

**Presentation for**

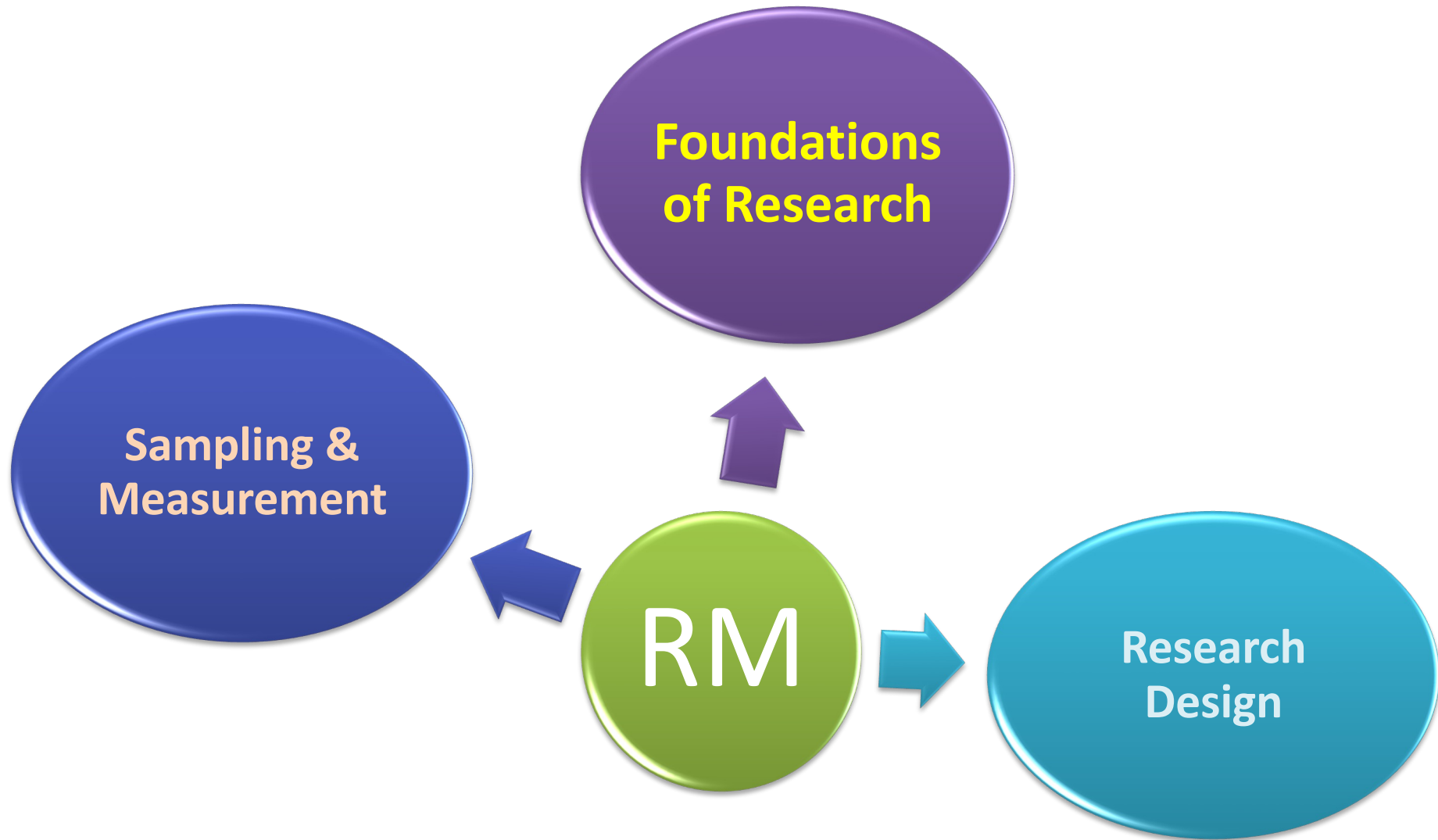
**M. Tech, Ph.D.**  
**DoT**

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# Research Methodology





# **Foundations of Research**

# Foundations of Research:

- ❖ Meaning, Objectives, Motivation.
- ❖ Concept of theory, deductive and inductive theory.
- ❖ Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable.
- ❖ Research Process.
- ❖ Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a Good Hypothesis – Null Hypothesis & Alternative Hypothesis.
- ❖ Hypothesis Testing – Logic & Importance

Research as a movement, a movement from the known to the unknown.

Common parlance refers to a search for knowledge

“A careful investigation or inquiry specially through search for new facts in any branch of knowledge”

“Systematized effort to gain new knowledge.”

An art of scientific investigation

❖ Meaning, Objectives, Motivation.



Research is the systematic process of collecting and analyzing information to increase our understanding of the world in general and of the phenomenon under study in particular.

Research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.

By - Clifford Woody



# Objectives of research

To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formative research studies).

To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies).



To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies).

To test a hypothesis of a casual relationship between variables (such studies are known as hypothesis-testing research studies)

1. Propose and test certain hypothesis that provide causal relationships between variables.
2. Discover and establish the existence of relationship, association and independence between two or more aspects of a situation or phenomenon.
3. Understand different phenomenon and develop new perceptions about it.
4. Study and describe accurately the characteristics of situations, problems, phenomenon, services, groups or individuals.
5. Explain the unexplored horizons of knowledge.
6. Test reported findings and conclusions on new data and novel conclusions on previously reported data.
7. Study the frequency of research that is connected with unspecified study.

## Motivation.

1. Desire to get a research degree along with its consequential benefits;
2. Desire to face the challenge in solving the unsolved problems, i.e., concern over practical problems initiates research;
3. Desire to get intellectual joy of doing some creative work;
4. Desire to be of service to society;
5. Desire to get respectability.

Conducting research takes a significant amount of preparation before you even begin asking anything.

However, the time you spend creating alignment and developing a research plan pays off *tremendously* because it keeps you on track as you carry out your research.

Starting with a good question *and* the right question will ensure you end up with a useful answer. A good research question is specific, actionable, and practical.

**That means:**

- It's possible to answer the question using the techniques and methods available to you.
- It's possible but not guaranteed that you can arrive at an answer with a sufficient degree of confidence to base decisions on what you've learned.

❖ Concept of theory, deductive and inductive theory.

In research, we often refer to the two broad methods of reasoning as the *deductive* and *inductive* approaches.

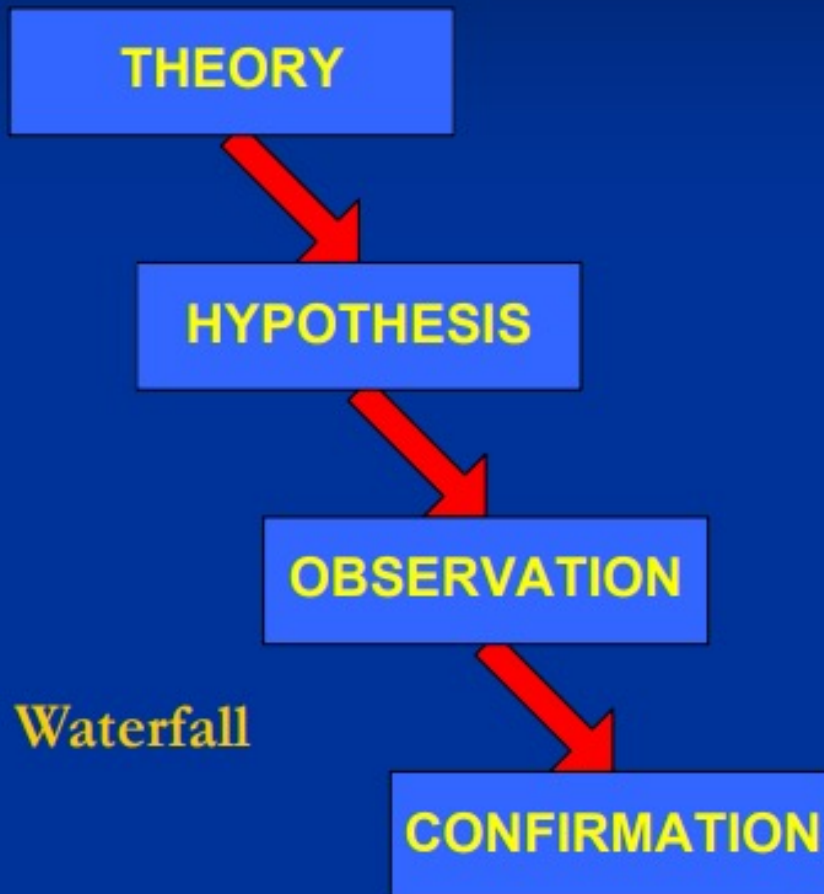


# What is deductive research?

Deductive research is a type of research in which the researcher starts with a theory, hypothesis, or generalization and then tests it through observations and data collection.

It uses a top-down method in which the researcher starts with a general idea and then tests it through specific observations. Deductive research is often used to confirm a theory or test a well-known hypothesis.

# Deductive Research Approach



- Deductive reasoning works from the more general to the more specific.
- Sometimes this is informally called a "top-down" approach.
- Conclusion follows logically from premises (available facts)

# Stages of deductive research process

The five steps in the process of deductive research are:

## 1. Formulation of a hypothesis:

The first step in deductive research is to develop a hypothesis and guess how the variables are related.

Most of the time, the hypothesis is built on theories or research that have already been done.



## 2.Design of a research study:

The next step is designing a research study to test the hypothesis. This means choosing a research method, figuring out what needs to be measured, and figuring out how to collect and look at the data.

## 3.Collecting data:

Once the research design is set, different methods, such as surveys, experiments, or observational studies, are used to gather data. Usually, a standard protocol is used to collect the data to ensure it is correct and consistent.

#### 4. Analysis of data:

In this step, the collected data are looked at to see if they support or disprove the hypothesis.

The goal is to see if the data supports or refutes the hypothesis. You need to use statistical methods to find patterns and links between the variables to do this.

#### 5. Drawing conclusions:

The last step is drawing conclusions from the analysis of the data.

If the hypothesis is supported, it can be used to make generalizations about the population being studied.

If the hypothesis is wrong, the researcher may need to develop a new one and start the process again.

The five steps of deductive research are repeated, and researchers may need to return to earlier steps if they find new information or new ways of looking at things.

In contrast to inductive research, deductive research aims to test theories or hypotheses that have already been made.

# What is inductive research?

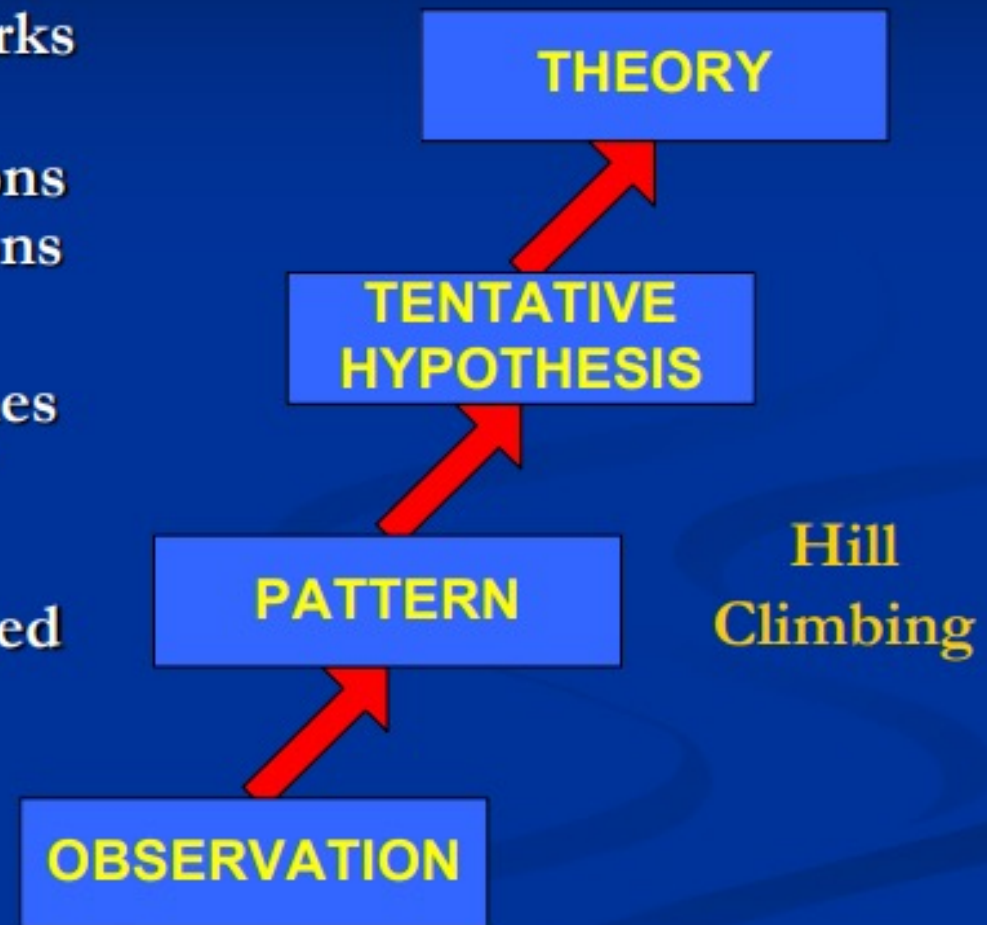
Inductive research is a method in which the researcher collects and analyzes data to develop theories, concepts, or hypotheses based on patterns and observations seen in the data.

It uses a “bottom-up” method in which the researcher starts with specific observations and then moves on to more general theories or ideas.

Inductive research is often used in exploratory studies or when not much research has been done on a topic before.

# Inductive Research Approach

- Inductive reasoning works the other way, moving from specific observations to broader generalizations and theories.
- Informally, we sometimes call this a "bottom up" approach
- Conclusion is likely based on premises.
- Involves a degree of uncertainty



Cite as:

## Stages of inductive research process

The three steps of the inductive research process are:

### 1.Observation:

The first step of inductive research is to make detailed observations of the studied phenomenon.

This can be done in many ways, such as through surveys, interviews, or direct observation.

## 2. Pattern Recognition:

The next step is to look at the data in detail once the data has been collected.

This means looking at the data for patterns, themes, and relationships.

The goal is to find insights and trends that can be used to make the first categories and ideas.

### 3.Theory Development:

At this stage, the researcher will start to create initial categories or concepts based on the patterns and themes from the data analysis.

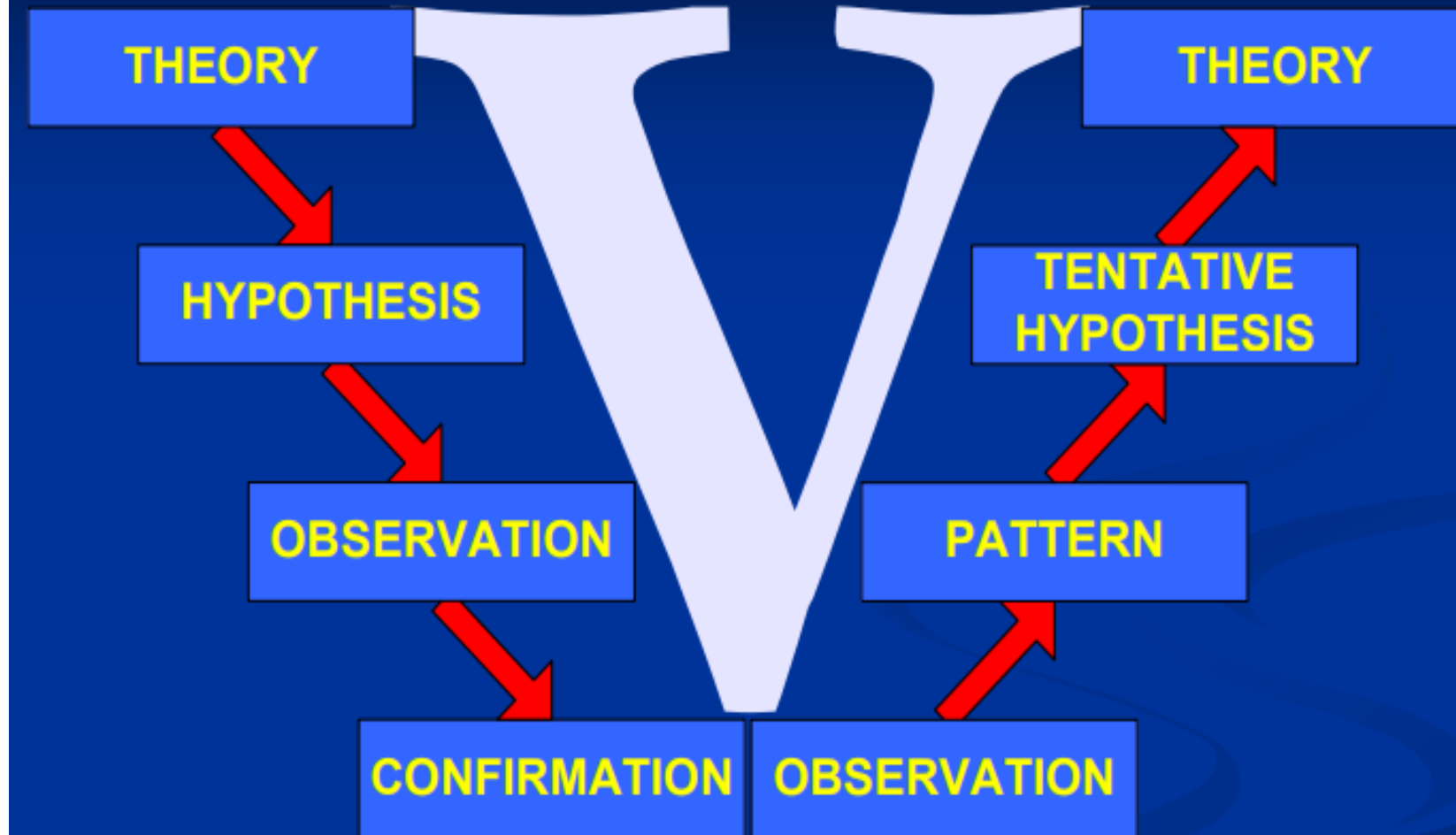
This means putting the data into groups based on their similarities and differences to make a framework for understanding the thing being studied.



These three steps are often repeated in a cycle, so the researcher can improve their analysis and understand the phenomenon over time.

Inductive research aims to develop new theories and ideas based on the data rather than testing existing theories, as in deductive research.

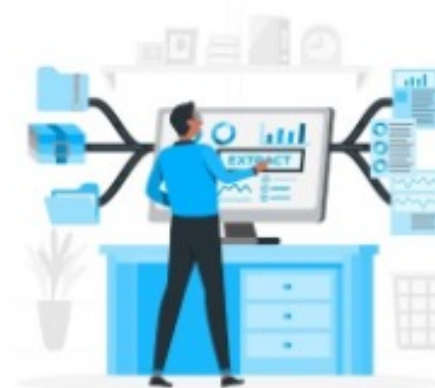
# Deductive Vs. Inductive





## Inductive Research

1. Bottom-up approach
2. Develops theories from observations
3. Used in exploratory studies
4. Flexible and adaptable to new findings
5. Relies more on qualitative analysis



## Deductive Research

1. Top-down approach
2. Tests theories through observations
3. Used in confirmatory studies
4. Structured and systematic
5. Relies more on quantitative analysis

## ❖ Understanding the language of research – Concept, Construct, Definition, Variable.

In research methodology is the ability to comprehend and interpret the specific terminology, concepts, and jargon commonly used in academic and scientific research.

Research involves a precise and structured language that :

- a) Allows researchers to communicate their findings effectively
- b) Ensure a clear understanding of their work among their peers and the wider academic community.

Key aspects of understanding the language of research include:

**1. Scientific Terminology:** Research involves the use of specialized terms and vocabulary that may not be familiar to the general public. Understanding these terms is essential for comprehending research papers, communicating with other researchers, and conducting effective literature reviews.

**2. Research Methods and Designs:** Different research studies employ various methods and designs, such as experimental, correlational, qualitative, or mixed methods. Understanding the distinctions between these methodologies is crucial for interpreting the strengths and limitations of each study.

**3. Statistical Analysis:** Research often includes statistical analyses to draw conclusions from data. Understanding statistical terms and concepts like p-values, significance levels, regression, and sample sizes is essential for critically evaluating research findings.

**4. Literature Review:** Research often builds upon existing knowledge. Understanding how to conduct a literature review, which involves searching, evaluating, and synthesizing relevant previous studies, is an integral part of the research process.

**5. Research Ethics:** Researchers must adhere to ethical principles and guidelines while conducting studies involving human participants or animals. Understanding the language of research ethics ensures the protection of subjects and the integrity of the research.

**6. Academic Writing Style:** Researchers communicate their findings through academic papers that follow a specific writing style, such as APA (American Psychological Association) or MLA (Modern Language Association) format. Understanding this style ensures clarity and consistency in academic writing.

## **Concept :**

A general idea or mental construct representing a class of objects, events, or behaviors. For example, “happiness” is a concept.

## **Construct :**

An abstract concept that cannot be directly observed but is inferred from observable variables. For example, “intelligence” is a construct that researchers might measure using different variables.

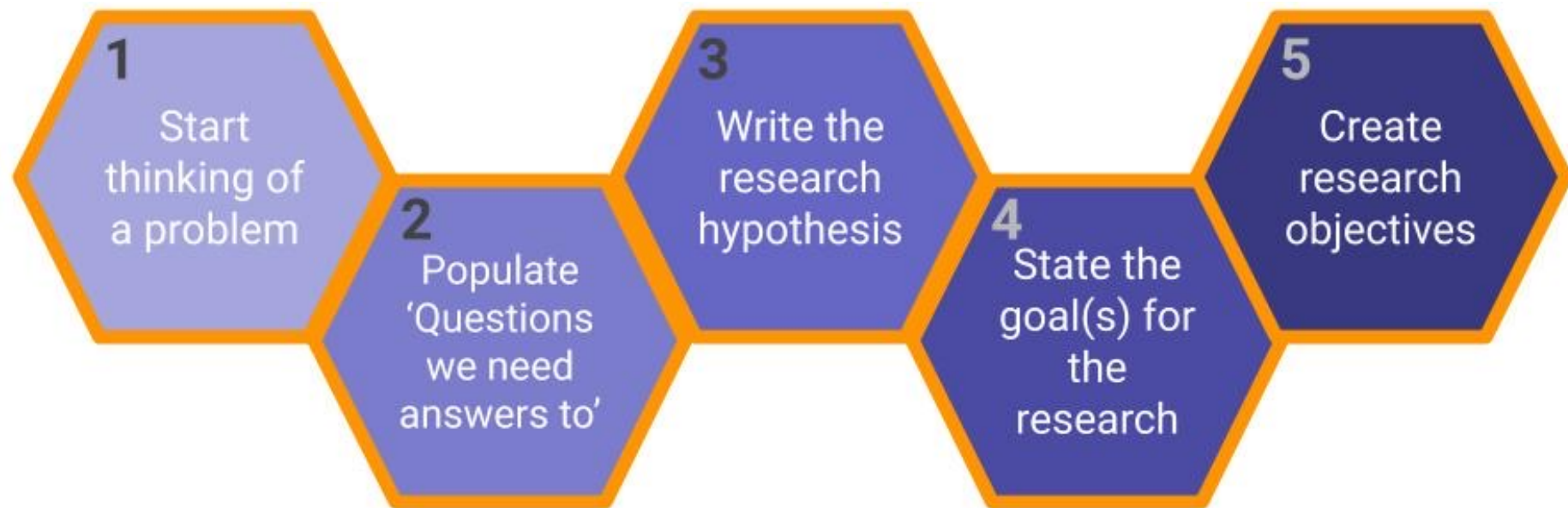


**Definition :**

The specific meaning or explanation of a concept or construct used in a particular study. Defining terms precisely helps avoid confusion and ensures consistency.

**Variable :**

Any characteristic, trait, or attribute that can vary and be measured or manipulated in research. Variables can be independent (manipulated by the researcher) or dependent (measured to observe the effect of the independent variable).



## ❖ Research Process.



**1. Formulating the Research Problem:** Identifying and defining the research question or problem that needs to be addressed.

**2. Literature Review:** Conducting a thorough review of existing literature and research related to the topic to understand what has already been studied and discovered.

**3. Developing the Hypothesis:** Creating a clear and testable statement that predicts the relationship between variables in the research.

**4. Research Design:** Planning the overall structure and approach of the study, including selecting the research methods and data collection techniques.

**5. Sample Design:** Determining the sample size and selecting the participants or subjects that will be part of the study.

**6. Data Collection:** Gathering relevant data through various methods, such as surveys, interviews, experiments, or observations.

**7. Execution of the Project:** Implementing the research plan and collecting the data as per the designed approach.

**8. Data Analysis:** Analyzing the collected data using appropriate statistical or qualitative techniques to draw meaningful conclusions.

**9. Hypothesis Testing:** Evaluating the hypothesis based on the analysis to determine whether it is supported or rejected.

**10. Generalizations and Interpretation:** Making broader connections and interpretations of the findings in the context of the research problem.

**11. Conclusion and Recommendations:** Summarizing the research results, drawing conclusions, and suggesting potential future research or practical implications.

## ❖ Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues –

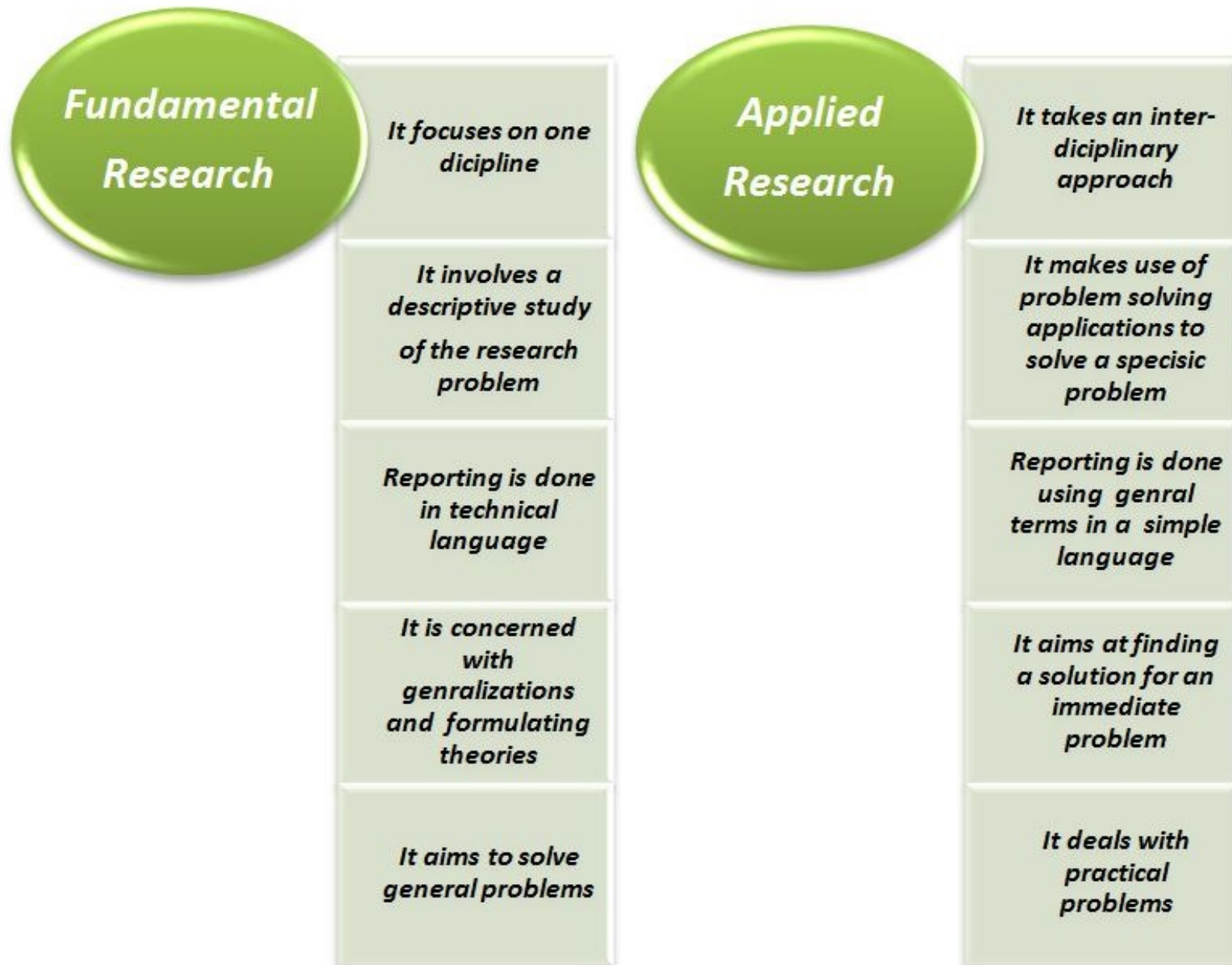
- A research problem is a statement that addresses a gap in knowledge, a challenge or a contradiction in a particular field.
- Scientists use research problems to identify and define the aim of their study and analysis.

Factors that ensure a research problem is clear, well-defined and easy to follow throughout the duration of a study.

- Reflecting on issues or required knowledge in a particular field prior to conducting a study
- Ensuring that the topic you aim to examine has a sufficient amount of relevant data
- Relying on reputable evidence and data and disregarding information that you can't verify
- Remaining practical, manageable and communicative with researchers involved in data collection and analysis
- Adhering strictly to a budget and timeline



# Types of research :



# 19 Types of Research

- |                             |                             |
|-----------------------------|-----------------------------|
| 1- Fundamental research     | 2- Applied research         |
| 3- Qualitative research     | 4- Quantitative research    |
| 5- Mixed research           | 6- Exploratory research     |
| 7- Longitudinal research    | 8- Cross-sectional research |
| 9- Field research           | 10- Laboratory research     |
| 11- Fixed research          | 12- Flexible research       |
| 13- Action research         | 14- Policy research         |
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| 19- Deductive research      |                             |

## Hypothesis – Qualities of a Good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing

### Hypothesis ????

- ❖ A tentative solution or an intelligent guess about a research question under study.
- ❖ An assumption or proposition whose tenability is to be tested on the basis of its implications with empirical evidence and with the previous knowledge.
- ❖ According to Van Dalen (1973) 'A hypothesis serves as a powerful beacon that lights the way for the research worker'.
- ❖ hypothesis is made up of two words 'hypo' (less than) and 'thesis', which means less than a thesis.

- ❖ It is the presumptive statement of a proposition or a reasonable guess, based upon the available evidences, which the researcher seeks to prove through his/her study.
- ❖ It is also a declarative statement in which the investigator makes a prediction or a conjecture about the outcome of the relationship.
- ❖ The conjecture or the prediction is not simply an "educated guess"; rather it is typically based on past researches, which investigators gathered as evidences to advance the hypothesized relationship between variables.

- ❖ In the formulation of hypothesis, the investigator looks for the statements where she/he relates one or more variables to make predictions about the relationships.
- ❖ The hypothesis tells the researcher what to do and why to do in the context of the problem.
- ❖ It is said to be a hunch, shrewd guess or supposition about what may be the answer to a problem.

- ❖ The terms hypothesis, theory or conclusion occur frequently in research literature, but differ slightly from each other.
  - 'Hypothesis' is defined as a tentative solution or working proposition suggested as a solution to problem, and
  - The 'theory' as the final hypothesis, which is defensibly supported by all evidence.
  - The final hypothesis, which fits all the evidences, becomes the chief 'conclusion' inferred from the study.

# SOURCES OF HYPOTHESIS

1. Experience and Creativity of the Researcher
2. Background Knowledge
3. Versatility of Intellect
4. Analogies
5. Scientific Theories
6. Authentic Knowledge

## TYPES OF HYPOTHESIS

- ❑ **Simple Hypothesis : 1 independent variables & 1 dependent variables**  
e.g. – eat more vegetables, will lose weights faster
- ❑ **Complex Hypothesis : no of independent and dependent variables**  
e.g. – eat more vegetables & fruits and exercise daily  
leads to weight loss, glowing skin and minimize risk of heart attack.
- ❑ **Null Hypothesis : No relationship between independent and independent variables**  
e.g. – there is no relationship between sugar intake obesity
- ❑ **Research or Alternative Hypothesis : replationship between independent and dependent variables**  
e.g. – Their is strong relationship between sugar intake and obesity



- ❑ **Directional** : direction between independent and dependent variable  
e.g. - there is strong positive relations between sugar intake and obesity
- ❑ **Non-directional** : shows the effect of independent and dependent variable, but the direction of the effect is not specified  
e.g – sugar intake effects human health.
- ❑ **Casual Hypothesis** : cause and effect of independent and dependent variable  
e.g. – smoking leads to lung cancer.
- ❑ **Associative Hypotheis** : connection between independent and depedent varilabe  
e.g. – lower the level of blood sugar lesser the chances of infection between diabetic patient.

# TESTING OF THE HYPOTHESIS

The necessary conditions for confirmation are:

- (i) all factual evidences collected through tests or other means (tools) should correspond with the deduced consequences;
- (ii) the data-collecting tools should take into account all factors and conditions that are suggested by the consequences;
- (iii) the consequences are logically deduced from the hypothesis.

## CHARACTERISITICS OF A GOOD HYPOTHESIS

1. It must be testable.
2. It must state the expected relationship between the variables.
3. It must suggest a tentative solution to the problem under study.
4. It must be clear and stated in a precise manner.
5. The hypothesis should be limited in scope.
6. A hypothesis must be consistent with known facts.
7. A hypothesis must explain what it intends to explain.

7. The variables should be defined operationally so that the predicted relations among them can be tested empirically. A good hypothesis is capable of explaining and testing significantly large number of consequences.
8. It must be based on some relevant theory or discovered truth.
9. The hypothesis should be amenable to testing within a reasonable time.

# SIGNIFICANCE AND IMPORTANCE OF A HYPOTHESES

1. A hypothesis directs, monitors and controls the research efforts.
2. The hypothesis not only indicates what to look for in an investigation but how to select a sample, choose a design of research, how to collect data and how to interpret the results to draw valid conclusions.
3. The hypothesis orients the researcher to be more sensitive to certain relevant aspects of problem so as to focus on specific issues and pertinent facts.

4. The hypothesis provides the researcher with rational statements, consisting of elements expressed in a logical order of relationships, which seek to describe or to explain conditions or events that have not yet been confirmed by facts.
5. Hypothesis formulation and its testing add a scientific rigor to all type of researches.
6. A well thought set of hypothesis places a clear and specific goal before the researcher and equips him with understanding.



# Research Design

A Research Design is simply a structural framework of various research methods as well as techniques that are utilized by a researcher.

The important elements of a research design-

- ❖ The method applied for analyzing collected details
- ❖ Type of research methodology
- ❖ Accurate purpose statement
- ❖ Probable objections to research
- ❖ Techniques to be implemented for collecting, analyzing research
- ❖ Timeline
- ❖ Measurement of analysis
- ❖ Settings for the research study



Any sound research design will do the following things:

1. Identify the research problem clearly and justify its selection,
2. Review previously published literature associated with the problem area,
3. Clearly and explicitly specify hypotheses [i.e., research questions] central to the problem selected,
4. Effectively describe the data which will be necessary for an adequate test of the hypotheses and explain how such data will be obtained, and
5. Describe the methods of analysis which will be applied to the data in determining whether or not the hypotheses are true or false.

# Characteristics of Research Design



Neutrality



Reliability



Validity



Generalization

## Characteristics of research design

- **Neutrality:** Right from the study assumptions to setting up the study, a neutral stance must be maintained, free of pre-conceived notions. The researcher's expectations or beliefs should not color the findings or interpretation of the findings. Accordingly, a good research design should address potential sources of bias and confounding factors to be able to yield unbiased and neutral results.

- **Reliability:** Reliability is one of the characteristics of research design that refers to consistency in measurement over repeated measures and fewer random errors. A reliable research design must allow for results to be consistent, with few errors due to chance.

- **Validity:** Validity refers to the minimization of nonrandom (systematic) errors. A good research design must employ measurement tools that ensure validity of the results.

- **Generalizability:** The outcome of the research design should be applicable to a larger population and not just a small sample. A generalized method means the study can be conducted on any part of a population with similar accuracy.

- **Flexibility:** A research design should allow for changes to be made to the research plan as needed, based on the data collected and the outcomes of the study

# 19 Types of Research

- |                             |                             |
|-----------------------------|-----------------------------|
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| 19- Deductive research      |                             |

# Types Of Research Designs

## 5) Experimental Research Design

The experimental research design involves manipulating one variable to determine if changes in one variable lead to changes in another variable.

Split research :

- 1) The control group : receives nothing, or, a placebo (e.g. sugar pill)
- 2) Experimental group is provided the dependent variable (e.g. a new medication).

e.g. The effects of sleep deprivation on cognitive performance

- 1) A group is deprived of sleep for 24 hours (experimental group),
- 2) A group is allowed a full night's sleep (control group).

The researcher then measures the cognitive performance of both groups. If the sleep-deprived group performs significantly worse, it could be inferred that sleep deprivation negatively affects cognitive performance.

## 6) Exploratory Research Design

Exploratory research is a type of research conducted to clarify ambiguous problems or discover ideas that can be potential research topics.

- ❖ Usually conducted when a problem is not clearly defined.
- ❖ Does not aim to provide conclusive results or decide a course of action.
- ❖ Instead, it focuses on gaining insights and familiarity with the subject.
- ❖ It's typically characterized by its flexibility, as it allows researchers to shift their focus as new data and insights are collected.
- ❖ The main methods of data collection for exploratory research are survey research, qualitative research, literature reviews, case studies, and focus groups.

e.g. Consider a business that is noticing a decline in its customer retention rates.

They may start with open-ended surveys or interviews with their customers to understand their needs and challenges.

Based on the initial feedback, they might find several possible causes – poor customer service, outdated product features, or increased competition.

These insights can help define further research to fully understand and address the identified issues.



## 7) Qualitative research

- ❖ It is subjective and exploratory. It determines relationships between collected data and observations. It is usually carried out through interviews with open-ended questions, observations that are described in words, etc.
- ❖ It is explanatory in nature and always seeks answers to “What’s” and “How’s”. It mainly focuses on why a specific theory exists and what would be the respondent’s answer to it.
- ❖ This allows a researcher to draw a conclusion with proper findings.
- ❖ Case studies are mainly used in Qualitative Research Design in order to understand various social complexities.

e.g.

- 1) A marketing organization presents a new commercial to a focus group before airing it publicly to receive feedback. The company collects non-numerical data—the opinions of the focus group participants—to make decisions.
- 2) A researcher conducting a phenomenological study might explore the lived experiences of individuals who have survived a natural disaster to understand the psychological and emotional impact of such events.



## 8) Quantitative research

- ❖ It is objective and employs statistical approaches.
- ❖ It establishes the cause-and-effect relationship among variables using different statistical and computational methods.
- ❖ This type of research is usually done using surveys and experiments.
- ❖ A researcher examines the various variables while including numbers as well as statistics in a project to analyze its findings.
- ❖ The use of graphics, figures, and pie charts is the main form of data collection measurement and meta-analysis (it is information about the data by the data).

e.g.

- 1) A car manufacturer compares the number of sales of red sedans compared to white sedans. The research uses objective data—the sales figures for red and white sedans—to draw conclusions.
- 2) An example of correlational research design could be studying the correlation between time spent watching crime shows and aggressive behavior in teenagers.



Qualitative research	Quantitative research
Deals with subjective aspects, e.g., experiences, beliefs, perspectives, and concepts.	Measures different types of variables and describes frequencies, averages, correlations, etc.
Deals with non-numerical data, such as words, images, and observations.	Tests hypotheses about relationships between variables. Results are presented numerically and statistically.
In qualitative research design, data are collected via direct observations, interviews, focus groups, and naturally occurring data. Methods for conducting qualitative research are grounded theory, thematic analysis, and discourse analysis.	Quantitative research design is empirical. Data collection methods involved are experiments, surveys, and observations expressed in numbers. The research design categories under this are descriptive, experimental, correlational, diagnostic, and explanatory.

Data analysis involves interpretation and narrative analysis.	Data analysis involves statistical analysis and hypothesis testing.
The reasoning used to synthesize data is inductive.	The reasoning used to synthesize data is deductive.
Typically used in fields such as sociology, linguistics, and anthropology.	Typically used in fields such as economics, ecology, statistics, and medicine.
Example: Focus group discussions with women farmers about climate change perception.	Example: Testing the effectiveness of a new treatment for insomnia.



## 9) Mixed-Method Research Design

Mixed-method research design is a method that combines both quantitative (numerical data) and qualitative (non-numerical data) research techniques, methods, approaches, concepts or language into a single study.

e.g. - An education researcher interested in student motivation might use a mixed-method approach.

- They could distribute a survey (quantitative method) to measure levels of motivation, and then
- Conduct interviews (qualitative method) to gain a deeper understanding of factors influencing student motivation.

## 10) Longitudinal Research Design

**Longitudinal studies take place over a long period of time to explore changes to the research subjects or variables over time.**

This sort of study is often valuable in detecting correlations between variables over the course of an intervention.

e.g. - The famous Minnesota Twins study examined identical twins who were raised in separate environments to examine whether behavioral and personality traits were genetic or environmental. The study by Thomas J Bouchard, which took place between 1979 to 1990, argued that identical twins who grew up separate and in different environments did not display any greater chances of being different from each other than twins that were raised together in the same house. The study indicated that similarities in personality and behavior between twins are likely genetic rather than environmental in nature, giving sway to the argument that nature is more powerful than nurture (Bouchard et. al., 1990).

## 11) Cross-Sectional Research Design

A cross-sectional research design involves collecting data on a sample of individuals at one specific point in time.

Unlike longitudinal studies, which examine variables across a time horizon, a cross-sectional design will only collect data at one point in time.

e.g. Psychologists could collect data on people's socioeconomic status (for example, their current income levels, education, and occupation). During the study, they may also gather data on self-reported mental health status using validated Likert scales. Based on this dataset, the researchers then explored the relationship between socioeconomic status and profession and mental health. While this provided excellent descriptive insights about which professions and SES groups tend to have higher mental health concerns, the researchers could not determine causal factors through the cross-sectional study alone.

Likert scale : a rating scale used to measure opinions, attitudes or behaviors.

## 12) Field Research Design

**Field research is a qualitative method of research concerned with understanding and interpreting the social interactions, behaviors, and perceptions within a specific social or environmental setting.**

It involves collecting data 'in the field', i.e., in a natural or social setting, and often involves direct and prolonged contact with participants.

e.g. - An anthropologist studying the social practices of a remote indigenous tribe may live with the tribe for several months, participating in their daily activities, observing, and documenting their practices and rituals. Through this field research, they can understand the tribe's social structure, beliefs, and customs in

### 13) Fixed research

Fixed research involves procedures determined ahead of time, such as how often testing will take place, where it will take place, the number of subjects and their types. The research depends on precise conditions and compliance with predetermined protocols to reduce variables. Experimentation is often fixed research.

**e.g.** - A researcher wants to test how different labels affect consumers' ratings of a sports drink. Participants are given the same drink with various labels at the same time and take a survey about taste and overall impressions. The timing of providing each drink and the subsequent surveys are critical to the study's validity.

## 14) Flexible research

Flexible research allows procedures to change throughout the course of the experiment. The different types of flexible research include:

- **Case studies:** Case studies are in-depth analyses and observations about a specific individual or subject.
- **Ethnographic studies:** Ethnographic studies are in-depth analyses and observations of a group of people.
- **Grounded theory studies:** Grounded theory studies are designed to develop theories based on carefully collected and analyzed data.

e.g. - A physician uses a case study methodology to follow a patient through symptoms, treatment and recovery.

## 15) Action research

Action research refers to examining actions, assessing their effectiveness in bringing about the desired outcome and choosing a course of action based on those results. It is typically used in educational settings for teachers and principals to perform a type of self-assessment and course correction.

**e.g.** - A teacher collects data about their methods of teaching fifth-grade math. At the end of the first school quarter, they discovered only 33% of students demonstrated proficiency in the concepts. As a result, the teacher implements new methods for the second quarter.

## 16) Policy research

Policy research examines the effects of current government or social policies or predicts the potential effects of proposed policies related to the distribution of resources.

Policy researchers often work within government agencies and conduct the following types of studies:

- Cost analysis
- Cost-benefit analysis
- Program evaluation
- Needs analysis

**e.g.** - An agency may research how a policy for vaccine distribution will affect residents in rural areas. The outcome may change where the government sets up free shot clinics.



## 17) Classification research

Classification research seeks to identify and classify individual elements of a group into larger groups or subgroups.

**e.g.** - Researchers study an animal species, placing them in defined categories based on shared characteristics, such as:

- Body segmentation
- Type of habitat
- Reproductive methods
- Diet

## 18) Comparative research

Comparative research identifies similarities and differences between two individuals, subjects or groups.

**e.g.** - A business owner reviews new hire training documentation and discovers that new employees receive much of the same information at orientation and in their initial departmental training. The owner incorporates materials into one session to allow more time for department-specific training.

## 19) Causal research

Causal research, also called explanatory research, seeks to determine cause-and-effect relationships between variables. It identifies how much one variable may cause a change in the other. Causal research is important for evaluating current processes and procedures and determining if and how changes should take place.

**e.g.** - A business studies employee retention rates before and after instituting a work-from-home policy after six months of employment to see if the approach increases employee retention.



# Sampling & Measurement

In planning a sample survey, the researcher needs to precisely define the following:

- Sampling Unit:** The individual person, animal, or object that has the measurement (observation) taken on them/it

- Population:** The entire group of individuals or objects that we wish to know something about. A numerical characteristic of the population is called a **parameter**.

- Sampling Frame:** The list of the sampling units from which those to be contacted for inclusion in the sample is obtained. The sampling frame lies between the population and sample. Ideally, the sampling frame should match the population, but rarely does because the population is not usually small enough to list all members of the population.

- Sample:** Those individuals or objects who provide the data to be collected. Numerical characteristics of the sample are called **statistics** and are typically used as estimates of population parameters.

**Statistical analysis** means investigating trends, patterns, and relationships using quantitative data. It is an important research tool used by scientists, governments, businesses, and other organizations.

To draw valid conclusions, statistical analysis requires careful planning from the very start of the research process. You need to specify your hypothesis and make decisions about your research design, sample size, and sampling procedure.

After collecting data from your sample,

- 1) Can organize and summarize the data using descriptive statistics.
- 2) Then, you can use inferential statistics to formally test hypotheses and make estimates about the population.
- 3) Finally, you can interpret and generalize your findings.

**Descriptive statistics** summarize and organize characteristics of a data set. A data set is a collection of responses or observations from a sample or entire population.

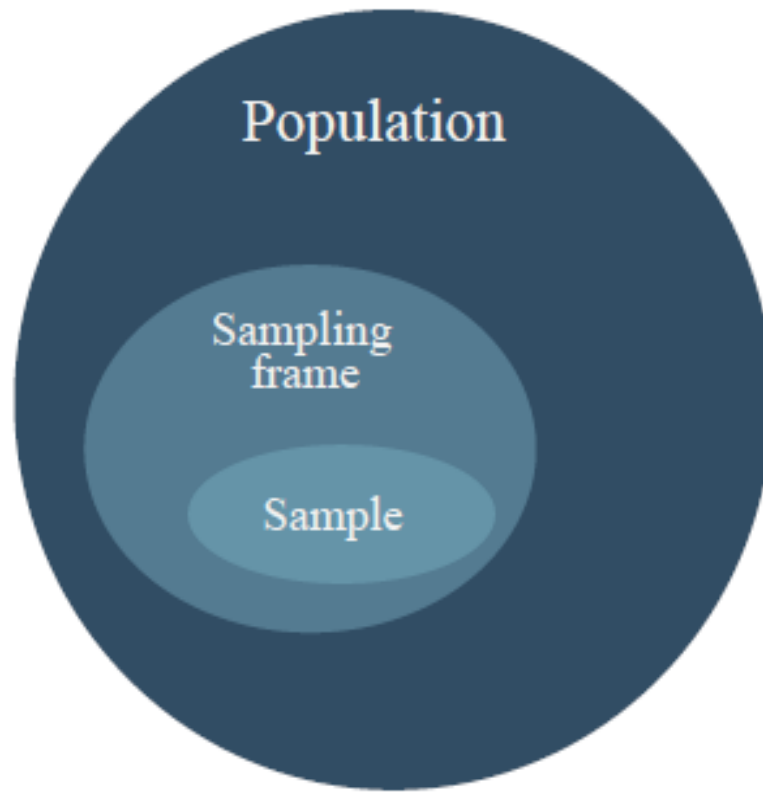
In quantitative research, after collecting data, the first step of statistical analysis is to describe characteristics of the responses, such as the average of one variable (e.g., age), or the relation between two variables (e.g., age and creativity).

The next step is **inferential statistics**, which help you decide whether your data confirms or refutes your hypothesis and whether it is generalizable to a larger population.

**Inferential statistics have two main uses:**

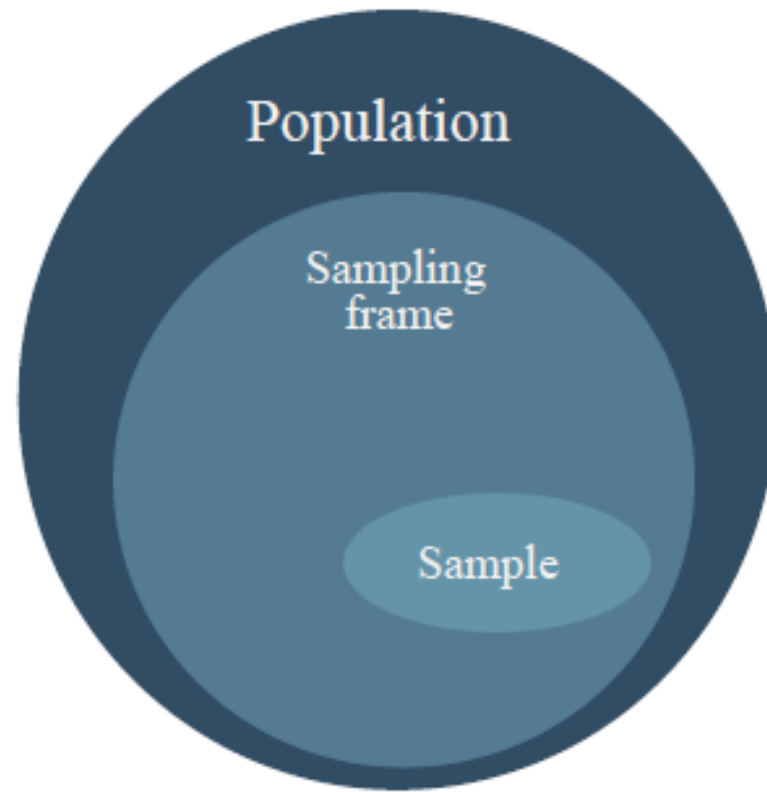
- Making estimates about populations  
(e.g. the mean SAT score of all 11th graders in the US).
- **Testing hypotheses** to draw conclusions about populations  
(e.g. the relationship between SAT scores and family income).

## Relationship between Population, Sampling Frame and Sample



### Undercoverage

Bias can result if the sampling frame does not include major parts of the population



### Sampling frame close to population

Having the sampling frame is essentially the same as the population avoids selection bias



For statistical analysis, it's important to consider the level of measurement of your variables, which tells you what kind of data they contain:

- 1) **Categorical** data represents groupings. These may be nominal (e.g., gender) or ordinal (e.g. level of language ability).
- 2) **Quantitative** data represents amounts. These may be on an interval scale (e.g. test score) or a ratio scale (e.g. age).

## Sampling for statistical analysis :

There are two main approaches to selecting a sample.

- 1) **Probability sampling:** every member of the population has a chance of being selected for the study through random selection.
- 2) **Non-probability sampling:** some members of the population are more likely than others to be selected for the study because of criteria such as convenience or voluntary self-selection.



Probability sampling	Non-probability sampling
Randomly selected samples	Subjective judgement of researchers are used to select samples
Equal chance for each member of population to get selected	Not everyone has equal chance to get selected
Used to reduce a sampling bias	Researcher is not overly concerned with sampling bias
Effective to collect data from diverse population	Useful in specific environment with sampling group members sharing similar characteristics
Useful in obtaining accurate representation of population	Does not help in representing the population accurately
Finding correct audience is difficult	Finding correct audience is simple

## Probability Sampling :

In probability sampling, each population member has a known, non-zero chance of participating in the study.

Randomization or chance is the core of probability sampling technique. Probability sampling methods use some form of random selection.

Therefore, application of this method offers the highest chance of creating a sample that is truly representative of the population.

# Probability Sampling Methodologies



## Random Sampling :

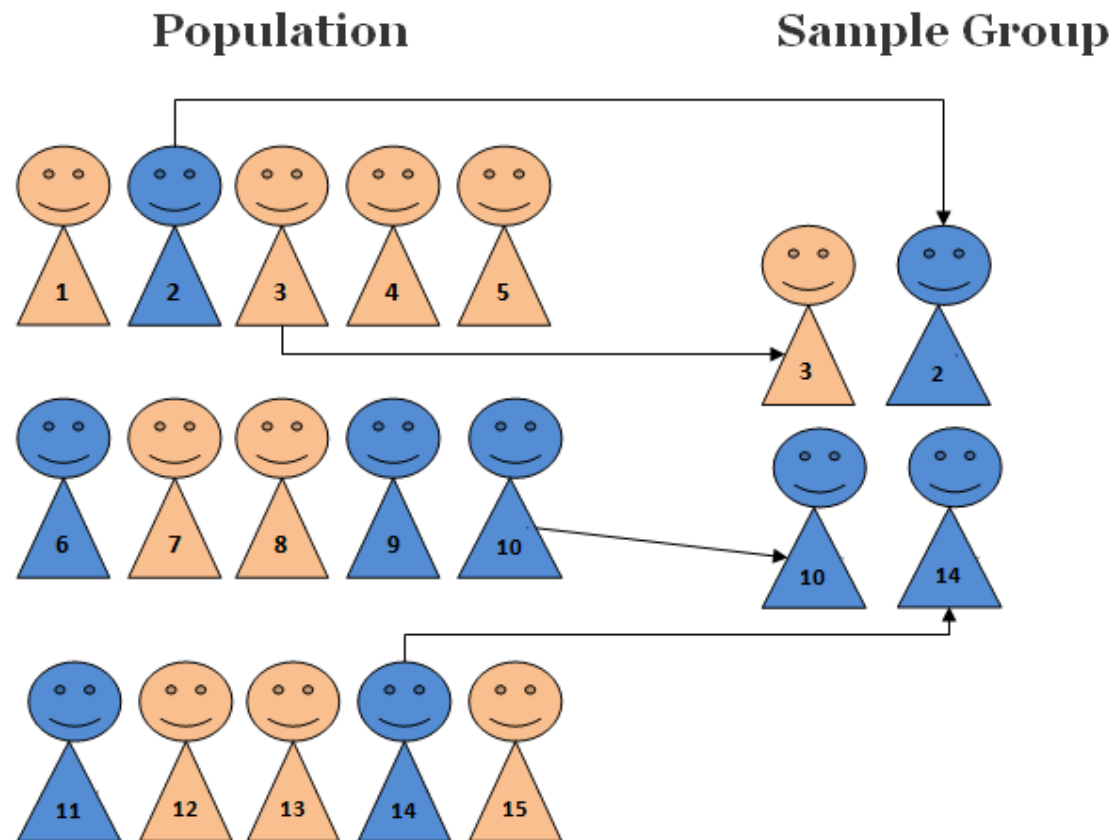
Random sampling is a type of probability sampling where everyone in the entire target population has an equal chance of being selected.

This is similar to the national lottery. If the “population” is everyone who bought a lottery ticket, then everyone has an equal chance of winning the lottery (assuming they all have one ticket each).

Random samples require naming or numbering the target population and then using some raffle method to choose those to make up the sample. Random samples are the best method of selecting your sample from the population of interest.

Ideally, the sample size of more than a few hundred is required in order to be able to apply simple random method in an appropriate manner.

It can be argued that this method is easy to understand in theory, but difficult to perform in practice. This is because working with a large sample size is not easy and it can be a challenge to get a realistic sampling frame.





## Advantages of Simple Random Sampling

- 1.If applied appropriately, simple random sampling is associated with the minimum amount of sampling bias compared to other sampling methods.
- 2.Given the large sample frame is available, the ease of forming the sample group i.e. selecting samples is one of the main advantages of this method.
- 3.Research findings can be generalized due to representativeness of this sampling technique and a little relevance of bias.
- 4.It is straightforward sampling method that requires no advanced technical knowledge

## Disadvantages of Simple Random Sampling

- 1.It is important to note that application of random sampling method requires a list of all potential respondents (sampling frame) to be available beforehand and this can be costly and time-consuming for large studies.
- 2.The necessity to have a large sample size can be a major disadvantage in practical levels.
- 3.This sampling method is not suitable for studies that involve face-to-face interviews covering a large geographical area due to cost and time considerations.

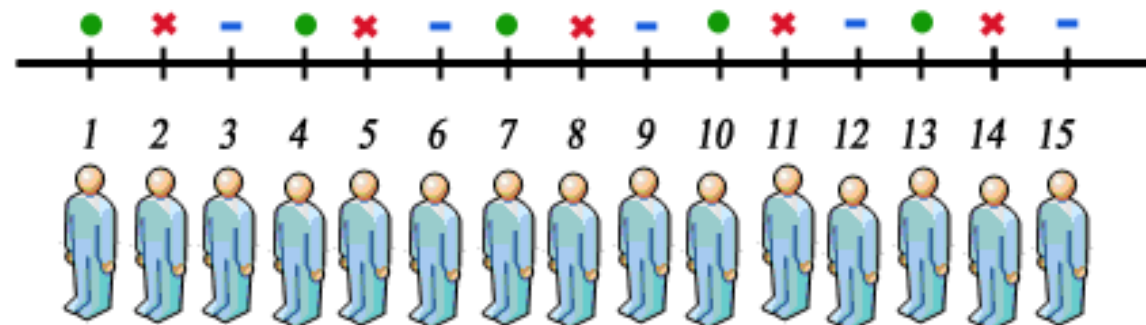
## Systematic Sampling:

In systematic sampling (also called systematic random sampling) every  $N$ th member of population is selected to be included in the study.

It is a probability sampling method. Systematic sampling can be more suitable than simple random sampling because the former can be time-consuming.

It has been stated that “with systematic sampling, every  $K$ th item is selected to produce a sample of size  $n$  from a population size of  $N$ ”.

This method requires an approximated frame for a priori but not the full list.



## **Advantages of Systematic Sampling**

1. When done correctly, this method will approximate the results of simple random sampling.
2. Systematic sampling is cost and time efficient. The selection of a sample is very convenient. This is an important aspect of systematic sampling which makes it applicable in many situations.
3. Systematic sampling is effectively suitable in collecting data from geographically dispersed cases (that do not require face-to-face contact).
4. Systematic sampling reduces the probability of contaminating the data
5. This method eliminates the phenomenon of clustered selection

## **Disadvantages of Systematic Sampling**

1. Systematic sampling can be applied only if the complete list of population is available.
2. If there are periodic patterns within the dataset, the sample will be biased.
3. If study participants deduce the sampling interval, this can bias the population as non-participants will be different from study participants.
4. The risk of over-representation or under-representation of particular patterns
5. Greater risk of manipulations with data.

## **Stratified Sampling :**


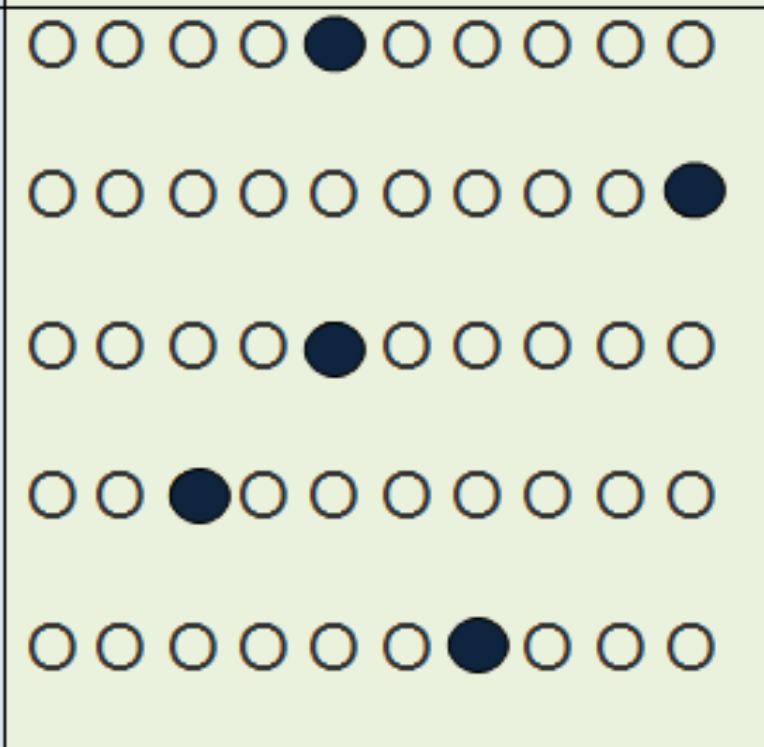
Stratified sampling is a probability sampling method and a form of random sampling in which the population is divided into two or more groups (strata) according to one or more common attributes.

These attributes can be sex, age, income, level of education etc. according to aims and objectives of the study.

Stratified random sampling intends to guarantee that the sample represents specific sub-groups or strata.

Accordingly, application of stratified sampling method involves dividing population into different subgroups (strata) and selecting subjects from each strata in a proportionate manner.

The example where sample group of 10 respondents are selected by dividing population into male and female strata in order to achieve equal representation of both genders in the sample group.

<i>First strata (e.g.males)</i>	<i>Second strata (e.g. females)</i>
	

Stratified sampling can be divided into the following two groups:

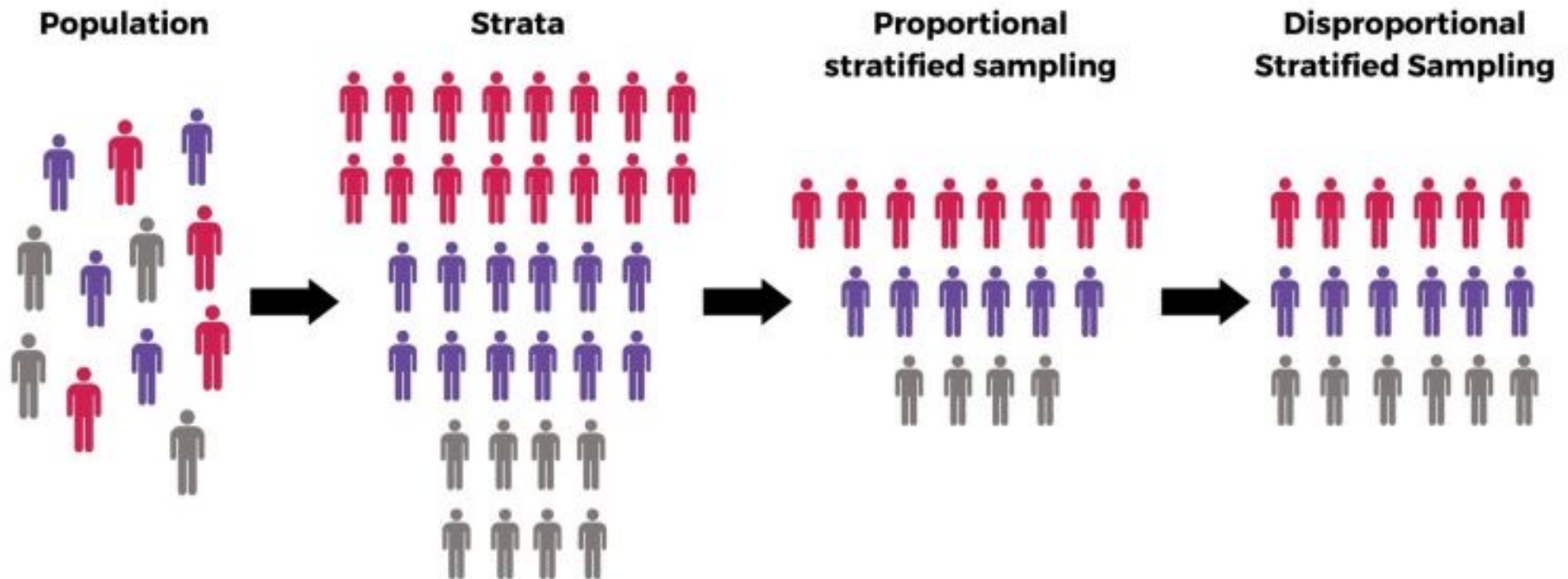
1) Proportionate : Application of **proportionate stratified random sampling** technique involves determining sample size in each stratum in a proportionate manner to the entire population.

e.g. : if the entire population for a research is 5000 people, in proportionate stratified random sampling the group can be divided into five strata with 1000 people in each stratum.

2) Disproportionate : In **disproportionate stratified random sampling**, on the contrary, numbers of subjects recruited from each stratum does not have to be proportionate to the total size of the population.

e.g. For sample of 5000 people, the population can be divided into five disproportionate strata with following unequal numbers of population in each stratum: 1000, 1500, 1200, 800 and 500.

## 2 Types of Stratified Sampling



## **Advantages of Stratified Sampling :**

- 1.Stratified random sampling is superior to simple random sampling because the process of stratifying reduces sampling error and ensures a greater level of representation.
- 2.This sampling method captures key characteristics of population in the sample.
- 3.Thanks to the choice of stratified random sampling adequate representation of all subgroups can be ensured.
- 4.When there is homogeneity within strata and heterogeneity between strata, the estimates can be as precise (or even more precise) as with the use of simple random sampling.

## **Disadvantages of Stratified Sampling :**

- 1.The application of stratified random sampling requires the knowledge of strata membership a priori. The requirement to be able to easily distinguish between strata in the sample frame may create difficulties in practical levels.
- 2.Overlapping issues may occur in a way that some subjects may fall into different subgroups. This can result in misrepresentation of the population.
- 3.Research process may take longer and prove to be more expensive due to the extra stage in the sampling procedure.
- 4.The choice of stratified sampling method adds certain complexity to the analysis plan.



## Cluster Sampling :

Cluster sampling (also known as one-stage cluster sampling) is a technique in which clusters of participants representing the population are identified and included in the sample.

This is a popular method in conducting marketing researches.

The main aim of cluster sampling can be specified as cost reduction and increasing the levels of efficiency of sampling. This specific technique can also be applied in integration with multi-stage sampling.

A major difference between cluster and stratified sampling relates to the fact that in cluster sampling a cluster is perceived as a sampling unit, whereas in stratified sampling only specific elements of strata are accepted as sampling unit.

Accordingly, in cluster sampling a complete list of clusters represent the sampling frame. Then, a few clusters are chosen randomly as the source of primary data.

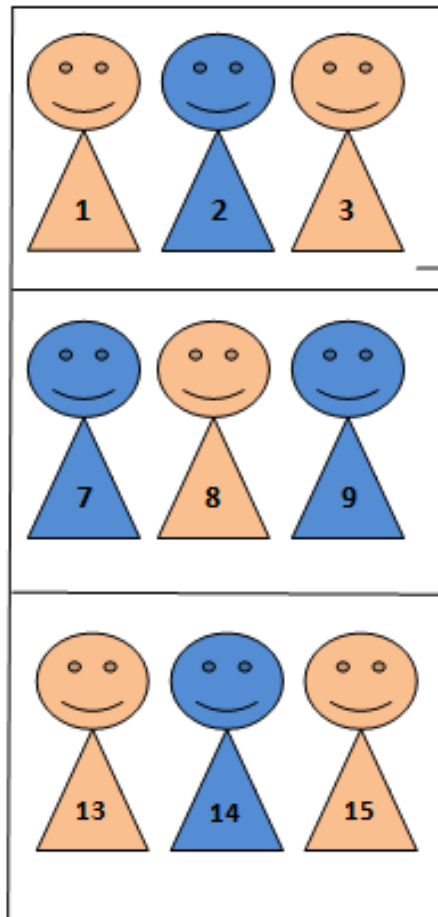
Cluster sampling process can be single stage or multistage.

In single stage sampling, all members of selected clusters are included in the study,

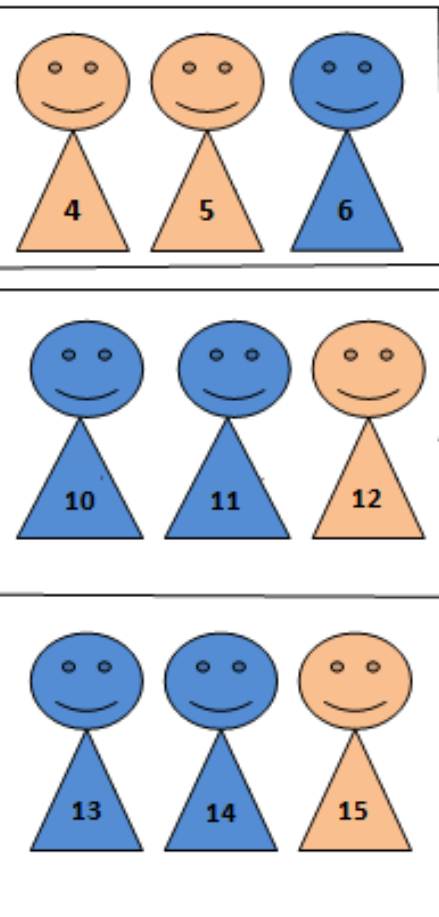
Whereas in multistage sampling additional sampling methods are used to choose certain individuals within selected clusters.

## Population

Clusters

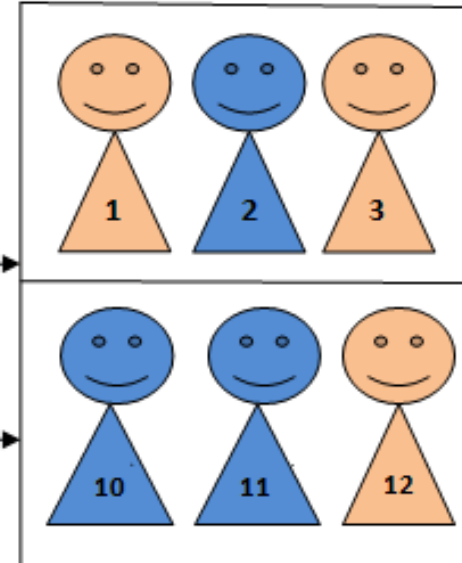


Clusters



## Sample Group

(2 Clusters)



## **Advantages of Cluster Sampling:**

- 1.It is the most time-efficient and cost-efficient probability design for large geographical areas
- 2.This method is easy to be used from practicality point of view
- 3.Larger sample size can be used due to increased level of accessibility of perspective sample group members

## **Disadvantages of Cluster Sampling :**

- 1.Requires group-level information to be known
- 2.Commonly has higher sampling error than other sampling techniques
- 3.Cluster sampling may fail to reflect the diversity in the sampling frame

## Non-Probability Sampling :

In non-probability sampling (also known as non-random sampling) not all members of the population have a chance to participate in the study.

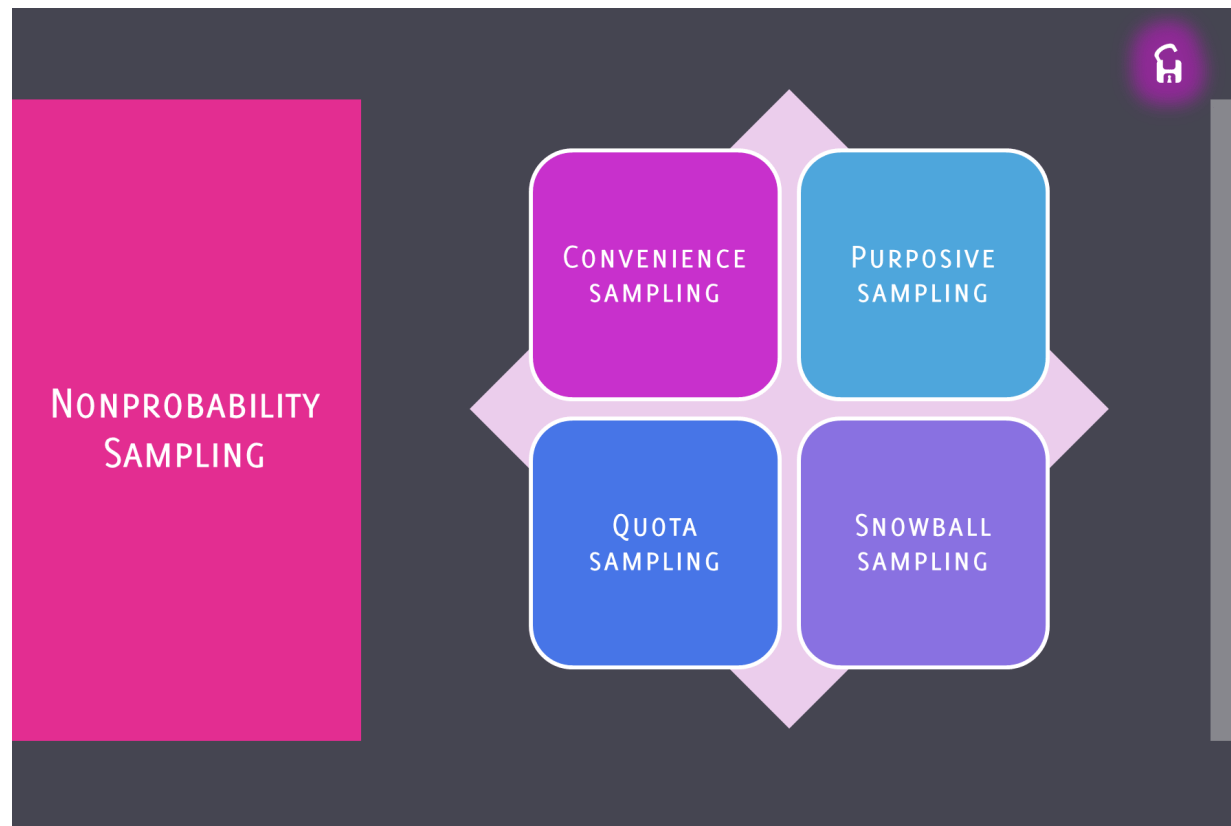
In other words, this method is based on non-random selection criteria. This is contrary to probability sampling, where each member of the population has a known, non-zero chance of being selected to participate in the study.

Necessity for non-probability sampling can be explained in a way that for some studies it is not feasible to draw a random probability-based sample of the population due to time and/or cost considerations.

In these cases, sample group members have to be selected on the basis of accessibility or personal judgment of the researcher.

Therefore, the majority of non-probability sampling techniques include an element of subjective judgment. Non-probability sampling is the most helpful for exploratory stages of studies such as a pilot survey.

The issue of sample size in non-probability sampling is rather ambiguous and needs to reflect a wide range of research-specific factors in each case.



## Convenience sampling :

Convenience sampling (also known as availability sampling) is a specific type of non-probability sampling method that relies on data collection from population members who are conveniently available to participate in study.

Facebook polls or questions can be mentioned as a popular example for convenience sampling.

Convenience sampling is a type of sampling where the first available primary data source will be used for the research without additional requirements.

In other words, this sampling method involves getting participants wherever you can find them and typically wherever is convenient.

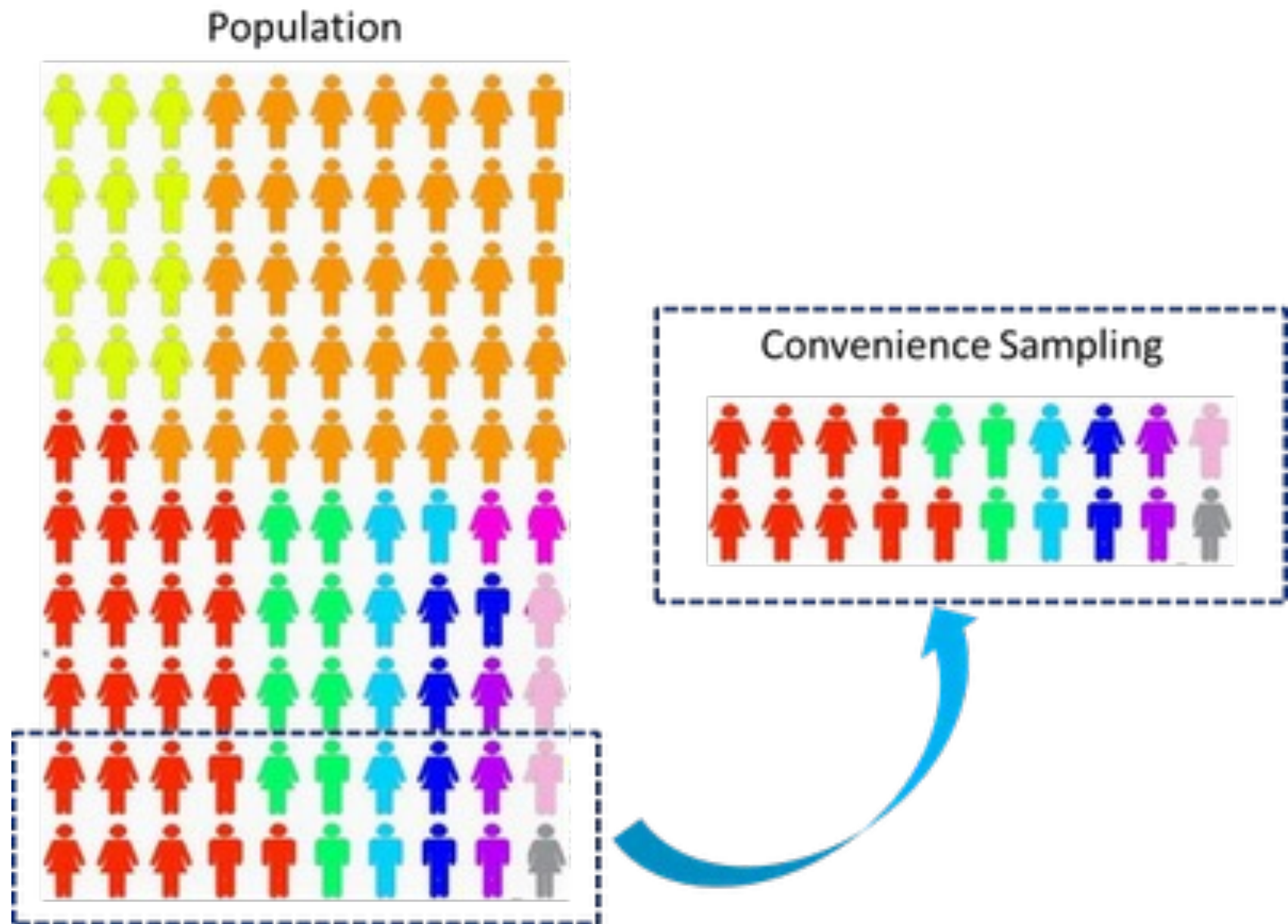
In convenience sampling no inclusion criteria identified prior to the selection of subjects. All subjects are invited to participate.

In business studies this method can be applied in order to gain initial primary data regarding specific issues such as perception of image of a particular brand or collecting opinions of perspective customers in relation to a new design of a product.

In its basic form, convenience sampling method can be applied by stopping random people on the street and asking questionnaire questions.

‘Pepsi Challenge’ marketing campaign can be referred to as a relevant example for this sampling method. ‘Pepsi Challenge’ is occasionally held in large shopping centers and other crowded locations and all members of population are invited to participate in the contest without any discrimination.





## Advantages of Convenience Sampling

1. Simplicity of sampling and the ease of research
2. Helpful for pilot studies and for hypothesis generation
3. Data collection can be facilitated in short duration of time
4. Cheapest to implement than alternative sampling methods

## Disadvantages of Convenience Sampling

1. Highly vulnerable to selection bias and influences beyond the control of the researcher
2. High level of sampling error
3. Studies that use convenience sampling have little credibility due to reasons above

## **Purposive sampling :**

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.

Purposive sampling is a non-probability sampling method and it occurs when “elements selected for the sample are chosen by the judgment of the researcher.

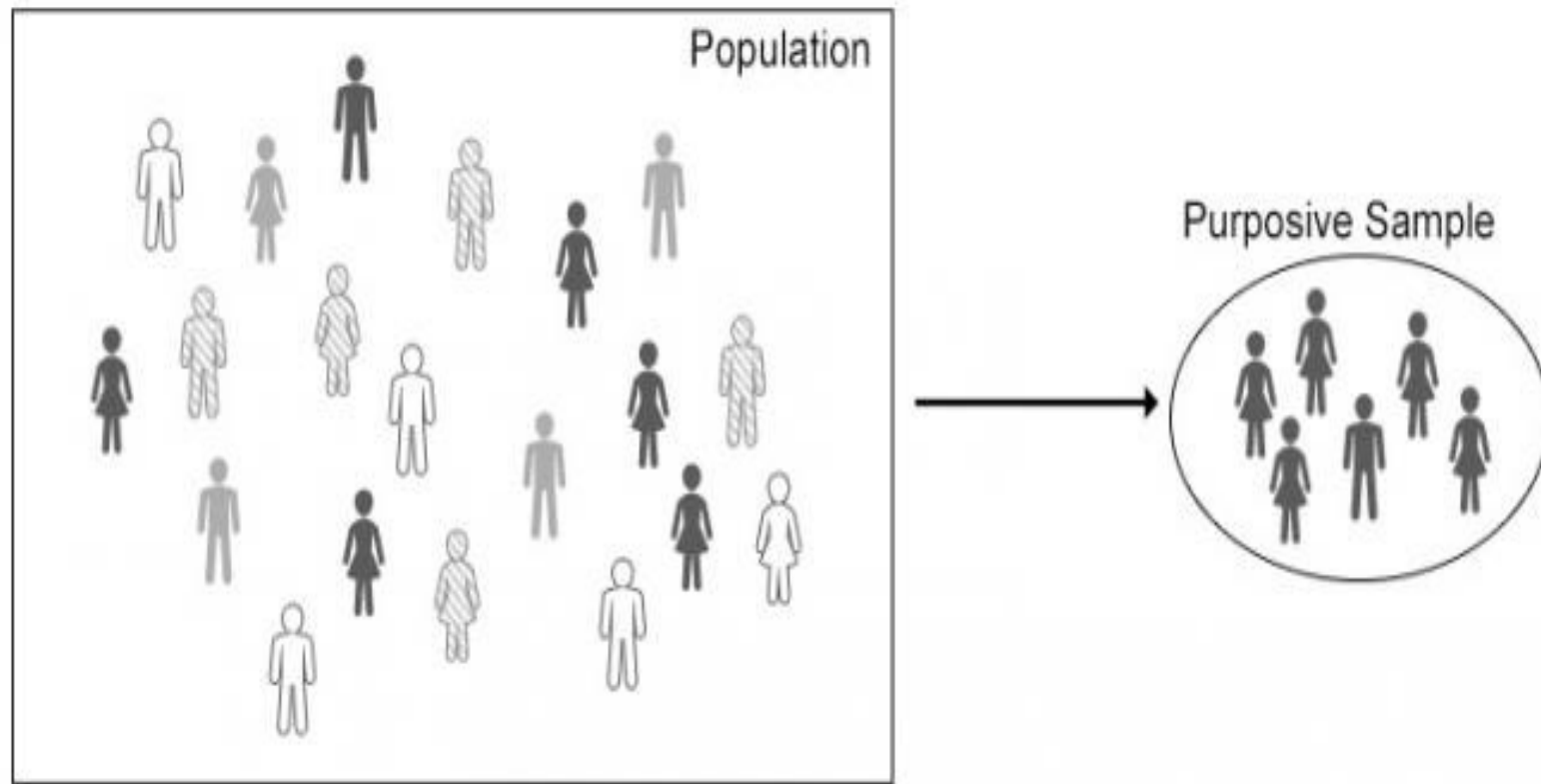
Researchers often believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money”.

TV reporters stopping certain individuals on the street in order to ask their opinions about certain political changes constitutes the most popular example of this sampling method.

However, it is important to specify that the TV reporter has to apply certain judgment when deciding who to stop on the street to ask questions; otherwise it would be the case of random sampling technique.

Alternatively, purposive sampling method may prove to be effective when only limited numbers of people can serve as primary data sources due to the nature of research design and aims and objectives.

For example, for a research analyzing affects of personal tragedy such as family bereavement on performance of senior level managers the researcher may use his/her own judgment in order to choose senior level managers who could particulate in in-depth interviews.



**Purposive Sampling**

## **Advantages of Purposive Sampling (Judgment Sampling):**

1. Purposive sampling is one of the most cost-effective and time-effective sampling methods available
2. Purposive sampling may be the only appropriate method available if there are only limited number of primary data sources who can contribute to the study
3. This sampling technique can be effective in exploring anthropological situations where the discovery of meaning can benefit from an intuitive approach

## **Disadvantages of Purposive Sampling (Judgment Sampling):**

1. Vulnerability to errors in judgment by researcher
2. Low level of reliability and high levels of bias.
3. Inability to generalize research findings

## Quota sampling :

Quota sampling method is a non-probability sampling and it can be defined as a sampling method of gathering representative data from a group.

Application of quota sampling ensures that sample group represents certain characteristics of the population chosen by the researcher.

Quota sampling can be divided into two groups:

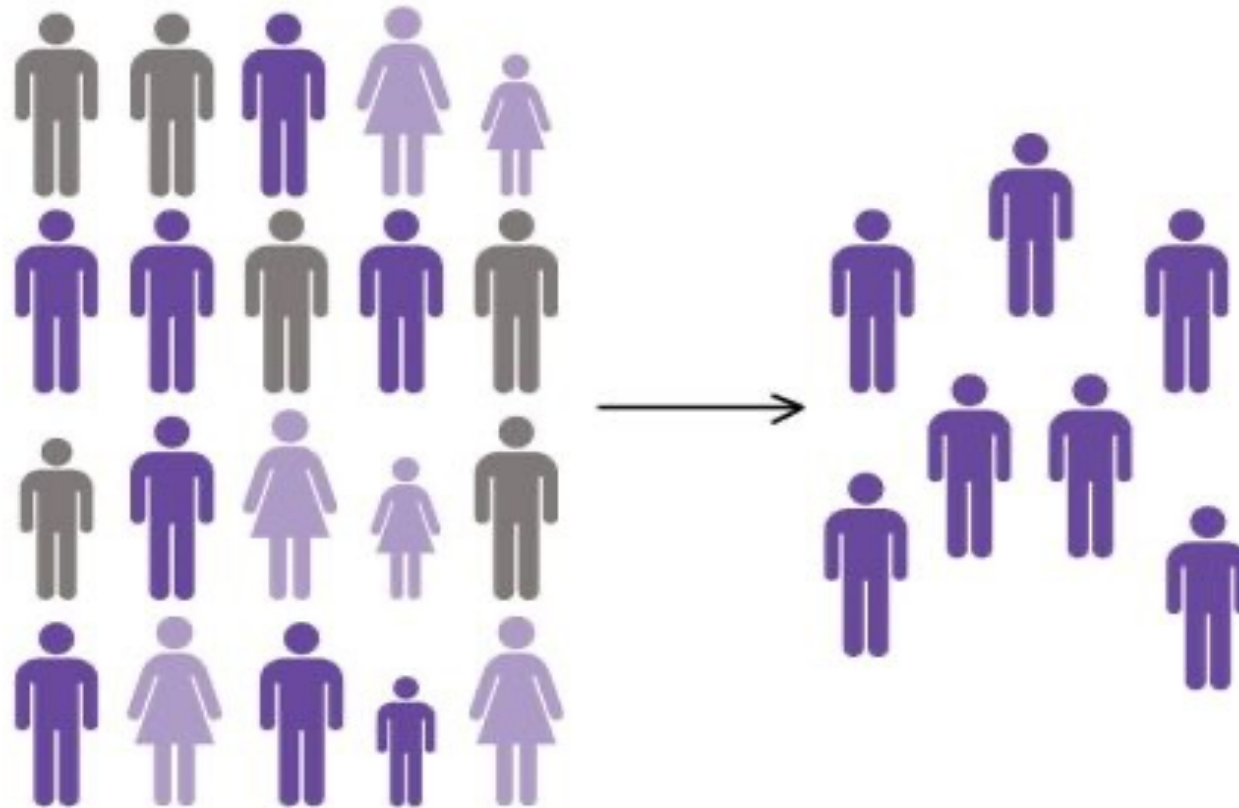
- 1) **Controlled quota sampling** involves introduction of certain restrictions in order to limit researcher's choice of samples.
- 2) **Uncontrolled quota sampling**, on the other hand, resembles convenience sampling method in a way that researcher is free to choose sample group members according to his/her will.

The main difference between quota and stratified sampling can be explained in a way that in quota sampling researchers use non-random sampling methods to gather data from one stratum until the required quota fixed by the researcher is fulfilled.

Accordingly, the quota is based on the proportion of subclasses in the population.



## Quota Sampling



## **Advantages of Quota Sampling :**

1. Quota sampling emerges as an attractive choice when you are pressed for time, because primary data collection can be done in shorter time.
2. The application of quota sampling can be cost-effective.
3. Quota sampling is not dependent on the presence of the sampling frames. In occasions where suitable sampling frame is absent, quota sampling may be the only appropriate choice available.

## **Disadvantages of Quota Sampling :**

1. Same as other non-probability sampling methods, in quota sampling it is not possible to calculate the sampling error and the projection of the research findings to the total population is risky.
2. While this sampling technique might be very representative of the quota-defining characteristics, other important characteristics may be disproportionately represented in the final sample group.
3. There is a great potential for researcher bias and the quality of work may suffer due to researcher incompetency and/or lack of experience

## Snowball sampling :

Snowball sampling (also known as chain-referral sampling) is a non-probability (non-random) sampling method used when characteristics to be possessed by samples are rare and difficult to find.

e.g. if you are studying the level of customer satisfaction among elite Nirvana Bali Golf Club in Bali, you will find it increasingly difficult to find primary data sources unless a member is willing to provide you with contacts of other members.

This sampling method involves primary data sources nominating another potential primary data sources to be used in the research.

In other words, snowball sampling method is based on referrals from initial subjects to generate additional subjects. Therefore, when applying this sampling method members of the sample group are recruited via chain referral.

There are following three patterns of snowball sampling:

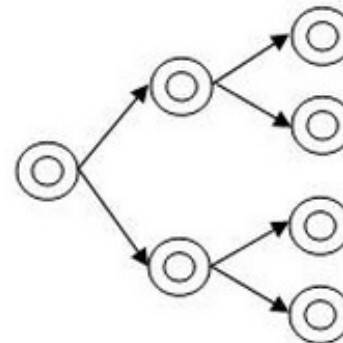
### **1. *Linear snowball sampling.***

Formation of a sample group starts with only one subject and the subject provides only one referral. The referral is recruited into the sample group and he/she also provides only one new referral. This pattern is continued until the sample group is fully formed.



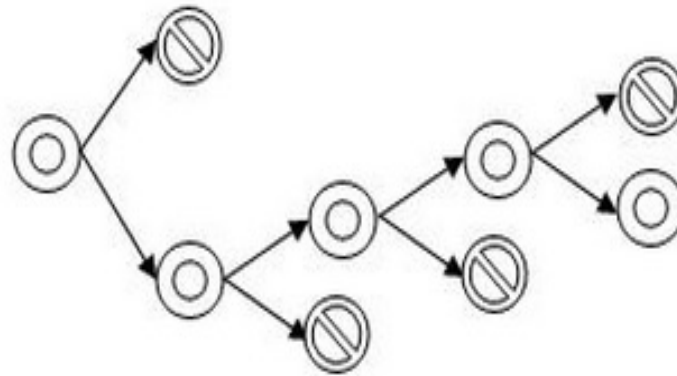
### **2. *Exponential non-discriminative snowball sampling.***

The first subject recruited to the sample group provides multiple referrals. Each new referral is explored until primary data from sufficient amount of samples are collected.



### 3. Exponential discriminative snowball sampling.

Subjects give multiple referrals, however, only one new subject is recruited among them. The choice of a new subject is guided by the aim and objectives of the study.



## Advantages of Snowball Sampling :

- 1.The ability to recruit hidden populations
- 2.The possibility to collect primary data in a cost-effective manner
- 3.Studies with snowball sampling can be completed in a short duration of time
- 4.A very little planning is required to start primary data collection process

## Disadvantages of Snowball Sampling :

- 1.Oversampling a particular network of peers can lead to bias
- 2.Respondents may be hesitant to provide names of peers and asking them to do so may raise ethical concerns
- 3.There is no guarantee about the representativeness of samples. It is not possible to determine the actual pattern of distribution of population.
- 4.It is not possible to determine the sampling error and make statistical inferences from the sample to the population due to the absence of random selection of samples

*Believe*  
in yourself  
—— & ——  
you will be  
*Unstoppable*

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I do.....