

Population and Sample

Q. 1 Explain the terms : Population, sample, sampling unit, sampling frame.

Ans. (a) Population : An aggregate of objects or individuals under study is called population or universe. For example, (i) In the study of agricultural yield, all the cultivated farms together will be a population. (ii) In the study of socio-economic conditions of a particular village, all families or houses in the village will be a population.

Thus population may be a group of students, collection of books, group of industries, group of employees, collection of explosives, total industrial production. Population may contain finite or infinite elements. Accordingly, it is called as finite or infinite population.

Many a times, we record some quantitative or qualitative characteristic of each member in the population. These observations are collectively called as statistical population.

(b) Sample : Some representative items are selected from the population, so that all important characteristics of population are covered in the items of this group. Such a group is called sample and the method of selecting such a group is called as sampling method. Thus any part of population under study is called as sample. For example, (i) While examining blood of a person, a few drops are taken out of his body for diagnosis. These drops form a sample whereas entire blood in the body is a population. (ii) To confirm whether the food is properly cooked or not, a housewife took a few particles out of the container. Here the food in the container is a population, whereas food taken out of container for inspection is a sample.

(c) Sampling unit : Members of elements of population are called sampling units. In the sampling process, population is divided into small units which are called the sampling units. For example, in the study of industrial development, all the industries under consideration is the population whereas any individual industry is a sampling unit.

Sampling units must be distinct and unambiguous in nature. Sampling units together must cover the entire population. In other

words, sampling unit is the smallest part of the population which cannot be further subdivided for the said purpose.

(d) Sampling frame : An exhaustive list of all members or elements of population is called as sampling frame. It gives guidelines to cover the entire population. It should be up-to-date and suitable to the purpose of survey or enquiry. To prepare a good frame is a difficult job. Defective frame does affect the result of the survey.

Q. 2 Define population. What are the different types of population ? Give one example of each type.

Ans. In a statistical investigation, the interest usually lies in the assessment of the general magnitude and the study of variation with respect to one or more characteristics relating to individuals belonging to a group. This group of individuals under study is called population or universe. Thus in statistics, population is an aggregate of objects, animate or inanimate, under study. The number of units constituting the population is called the size of the population. According to size of the population there are two types of populations : -

(i) Finite population : When the number of units in population is finite, it is called finite population. e.g. the population of students enrolled in an year in a college is a finite population as the number of students is a finite number.

(ii) Infinite population : When the number of units in population is infinite, it is called infinite population. e.g. the population of units produced of a product in continuous process of production is an infinite population.

Q. 3 Explain the necessity of a sampling a population by giving suitable examples.

Ans. It is obvious that for any statistical investigation, complete enumeration of the population is rather impracticable. For example, if we want to have an idea of the average per capita (monthly) income of the people in India, we will have to enumerate all the earning individuals in the country, which is rather a very difficult task.

If the population is infinite, complete enumeration is not possible. Also if the units are destroyed in the course of inspection (e.g. inspection of crackers, explosive materials, etc.), 100% inspection, though possible, is not at all desirable. But even if the population is finite or the inspection is not destructive, 100% inspection is not taken recourse to because of multiplicity of causes,

viz., administrative and financial implications, time factor, etc. and we take the help of sampling. A finite subset of statistical individuals in a population is called a sample and the number of individuals in a sample is called the sample size.

For the purpose of determining population characteristics, instead of enumerating the entire population, the individuals in the sample only are observed. Then the sample characteristics are utilised to approximately determine or estimate the population. For example, on examining the sample of a particular stuff, we arrive at a decision of purchasing or rejecting that stuff. The error involved in such approximation is known as sampling error and is inherent and unavoidable in any and every sampling scheme. But sampling results in considerable gains, especially in time and cost not only in respect to making observations of characteristics but also in the subsequent handling of the data.

Sampling is quite often used in our day-to-day practical life. For example, in a shop we assess the quality of sugar, wheat or any other commodity by taking a handful of it from the bag and then decide to purchase it or not. A housewife normally tests the cooked products to find if they are properly cooked and contain the proper quantity of salt, etc.

Q. 4 What are the essentials of sampling ?

Ans. If the sample results are to have any worthwhile meaning, it is necessary that a sample possesses the following essentials : -

(i) **Representativeness** : A sample should be so selected that it truly represents the universe otherwise the results obtained may be misleading. To ensure representativeness, the random method of selection should be used.

(ii) **Adequacy** : The size of sample should be adequate, otherwise it may not represent the characteristics of the universe.

(iii) **Independence** : All items of the sample should be selected

Q. 5 Describe simple random sampling with and without replacement. Under which conditions will you recommend SRSWOR ?

Ans. Simple random sampling : It is a procedure of drawing a sample in which each element of population has equal chance of being included in the sample. If population consists of N elements, then probability of selecting any element at any drawn is $\frac{1}{N}$. This is the easiest and the most commonly used method of sampling. There are two types of simple random sampling. In one of them, the units are drawn one by one, without replacement and in the other, units are drawn with replacement. Accordingly the procedures are known as simple random sampling without replacement and simple random sampling with replacement.

(i) Simple random sampling with replacement (SRSWR) : In this method, first element is selected at random from the population. It is recorded or studied completely and then replaced back in the population. Afterwards second element is selected similarly. This process is continued till a sample of required size is selected. In this method, population size remains the same at every draw. Due to replacement, it is quite likely that the same unit may be included more than once in the sample. This procedure is very rarely used in practice.

(ii) Simple random sampling without replacement (SRSWOR) : It is the method of sampling in which elements in the population are drawn one by one in such a way that every unit in the population has equal chance of being drawn in first draw and in subsequent draws every element has equal chance of being drawn in the sample among the available units in the population. In this method of sampling, the elements are selected at random but those are not replaced back in the population. Hence the same element is not included in the sample more than once. In this method population size goes on decreasing at each draw. This method of sampling is most commonly used.

SRSWOR is more suitable for drawing a representative sample when the population is more or less homogeneous. It should not be used directly for those populations which have significant variability among the units in the population. It is certainly a useful procedure for finite populations and large populations whose elements are concentrated in a small area.

drawback - it may not be proper representative when population is heterogeneous.

Illustrations : (i) Testing human blood by taking few drops out a individual's body, is a SRSWOR. (ii) In order to conduct a socio-economic survey of a certain village, the procedure of SRSWOR is useful to find per capita income of a village. (iii) To find diameter of a rod, generally we take readings at few points on a rod and then find the average of readings. These readings form a SRSWOR. This is practised for physical measurements. (iv) Suppose a lot of 500 articles is submitted for inspection. To determine the proportion of defective articles one can use SRSWOR.

Q. 6 Explain the procedure of stratified random sampling. Mention some real life situations in which stratified sampling is suitable. *it is most suitable for administrative point of view.*

Ans. When population is not homogeneous, simple random sampling method is not very effective. When population is heterogeneous in nature, it is divided into number of homogeneous groups, usually termed as strata, which differ from one another but each of these groups is homogeneous within itself. Then units are sampled at random from each of these stratum. The sample size in each stratum varies according to the relative importance of the stratum in the population. The sample, which is the aggregate of the sampled units of each of the stratum, is termed as stratified sample and the technique of drawing this sample is known as stratified sampling. Such a sample is by far the best and can safely be considered as representative of the population from which it has been drawn. Stratified sampling is found to be a more efficient and widely used procedure of drawing a random sample.

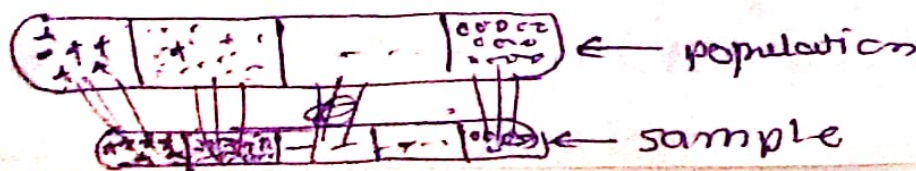
The situations where stratified sampling is used are described below :

✓(i) To conduct health survey in a college, we can use stratified random sampling by considering strata as the faculties or classes or sex, etc.

✓(ii) To estimate the proportion of defective articles in a manufacturing process, the stratified random sampling method is used by taking strata as production in the different shifts.

(iii) To estimate the total power consumption in an industrial belt, the industrial units can be stratified into strata of small scale industries and large scale industries.

(iv) To estimate crop yield we can divide the field under cultivation in plots, which are equally fertile considered as strata.



inferior - lower status or less than

Q. 7 Explain the method of systematic sampling.

Ans. Systematic sampling : A systematic sample is formed by selecting one unit at random and then selecting additional units at evenly spaced intervals until the sample has been formed. This method is popularly used in those cases where a complete list of the population from which sample is to be drawn is available. The list may be prepared in alphabetical, geographical, numerical or some other order. The items are serially numbered. The first item is selected at random generally by following the lottery method. Subsequent items are selected by taking every k^{th} item from the list where 'k' refers to the sampling interval or sampling ratio i.e. the ratio of population size to the size of the sample.

$$\text{Symbolically, } k = \frac{N}{n}$$

where k is sampling interval, N is Universe size and n is sample size.

While calculating k , it is possible that we get a fractional value. In such a case we should use approximation procedure, i.e. if the fraction is less than 0.5, it should be omitted and if it is more than 0.5, it should be taken as 1. If it is exactly 0.5, it should be omitted if the number is even and should be taken as 1, if the number is odd.

(Systematic sampling is relatively a simple technique and may be more efficient statistically than simple random sampling provided the lists are arranged wholly at random. However, it is rarely that this requirement is fulfilled. The nearest approach to randomness is provided by alphabetical lists such as are found in telephone directory although even these may have certain non-random characteristics.

Q. 8 What are the merits and limitations of stratified random sampling ?

Ans. Merits of stratified random sampling :

(i) **More representative :** Since the population is first divided into various strata and then a sample is drawn from each stratum, there is a little possibility of any essential group of the population being completely excluded. A more representative sample is thus secured.

(ii) **Greater accuracy :** Stratified sampling ensures greater accuracy. The accuracy is maximum if each stratum is so formed that it consists of uniform or homogeneous items.

(iii) **Greater geographical concentration** : As compared with random sample, stratified samples can be more concentrated geographically, i.e. the units from the different strata may be selected in such a way that all of them are localised in one geographical area. This would greatly reduce the time and expenses of interviewing.

Limitations of stratified sampling :

(i) Utmost care must be exercised in dividing the population into various strata. Each stratum must contain, as far as possible, homogeneous items as otherwise the results may not be reliable. If proper stratification of the population is not done, the sample may have the effect of bias.

(ii) The items from each stratum should be selected at random. But this may be difficult to achieve in the absence of skilled sampling supervisors and a random selection within each stratum may not be ensured.

(iii) Because of the likelihood that a stratified sample will be more widely distributed geographically than a simple random sample cost per observation may be quite high.

Q. 9 What are the merits and limitations of systematic sampling ?

Ans. Merits of systematic sampling :

(i) It is simple and convenient to adopt.

(ii) The time and work involved in sampling by this method are relatively less.

(iii) The results obtained are found to be generally satisfactory provided care is taken to see that there are no periodic features associated with the sampling interval.

Limitations of systematic sampling

(i) This method becomes less representative if we are dealing with populations having " hidden periodicities ". For example, suppose sales during a year are available. If we take sales of every seventh day in a sample, then sample may contain all Sundays, on which sales might be high.

Q. 10 Write a note on Census method.

Ans. Census method : It is a method of data collection. In complete enumeration survey (census) method, data are collected for each and every unit (person, shop, household, factory, field, etc.) of the population or universe which is the complete set of items which are of interest in any particular situation. For example, if the average wage of workers working in sugar industry in India is to be calculated, then wage figures would be obtained from each and every worker working in the sugar industry and by dividing the total wage which all these workers receive by the number of workers working in sugar industry, we would get the figure of average wage.

Merits of census method : (i) Data are obtained from each and every unit of the population. (ii) The results obtained are likely to be more representative, accurate and reliable. (iii) It is an appropriate method of obtaining information on rare events such as areas under some crops and yield thereof. (iv) Data of complete enumeration census can be widely used as a basis for various surveys.

Limitations of census method : The effort, money and time required for carrying out complete enumeration will generally be very large and in many cases cost may be so prohibitive that the very idea of collecting information may have to be dropped. This is more true of underdeveloped countries where resources constitute a big constraint. Also if population is infinite or the evaluation process destroys the population unit, the method cannot be adopted.

Q. 11 Explain the term "Sampling". What are the merits and limitations of sampling ?

Ans. Sampling is simply the process of learning about the population on the basis of a sample drawn from it. Thus, in the sampling technique, instead of every unit of the universe, only a part of the universe is studied and the conclusions are drawn on that basis for the entire universe. A sample is a subset of population units. The process of sampling involves three elements : - (i) Selecting the sample, (ii) collecting the information and (iii) making an inference about the population. These three elements cannot be considered in isolation from one another. Sample selection, data collection and estimation are all interwoven and each has an impact on the others.

A sample is not studied for its own sake. The basic objective of its study is to draw inference about the population. In other words,

sampling is a tool which helps to know the characteristics of the universe or population by examining only a small part of it.

Merits of Sampling :

(i) Since sampling is a study of a part of the population, considerable time and labour are saved when a sample survey is carried out. Due to sampling, time is saved not only in collecting data but also in processing it. For these reasons, sampling provides more timely data in practice.

(ii) In sampling we study only a part of population. So the total expense of collecting data is less than that required when the census method is adopted.

(iii) The results obtained in sampling are more reliable, because more effective precautions can be taken in a sample survey to ensure that information is accurate and complete.

(iv) Since sampling technique saves time and money, it is possible to collect more detailed information in a sample survey.

(v) Sampling method is the only method that can be used in certain cases. For example, if the producer wants to find out whether the tensile strength of a lot of steel wires meets the specified standard, he must resort to sample method, because census would mean complete destruction of all the wires. Also if the population under investigation is infinite, sampling is the only possible solution.

Limitations of sampling :

(i) A sample survey must be carefully planned and executed otherwise the results obtained may be inaccurate and misleading. It sampling procedure is not perfect, serious errors may arise in sampling.

(ii) Sampling generally requires the services of experts, if only for consultation purposes. In the absence of qualified and experienced persons, the information obtained from sample surveys cannot be relied upon.

(iii) If the size of the sample is a large proportion of the total population and if complicated weighted procedures are used, then sampling requires more time, labour and money than a complete count.

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