Sampling Design

Statistical data needed for statistical investigation may be obtained by two methods, the *Census method* and the *Sampling method*.

a) Census Method:

In a census method, information is collected from every unit of the population or universe. The group of individuals or units under study is known as the **population** or **universe**. In this method, complete enumeration is done.

Merits:

- 1. The data are collected from every item of the population.
- 2. The results are more accurate and reliable because every item of the universe is included.
- 3. Intensive study is possible.
- 4. The data collected may be used for various surveys, analyses etc.

Demerits:

- 1. It requires a large number of enumerators and it is a costly method.
- 2. It requires more money, labour, time, energy etc.
- 3. It is possible in some circumstances where the universe is infinite.

b) Sample method:

Only a part of the whole group of the population will be studied in this method of sample enquiry. We may study a sample drawn from a large population and that sample is adequately representative of the population. With this sample, we should be able to arrive at valid conclusions. The results obtained from the sample study can be applied to the whole population or universe. This type of sample study will give a correct idea of the population or universe.

Merits:

- 1. It saves time because fewer items are collected and processed.
- 2. It reduces cost: only a few selected items are included in the sampling.
- 3. More reliable results can be obtained because there are fewer chances of sampling statistical errors.
- 4. The organization and administration of the sample survey are easy.

Demerits:

- 1. If a sample enquiry is not carefully planned and executed, the conclusions may be inaccurate and misleading.
- 2. To make a representative sample is a difficult task.
- 3. There may be personal biases and prejudices concerning the choice of technique and drawing of sampling units.
- 4. If the size of the sample is not appropriate then it may lead to untrue characteristics of the population.

Essentials of Sampling:

To have clear conclusions, a sample should possess the following essentials.

i) **Representative**: The sample selected should have a similar characteristic of the original universe from which it has been selected.

- ii) **Homogeneity:** There is no basic difference in the nature of units of the universe and that of the sample.
- iii) **Adequacy:** The size of the sample should be adequate; otherwise, it may not represent the characteristics of the universe.
- iv) **Independence:** All items of the sample should be selected independently of one another.

Methods of Sampling

There are many methods of sampling. The choice of method will be determined by the purpose of sampling. The various methods can be grouped into two groups.

- 1. Random sampling method
 - a) Simple random sampling
 - i) Lottery method
 - ii) Table of random numbers
 - b) Restricted random sampling
 - i) Stratified sampling
 - ii) Systematic sampling
 - iii) Multi-stage or Cluster sampling
- 2. Non-random sampling method

Random Sampling method

'Random' as used in statistics is a technical word; it has a meaning different from popular usage. When a sample is called '**random**', this describes the **process** by which the sample was obtained. According to Dr.F.Yates, a random sample is one in which every member of the parent population has had an equal chance of being included.

a) Simple random sampling:

It is a technique in which a sample is drawn from a population, each and every unit in the population has an equal and independent chance of being included as a sample. Several methods have been adopted for random selection of the sample. They are,

i) Lottery method:

This is the most popular and simplest method. In this method, all the items of the universe are numbered on separate slips of paper of the same size, shape and colour. They are folded and mixed up in a drum or container. A blindfold selection is made. The selection of items thus depends on chance. This method is also called **unrestricted random sampling** because units are selected from the populations without any restriction. This method is mostly used in lottery draws.

ii) Table of Random numbers:

As the lottery method cannot be used, when the population is indefinite, the alternative method is that of using the table of random numbers. There are several standard tables of random numbers. But the credit for this technique goes to Prof.L.H.C.Tippet (1927). It is a scientific method and sampling error can be measured. This method is economical as it saves times, money and labour.

b) Restricted random sampling

i) Stratified sampling:

When a population is heterogeneous or different segments or strata exist in the population, then it is stratified. We stratify the population by dividing it into strata so that each stratum is more or less homogenous and make a random selection of samples from each stratum. Each stratum is called a subpopulation. These sub-populations are non-overlapping and together they comprise the whole of the population. There are two types of stratified random sampling. They are proportional and non-proportional.

ii) Systematic sampling:

According to this method, a list of the universe is prepared on some basis. The basis may be alphabetical, numerical or in some other order. The items are serially numbered. The first item is selected at random, generally following the Lottery method. Subsequent items are selected by taking every K^{th} item from the list and 'k' refers to the sampling interval or sampling ratio. Symbolically,

$$k = \frac{N}{n}$$

Where k = Sample interval, N= Numerical size, n= sample size

iii) Multi-stage or Cluster sampling:

Under this method, the random selection is made of primary, intermediate and final units from a given population. There are several stages in which the sampling process is carried out. At first, the first stage units are sampled by some suitable method, such as simple random sampling. Then, a sample of second stage units is selected from each of the selected first stage units, again by some suitable method. Further stages may be added as required.

To take an example in a particular survey, we wish to take a sample of 10,000 students from Delhi University. We may take colleges primary units as the first stage, then draw department as the second stage and choose students as the third and last stage.

Merits of random sampling:

- 1. **Scientific method:** It is a more scientific method of taking out a sample from a universe. Every item in the universe has an equal chance of being selected.
- 2. **Sampling error can be measured:** Almost any sampling method will have some pattern of variability, but random samples are the only ones that have a known pattern of variability.
- 3. **Theory of Probability:** Randomness is important in statistics, primarily because if a sample is random the theory of probability is applicable.
- 4. **Representative:** The greater the number of items in the sample selected at random.
- 5. **Economical:** It is economical and saves time, money and labour in investigating a problem.

Demerits of Random sampling:

- 1. There may be occasions when only a few items are to be included in the sample.
- 2. If the size of the sample is small, and there is great variability in the universe, the sample will not be a true representative of the universe.
- 3. If the units of the universe are spread over a large area, the investigation will then be a difficult job.