, then the outcome will be devastated.

Non-probability sampling	Probability sampling
Sample selection based on the subjective judgment of the researcher.	The sample is selected at random.
Not everyone has an equal chance to participate. ➤Subjective units of population have a zero or unknown probability of selection	Everyone in the population has an equal chance of getting selected. each member of the population has a known / non-zero probability of being selected
The researcher does not consider sampling bias.	Used when sampling bias has to be reduced.
Useful when the population has similar traits.	Useful when the population is diverse. Generalization is possible (from sample to population)
The sample does not accurately represent the population. Sampling error can not be computed	Used to create an accurate sample.
Finding respondents is easy.	Finding the right respondents is not easy.

Probability Sampling Method cont'd …

– Simple Random Sampling,

– Systematic Sampling,

– Stratified Random Sampling,

– Cluster Sampling

Process

The sampling process comprises several stages:

– Defining the population of concern

– Specifying a sampling frame, a set of items or events possible to measure

– Specifying a sampling method for selecting items or events from the frame

– Determining the sample size

– Implementing the sampling plan

– Sampling and data collecting

– Reviewing the sampling process

1. Simple Random Sampling(SRS)

▶ Simple random sampling is the most straightforward of the random sampling strategies.

▶ Each member of the population has an equal and known chance of being selected.

▶ All individual member of population or sample frame should list or assign number in table unordered list form

▶ To use SRS there should be

   o population is small, relatively homogeneous & readily available

N=15

n= 5

n/N=5/15

=1/3=0.33

Simple Random Sampling cont'd …

▶ Procedures to select the sample

➤ They prepare a list of all the population members initially, and each member is marked with a specific number (for example, if there are nth members, then they will be numbered from 1 to N).

➤ Researchers from this population choose random samples using

  ➤ These are lottery method,

  ➤ Table of random number (they are available in the appendix of many research methods and statistics textbooks) or computer generated random number.

- the lottery method is one of the oldest ways and is a mechanical example of random sample. Researchers draw numbers from the box randomly to choose samples. In this method, the researcher gives each member of the population a number. Using

- Using random table numbers is an alternative method that also involves numbering the population. A numbered table similar to the one below can help with this sampling technique. N=100 , let n=10 , select as you want from Nth only 10 samples. 5 , 20, 38, ...

Random Number Table

1	69	24	40	68	29	39	95	60	30
97	23	70	59	79	4	47	19	38	20
13	44	5	71	12	99	78	34	9	96
34	55	83	21	72	3	37	85	61	2
22	80	18	82	54	32	84	16	46	88
7	43	6	48	11	92	63	53	86	28
56	90	36	91	64	45	15	73	10	87
49	65	50	14	51	33	89	52	74	57
98	17	100	58	5	8	77	25	62	31
27	76	66	81	26	93	41	94	67	42

Consider that a hospital has 1000 staff members and must allocate a night shift to 100 members. All their names will be put in a bucket to be randomly selected. Since each person has an equal chance of being selected. Since we know the population size (N) and sample size (n), the calculation can be as follows **Simple Random Sampling Formula**

=n/N

=100/1000

=10%

Simple Random Sampling cont'd ...

▸ Lottery method is appropriate if the total population is not too large, otherwise if the population is too large then it will be very difficult to use lottery method.

▸ Thus, table of random number or computer generated random number is the feasible method to be used.

Advantage

- It is a fair sampling method
- It helps reduce any bias to select , compared to any other sampling method.
- It is usually easy to pick a smaller sample size from the existing larger population.

Disadvantage

- You may not select enough individuals with your characteristic of interest.
  – example: - Male and Female , may be 10 males or 2F and 8M

2. Systematic Random Sampling

✦ Systematic sampling is thought as random, as long as the periodic interval is determined beforehand and the starting point is random

✦ Typically, every n^{th} member is selected from the total population for inclusion in the sample population.

o Systematic sampling involves a random start and then proceeds with the selection of every **kth** element from then onwards. In this case, k =(population size/sample size).

o It is important that the starting point is not automatically the first in the list, but is instead randomly chosen from within the first to the kth element in the list.

Systematic Random Sampling cont….

It needs the population to be homogeneous, however the method does not require frame.

Population

K=N/n , 12/4=3
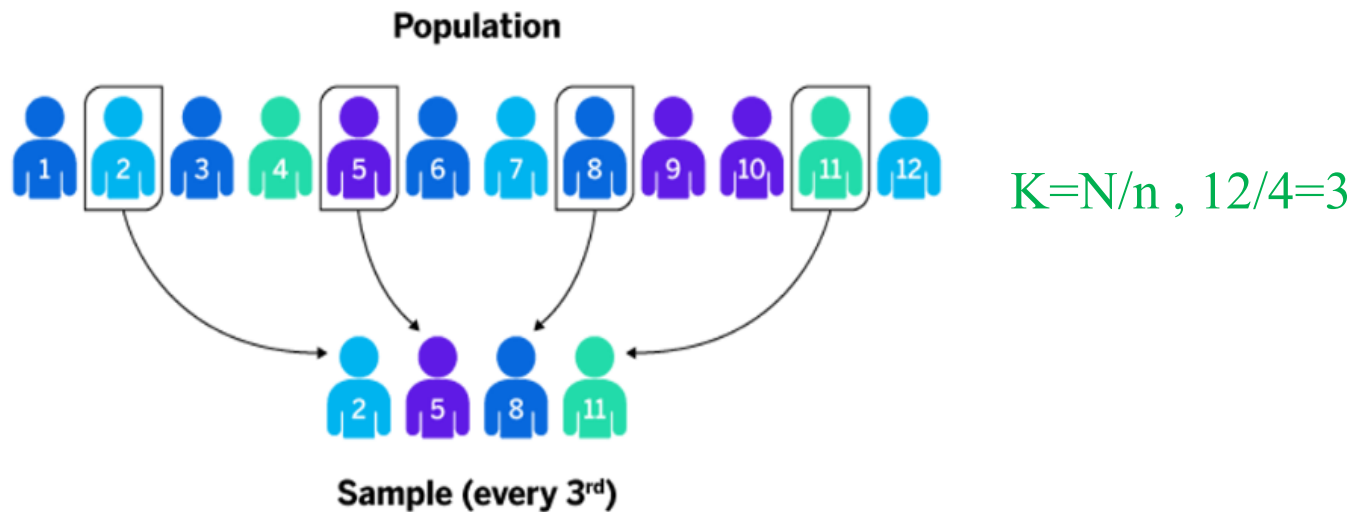
Sample (every 3rd)

Example: If you had a list of 1,000 customers ([your target population](#)) and you wanted to survey 200 of them, your interval would be 5. This means that you would sample every **5th** person in your list of 1,000 customers.

- you might randomly start with the 2nd name in the list and
- then sample every 5th person (e.g. 2, 7, 12, 17 and so on).

E.g. systematic sampling

- N = 1200, and n = 60

  sampling fraction = 1200/60 = 20

- List persons from 1 to 1200

- Randomly select a number between 1 and 20 (e.g. 8)

- 1st person selected = the 8th on the list

- 2nd person = 8 + 20 = 28th list e.t.c.

Advantage

- More accurate and reduce selection bias than SRS
- It is user-friendly and convenient

Disadvantage

- Lack of Diversity
- If the same Order at 1st males and female next , more included males or females

3. Stratified Random Sampling

▶ It is used when we have subgroups in our population that are likely to differ substantially in their responses or behavior (i.e. if the population is heterogeneous).

▶ Sample should homogeneous (eg. M and F strata , In m not included F)

▶ It involves dividing the entire population into homogeneous groups called strata (plural for stratum). Random samples are then selected from each stratum.

   ▶ For example, The researcher will soon find that there were almost 200,000 MBA graduates for the year. They might decide just to take a simple random sample of 50,000 graduates and run a survey. Better still, they could divide the population into strata and take a random sample from the strata. To do this, they would create population groups based on gender, age range, race, country of nationality, and career background.

Stratified Random Sampling cont'd…

▶ Stratified sampling is a method of random sampling where researchers first divide a population into smaller subgroups, or strata, based on shared characteristics of the members and then randomly select among these groups to form the final sample.

▶ These shared characteristics can include gender, age, sex, race, education level, or income

Stratified sampling

▶ Often we used simple random sampling to select a sample from each strata after stratification.

Stratified sampling

Stratified Random Sampling cont'd…

- There are two methods to get the study subject from each subgroup,
  - Proportional allocation or
  - Equal allocation /Disproportionate Stratification
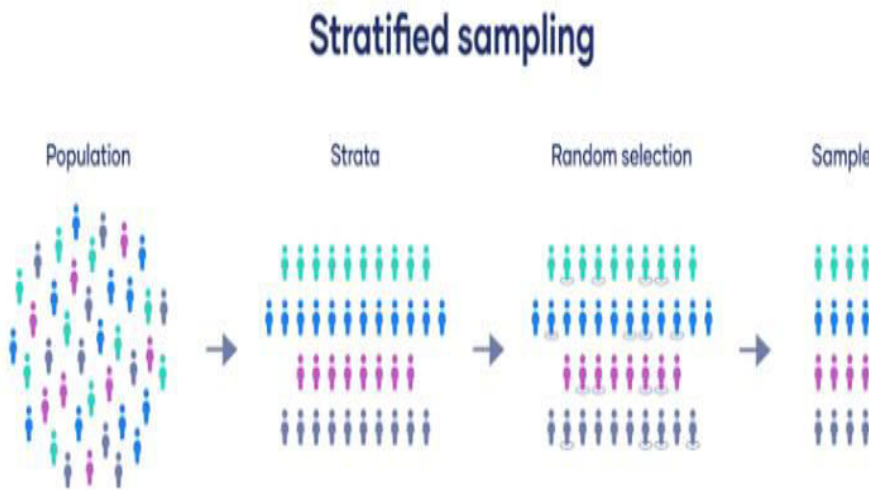
Fig: Disproportionate
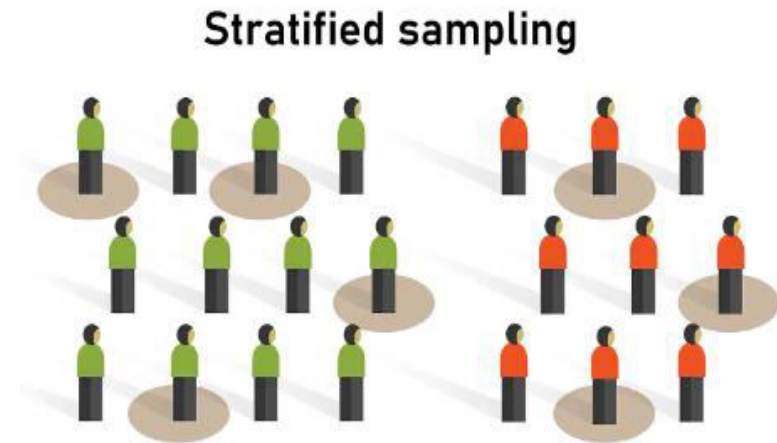
Fig: proportionate(equal)

Stratified Random Sampling cont'd…

- For example, if the researcher wanted a sample of 50,000 graduates using age range, the proportionate stratified random sample will be obtained using this formula: (sample size/population size) × stratum size. The table below assumes a population size of 180,000 MBA graduates per year.

Age group	24–28	29–33	34–37	Total
Number of people in stratum	90,000	60,000	30,000	180,000
Strata sample size	25,000	16,667	8,333	50,000

The strata sample size for <u>MBA graduates</u> in the:-
- **age range of 24 to 28 years old is calculated as (50,000/180,000) × 90,000 = 25,000.**
- **29–33 age range =16,667 graduates**
- **37-37 age range = 8,333**

Advantage of stratified sampling over simple random sampling

MERIT

➡ It improve representativeness of the sample

➡ It increase accuracy

➡ It reduce sampling bias

DEMERIT

- A population can't be organized into subgroups if there are too many differences within the population or there is not enough information about the population at hand.

- It required knowledge of the appropriate characteristics of the sampling frame(To identify group of characteristics)

4. Cluster Random Sampling

- Cluster sampling when used, gives every unit/person in the population an equal and known chance of being selected in the sample group.

- In statistics, cluster sampling is a sampling method in which the entire population of the study is divided into externally, homogeneous but internally, heterogeneous groups called clusters. Essentially, each cluster is a mini-representation of the entire population

- The clusters are externally homogeneous as they appear to be grouped together by a shared characteristic/criteria but are internally heterogeneous because the subpopulations within the clusters have different compositions.

- Cluster sampling is a method of probability sampling where researchers divide a large population up into smaller groups known as clusters, and then select randomly among the clusters to form a sample.
- Clusters may be divided by different cities in a country, different areas in a city, different organizations, different universities, different industrial estates, etc. After these clusters have been decided, researchers select certain clusters and eliminate the rest.
- For example, if you're conducting a study across all cities in the United States, you can use cluster sampling to eliminate certain cities, or clusters, in order to select your final sample group.

▶ Consider the following graphical display:
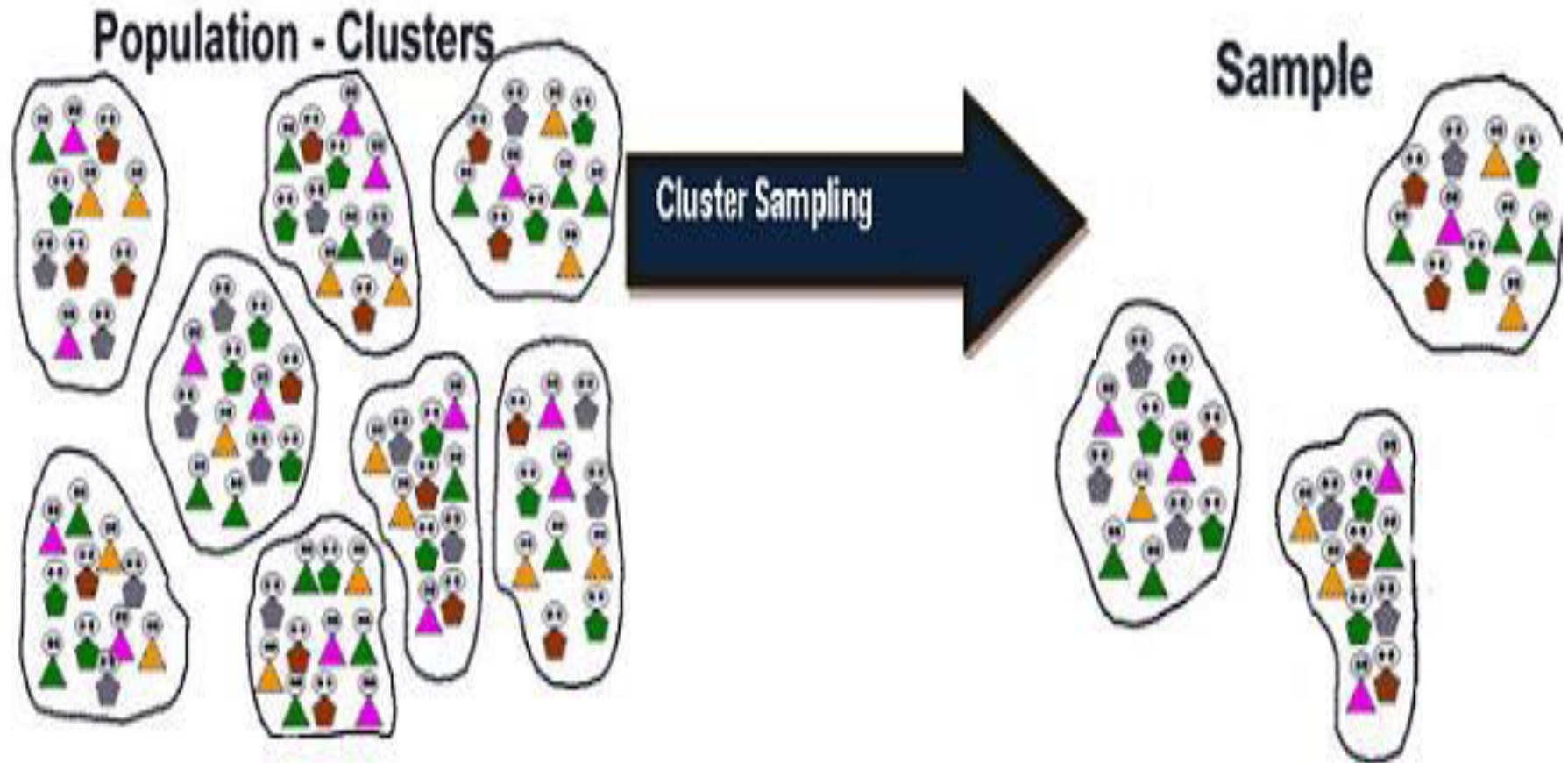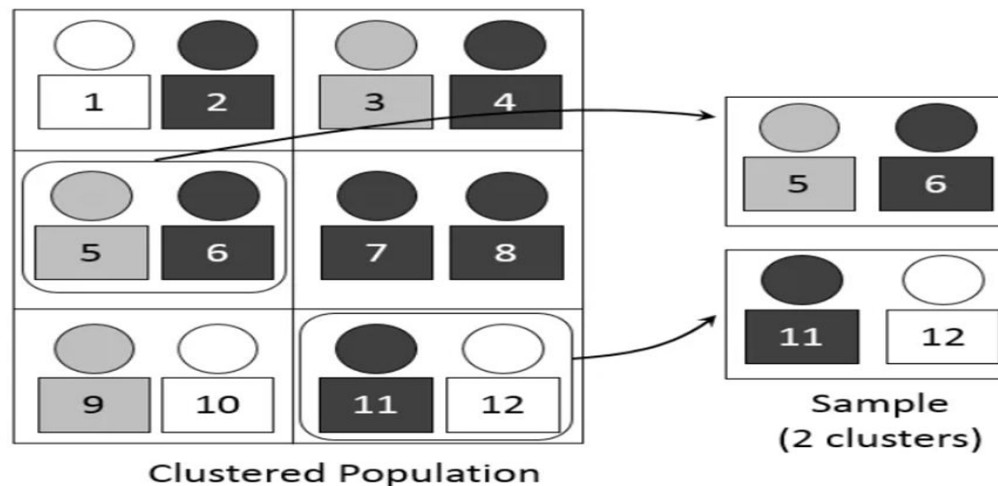
Types of cluster sampling

▶ **One-stage** and **Two-stage**.

1. **One-stage** sampling, also known as single-stage cluster sampling, is a method where every element within the selected clusters will become a part of the sample group. This is oftentimes not feasible if the target population is vast, and the clusters are too large to include fully.
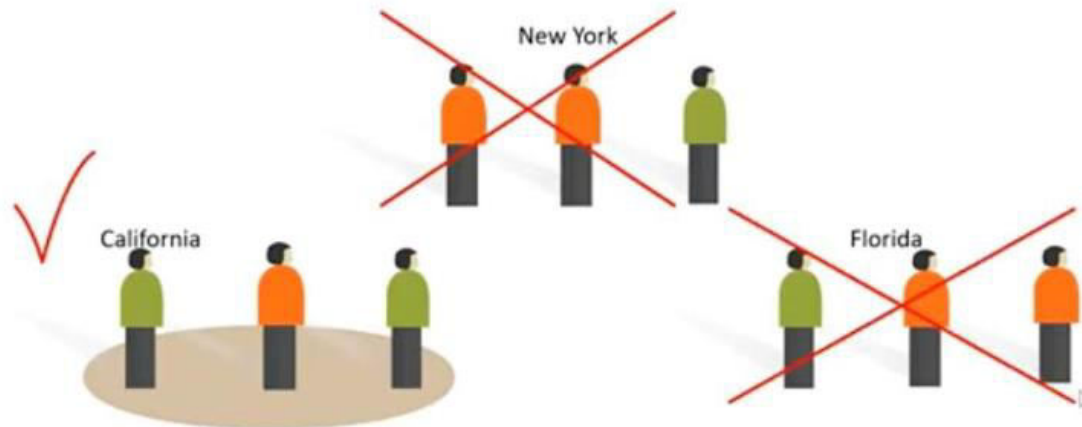
2. **Two-stage** sampling is a more feasible and realistic method of sampling in cases where the population is too large or is scattered over a large geographical area.

- With two-stage sampling, you can use simple random sampling to select elements from each one of the selected clusters. The units of the narrowed-down sample group will be the selected respondents for the study on soda consumption.
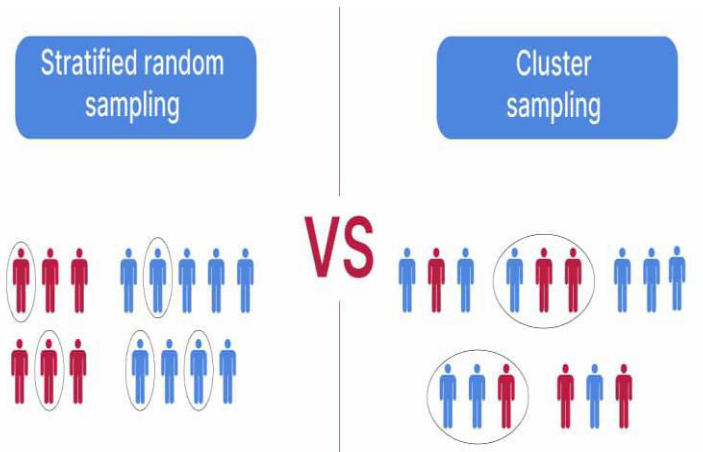

Clustered Population

Sample
(2 clusters)

Pros

- If the study covers wide geographical area, using the other methods will be too costly
- Easy to implement
- Very efficient
- High reliability
- More feasible

Cons

- Prone to biases
- High sampling error

Stratified random sampling

Cluster sampling

VS

Both are opposite / unlike

Cluster sampling vs stratified sampling

Cluster Sampling

1. Cost reduction
2. Randomly selected clusters
3. Division naturally formed
4. More errors
5. Homogeneity externally

Stratified Sampling

1. Enhanced precision
2. Randomly selected members from strata
3. Depends on the researcher
4. Reduced errors
5. Homogeneity internally

33

Non-Probability Sampling Method

➢ Subjective units of population have a zero or unknown probability of selection before drawing the as sample. Hence obtained a non-representative samples.

➢ Sampling error can not be computed

➢ Survey results cannot be projected to the population

Advantages

■ Cheaper and faster than probability

■ Reasonably representative if collected in a thorough manner

34

1. Judgment Sampling/ Purposive sampling

▶ The researcher selects the sample based on judgment. **A researcher exerts some effort in selecting a sample that** **seems to be most appropriate for the study**.

▶ A researcher has authorize , as he want make interview and any where he can apply it.

▶ Purposive sampling (also known as judgment, selective or subjective sampling) is a sampling technique in which researcher relies on his or her own judgment when choosing members of population to participate in the study.

▶ Also called judgmental sampling, this sampling method relies on the researcher's judgment when identifying and selecting the individuals, cases, or events that can provide the best information to achieve the study's objectives.

▶ Advantage: Save time and cost-effectively

2. Convenience Sampling

▶ Convenience sampling selects a particular group of people but it does not come close to sampling all of a population.

• Convenience sampling (also called accidental sampling or grab sampling) is a method of non-probability sampling where researchers will choose their sample based solely on the convenience.

• participant only takes as sample .

  – Some group may celebrate culture

  – Some group are in shopping or hotel or hospital , during exam , some students

Cont'd………..

- **Examples** of convenience sampling include **online and social media surveys, and surveying people in a mall, on the street, and in other crowded locations**.

- Sometimes known as grab or opportunity sampling or accidental or haphazard sampling.

- A type of non probability sampling which involves the sample being drawn from that part of the population which is close to hand. That is, readily available and convenient.

- This type of sampling is most useful for pilot testing.

Pros

- Quick, uncomplicated method of data collection

- Inexpensive

- Readily available sample

Cons

- Bias

- Low external validity

3. Quota sampling

▶ A quota refers to a specific requirement or category.

▶ It is a method that ensures a certain number of sample units from different categories with specific characteristics are represented. The investigator interviews as many people in each category of study unit as he can find until he has filled his quota.

▶ Then judgment used to select subjects or units from each segment based on a specified proportion.

▶ For example, an interviewer may be told to sample 200 females and 300 males between the age of 45 and 60.

▶ 20% Quota for females

4. Snowball sampling

- It is a special non-probability method used when the desired sample characteristic is rare.

- Snowball sampling relies on referrals from initial subjects to generate additional subjects.

- What we need to do in case of snowball sampling is that first identify someone who meets the criteria and then let him/her bring the other he/she knew.

- Friends of friends

- Used to sample from low incidence or rare populations

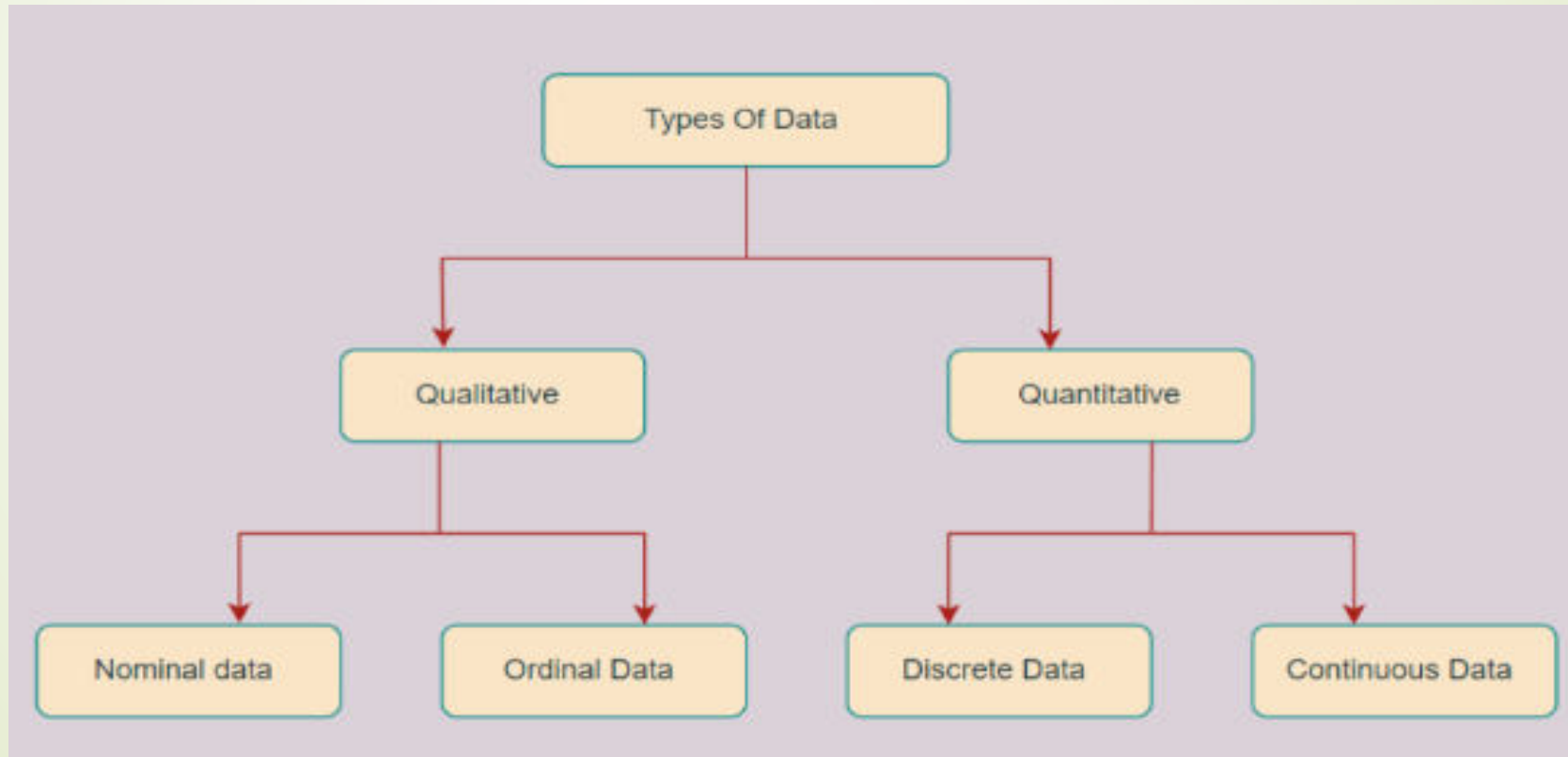# Methods of data collection in research methodology
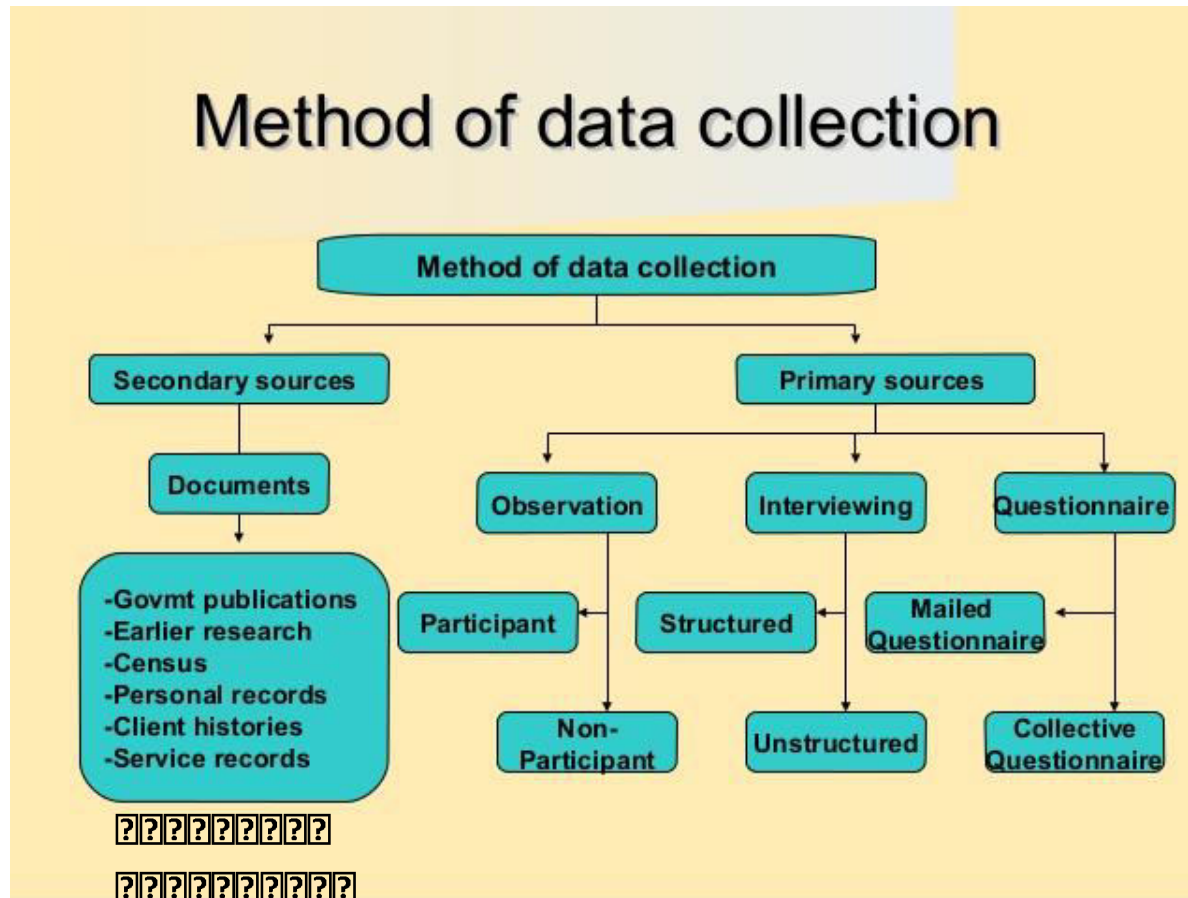
Chapter 5

Data presentation , Analysis and interpretation

Two types of data: Qualitative and Quantitative data

■ **The data is classified into four categories:**

Types of Data … cont

Qualitative or Categorical Data

- Qualitative or Categorical Data is data that can't be measured or counted in the form of numbers. These types of data are sorted by category, not by number. That's why it is also known as Categorical Data. These data consist of audio, images, symbols, or text. The gender of a person, i.e., male, female, or others, is qualitative data.

Examples of qualitative data are :

- What language do you speak
- Favorite holiday destination
- Opinion on something (agree, disagree, or neutral)
- Colors

Nominal Data

- **It** is used to label variables without any order

- **Examples of Nominal Data :**

  - Colour of hair (Blonde, red, Brown, Black, etc.)

  - Marital status (Single, Widowed, Married)

  - Nationality (Indian, German, American)

  - Gender (Male, Female, Others)

  - Eye Color (Black, Brown, etc.)

Ordinal data

- It is qualitative data for which their values have some kind of relative position.
- These kinds of data can be considered "in-between" qualitative and quantitative data.
- The ordinal data only shows the sequences and cannot use for statistical analysis.
- Compared to nominal data, ordinal data have some kind of order that is not present in nominal data.

Examples of Ordinal Data :

- When companies ask for feedback, experience, or satisfaction on a scale of 1 to 10
- Letter grades in the exam (A, B, C, D, etc.)
- Ranking of people in a competition (First, Second, Third, etc.)
- Economic Status (High, Medium, and Low)
- Education Level (Higher, Secondary, Primary)
- Economic status, customer satisfaction, education level, letter grades, etc

Types of Data ... cont

Quantitative Data

- Quantitative data can be expressed in numerical values, making it countable and including statistical data analysis. These kinds of data are also known as Numerical data. It answers the questions like "how much," "how many," and "how often."

- For example, the price of a phone, the computer's ram, the height or weight of a person, etc., falls under quantitative data.

Examples of Quantitative Data :

- Height or weight of a person or object

- Room Temperature

- Scores and Marks (Ex: 59, 80, 60, etc.)

- Time

The Quantitative data are further classified into two parts :

Discrete Data

- The term discrete means distinct or separate.

- The discrete data contain the values that fall under integers or whole numbers. The total number of students in a class is an example of discrete data. These data can't be broken into decimal or fraction values.

Examples of Discrete Data :

- Total numbers of students present in a class

- Cost of a cell phone

- Numbers of employees in a company

- The total number of players who participated in a competition

- Days in a week

Quantitative data cont....

Continuous Data

- Continuous data are in the form of fractional numbers.

- It can be the version of an android phone, the height of a person, the length of an object, etc.

- Continuous data represents information that can be divided into smaller levels. The continuous variable can take any value within a range.

Examples of Continuous Data :

- Height of a person

- Speed of a vehicle

- "Time-taken" to finish the work

- Wi-Fi Frequency

- Market share price

Data analysis using SPSS

- Download
- Install
- Data analysis