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Sampling Methods in Research: A Review

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ABSTRACT

The accuracy of a study is heavily influenced by the process of sampling. The article provides an overview of the various sampling techniques used in research. These techniques can be broadly categorised into two types: probability sampling techniques and non-probability sampling techniques. Probability sampling techniques include simple random sampling, systematic random sampling, and stratified random sampling. On the other hand, non-probability sampling techniques include quota sampling, self-selection sampling, convenience sampling, snowball sampling, and purposive sampling.

KEYWORDS: *Cluster, Medical statistics, Sampling, Snowball*

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INTRODUCTION

The term "research" has its origins in the Middle French language, specifically from the word "recherche", which translates to "to go about seeking". This word is derived from the Old French term "recerchier", which is a combination of "re-" and "cerchier" or "sercher", meaning "search". The earliest recorded use of the term was in 1577.[1]

Definition of Research: According to Clifford Woody, research comprises defining and redefining problems; formulating hypothesis or suggested solutions; collecting, organizing, and evaluating the data; making deductions and reaching conclusions; and at last, carefully testing the conclusions to determine whether they fit the formulating hypothesis. [2] definition of research is given by John W. Creswell, who states that "research is a process of steps used to collect and analyze information to increase our understanding of a topic or issue". It consists of three steps: pose a question, collect data to answer the question, and present an answer to the question. [3] Research can be regarded as a means of augmenting the current body of knowledge, thereby enhancing its sophistication. The primary aim of research is to systematically acquire knowledge or ascertain solutions to inquiries through scientific methodologies.

Some of the general objectives of research are as follows:

1. To know about a subject or to find out something new in that – exploratory or formulative research
2. To know about the subject in depth, for example, the characteristics, nature of a particular group, or individual-descriptive research
3. To correlate the association of some particulars with something else – diagnostic research

There are different types of research; some of them are listed below:

- Descriptive and analytical
- Applied and fundamental

- Quantitative and qualitative
- Conceptual and empirical
- Other types include clinical, historical, and conclusion oriented.

The research process can be facilitated by following a set of procedural guidelines that encompass various steps. Some of these steps include:

1. Formulating the research problem
2. Extensive literature survey
3. Hypothesis developing
4. Preparing research design
5. Determining the sample size
6. Collecting the data
7. Execution of the project
8. Analysis of data
9. Hypothesis testing
10. Generalization and interpretation
11. Preparation of report or presentation of the results

As per the aforementioned procedures, it is imperative to formulate the research design and ascertain the appropriate sample size in order to conduct comprehensive research. Therefore, we will thoroughly examine the various sampling techniques or sample designs.

Materials and Methods:

Information on Sampling methods was collected from different books of medical research methodology and peer reviewed journal.

Result and Discussion:

Defining sampling: Sampling is the process of choosing a sample of a population from an individual or a large group for a certain type of research objective. The use of sampling has a variety of benefits and drawbacks. We might occasionally wonder, "Why is sampling necessary?" The reason we employ sampling is because it would be extremely expensive and time-consuming to survey the entire population for a research study. [4] [5] [6]

Types of sampling: A sample is a collection of individuals, things, or things collected from a large population for measurement in research. So sampling is done in order to obtain accurate data. [7] To examine whether all the chips in a factory are good or not, for instance, would be quite challenging. Instead, we would choose a random chip and assess its flavour, shape, and size. Therefore, sampling is a critically important research method when there is a huge population. Due of this, we have separated it into two categories: Probability and nonprobability. [8]

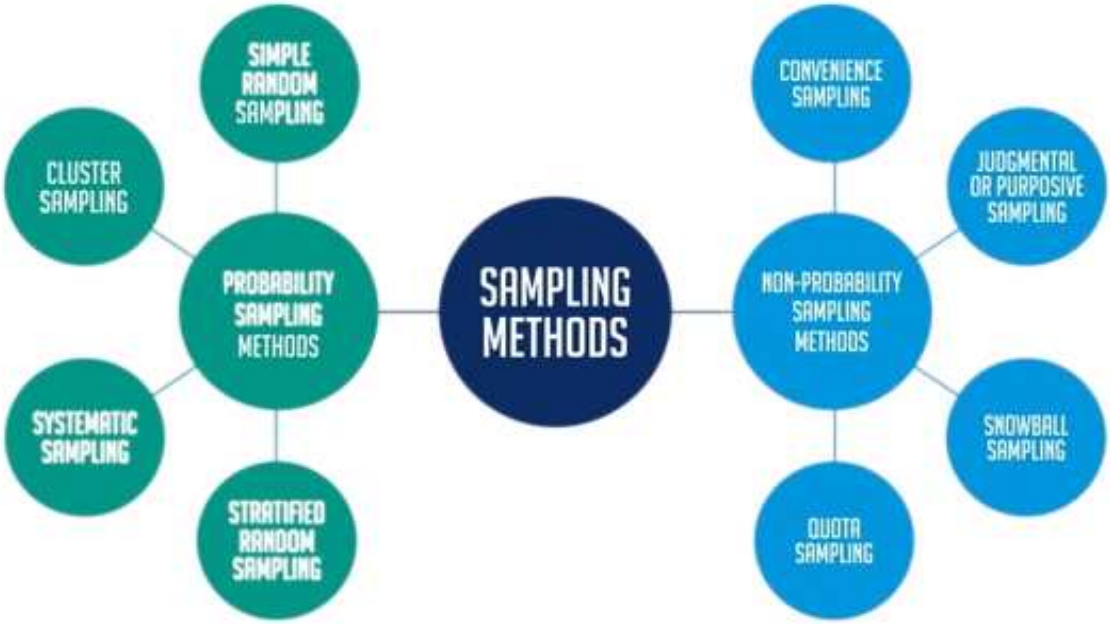


Image-1: Type of Sampling

Probability sampling:[9]

In probability sampling, every member of the population has a predetermined chance of being chosen for inclusion in the sample. In cases where the population exhibits a high degree of homogeneity, the likelihood of any given member being selected in a sample is significantly increased. In a scenario where a bag is filled with rice, the likelihood of selecting each individual grain of rice in a sample is considerably high. Therefore, the collected sample will be indicative of the entire contents of the rice bag. In the context of this study, the population is considered to be relatively homogeneous due to the fact that each member of the population is a potential respondent for the research.

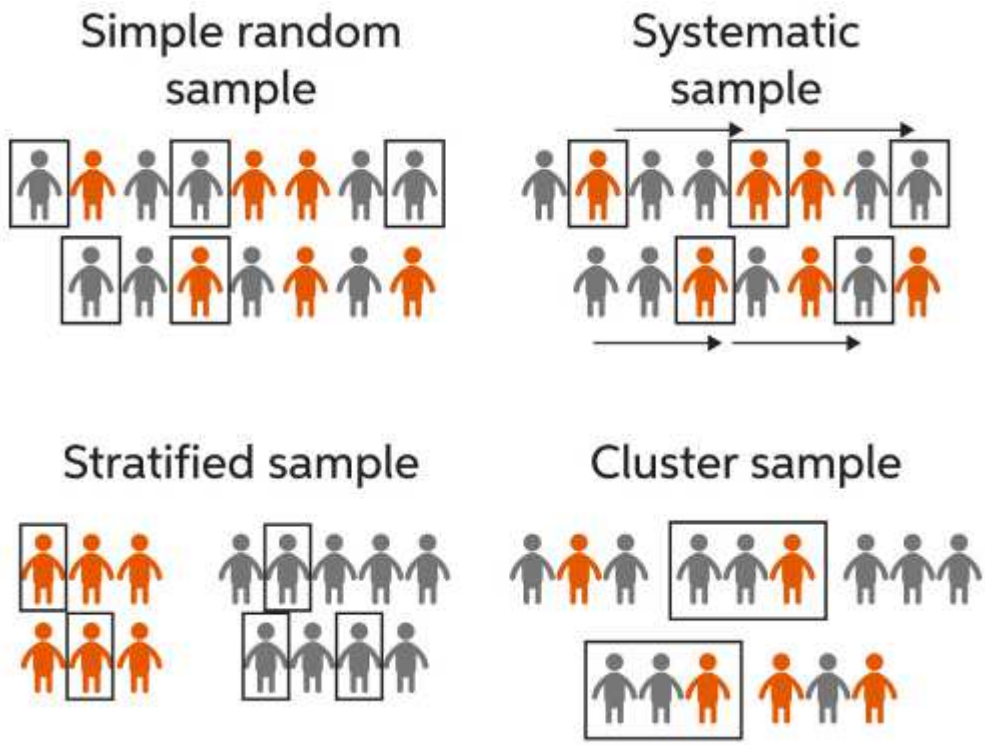


Image-2: Type of Probability Sampling

Simple random sampling is a method of selecting a sample from a population in which each member of the population has an equal chance of being selected. This technique is commonly used in research studies to ensure that the sample is representative of the population and to minimise bias. By randomly selecting participants, researchers can increase the likelihood that their findings will be generalizable to the larger population. In this sampling methodology, the selection of sample members is based solely on chance and randomization. Consequently, the sampling process ensures that the sample quality remains unaffected, as each member of the population has an equal probability of being chosen for inclusion in the sample. This sampling method is most suitable for a population that exhibits a high degree of homogeneity. There exist two distinct methodologies for conducting this particular form of sampling: The lottery method, also known as the envelope method, is a technique used to allocate resources or distribute tasks among a group of individuals. The present approach involves the allocation of distinct numerical values to individual constituents or entities within the populace. For instance, in a population comprising 100 members, ordinal numbers ranging from 1 to 100 are designated to each member and inscribed on a piece of paper, which is subsequently deposited in a receptacle. Subsequently, a chit will be extracted, and the numerical value inscribed on it will represent a randomised sample. Nonetheless, in this approach, the task of inscribing the name of each number on the chits becomes challenging as the population size increases. Therefore, an alternative approach is employed, namely the utilisation of a random number table (which will be further elaborated upon subsequently). An additional illustration provided involves the utilisation of an envelope method. For instance, in a research endeavour aimed at selecting patients with Hypertension for participation in yoga, this approach may be employed. Each envelope will contain the details of 100 patients, and a random selection will be made from among them. Therefore, in this context, the probability of all patients being selected as a sample is equivalent.

The random number table method is a statistical technique used to generate random numbers for research purposes. This method involves using a table of random digits to select numbers at random, which can then be used in various statistical analyses. The random number table method is commonly used in experimental design, survey research, and other areas of social science research. Various random tables are accessible, including Fisher's and Yates' tables, as well as Tippet's random number table. Initially, numerical values are assigned to the population in this context. In the scenario where there is a population of 20 and a sample of five is required, a random selection of five numbers from the table must be made. As an illustration, a selection comprising the integers -12, 19, 01, 08, and 15 is made. Therefore, individuals belonging to these numerical categories will be chosen as the sample.

The preceding section has expounded upon the techniques employed in conducting a simple random sampling. This section will cover the various types of simple random sampling. The methodology of selecting a sample from a population using a random process, whereby each member of the population has an equal chance of being

selected and the selection is made with replacement, is referred to as simple random sampling with replacement. The process of choosing "n" units from a total of "N" units, one at a time, is referred to as random sampling. This method ensures that each unit has an equal probability of being selected at each stage of the selection process, which is 1/N. The method of selecting a sample from a population in which each member has an equal chance of being chosen, without replacing the selected member back into the population, is known as simple random sampling without replacement. The process of selecting a sample involves choosing "n" units from a total population of "N" units, one at a time. It is important to ensure that at any stage of the selection process, each remaining unit has an equal probability of being chosen, which is 1/N. Suppose we seek to determine the population of turtles inhabiting a village pond. If we opt to capture turtles from the pond, measure them, and subsequently release them back into the water, we run the risk of selecting the same turtle multiple times. This scenario is indicative of a simple random sampling with replacement (SRSWR) methodology. Nevertheless, if the turtle is removed from the aquatic environment and not reintroduced until another turtle is taken, the situation can be classified as SRSWOR.

Stratified random sampling is a statistical technique that involves dividing a population into subgroups or strata based on certain characteristics, and then selecting a random sample from each stratum. This method is commonly used in research studies to ensure that the sample is representative of the population and to increase the precision of the estimates. By stratifying the population, the variability within each stratum is reduced, which can lead to more accurate results. Overall, stratified random sampling is a valuable tool for researchers seeking to obtain a representative sample from a larger population.

Proportionate stratified sampling is a statistical sampling technique that involves dividing a population into subgroups or strata based on certain characteristics, and then selecting a proportional number of individuals from each stratum to be included in the sample. This method is commonly used in research studies to ensure that the sample accurately represents the population being studied.

Proportionate stratified sampling is a sampling technique where the sample size allocated to each stratum is proportional to the size of the stratum relative to the entire population. Upon determining the sample size, researchers proceed to compute the percentage or proportion of each stratum in relation to the size of the target population. After determining the relative size of each stratum, it is possible to establish a sample size for each stratum. Upon completion of the aforementioned step, the technique of simple random sampling may be employed to randomly select elements from each respective stratum. The aforementioned sampling technique is comparatively less complex, time-efficient, and direct in contrast to disproportionate stratified sampling. The utilisation of this approach is motivated by the observation that larger strata or subpopulations exhibit greater standard deviations with respect to the selected stratified variables. Consequently, in order to enhance the accuracy of the investigation, it is imperative to select larger sample sizes from these strata.

Disproportionate stratified sampling is a sampling technique that involves dividing a population into strata based on certain characteristics and then selecting a sample from each stratum in a manner that is not proportional to the size of the stratum. Disproportionate stratified sampling involves selecting a sample size from each stratum that is proportional to both the stratum's relative size and the standard deviation in the distribution of characteristics among the elements within that stratum. The selection of sample units from each stratum is based on the researcher's discretion and the underlying rationale of their study.

Systematic sampling is a statistical sampling technique that involves selecting a sample from a larger population using a predetermined interval. This method ensures that every nth member of the population is included in the sample, resulting in a representative subset of the population. Systematic sampling is commonly used in research studies and surveys to obtain a sample that is both efficient and unbiased. Systematic sampling is a sophisticated variant of the simple random sampling technique that requires comprehensive information pertaining to the population. In this process, a member is chosen at regular intervals. The selected individual will henceforth be referred to as the Kth element.

Linear systematic sampling is a statistical sampling technique that involves selecting every kth element from a list or population after a random starting point has been determined. This method is commonly used in research studies to obtain a representative sample of a larger population. The entire population list is sequentially compiled into a list. The determination of sample size and calculation of sampling interval can be achieved through the use of a specific formula. The formula K = N/n represents the Kth element, where N denotes the entire population and n represents the number of samples. Select a random integer within the range of 1 to K, and subsequently add K to the selected integer to obtain the subsequent sample.

The methodology of circular systematic sampling involves the initial determination of the sample interval, followed by the selection of the number closest to the ratio of N/n. Suppose that N equals 17 and n equals 4. In this scenario, the value of k is considered to be 4 instead of 5. The selection process involves choosing units randomly from the range of 1 to N, while skipping K units after each selection until a total of n units have been chosen. In this particular type of sampling, the number of samples N is greater than the number of samples K found in linear systematic sampling.

Cluster sampling involves partitioning a population into clusters, from which a random sample of members is selected. Cluster sampling and stratified sampling are distinct sampling techniques. Stratified sampling involves the division of a population into subgroups based on characteristics such as age, sex, and profession. On the other hand, cluster sampling entails the random selection of pre-existing or naturally occurring groups or clusters, such as towns within a district or families within a society. In an urban setting, identifying a comprehensive roster of individuals afflicted with HBsAg can prove challenging. However, by conducting a search according to geographical regions, more favourable outcomes may be achieved. In this context, the region functions as a cluster and the individuals are regarded as sampling units. This approach involves the formation of clusters based on specific criteria, followed by the selection of a sample through either simple random sampling or systematic sampling techniques.

Multi-stage sampling, also referred to as multi-stage cluster sampling, is a sophisticated variant of cluster sampling that involves the selection of samples in two or more stages. Multi-stage sampling is a technique used to facilitate primary data collection by dividing large clusters of population into smaller clusters through several stages. It is imperative to recognise that multi-stage sampling, while not as efficacious as true random sampling, does mitigate certain drawbacks inherent in the latter approach, such as excessive cost and time consumption. Despite its nomenclature, the implementation of multi-stage sampling in business research can be straightforward. The utilisation of this sampling technique can be categorised into four distinct phases. The process of selecting a representative subset of discrete groups involves several steps, including the careful selection of a sampling frame, the assignment of unique numerical identifiers to each group, and the subsequent selection of a small but relevant sample. The process of selecting a sampling frame that comprises pertinent discrete sub-groups. This task ought to be carried out utilising pertinent distinct groups that were chosen in the preceding phase. If deemed necessary, the second stage should be repeated. The process of selecting individuals for the sample group involves utilising a form of probability sampling to draw from the sub-groups. The practical implementation of the aforementioned stages can be demonstrated through a particular instance. The aim of the study is to assess the online expenditure habits of American households by means of online surveys. One possible approach for forming a sample group of 120 households is as follows, select six states in the United States of America utilising a method of probability sampling such as simple random sampling. Utilise a systematic sampling technique, or any other form of probability sampling, to select four districts from each state. Select a sample of five households from each district utilising either simple random or systematic sampling techniques. The inclusion of 120 households in the sample group will ensue.

Nonprobability Sampling: [10]

Nonprobability sampling is a sampling technique in which the likelihood of each member of the population being selected for the sample is not known. To investigate the effects of child labour on minors, the researcher will exclusively seek out and conduct interviews with children who have been exposed to such labour practises.

In *purposive sampling*, individuals are chosen for inclusion in a sample based on their relevance to the research objectives. The term "deliberate sampling" is also commonly utilised. This sampling technique is alternatively referred to as judgmental sampling. To investigate the effects of yoga on individuals with Hypertension, it is recommended that only hypertensive patients be selected as the most suitable participants. Including individuals with other forms of heart disease may not yield optimal results for this study. Therefore, the investigator intentionally chooses exclusively individuals diagnosed with hypertension as participants for the present investigation.

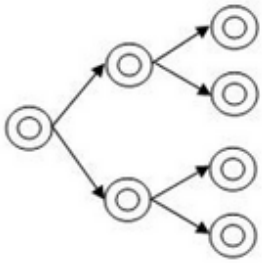
The act of choosing sample members based on their ease of accessibility is referred to as *convenience sampling*. The selection process involves choosing members who are readily available to the researcher. This sampling method utilises the existing data without imposing any additional criteria. This is a more prevalent practise in pilot testing. The study's participants or samples are chosen based on their ease of recruitment.

Snow‑ball sampling method is commonly referred to as chain sampling or sequential sampling, and is employed when a respondent recruit additional respondents from their personal network, such as friends, relatives, or

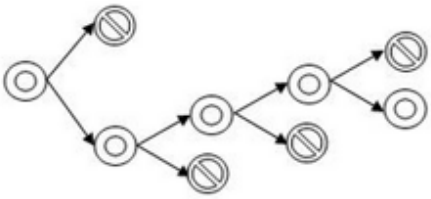
acquaintances. This type of sampling is utilised in scenarios where the identification of sample members is challenging. As an illustration, a scholar intends to investigate the challenges encountered by migrant populations within a given locality. The researcher will initiate the sampling process by selecting one migrant, who will then provide information about another migrant. This will create a chain effect, resulting in a snowball-like growth of the sample. The researcher will continue this method until the desired sample size is attained.

There are three patterns of snowball sampling. *Linear snowball sampling* is a technique that Only one subject and one referral are provided by the subject for forming a sample group. The referral is added to the sample group and contributes just one additional referral. Up until the sample group is complete, this procedure is followed. *Exponential Non-Discriminative Snowball Sampling* The first participant chosen for the sample group contributes numerous recommendations. Every new referral is investigated until enough primary data from samples are gathered. *Exponential discriminative snowball sampling* is a technique. Multiple recommendations from subjects are received, but only one new subject is chosen from them. The purpose and goals of the study serve as a guide when selecting a new subject.

Linear snowball sampling



Exponential Non-Discriminative Snowball Sampling



Exponential Discriminative Snowball Sampling

Image-3: Type of Snowball Sampling

In *quota sampling*, participants are picked based on a set of predetermined criteria that the researcher has established. These particular traits work as a quota for choosing the sample's participants. We acquire representative data from a group via this kind of sampling. It is comparable to probability sampling techniques like stratified random sampling. The sole distinction between the two is that whereas quota sampling does not use random selection, stratified random sampling does. In a well-planned manner, the participants are divided into specified categories, such as 100 men and 100 women. It comes in two flavours: controlled quota sampling, where the researcher's options are constrained. The alternative type is uncontrolled quota sampling, where there are no restrictions and samples are chosen based on the research's convenience.

Conclusion:

Sampling techniques are essential to research and data analysis because they allow us to infer important information about vast populations from a smaller group of data. Each sampling technique, including simple random sampling, stratified sampling, cluster sampling, and systematic sampling, has advantages and disadvantages. To choose the best sampling strategy, researchers must carefully assess their study's goals, the population's characteristics, and the resources at their disposal. Researchers can increase the validity and dependability of their findings by using sound sampling techniques, thereby advancing knowledge in a variety of domains.

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