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Census Investigation

Census method is that method of statistical enumeration where all members or elements of the population are studied. Census investigation process in which information is collected from each and every individual of the population. A population refers to the set of all observations under concern. For example, if you want to carry out a survey to find out student's feedback about the facilities of your school, all the students of your school would form a part of the 'population' for your study. At a more realistic level, a country wants to maintain information and records about all households. It can collect this information by surveying all households in the country using the census method. In our country, the Government conducts the Census of India every ten years. The Census appropriates information from households regarding their incomes, the earning members, the total number of children, members of the family, etc. This method must take into account all the units. I cannot leave out anyone in collecting data. Once collected, the Census of India reveals demographic structure such as birth rates, death rates, total population, Population growth rate of our country, etc. The last census was conducted in the year 2011 All items in any field of inquiry constitute a universe or population. A complete enumeration of all items in the population is known as 'Census Inquiry'. It can be presumed that in such an inquiry, when all the items are covered, no element of chance is left and highest accuracy is obtained. But in practice this may not be true even the slightest element of bias in such an inquiry will get larger and larger as the number of observations increase. Census type of inquiry involves a great deal of time, money and energy. When field of inquiry is large this method becomes difficult to adopt because of the resources involved. Moreover, this method is practically beyond the reach of ordinary researchers. Further it is not possible to examine every item in the population sometimes and it is not possible to obtain sufficiently accurate results by studying only a part of total population. When the field of studies or the universe is a small one, it is no use in resorting to a sample survey. When the field studies are undertaken in practical life, considerations of time and cost almost invariably lead to a selection of respondents i.e.. a selection of only a few items. Therefore, sampling investigation is preferred

Advantages of Census Method

1. **Accuracy and Reliability:** Census method ensures higher degree of accuracy than other techniques. It provides complete information because each and every item is investigated carefully. So, it is very reliable method of data collection.
2. **Suitability:** This method is effective if the universe is small.
3. **Intensive Study:** Census method completely examines each unit and gathers important data for intensive study.
4. **Indispensable:** Census method is indispensable in certain cases where other methods cannot provide reliable and accurate result.

5. **Heterogeneous Units:** Census method is applicable to examine heterogeneous units

Disadvantages of Census Method

1. **Costly Method:** It is very costly method of data collection
2. **Time Consuming**: It consumes more time and labor to complete data collecting task
3. **Unsuitability**. This method is not applicable or suitable if the universe is large. It is suitable only for small universe.
4. **Chance of Errors:** There is a high chance of statistical errors in this method.

Sample

A sample is a smaller representation of a large unit or value. In other words a sample is that part of the universe or population which we select for the purpose of investigation. In the ordinary course we make judgment and take decisions on the basis of samples.

For example, When we go to a shop, we examine a handful of rice to find the quality of rice in the whole bug. A doctor examines only a few drops of blood to draw conclusions about the blood group, possible in order to produce a miniature cross section. The selected respondents constitute is called "Sampling Technique".

Similarly when field studies are undertaken in practical life, considerations of time and costs almost invariably lead to a selection of respondents ie., a selection of only a few items from the population. The The respondents selected should be a representative of the total population as
what is technically called a sample and the selection The survey so conducted is called as Sample Survey process

Characteristics of a good sample

i.   A good sample must be representative of the universe. It should contain majority of the characteristics of the universe, if not all. In other words, a good sample should posses all the basic characteristics of the universe.
ii.   A good sample is that it is free from bias. Bias may be in the selection of the sample for reasons like convenience, substitution, mistake in the adoption of sampling method and failure to cover the whole of the chosen sample.
iii.   The third essential of a good sample is its adequacy. Adequacy in the sense that the sampling size must be adequate to yield reasonable conclusions regarding the population from the sample drawn.
iv.   The sample must enable the measures of sampling error in fact the representativeness of the sample and the validity of conclusions depend to a large extent on these errors even if a proper selection is employed, a sample may not be exactly representative of the population owing to sampling errors. As such the

researcher must be in a position to estimate the influences of these errors and declare to the readers the percentage of accuracy of his survey results.

v.   Finally, the results of a good sample should be applicable to all items of the universe with a reasonable level of confidence. Unless the sample has this characteristic there is no use in conducting a research study.

The advantages of sampling over Census Investigation in statistics.

a. In any sampling method we consider only a small part of the entire population available and hence it requires less time, money and manpower. Complete enumeration on the other hand, of course require all these factors in large quantities and therefore this method is more expensive.

b. While adopting sampling technique a few selected and sufficiently trained efficient investigators on that field are engaged who can success collect the required information from the large population through fully collected a well-designed and quite comprehensive questionnaire prepared earlier following the cross-checking" method. Naturally, the data so obtained are much dependable for the researchers and for other users also. Complete enumeration can never produce such data within that limited

time and monetary expenses. As far as errors in both the methods are concerned. the sampling technique usually contains sampling errors to a small extent. For the

c. complete enumeration procedure, instead of sampling errors, non- sampling errors are much predominant here and it thus affects the results of the required investigation much significantly and drastically. d. Because of the above advantages of sampling over complete enumeration, sampling techniques are much more popular and widely used in different disciplines today. However, for a particular population where the units contained in are completely different in their own characteristics, the complete enumeration procedure will give us better results. Sampling Investigation Sampling is a statistical procedure that is concerned with the selection of the individual observation; it helps us to make statistical inferences about the population.

The methodology used to sample from a larger population depends on the type of analysis being performed but may include simple random sampling or systematic

Sampling Steps in Sampling or Sampling Process:

- Define the population and determine the sampling unit: The population is the aggregate of all the elements to be studied. When the number of unit belonging to a

particular universe is certain, it is called 'Finite Universe for example, Number of workers in a factory, area of a town etc. When the number of unit cannot be ascertained, it is called as 'Infinite Universe'. Example: number of leaves of the tree, listeners of a specific radio program etc.

- Identify the Sample frame or Source list: It is a list which contains the names of the unit of the population universe.
- Determine the Sample Size: It refers to the number of items to be selected from the universe to constitute a sample. The size of the sample shall be optimum while fulfil the requirements of efficiency, representativeness, reliability and flexibility. The size the sample depends upon a number of factors like: Homogeneity and heterogeneity of the universe: If the items in the universe are homogeneous, a small sample is required and vice-versa.
- Number of classes: If many classes or groups are to be framed, then a large sample is required so that every class must be of proper size for statistical analysis for his study.
- Finally, the researcher must decide the type of sample he will use i.e. he must decide about the techniques to be used in selecting the items for the sample. There are several samples designs out of which the researcher must choose the best one fit.

Advantages of sampling

Sampling ensures convenience, collection of intensive and exhaustive data, suitability in limited resources and better rapport. In addition to this, sampling has the following advantages also.

1. Low cost of sampling: If data were to be collected for the entire population, the cost will be quite high. A sample is a small proportion of a population. So, When the size of population or universe is 5 very large, sampling technique is best suited for the collection of data as it economizes money, time and effort.

2. Less time consuming in sampling: Use of sampling takes less time also. It consumes less time than census technique. Tabulation, analysis etc., take much less time in the case of a sample than in the case of a population.

3. Scope of sampling is high: Investigator is concerned with the generalization of data. To study a whole population in order to arrive at generalizations would be impractical. Some populations are so large that their characteristics could not be measured. Before the measurement has been completed, the population would have changed. But the process of sampling makes it possible to arrive at generalizations by studying the variables within a relatively small proportion of the population.

4. Accuracy of data is high: Having drawn a sample and computed the desired descriptive statistics, it is possible to determine the stability of the obtained sample value. A sample represents the population from which it is drawn. It permits a high degree of accuracy due to a limited area of operations. Moreover, careful execution of field work is possible. Ultimately, the results of sampling studies turn out to be sufficiently accurate.

5. Organization of convenience: Organizational problems involved in sampling are very few. Since sample is of a small size, vast facilities are not required, Sampling is therefore

economical in respect of resources. Study of samples involves less space and equipment. 6. Feasible for homogenous population: In sample studies, measurements or observations are made of a limited number: So, intensive and exhaustive data are collected. When the item of population is more homogeneous in nature, sampling technique is more feasible and useful. method may be unsuitable. There will be chances of errors even if samples are drawn most carefully.

Laws of Sampling

There are two fundamental laws of statistics namely, Law of Statistical Regularity and Law of Inertia of Large Numbers. These laws are very important when an investigator adopts sampling method in an enquiry. In fact, in sampling investigation, the study of only few selected items is made and on the basis of their results, researcher makes estimation about the characteristics of the whole universe. Hence, it becomes very essential to select an adequate size of sample and true representative too, so that the results of the sample can be close to that of universe as much as possible. These statistical laws are based on this fundamental needs of the sampling technique.

1. The Law of Statistical Regularity: This law was derived from mathematical theory of probability. This law refers to the selection of the items for a sample with this assumption that if moderately large number of items of the universe are chosen at random, the probability of
these items to have the characteristics of the universe is fairly high. According to this principle, when a large number of items are selected at random from the universe, then it is likely to possess the same characteristics as that the entire population. This principle asserts that the sample selection is random. i.e. every item has an equal and likely chance of being selected. It is believed that sample selected randomly and not deliberately acts as a true representative of the population. Thus, this principle is characterized by the large sample size and the random selection of a representative sample. to possess the characteristics of the large group". In other words, this law points out that if a sample is taken at random from a population, it is likely to possess almost the
In the words of King: "the law of statistical regularity lays down that a moderately large number of items chosen at random from a large group are almost sure on the average same characteristics as that of the population.
According to Wheldom, "The Law of Statistical Regularity states that a reasonably large number of items selected at random from a large group of items will on the average, be representative of the characteristics of the large group or population".

In fact, various statistical measures like average, dispersion, index numbers, correlation etc. are mostly calculated from a sample and then generalization pertaining to these characteristics can be correctly made if the observations (items) are large. For example, if a study is to be made about annual family income of workers in sugar industry of U.P., the researcher cannot collect the information about each of the employees in all the firms. Rather he will select, say 500 workers out of total 20000 workers. If these 500 workers are selected at random and their average annual income is calculated this figure would be almost same as the average income of entire population. A life insurance company forecasts

the likely member of deaths of insured persons in a year but it cannot predict who will be casualty particularly in a year.

This law holds good subject to following:
(a) Selection of items out of the parent population is random
(b) The number of items in the sample should be reasonably large so as to avoid sampling fluctuation.
(c) Sampling results will be true on an average over a long period of time.

2. The Law of Inertia of Large Numbers: This law is a corollary to the Law of Statistical Regularity. The law depicts that the large numbers or aggregates remain more stable than small ones. The principle of Inertia of large numbers states that the larger the size of the sample, the more accurate the conclusion is likely to be. This principle is based on the notion, that large numbers are more stable in their characteristics than the small numbers, and the variation in the aggregate of large numbers is insignificant. It does not mean that there is no variation in the large numbers, there is, but is less than in the smaller numbers. Thus, both the principles talk increases, accuracy and reliability of the results will also increase proportionately. The reason
about the sample size the larger it is, the larger is the accuracy of the results obtained, In other words the law states. Other things remaining the same as the sample size behind this fact is that in large numbers, the chances of compensatory actions are greater. In a larger group the data would move in both the directions and extreme observations in one side get compensated by the extreme ones in opposite direction.
For example, if we select only wo students in a class of total their intelligence level, it is very unlikely to get the correct information because these two students may be either very much intelligent or very poor. However, if six, eight or more students are selected for this purpose, it is quite possible to have the 100 students for knowing students of different levels in the sample.

Sampling Techniques

There are a number of sampling techniques which are grouped into two main categories

Sampling Types

Random Sampling or Probability Sampling

Non-Random Sampling or Probability Sampling.
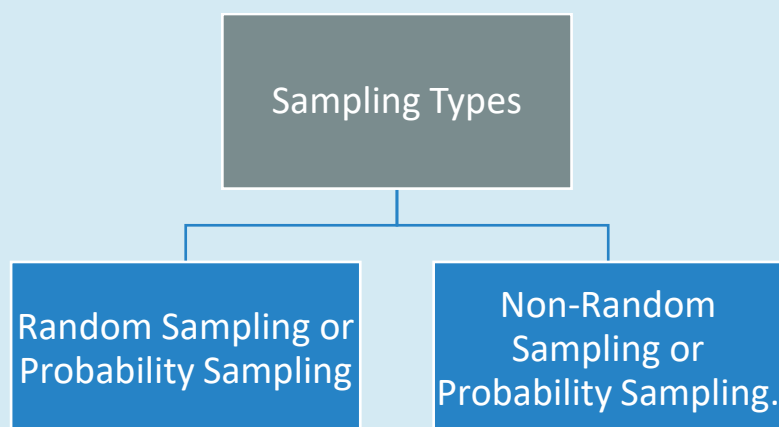
The difference lies between the above two is whether the sample selection is based on randomization or not. With randomization, every element gets equal chance to be picked up and to be part of sample for study.

I. Random Sampling or Probability Sampling or chance Sampling

This Sampling technique uses randomization to make sure that every element of the population gets an equal chance to be part of the selected sample. According to Parten- "Random Sampling is the form applied when the method of selection assures each individuals or elements in the universe an equal chance of being chosen." the main types of Random Sampling are as follows: 1. Simple

1.Random Sampling

Simple random sampling also referred to as random sampling. It is the purest and the most important probability sampling strategy. It is also the most popular method for choosing a sample among population for a wide range of purposes. In simple random sampling each member of population is equally likely to be chosen as part of the sample. It has been stated that the logic behind simple random sampling is that it removes bias from the selection procedure and should result in representative samples" Ideally, the sample size of more than a few hundred is required in order to be able to apply simple random sampling in an appropriate manner. It can be argued that simple random sampling is easy to understand in theory, but difficult to perform in practice. This is because working with a large sample size is not easy and it can be a challenge to get a realistic sampling frame. It is used when we don't have any kind of prior information about the target population. For example: Random selection of 30 students from class of 60 students. Each student has equal chance of getting selected. Here probability of selection is 1/60. There are three popular methods of random selection that are aimed to minimize the relevance of bias in the process of random sampling selection. These methods are lottery Method, use of random numbers and by Rotating the drum method.

A. Lottery Method: The method of lottery is the most primitive and mechanical example of random sampling. In this method you will have to number each member of pieces of population in a consequent manner, writing numbers in separate paper. These pieces of papers are to be folded and mixed into a box. Lastly, samples are to be taken randomly from the box by choosing folded pieces of papers in a random manner. For the reliability of this method it is necessary that all slips should be homogenous in color, size and shape. The slips should be thoroughly shuffled before selection of units of sample. The selection of drawing slips should be done by unbiased person,

B. Random numbers: Random number tables have been used in statistics for tasks such as selected random samples. This was much more effective than manually selecting the random samples (with dice, cards, etc.). Nowadays, tables of random numbers have been replaced by computational random number generation.

2. Stratified Sampling

This technique divides the elements of the population into small subgroups (strata) based on the similarity in such a way that the elements within the group are homogeneous and heterogeneous among the other subgroups formed. Then the elements are randomly

selected from each of these strata. We need to have prior information about the population to subgroups. if selection in each stratum is done random then the process called stratified random sampling.

3. Cluster Sampling

Our entire population is divided into clusters or sections and then the clusters are randomly selected. All the elements of the cluster are used for sampling. Clusters are identified using details such as age, sex, location etc. Cluster sampling can be done by Single Stage Cluster Sampling in which entire cluster is selected randomly for sampling. The cluster sampling method must not be confused with stratified sampling. In stratified sampling, the population is divided into the mutually exclusive groups that are externally heterogeneous but internally homogeneous. For example, in stratified sampling, a researcher may divide the population into two groups: males vs. females. Conversely, in cluster sampling, the clusters are similar to each other but with different internal composition. There are primarily two methods of sampling the elements in the cluster sampling method: one stage and two-stage. In one-stage (cluster) sampling, all elements in each selected cluster are sampled. On the contrary, in two-stage (cluster) sampling, simple random sampling is applied within each cluster to select a subsample of elements in each cluster

4. Systematic Random Sampling

The selection of elements is systematic and not random except the first element. Elements of a sample are chosen at regular intervals of population. All the elements are put together in a sequence first where each element has the equal chance of being selected. a sampling technique in which sampling units are arranged in some systematic order, according to magnitude, geographical area, alphabetical etc. only the first unit of the sample is selected at random and thereafter rest of the units are automatically selected at equally spaced intervals. is called systematic sampling. For example, the researcher has a population total of 100 individuals and need 12 subjects. He first picks his starting number, 5. Then the researcher picks his interval.

5. Multi-Stage Sampling:

It is the combination of one or more methods described above. Population is divided into multiple clusters and then these clusters are further divided and grouped into various sub groups (strata) based on similarity. One or more clusters can be randomly selected from each stratum. in other words. A sample is taken of the large units at the first stage and from those selected a further sample is taken at the second stage and so on. For example country can be divided into states, cities, urban and rural and all the areas with similar characteristics can be merged together to form a strata.

II. Non-Probability Sampling or Non-Random Sampling

In non-probability sampling, the cases are selected on bases of availability and interviewer judgment. Non-probability sampling has its strength in the area of convenience. This technique is more reliant on the researcher's ability to select elements for a sample. Outcome of sampling might be biased and makes difficult for all the elements of population to be part of the sample equally. This type of sampling is also known as non-random

sampling. The various methods of non-random sampling are Purposive Sampling or deliberate sampling, Quota Sampling, Convenience Sampling and extensive sampling.

Purposive Sampling or deliberate Sampling

This is based on the intention or the purpose of study. This method of sampling is also known as subjective or judgment sampling method. Accordingly, investigator himself purposively chooses certain items which to his judgment are best representatives of the universe. Here the selection is deliberate and based on own idea of the investigator about the sample units. As such under this method, the chance of inclusion of some items in the sample very high while that of others is very low. However, for better selection of items under this method certain criteria of selection is first laid down and then the investigator is allowed to make the selection of the items of his own accord within the orbit of those criteria. The relative advantages and disadvantages of this method can be outlined as under: entering into the sample per chance. (ii) Intensive study: It ensures intensive study of the selected items. (iv) Accurate Results: It gives better results if the investigator is unbiased and has the capacity of keen observation and sound judgment.

Quota Sampling

This type of sampling depends of some pre-set standard. It selects the representative sample from the population. Proportion of characteristics/trait in sample should be same as population. Elements are selected until exact proportions of certain types of data is obtained or sufficient data in different categories is collected. Quota sampling combines the features of purposive sampling and stratified sampling. Under quota sampling. the field workers include only those units which conform to certain specified parameters in the sample: Each field worker is assigned quotas of number of units to include according to one or more characteristics. In order to increase the representativeness of a quota sample, the field worker may be instructed to contact every fourth house and interview one person till the quota is fulfilled. For example: If our population has 45% females and 55% males then our sample should reflect the same percentage of males and females.

❖ Extensive sampling

Extensive Sampling is less or more resemble to census method which the entire universe is studied and no unit is left out expect the irrelevant items. Suppose if we study the opinion of south Korea educated person about the future family system, we dropped out the non-south Korean and uneducated from our sampling and will interview the rest individuals.

❖ Snowball Sampling

It is also known as Chain sampling, referral sampling, cold calling etc. It's a type of non-probability sampling where researcher himself does not selects all elements to be included in a sample. Here the sample group is said to grow like a rolling snowball. It is basically useful where either there is no information about the subjects or elements of the study