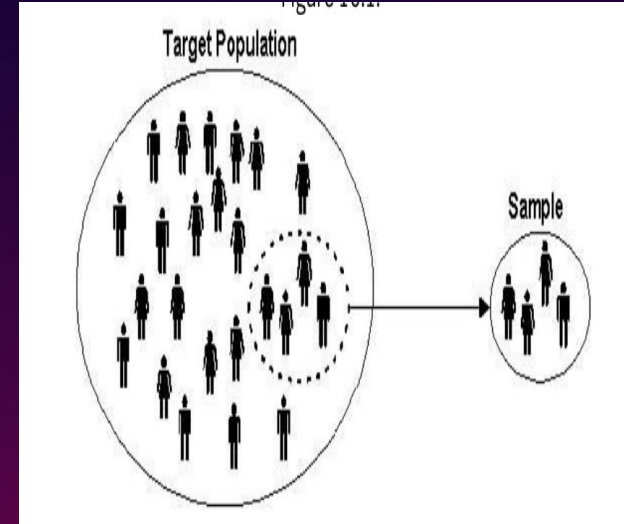


## Chapter 10

# SAMPLING TECHNIQUES



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# Census Survey

The traditional method of acquiring knowledge about an aggregate of individuals is to enumerate them all. Census of population of a country and study of total agricultural production of a country are examples of **complete enumeration**.

Instead of examining the whole population, which may be difficult or impossible to do, one can examine a small part of the population. This is called sample. The process of drawing samples is called **sampling**.

## 10.1 Need and Importance of Sampling

In homes, ladies take out one or two rice grains (any other food item) from the cooking pan to examine whether the grains are fully cooked or not. In clinical laboratory, a few drops of blood are collected to test to know whether the blood has any abnormalities or not.



Whatever observed in the few drops of blood is true for whole blood of the body. In a bulb manufacturing factory, one tests the life of few bulbs and comes to a conclusion about the average life of bulbs in the whole lot. Similarly, instead of examining the whole population, which may be difficult or impossible to do, one can examine a small part of the population. This is called sample. The process of drawing samples is called sampling. These examples reveal that sampling is an age old practice. Now-a-days, sampling methods are extensively used in socio-economic surveys to know the living condition, cost of living index etc of a class of people.

# Census and Sampling - Advantages and Disadvantages

Advantages	Disadvantages
(i) Saves time and money	(i) Improper sampling technique may lead to misleading results
(ii) When population is too large or items are destructive in nature, sampling alone can be adopted (eg. Testing the breaking strength of chalks)	(ii) If information is required from each and every unit of population, sampling is inadequate (eg: Leprosy test in school children)
(iii) More accuracy is expected	
(iv) The expected error also can be estimated	



Table 10.1: Census:- Advantages and Disadvantages

Advantages	Disadvantages
<p>(i) 100% perfect.</p> <p>(ii) For an enquiry, if all the units in the population are to be inspected, census is the only method</p> <p>(iii) The data obtained by census method may be used for further investigations</p>	<p>(i) If the population is infinite, the study is impossible.</p> <p>(ii) Census method requires more time, money, trained persons etc</p> <p>(iii) If the units are destroyed in the course of inspection, census is not at all desirable.</p>

## Errors in survey

The results obtained from statistical studies may not be free from errors. The errors involved in the collection, processing and analysis of data may be broadly classified under two heads

- (i) sampling error and
- (ii) non-sampling error.

# Sampling Errors

Sampling errors are seen in sample surveys due to the fact that only a part of the population is used for enquiry. Clearly, sampling errors are absent in census

## Sampling errors arise due to the following

- (i) Lack of clarity about the coverage of the population
- (ii) Faulty selection of the sample
- (iii) Inadequate sample size
- (iv) Inappropriate of questionnaire
- (v) Errors due to substitution

Errors other than sampling errors in a survey are called non-sampling errors.

# Non sampling errors

Non sampling errors may arise due to

1. Irrelevant responses to questions
2. Errors in printing and publication of results
3. Errors in data processing



## Methods of Sampling

Sampling are two type

- 1) Non Probability sampling
- 2) Probability sampling



# I) Non Probability Sampling

In non probability sampling, members are selected from the population in some non- random manner.

The important non probability sampling are

1) convenience sampling

2) judgment sampling

3) quota sampling.



# 1) Convenience Sampling

A convenience sample is obtained by selecting convenient population units. A sample obtained from readily available lists such as auto mobile registrations, telephone directories, etc. is a convenience sample, if the sample is drawn according to the convenience of the investigator. The results obtained by this method will not be a representative of the population. This method is very popular in online research.

## 2) Judgment Sampling

The investigator exercises his judgment in the choice and includes those items in the sample which he thinks are most typical of the universe with regard to the characteristics under investigation.



For example

If a sample of ten students is to be selected from a class of sixty for analysing the spending habits of students, the investigator would select 10 students who, in his opinion, are representative of the class

### 3) Quota Sampling

In this method quotas are set up according to some specified characteristics such as several income groups. Within the quota the selection of sample items depends on personal judgment.

#### Example

In an income survey, the interviewers may be told to interview 100 people living in certain area in which 60 are housewives, 25 are regular employees and 15 are businessmen. Within these quotas the interviewer is free to select the people to be interviewed. This method often used in public opinion studies and personal interviews and people are systematically according to some fixed quota.

## II) Probability Sampling

Probability sampling is the scientific method of selecting samples according to some laws of chance in which each unit in the population has some definite pre-assigned probability of being selected in the sample.

Different types of probability sampling includes

1. Simple Random Sampling
2. Systematic Sampling
3. Stratified Random Sampling
4. Cluster Sampling
5. Multistage Sampling






# Simple Random Sampling (SRS)

Simple Random Sampling is a random sampling in which each unit in the population has an equal chance of being included in the sample. In this case the sampling units are selected at random.

There are two types of Simple Random Sampling -

- 1) Simple Random Sampling Without Replacement (SRSWOR)
- 2) Simple Random Sampling With Replacement (SRSWR)

Suppose you are going to buy orange from a fruit shop. You are selecting five oranges one by one from a basket of oranges without replacing the selected ones. This type of sampling in which all units have an equal chance of being included in the sample is called as **simple random sampling without replacement(SRSWOR)**. If the sampling is done by replacing the selected unit it is called **simple random sampling with replacement(SRSWR)**. 

If a population consists of  $N$  units and a sample of  $n$  units to be taken

The possible number of samples in SRSWOR =  $N C_n$

The possible number of samples in SRSWR =  $N^n$

### Illustration 10.1

If a population consists of 5 numbers 2,3,6,8 and 11

Consider all simple random samples of size 2 that can be drawn

1. with replacement
2. without replacement

Solution:



Number of possible Samples  
using SRSWOR =  ${}^5C_2$   
= 10

2,3,6,8,11

$${}^nC_r = \frac{n!}{r! \cdot (n-r)!}$$
$${}^5C_2 = \frac{5!}{2! \cdot (5-2)!}$$

$$= \frac{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{2 \cdot 1 \cdot 3 \cdot 2 \cdot 1}$$
$$= 5 \cdot 2 = 10$$

(2,3), (2,6), (2,8), (2,11), (3,6), (3,8), (3,11), (6,8), (6,11), (8,11)

*Samples : Using SRSWR*

(2,2), (2,3), (2,6), (2,8), (2,11), (3,2), (3,3), (3,6), (3,8), (3,11), (6,2), (6,3), (6,6), (6,8), (6,11), (8,2), (8,3), (8,6), (8,8), (8,11), (11,2), (11,3), (11,6), (11,8), (11,11)

$5^2 = 25$  samples

## Methods of Sample Selection - SRS



Random samples can be obtained by any of the following methods

- (i) Lottery Method
- (ii) Random Number Table Method

# Lottery Method

The Simplest method of selecting a simple random sample is the lottery method. Suppose we want to select  $n$  candidates out of  $N$ . We assign the numbers serially starting from 1 to  $N$ . Write these numbers (1 to  $N$ ) on  $N$  slips. These slips are made as homogeneous as possible in shape, size, colour etc. These slips are folded and put in a bag and shuffled thoroughly and then  $n$  slips are drawn one by one. The  $n$  candidates corresponding to numbers on the selected slips are drawn, will constitute a random sample.



# Random Number Table Method(RNT method)

The limitation of lottery method is that it is quite time consuming if the population is large. The most practical and inexpensive method of selecting a random sample consists of the use of Random Number Tables. The random number table are in such a way constructed that each of the digits 0,1,2,3,4,5,6,7,8,9 appears approximately in the same frequency. The digits are also independent.

The method of drawing a random sample by this method consists of the following steps.

Let  $N$  be the population Size with  $k$  digits and  $n$  be the Sample Size to be drawn.

- 1) Identify the  $N$  units in the population with the numbers from 1 to  $N$
- 2) Select at random, any page of the table and pickup the successive  $k$  digit numbers in any row or column or diagonal at random until we get  $n$  number of units.
- 3) Discard numbers which are greater than  $N$  .
- 4) The population units corresponding to the numbers selected  
Constitute the random sample

# Systematic Sampling

A sampling method in which one unit is selected at random and the remaining units are selected at an interval of predetermined length is called systematic sampling.

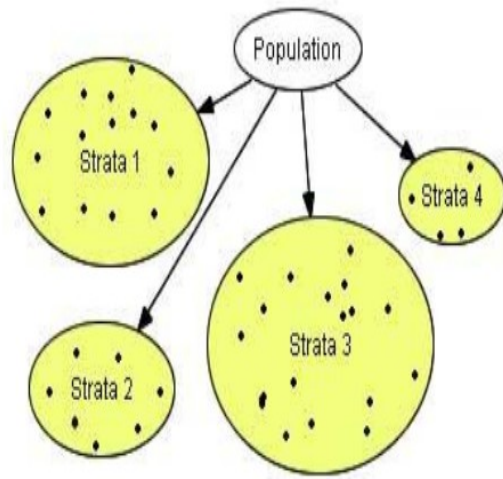
Suppose we want to select a systematic sample of 8 units out of 48 units.



To do this we first find the sampling interval  $k = N/n = 48/8 = 6$ . The first unit in the 8 sample is selected by a random number  $r$  between 1 and 6. Let it be 3. Then the third unit will be selected to the sample. There after every sixth unit will be selected automatically into the sample. Hence the resulting systematic sample will contain the units with the following serial numbers  
3, 9, 15, 21, 27, 33, 39

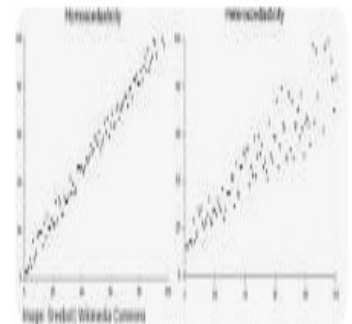
# Stratified Sampling

Simple Random Sampling is suitable for homogeneous population. When the population is heterogeneous, it is first subdivided into non overlapping exhaustive homogeneous subgroups. These subgroups are called strata or stratum. From each stratum, units are selected at random. The number of items taken from each subgroup may be in proportion to its size. This type of sampling is called stratified sampling. This method is applied so that units within each group are as homogeneous as possible and the group means are as widely different as possible.



## Homogeneous Data

A **data** set is **homogeneous** if it is made up of things (i.e. people, cells or traits) that are similar to each other. For example a **data** set made up of 20-year-old college students enrolled in Physics 101 is a **homogeneous**



# Cluster Sampling

If we are interested in obtaining the income data in a city, the whole city may be divided into different blocks (clusters) and a Simple Random Sample of required number of blocks is drawn. The individuals of these selected blocks constitute the Cluster Sample. In Cluster Sampling, the total population is divided into some recognizable subdivisions which are termed as clusters and a Simple Random Sample of these clusters is drawn. These clusters are examined completely. This sampling procedure is called Cluster Sampling.



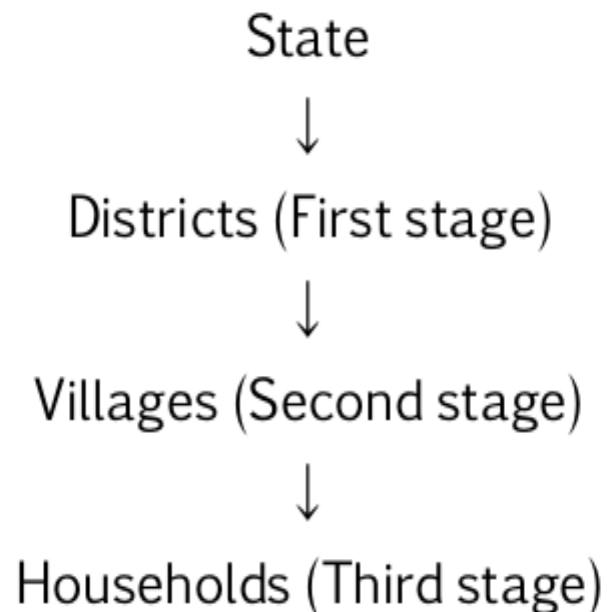
 **Illustration 10.4**

<i>Population</i>	<i>All school students in the District</i>
<i>Clusters</i>	<i>Each school in the district</i>
<i>Obtain SRS of clusters</i>	<i>Four schools from the district</i>
<i>Sample</i>	<i>Every student in the four schools</i>



## 10.10 Multi-Stage Sampling

Selection of a sample of households from a particular State can be done through different stages. The first stage units may be districts, second stage units may be villages in the selected districts and third stage units may be households in the Villages, which are the ultimate units.



Such type of sampling is called Multi-stage Sampling. As the name indicates, multistage sampling refers to a sampling technique which is carried out in various stages. Multi stage sampling consists of sampling first stage units by some

suitable method of sampling. From among the selected first stage units, a sub sample of secondary stage units is drawn by some suitable method of sampling which may be same as or different from the method used in selecting first stage units. Further stages may be added to arrive at a sample of desired sampling units. If the sampling is done only in two stages, it is called Sub-sampling.

## Probability Sampling Methods and Strategies

Type of Sampling	Selection Strategy
Simple	Each member of the population has an equal probability of being selected.
Systematic	Each member of the population is either assembled or listed, a random start is designated, then members of the population are selected at equal intervals
Stratified	Each member of the population is assigned to a group or stratum, then a simple random sample is selected from each stratum
Cluster	Each member of the population is assigned to a group or cluster, then clusters are selected at random and all members of each selected cluster are included in the sample.

Two stage Sampling	Each member of the population is divided into sub groups, a sample of these groups are selected at random and then a sample of members of each selected subgroups are included in the sample
Multistage sampling	The above stage is extended to multi-levels