"Sampling theory deals with inductive inference which is the process by which we draw a conclusion about some measure of population based on a sample value."

– W. A. Spur and C. P. Bonini

7

Sampling Methods

Contents :

7.1 Population and Sample

Meaning :

A set or group of all units or items under study is called a **Population**. A set or group of units selected from a population on the basis of some definite criteria is called a **sample**.

Suppose we want to study the IQ level of students in XII standard of Gujarat Board, then all XII standard students of Gujarat Board is the **Population.** If we select 1000 students from all XII standard students of Gujarat board based on some criteria, then set of these 1000 students becomes our **Sample**. Selection of sample is often used in day to day life. Before purchasing vegetables or fruits, we select and inspect a few from the whole lot of vegtables and fruits that shopkeeper has. All the vegetables or fruits this shopkeeper has, is the population and a few selected vegetables or fruits is the sample.

A sample can be selected with or without replacement from the population. A sample in which each unit is selected from the population after replacing the unit selected earlier in the population is called a **sample with replacement.** A sample in which each unit is selected from the population without replacing the unit selected earlier in the population is called a **sample without replacement.** Similarly, if units are selected simultaneously from the population then it is also a sample without replacement.

7.2 Population Inquiry and Sample Inquiry

There are two methods of collecting information or data about the population under study. The inquiry in which information is collected from each and every unit of the population is called **population inquiry or census survey.**

The census survey conducted every ten years in India is an example of population inquiry. Suppose, the study is about marks of XI and XII standard students of a particular school and we collect marks of each and every XI and XII standard student of that school then it is a population inquiry. Inspection of all votes cast during a particular election is another example of population inquiry.

The inquiry in which information is collected from a few units selected from the population is called **sample inquiry or sample survey.** Suppose, the study is to analyze spending habit of students of a particular college. If we collect information of spending habit of few students (selected with definite criteria) of that college then it is an example of sample inquiry. Testing a drop of blood drawn from the body to determine the blood group of a person is also an example of sample survey.

The procedure of selecting a sample from a population is called **sampling.**

7.3 Need for sampling

We often use sampling in real life. The quality control department of a factory randomly selects a few units from the total production to check the quality of the units produced. The total production of that factory is considered as population and a few units selected for determining the quality becomes the sample. The procedure of selecting some milk for determining the fat from the milk brought by milkman to the dairy, checking the blood sample of few patients suffering from a particular disease to detect the cause of the disease, etc. are other examples of sampling.

Sampling is inevitable in following situations:

- The number of units in a population is very large.
- Units of the population are spread over wide geographical area.
- The units under inquiry are to be destroyed i.e. when inspection of units is destructive in nature.

  e.g. Inquiry of life of electric bulb.
- Limited availability of resources like time, money and experts for conducting an inquiry.

Generally, population inquiry is undertaken according to the constitutional and legal provision and for administrative reasons as well. Even in situations where population inquiry is feasible, preference is given to sample inquiry because a population inquiry involves more time, money and man power. Moreover, a large number of errors creep into the population inquiry because the task of organizing population inquiry is extensive and complicated.

The main objective of sampling is to draw inferences about the characteristics of the population on the basis of a sample inquiry. The measures such as mean, standard deviation, etc. calculated from the numerical data obtained from sample units are called **sample** statistics. All these measures for population data are called **parameters.**

7.4 Characteristics of an Ideal sample

Sample inquiry is used to draw conclusions of the population on the basis of the sample selected from the population. Thus, a sample selected from a population plays a vital role in obtaining information of the population. Hence, it is absolutely essential that a sample is appropriately selected from the population. A sample possessing the following characteristics is called an **ideal sample.**

(1) It should represent the population i.e. all the characteristics of the population should be included in the sample.

(2) It should be randomly selected i.e. no units of the population should be favoured or prejudiced.

(3) The sample units should be selected in the same period of time and under identical conditions i.e. there should not be any major fluctuations affecting the study during the period of sampling.

(4) Selection of sample units should be independent i.e. the selection of a unit should not be dependent on selection of any other unit of the sample.

(5) The size of the sample should be adequate and determined in an appropriate manner.

7.5 Points to be considered while determining the sample size

The sample size means the number of units in the sample selected from the population. The following points should be considered while determining the sample size :

(1) The size of the population and scope of the study

(2) The variability in the units of the population or heterogeneity of population

(3) Availability of resources like time, money and technical expertise

(4) Expected level of accuracy of sample results

Additional information for understanding

Considering the availability of resources, large sample should be selected if population is large, heterogeneity of population is more and expected level of accuracy is high.

7.6 Sampling Methods

Method of selecting sample from the population is called **sampling method**. There are various methods of sampling that may be used singly or along with the other. The choice will be determined by the purpose for which sampling is sought and the nature of the population.

There are various methods of sampling but we shall study following methods:

(1) Simple random sampling (2) Stratified random sampling (3) Systematic sampling

7.6.1 Simple Random Sampling

7.6.1.1 Meaning

Under this method, the whole population is taken as a single composite unit for the purpose of sampling. A sampling in which units are selected independent of each other in such a way that each unit belonging to the population has an equal chance of being a part of the sample is called a **simple random sampling.** Simple random sampling gives reliable results if the population is fairly homogenous, i.e. population observations possess almost same characteristics.

If the units are selected one by one and each unit is selected from the population after replacing the unit selected earlier in the population then the sampling procedure is called **simple random sampling with replacement.** If the units are selected one by one and each unit is selected from the population without replacing the unit selected earlier in the population then the sampling procedure is called **simple random sampling without replacement.**

Generally, in simple random sampling, the following two methods are used to select a random sample:

(a) Method of Lottery (b) Method of random number table

7.6.1.2 Method of Lottery

This is the simplest and the most popular method of drawing a random sample from a population. In this method, units of the population are assigned numbers 1, 2, 3,... to identify them. Small and identical slips of paper bearing each number are prepared. (Identical slips means similar in colour, size and shape so that there is no bias in selection.) The slips are folded and mixed together in a vessel or a box. A blindfold selection of slips is made one by one until a sample of required size is obtained. The units bearing the numbers on the slips selected constitute a random sample of required size. In modern times, a mechanical device is also used to draw a random sample.

7.6.1.3 Method of Random Number Table

The method of lottery for selecting a random sample becomes time consuming and cumbersome when the population is very large. In such a situation, drawing a random sample becomes easy using readymade tables of random numbers. Random number tables are scientifically generated. The random number tables in common use are listed below :

(i) L.H.C. Tippett's random number tables (ii) Fisher and Yates' random number tables (iii) Random number tables of Rand Corporation of America

When a random sample is to be drawn, a page of the booklet of random number tables is opened at random and any row or column of that page is randomly selected. The random numbers appearing in order in the selected row or column are taken as the units according to the size of the population.

Tippett's random number table is commonly used to draw a random sample. We shall use it for illustrations of drawing a random sample. A part of the table is reproduced below for the purpose of illustration :

	1	2	3	4
(1)	053	274	323	599
(2)	667	484	786	833
(3)	992	347	253	338
(4)	428	982	564	785
(5)	278	154	490	076
(6)	819	314	589	889
(7)	195	222	428	924
(8)	390	379	699	786
(9)	420	598	443	692
(10)	664	430	343	118
(11)	171	035	189	236
(12)	289	505	667	484
(13)	535	300	112	089
(14)	784	280	257	154
(15)	640	143	364	326

Illustration 1 : Draw a random sample of 10 students without replacement from a population of 70 students of X standard of a particular school for testing the IQ level.

We shall first assign numbers 1 to 70 to the students of X standard of the school.

The size of this population (N) = 70, a two - digit number. Hence, we consider only first two digits of random numbers. We can select any row or column of any page of random number table booklet but we shall use the part of the table given above for clarity of understanding.

Suppose, we begin with the random numbers from the third row and then the consecutive rows for selecting the random sample. The random numbers with first two digits of each number are listed below :

(3)	99	34	25	33
(4)	42	98	56	78
(5)	27	15	49	07
(6)	81	31	58	88
(7)	19	22	42	92
(8)	39	37	69	78
(9)	42	59	44	69
(10)	66	43	34	11
(11)	17	03	18	23
(12)	28	50	66	48
(13)	53	30	11	08
(14)	78	28	25	15
(15)	64	14	36	32

Since the size of population is 70, we shall ignore random numbers which are greater than 70. As the sample has to be selected without replacement, we shall also ignore the random numbers which are repeated more than once. Considering this, we are left with the following numbers :

(3)	—	34	25	33
(4)	42	—	56	—
(5)	27	15	49	07
(6)	—	31	58	—
(7)	19	22	—	—
(8)	39	37	69	—
(9)	—	59	44	—
(10)	66	43	—	11
(11)	17	03	18	23
(12)	28	50	—	48
(13)	53	30	—	08
(14)	—	—	—	—
(15)	64	14	36	32

As we require a random sample of size 10, we shall select the first 10 random numbers. The selected random numbers are: 34, 25, 33, 42, 56, 27, 15, 49, 7, 31.

Thus, students with above numbers are selected. So, we have 10 students randomly selected from the school for testing their IQ level.

NOTE : As the selection of random numbers from random number tables can be from any row or column, random numbers obtained can be different for different persons.

Illustration 2 : Draw a random sample of 7 Income tax files without replacement from a population of 5000 Income tax files for scrutiny.

We shall first assign numbers 1 to 5000 to 5000 Income tax files.

The size of this population is N = 5000, a four - digit number. Hence, we shall consider three digits of a column and first digit of the next column. We can select any row or column of any page of random number table booklet, but we shall use the part of the table given above for clarity of understanding.

Suppose, we begin with the random numbers from the first row and then the consecutive rows for selecting the random sample.

	1	2	3	4
(1)	053	274	323	599
(2)	667	484	786	833
(3)	992	347	253	338
(4)	428	982	564	785
(5)	278	154	490	076
(6)	819	314	589	889
(7)	195	222	428	924
(8)	390	379	699	786
(9)	420	598	443	692
(10)	664	430	343	118
(11)	171	035	189	236
(12)	289	505	667	484
(13)	535	300	112	089
(14)	784	280	257	154
(15)	640	143	364	326

Since the size of the population is 5000, we shall ignore a random numbers which are greater than 5000. As the sample has to be selected without replacement, we shall also ignore the random numbers which are repeated more than once. The population size (N) = 5000, which has a four digits but the random number given in the above table is a three digit number. So, as shown in the above table, we shall join the three digits of the first column with the first digit of the second column to make random numbers of 4 digits. As we require random sample of size 7, we shall select first 7 random numbers. The selected random numbers are:

0532, 4289, 2781, 1952, 3903, 4205, 1710.

Thus, Income tax files with above numbers are selected. So, we have 7 randomly selected Income tax files for scrutiny.

Illustration 3 : Draw a random sample of size 5 (i) with replacement (ii) without replacement from a population of 50 units using the following 15 two digit random numbers: 62, 25, 6, 60, 95, 55, 98, 11, 71, 25, 20, 45, 89, 27, 40

We shall first assign numbers 1 to 50 to the 50 units of the the population.

Since the size of the population is 50, we shall ignore random numbers which are greater than 50. So we are left with random numbers : 25, 6, 11, 25, 20, 45, 27 and 40.

(i) As the sample has to be selected **with replacement,** we shall not ignore the random numbers which are repeated more than once. As we require random sample of size 5, we shall select first 5 random numbers. The selected random numbers are: 25, 6, 11, 25, and 20.

(ii) As the sample has to be selected **without replacement,** we shall ignore the random numbers which are repeated more than once. As we require random sample of size 5, we shall select first 5 random numbers. The selected random numbers are: 25, 6, 11, 20, and 45. (as 25 cannot be selected again)

7.6.1.4 Advantages and Disadvantages of Simple Random Sampling

Advantages :

(1) There is no scope of bias or prejudice in the selection of a sample since each unit of the population has equal chance of selection.

(2) The chance that a random sample represents the population is high. As the size of the sample increases, it becomes increasingly representative of the population.

(3) Reliable information about the characteristics of the population can be obtained with less cost and time.

Disadvantages :

(1) It requires complete list of units of the population. Absence of complete list restricts the use of this sampling design.

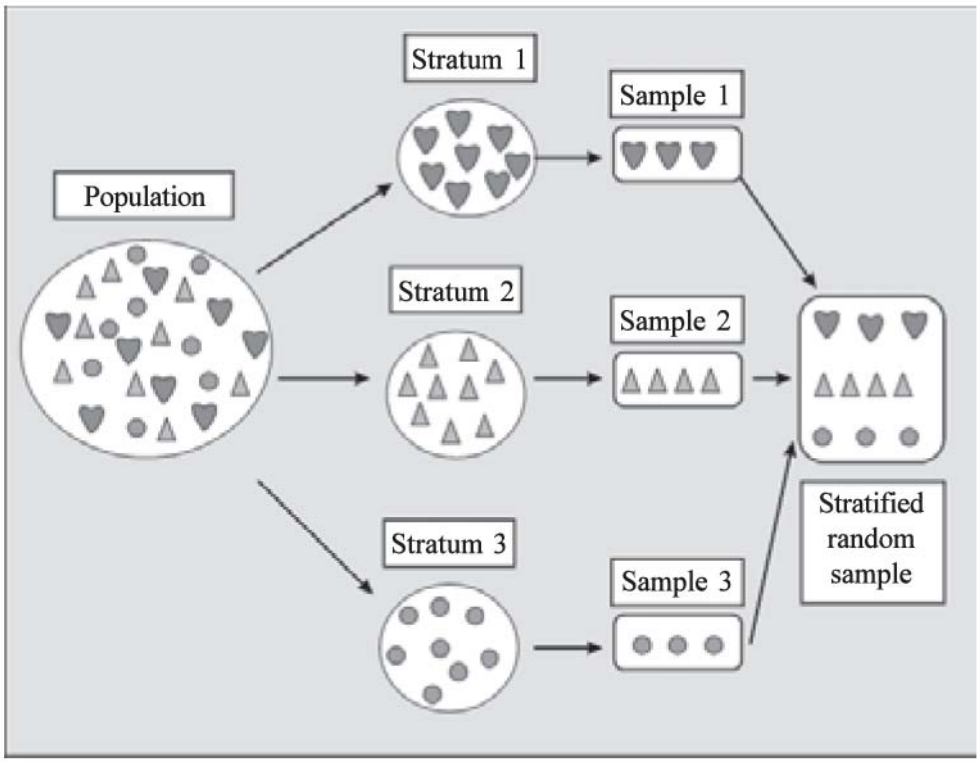
(2) When the size of population is large, the preparation of slips or assigning numbers to the population units becomes tedious and time consuming.

(3) Sample will not be a representative sample if the sample size is small and population is heterogeneous.

7.6.2 Stratified Random Sampling

7.6.2.1 Meaning

When the population is heterogeneous i.e. when there is considerable amount of variation among the units of population, the use of stratified random sampling is more appropriate than simple random sampling. In this form of sampling, the population is first divided into two or more mutually exclusive groups based on some characteristics of variables under study. A process of dividing heterogeneous population into non-overlapping fairly homogeneous groups is called stratification and these groups are called strata. These strata differ from one another and the units of each stratum have almost same characteristics in terms of variation. A random sample is independently drawn from each stratum and random samples so obtained from all strata are combined to get a sample which is called a **stratified random sample** and the method of selecting such a sample is called **stratified random sampling method.** Strategies like proportional allocation, optimal allocation, cost minimization etc. can be used for deciding number of units taken from each stratum.



In order to study the spending habits of commerce college students, all students of the college are divided into three income groups (strata) as high, middle and low income group of students. Certain fixed number of students is randomly selected from each of the three groups (strata). When these three samples are combined into a single sample, we get a stratified random sample.

Similarly, when we want to check the quality of the units produced in a factory, total production of the factory is divided into two groups (strata) as units produced in morning shift and units produced in night shift. Certain fixed number of units is randomly selected from each of two groups (strata). When these two samples are combined into a single sample, we get stratified random sample.

Illustration 4 : Draw a random sample of 1 percent students without replacement from 1500 students of a particular college for giving their opinion on college facilities. There are 600 students in First year (FY), 500 students in Second year (SY) and 400 students of Third year (TY) class in the college. Use the following 40 three – digit random numbers :

158, 092, 411, 745, 009, 724, 674, 550, 716, 359, 419, 969, 200, 458,
384, 019, 676, 631, 390, 557, 299, 786, 706, 206, 729, 344, 543, 309,
227, 483, 741, 766, 027, 070, 648, 956, 238, 912, 480, 558.

(Use the first 14 random numbers for FY, next 14 random numbers for SY and remaining random numbers for TY)

We shall first divide 1500 students of the college into three groups (strata) First Year, Second Year and Third Year students. Now we will select a random sample of 1% from each group. 1% of 600 of First year class i.e. 6, 1% of 500 of Second year class i.e. 5 and 1% of 400 of Third year class i.e. 4 will be selected using simple random sampling method.

Selecting sample of size 6 from 600 FY students :

Random numbers for FY : 158, 092, 411, 745, 009, 724, 674, 550, 716, 359, 419, 969, 200, 458.

Numbers 1 to 600 will be assigned to 600 students of FY. Since there are 600 students in FY, we shall ignore random numbers which are greater than 600. As the sample has to be selected without replacement, we shall also ignore the random numbers which are repeated more than once. We require a random sample of size 6, so we shall select first 6 random numbers. Thus, the selected random numbers are: 158, 092, 411, 009, 550, 359. Students with these numbers are selected from FY in our sample.

Selecting sample of size 5 from 500 SY students :

Random numbers for SY: 384, 019, 676, 631, 390, 557, 299, 786, 706, 206, 729, 344, 543, 309

Numbers 1 to 500 will be assigned to 500 students of SY. Since there are 500 students in SY, we shall ignore random numbers which are greater than 500. As the sample has to be selected without replacement, we shall also ignore the random numbers which are repeated more than once. We require a random sample of size 5, so we shall select first 5 random numbers. Thus the selected random numbers are: 384,019,390,299,206. Students with these numbers are selected from SY in our sample.

Selecting sample of size 4 from 400 TY students :

Random numbers for TY : 227, 483, 741, 766, 027, 070, 648, 956, 238, 912, 480, 558

Numbers 1 to 400 will be assigned to 400 students of TY. Since there are 400 students in TY, we shall ignore random numbers which are greater than 400. As the sample has to be selected without replacement, we shall also ignore the random numbers which are repeated more than once. We require a random sample of size 4, so we shall select first 4 random numbers. Thus the selected random numbers are: 227, 027, 070, 238. Students with these numbers are selected from TY in our sample.

Stratified random sample of size 15 is the combination of 6 students selected from FY, 5 students selected from SY and 4 students selected from TY.

Illustration 5 : For studying the usage of mobile phones, randomly select 7 persons without replacement from 30 boys and 20 girls from a locality of a city. There should be 3 boys and 4 girls in the randomly selected 7 persons.

Random numbers for boys : 82, 95, 18, 96, 20, 84, 56, 11, 52, 03

Random numbers for girls : 04, 40, 34, 13, 72, 11, 50, 55, 08, 11, 76, 18

We shall first divide 50 persons into two groups (strata) Boys and Girls. Now we will select a random sample of 3 boys from 30 boys and 4 girls from 20 girls using simple random sampling method.

Selecting sample of size 3 from 30 boys :

Numbers 1 to 30 will be assigned to 30 boys. Since there are 30 boys, we shall ignore random numbers which are greater than 30. As the sample has to be selected without replacement, we shall also ignore the random numbers which are repeated more than once. We require a random sample of size 3, so we shall select first 3 random numbers. Thus, the selected random numbers are: 18, 20 and 11. Boys with these numbers are selected from all boys of the locality.

Selecting sample of size 4 from 20 girls :

Numbers 1 to 20 will be assigned to 20 girls. Since there are 20 girls, we shall ignore random numbers which are greater than 20. As the sample has to be selected without replacement, we shall also ignore the random numbers which are repeated more than once. We require a random sample of size 4, so we shall select first 4 random numbers. Thus, the selected random numbers are: 04, 13, 11 and 8. Girls with these numbers are selected from all girls of the locality.

Stratified random sample of size 7 is the combination of these selected 3 boys and 4 girls.

7.6.2.2 Advantages and Disadvantages of Stratified Random Sampling

Advantages:

(1) In this method, sample is selected from each stratum so stratified sample provides representative sample.

(2) Generally, stratified sampling provides estimates with increased accuracy.

(3) This method enables to maintain predetermined level of accuracy for each of the stratum.

(4) Administrative convenience increases in this method.

(5) Separate enumerators can be appointed to select samples from different strata.

Disadvantages :

(1) At times, it is difficult task to divide population into homogeneous strata.

(2) If stratification is not proper, accuracy of the results obtained by sample inquiry decreases.

(3) The procedure of estimating population parameters in this method is more complicated as compared to simple random sampling.

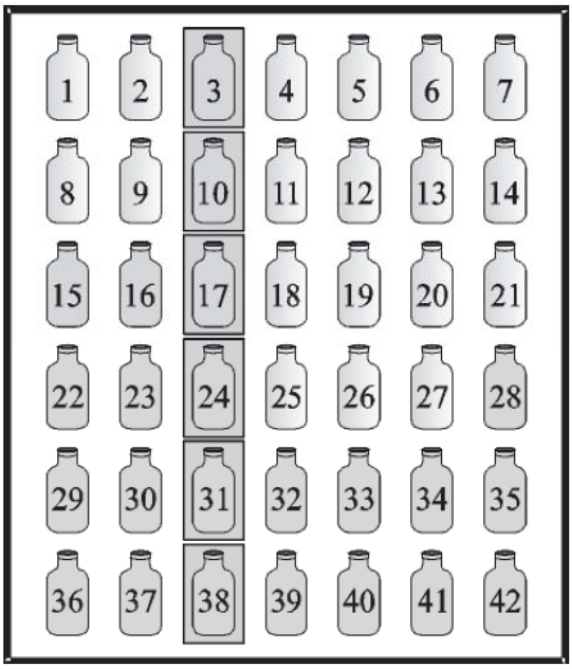
7.6.3 Systematic Sampling

7.6.3.1 Meaning

In this method, the first sample unit is randomly selected and the remaining units are automatically sélected in definite sequence at uniform interval from one another. This method of sampling is usually recommended if the complete list of population units is available and the units are arranged in some systematic order such as alphabetical, chronological, geographical, etc. Systematic sample units are uniformly distributed over the population.

Suppose that the N units in the population are arranged in some systematic order and are numbered 1 to N. We want to select a sample of n units from it such that $N = n \times k$ or $k = N/n$ where k is usually called the **sampling interval.** Here we will assume k to be an integer value. We select a unit at random, from the first units and select every k-th unit thereafter. Set of such selected units is called **systematic sample** and the method of obtaining such a sample is called **systematic sampling.**

Suppose we want to select 6 plastic bottles from 42 plastic bottles manufactured in a factory. We will first assign the numbers 1 to 42 to bottles manufactured in the factory. Here population size (N) is 42, sample size (n) is 6, so $k = N/n = 42/6 = 7$. Select a bottle from 1 to 7 using simple random sample, say bottle number 3 is selected. There after, every 7th (k-th) bottle, that is the 10th, 17th, 24th, 31th and 38th bottle will be selected in the sample.



Suppose, for a study, we want a sample of 10 houses from a society of 120 houses. Here, $k = \frac{120}{10} = 12$. So, every 12th house is chosen after a random starting point between 1 and 12. If house with number 8 is randomly selected, from the first 12 houses then the houses with following numbers will be selected:

8, 20, 32, 44, 56, 68, 80, 92, 104 and 116.

(If every selected house in the sample was a "corner house" then this corner pattern could destroy the randomness of the sample.)

Additional information for understanding

When $N \neq nk$, one of the following procedures may be adopted to obtain systematic sample.

- Drop one unit at random if sample has $(n + 1)$ units.
- Eliminate some units so that $N = nk$.
- Use circular systematic sampling scheme.
- Round off the fractional interval k.

Illustration 6 : There are 40 flats in a multi-storied apartment. 5 flats are to be selected using systematic sampling from 40 flats for decoration in a cultural program. Explain how the sample can be selected ?

Here, total number of flats is 40 i.e. N = 40 and we have to select 5 flats i.e. n = 5. So, the sampling interval $k = N/n = 40/5 = 8$. Now, every 8th flat will be selected after randomly selecting one flat from flat number 1 to 8. Suppose flat number 3 is selected from first 8 flats then flats with following numbers are selected:

3, 11, 19, 27, 35.

Illustration 7 : An owner of a service station has a list of 1000 car owners who have got their car repaired at his service station. He wishes to conduct satisfaction survey of 50 car owners. Explain how a sample of 50 car owners can be selected using systematic sampling.

Here, total number of car owners is 1000 i.e. N = 1000 and we have to select 50 car owners i.e. n = 50. So, the sample interval $k = N/n = 1000/50 = 20$. Now, every 20th car owner will be selected after randomly selecting one car owner from 1 to 20. Suppose car owner number 11 is selected from first 20 car owners then the car owners with following numbers will be selected in systematic sample for conducting satisfaction survey 11, 31, 51, 71, ..., 991.

Illustration 8 : Select all possible systematic samples of size 3 from a population of size 12.

Here population size (N) is 12 and sample size (n) = 3. So the sample interval $k = N/n = 12/3 = 4$. Now, every 4th unit will be selected after randomly selecting the first unit from 1 to 4. Thus we will get 4 possible samples.

	1	2	3	4
	5	6	7	8
	9	10	11	12
SAMPLE NO.	I	II	III	IV

Thus, possible samples are:
Sample I : 1, 5, 9
Sample II : 2, 6, 10
Sample III : 3, 7, 11
Sample IV : 4, 8, 12

7.6.3.2 Advantages and Disadvantages of Systematic Sampling :

Advantages :

(1) It is easier to draw a sample and often easier to execute without mistakes.
(2) Sample is evenly spread over the entire population.
(3) It requires less time and labour compared to simple random and stratified random sampling.

Disadvantages :

(1) It works well only if complete list of population units is available.
(2) Arranging all population units in a systematic order is time consuming, tedious and at times, not feasible.
(3) Systematic sample is not completely random sample.
(4) Sample may be biased if hidden periodicity in population coincides with that of selection of sample.

Summary

- A set or group of all units or items under study is called **population.**
- A set or group of units selected from population on basis of some definite criteria is called a **sample.**
- The inquiry in which information is collected from each and every unit of the population is called **population inquiry** or **census survey.**
- The inquiry in which information is collected from a few units selected from the population is called **sample inquiry** or **sample survey.**
- The procedure of selecting a sample from a population is called **sampling.**
- The measures such as mean, standard deviation, etc. calculated from the numerical data obtained from sample units are called **sample statistics.** All these measures of the population data are called **parameters.**
- Method of selecting sample from the population is called **sampling method.**
- The sampling in which units are selected independent of each other in such a way that each unit belonging to the population has an equal chance of being a part of the sample is called **simple random sampling.**
- When the population is heterogeneous, the use of stratified random sampling is more advantageous than simple random sampling.
- A random sample is independently drawn from each stratum and random samples so obtained from all strata are combined to get a sample which is called a **stratified random sample** and the method of selecting such a sample is called stratified random sampling method.
- In systematic sampling, the first sample unit is randomly selected and the remaining units are automatically selected in definite sequence at uniform interval from one another.

EXERCISE 7

Section A

For the following multiple choice questions choose the correct option :

1. A sample selected from a population consists which of the following ?

(a) All units of the population (b) Only 50% of the units of the population

(c) Only 15% of the units of the population (d) Some units of the population

2. Which of the following statements is true ?

(a) A sample in which a unit is selected after replacing the unit selected earlier in the population is called a sample without replacement.

(b) If a unit is to be destroyed during an inquiry then sample inquiry is not only necessary but also inevitable.

(c) In any sampling method, the sample size is larger than the population size.

(d) Stratified random sampling is best if the population is homogeneous.

3. Which of the following statements is true ?

(a) In stratified random sampling, all the units of the population have equal chance of being selected in the sample.

(b) In simple random sampling all units of the population have equal chance of being selected in the sample.

(c) In any sampling method, the sample size does not depend on population.

(d) In systematic sampling, all units of the population have equal chance of being selected in the sample.

4. A parameter and statistic respectively are characteristics of which of the following ?

(a) Population and sample (b) Sample and population

(c) Sample and sample (d) Population and population

5. Which sampling is affected the most if there is hidden periodicity in population ?

(a) Simple random sampling (b) Stratified random sampling

(c) Systematic sampling (d) Both (b) & (c)

6. Suppose we are using stratified sampling for a particular population and have divided it into strata of different sizes. How can we now make sample selection ?

(a) Select an equal number of units from each stratum at random.

(b) Draw unequal number of units from each stratum and weigh the results.

(c) Draw number of units from each stratum proportional to their size in the population.

(d) None of the above.

7. A security checkpoint that checks every vehicle entering into the mall is an example of which of the following ?

(a) Census inquiry (b) Stratified random sampling

(c) Systematic sampling (d) Simple random sampling

Section B

State whether the following statements are 'true' or 'false' :

1. A sampling plan that selects units from a population at uniform intervals in time, value or position is called stratified sampling.
2. A statistic is a characteristic of a population.
3. Units in the sample should be selected within the same time duration.
4. When properties of the units of the population have more dissimilarity, the use of stratified random sampling method is advantageous.
5. In simple random sampling method, each unit of the population has an equal chance of being included in the sample.
6. A sampling method that divides the population into homogeneous groups from which random samples are drawn is known as systematic sampling.
7. Each unit of the populations is examined in census inquiry.

Give answer in one sentence of the following questions :

1. What is the process by which inference about a population is made from sample information ?
2. Which sampling should be used when each group considered has small variation within itself but there is wide variation between different groups ?
3. In which sampling method, units are selected from the population at uniform intervals ?
4. Which table of random numbers is most commonly used ?
5. Which type of inquiry involves more errors ?
6. What is meant by population inquiry ?
7. What do you mean by a sample without replacement ?
8. When is the use of stratified random sampling considered to be favourable or suitable ?
9. When can the systematic random sample be biased ?
10. Define heterogeneous population.
11. Give an example an inquiry where units are destreyed during inspection.
12. If the three - digit random numbers are given and population size is of two digits, how will random numbers be used for selecting the sample ?
13. If the two-digit random numbers are given and population size is of three digits, how will random numbers be used for selecting the sample ?
14. Define parameters of the population.
15. Define sample statistics.

Section C

Answer the following questions :

1. When is sample inquiry undertaken ?
2. What is sampling ?
3. State the methods of selecting a simple random sample.
4. Name various methods of sampling.
5. State the strategies used for deciding the number of units to be selected from each stratum in stratified random sampling.
6. Explain sample interval in systematic random sampling.
7. Explain the process of stratification.
8. Define stratum in stratified random sampling.

Section D

Answer the following questions :

1. Explain the meaning of population inquiry and sample inquiry with an illustration.
2. Differentiate population inquiry and sample inquiry.
3. State the characteristics of an ideal sample.
4. State the points to be considered while determining the sample size.
5. State the advantages of simple random sampling.
6. Write a note on simple random sampling.
7. Write a note on stratified random sampling.
8. State the disadvantages of stratified random sampling.
9. Write a note on systematic sampling.
10. State the advantages of systematic random sampling.
11. Why is population inquiry usually not feasible in practice ?
12. State advantages of sampling.
13. Use the following random numbers to select a random sample of 5 ATMs without replacement from a total of 100 ATMs of a bank.

    018, 502, 153, 096, 027, 007, 118, 245, 012, 054, 444, 211, 323, 428, 137.
14. There are 70 students in a class-room. A teacher wants to select 7 students for 7 activities. Obtain a random sample with replacement using the following random numbers.

    274, 323, 923, 599, 667, 320, 910, 484, 786, 253, 009, 885, 115.
15. Three digit random numbers are given below :

    170, 111, 352, 002, 563, 203, 405, 545, 111, 446, 776, 691, 816, 233, 616, 300, 250, 816, 010.

    Using the random numbers, select a 2% random sample with and without replacement from a population of 350 units.

16. Draw a random sample of 2 percent students without replacement from 600 students of a particular college for giving their feedback on faculty members. There are 200 students in each of the three years (F.Y., S.Y. and T.Y.). Use the following three – digit random numbers:

For F.Y. : 158, 092, 411, 745, 009, 724, 674, 550, 716, 359, 419, 696, 200, 458

For S.Y. : 384, 019, 679, 131, 390, 057, 299, 786, 006, 206, 729, 344, 543, 309

For T.Y. : 227, 483, 741, 766, 027, 070, 648, 956, 198, 912, 200, 058, 696, 500

17. To study the usages of fertilizer, randomly select 10 farmers without replacement from 30 small farm owners and 20 large farm owners. There should be 6 small farm owners and 4 large farm owners in the randomly selected 10 farmers.

Random numbers for small farm owners :

12, 95, 18, 96, 20, 84, 56, 11, 52, 03, 10, 45

Random numbers for large farm owners :

04, 40, 34, 11, 72, 11, 50, 55, 08, 13, 76, 18.

18. There are 60 employees in the office of an I.T. company. 5 employees are to be selected using systematic random sampling for a trial of 'work from home' concept. Explain how can a sample be selected ?

19. Select all possible samples of size 4 using systematic sampling from a population of 20 units.

20. A Teacher wants to check home-work of 10 students out of 30 students of Standard Xl of a school. How many random samples can be obtained using systematic sampling ?

W. G. Cochran

(1909 - 1980)

Prof. Cochran began his career at Rothamsted Research without a Ph.D., Cochran published 18 papers while at Rothamsted and attended the lectures of R.A. Fisher before leaving England for the United States. He was tasked with developing the graduate program in Statictics within the Mathematics Department. During this time, Cochran also worked on the advisory panel to the U.S. Census.

Later, he moved to Johns Hopkins University's Department of Biostatistics, where his work shifted from agricultural issues to medical applications of Statistics. While at Johns Hopkins, he wrote Sampling Techniques and Experimental Designs. From 1957 until his retirement in 1976, Cochran worked at Harvard. His last position was Professor Emeritus.