# Sampling:
# Methods and Applications

**Dr. Prahllad Gain**
Assistant Professor, Dept. of Education
Mahitosh Nandy Mahavidyalaya, Jangipara,Hooghly
Affiliated to University of Calcutta, WB, India
Contact & Whatsapp no. : 9735285567
Email: prahlladgain@gmail.com

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## 1. Population

**In statistics, *population* means the whole or totality of the set of objects under review. Population refers to the whole of the information which comes under the purview of a statistical investigation. Population is also known as universe. The word 'population' may mean all workers in a plant/factory, all items produced by a machine on a particular day, all shares traded in a particular Stock Exchange in a week/month.**

## 2. Census

When information is collected in respect of every individual item of the population, the inquiry is said to be done by ***Complete Enumeration or Census***. For example, during the Census of Population information in respect of each individual person residing in India is collected. This method provides information for each and every unit of the population with greater accuracy. But this method involves huge amount of money, long time and much effort.

# 3. Sample

In order to reduce time and cost, most of the statistical investigation is confined only to a small portion of the population which is known as sample. Thus, a ***sample*** is a selected small portion of the population which is examined with a view to assessing the characteristics of the population. For example, to assess the quality of a bag of rice, we examine only a small portion of it. The selected small portion of rice from the bag is called a sample.

Advantages are:

- In most cases it gives almost the same result about the population.
- It assesses the characteristics (i.e., quality) of the population.
- It saves time, cost and effort of the investigation.

# 4. Sampling

In simple sense, sampling means a process of drawing a sample from the population.

The main objectives of sampling are:

- To obtain information about the population on the basis of sample drawn from the population.
- To set up the limits of accuracy of the estimates of the population parameters computed on the basis of sample statistic.
- To test the significance about the population characteristics on the basis of sample statistic.

# 5. Statistical Inference

Statistical inference deals with computations of various sample statistics, arriving at the results and ends on generalization of findings which are made applicable to the whole field of inquiry.

# 6. Methods of Sampling

Important methods of sampling are explained under two separate heads.

***Random Sampling Methods:***

(1) Simple Random Sampling or Probability Sampling
(2) Stratified Random Sampling
(3) Systematic Random Sampling or Quasi Random Sampling
(4) Multi-stage Random Sampling

***Non-random Sampling Methods:***

(1) Purposive Sampling or Judgment Sampling
(2) Quota Sampling
(3) Convenience Sampling
(4) Cluster Sampling or Block Sampling
(5) Sequential Sampling

6.1 Simple Random Sampling—Simple Random Sampling is the process of selecting a sample from a population in such a way that each member of the population has an equal chance of being selected in the sample. The sample obtained by the process of random sampling is called a random sample. According to W M Harper, “A random sample is a sample selected in such a way that every item in the population has an equal chance of being included.” Sampling has some characteristics:

- It is simple and most important among other sampling methods.
- It is free from personal bias.
- Selection of each item purely depends on chance.

## There are two types of Simple Random Sampling:

*(1)* Simple Random Sampling with replacement (SRSWR)—When items of a sample are drawn one by one from the population in such a way that after each drawing the selected item is returned to the population and that each time a drawing is made, every item of the population has an equal chance of being included, then the sampling is known as Simple Random Sampling with replacement. ***When population size is finite, this sampling is most suitable.***

*(2)* Simple Random Sampling without replacement (SRSWOR)—When items of a sample are drawn one by one from the population in such way that after each drawing the selected item is not returned to the population and that each time a drawing is made, every one of the remaining items has an equal chance of being selected, then the sampling is termed as Simple Random Sampling without replacement. ***When population size is infinitely large (i.e., like normal distribution), this sampling with or without replacement is used.***

***A random sample may be drawn again in two ways:***

***(i) Lottery method—When the population is not sufficiently large, this method may be used in drawing random sample. Under this method, each item of the population is assigned a number on small and identical slips of paper which are folded and mixed together in a box or drum thoroughly. A blindfold selection is then made of the number of slips required to constitute the desired sample.***

***(ii) Use of table of Random Numbers—When the population is sufficiently large and some members of the population may not be movable, this method is suitable. However, use of Random Numbers for selecting sample may be shown later on separately.***

6.2 Stratified Random Sampling—Stratified Random Sampling is a commonly used restricted random method. Under this sampling, the population is sub-divided into several parts called strata. Each stratum is known as sub-population. Then a small sample (i.e., sub-sample) is chosen from each stratum at random. All the sub-samples combined together give a Stratified Random Sampling.

Stratified Random Sampling is generally ***used when the population is heterogeneous***, but can be sub-divided into strata according to some relevant characteristics ***so that each stratum is more or less homogeneous***. Some prior knowledge is necessary for sub-division into strata, called stratification.

*If proper stratification can be made so that strata differ from one to another as much as possible, but there is much homogeneity within each stratum, then a stratified random sample will give better estimates of the population characteristics than a random sample of the same size.* This is so, because in a stratified random sample the different sections of the population are suitably represented through the sub-samples, while in random sampling some of these sections may be over-represented or under-represented or may even be omitted. The objectives of stratification are:

- To increase the accuracy of overall estimates.
- To ensure that all sections of the population are adequately represented.
- To avoid large size of population.
- To avoid the heterogeneity of the population.

## 6.3 Systematic Random Sampling—

Systematic Random Sampling is a slight variation of the simple random sampling. It involves the selection of sample units at equal intervals, all the units in the population have been arranged in some definite order. If the population size is finite, all the units are first serially listed and arranged in the order. Then from the first *k* units, one unit is chosen at random. This unit and every k-th unit of the serially listed population combined together to constitute a Systematic Random Sampling.

6.4 Multi-stage Random Sampling—In this method, the sampling process is carried out in several stages. The population is first divided into large groups, called first-stage units. These first-stage units are then divided into smaller units, called second-stage units, and second-stage units are divided into third-stage units, and so on, until we reach the ultimate units. A first, a sample of the first-stage units is selected by any suitable method. Then a sample of second-stage units is selected from each of the selected first-stage units and the process is repeated from stage to stage until we reach the ultimate units.

***Multi-stage random sampling is useful in cases where the survey is contemplated over a wide area and journey from one part to the other is rather difficult and expensive.***

## *Non-random Sampling Methods:*

6.5 Purposes Sampling or Judgment Sampling— When the selection of the individual items of a sample is entirely dependent on the discretion (i.e., judgment) of the investigator, it is known as Purposive or Judgment Sampling. In this type of sampling, the items constituting the sample are selected not according to some definite procedure, but according to convenience and personal choice of the investigator who selects the sample.

Purposive selection is always subject to some kind of bias. However, ***this method is suitable when the sample as well population size is small.***

6.6 Quota Sampling—In stratified random sampling, the cost of selecting a random sample from individual strata is often so expensive, the investigators are given quota to be filled from different strata, the actual selection of items for sample being left to the judgment of the investigators. This is called Quota Sampling. The size of the quota for each stratum is generally proportionate to the size of that stratum in the population. Quota Sampling is a type of Judgment Sampling.

It is easy and cheap, but it is open to various types of errors and bias. ***This method is often used in marketing research studies.***

6.7 Convenience Sampling—In this sampling, a sample is selected from readily available source like, Telephone directories, Automobile registration records, Stock Exchange directories, etc. This is because it is so convenient to use these sources. Such a sample is called a convenience sample and it is a convenient slice of the population. ***Convenience sampling is useful in public opinion surveys, making pilot studies and to audit accounts.***

6.8 Cluster Sampling or Block Sampling—Under this method, we first form suitable clusters or blocks of units such that there is maximum heterogeneity within the clusters and minimum amongst the clusters. Then we survey all the units in some clusters selected by any suitable sampling method. Cluster sampling is also called area sampling. ***This sampling is useful when the population is widely dispersed and consists of an unequal concentration of individual units. Generally, Cluster sampling is used for geographical studies.***

6.9 Sequential Sampling—In this method, a number of samples are drawn one after another from a population depending on the results of the earlier samples. If the first sample is nicely acceptable, no new sample is drawn. If the first sample is completely unacceptable, it is rejected. If the first sample leads no clear decision, a second sample is drawn and, as before, if required a third sample is drawn to arrive at a final decision to accept or reject the sample. ***This sampling is generally adopted in statistical quality control.***

# Drawing of Sample

## 1. Simple Random Sampling or Probability Sampling:

***Problem:*** To test the quality of rice, suppose we have to select a random sample of 10 bags of rice out of 56 bags.

***Solution:*** The rice bags are serially numbered horizontally from 1 to 56. Since the population size '56' is two-digited, the identity numbers must be two-digited. Thus we have:

Serial Nos. : 1 2 3 ……. 56

Identity Nos. : 01 02 03 ……. 56

Two-digited Random Numbers (divided by 56 leaving remainders) starting from 1st column and 1st row and proceeding row-wise are:

45 04 39 23 32 26 37 00 06 53 10 …14

Selected members of the sample are 45, 04, 39, 23, 32, 26, 37, 00(rejected), 06, 53 and 10 on first appearance basis: and all others are rejected.

***Random Numbers (Taken from N G Das)***

| | | | | |
|---|---|---|---|---|
| 4504 | 9523 | 3282 | 3756 | 0653 |
| 1014 | 7894 | 9307 | 0458 | 9983 |
| 1575 | 2458 | 9200 | 8566 | 7302 |

## 2. Stratified Random Sampling:

**Problem:** The wage level of workers of Andrew Yule & Company Ltd. is to be studied.

**Solution:** With a view to studying the wage level of workers of the company, it would be better to classify all workers into unskilled, semi-skilled and skilled with male and female break up; and then select a small sample (called sub-sample) at random from each class (stratum) in proportion to the size of that stratum in the population. The combined sample so obtained will represent better characteristics of the whole population.

## 3. Systematic Random Sampling or Quasi Random Sampling:

**Problem:** It is desired to select a systematic random sample of 400 villages from the West Bengal having 40,000 villages.

**Solution:** A list of all villages which is our population is prepared and serially numbered. We see that the population size is 100 times of the sample size. In order to select the systematic random sample, the first member between ***'1 to 100'*** is to be selected at random with the help of random numbers. Suppose, ***'28'*** is the first selected member of the sample. After the selection of the member, every subsequent 100th village in the list, i.e., those with serial numbers ***128, 228, 328*** etc. are to be selected as the sample.

## 4. Multi-stage Random Sampling:

**Problem:** Let us try to choose 500 villages from West Bengal with a total number of 40,000 villages.

**Solution:** The whole of the State may firstly supposed to be composed of Police Stations, nearly 300 in number. It is not difficult to choose a few amongst them. These Police Stations is first-stage sampling units. Again, Police Stations are composed of several Unions/Blocks, and we choose a number of Unions/Blocks from each of the selected Police Stations. The Unions are second-stage sampling units. From each of the Unions/Blocks thus selected, we finally choose required number of villages. The selected villages are third-stage sampling units.

# Thank You