Statistical Inference: A Fulcrum in Research Methodology

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Introduction

The fundamental step of all types of researches is collection and analysis of the data about a particular topic of interest from various units of the population or all the units of the population. The raw data collected by the researcher using the survey method or through the use of administered data forms the basis of drawing inferences and making judgements about the population characteristics on certain parameters.

Before preceding towards the understanding of the Descriptive or Inferential Statistics, it is important to have a clear understanding of the thin line of difference between Data, Information and Statistics.
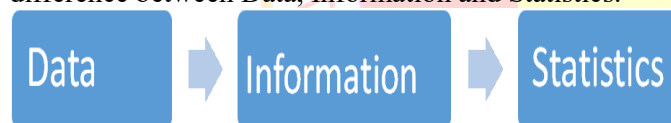
Data: The raw data or the raw facts and figures from which the conclusions can be made is termed as Data.
Information: One the data is collected, it is recorded, classified, organized and processed within a framework to derive some knowledge and is termed as Information.
Statistics: The numerical information obtained through the mathematical operations on the numerical data is known as Statistics.
Following table defines the difference between Data, Information and Statistics

Data	Information	Statistics
20 kg, 25 kg	5 individuals in 20-35 kg range	Mean weight =22.5 kg
28 kg, 30 kg etc.	15 individuals in 26-30 range	Median weight= 28kg

The statistical data may be presented either through table or graph. Central tendency and Dispersion are the two vital parameters frequently used in statistical analysis and drawing conclusions.

Statistical Inference:

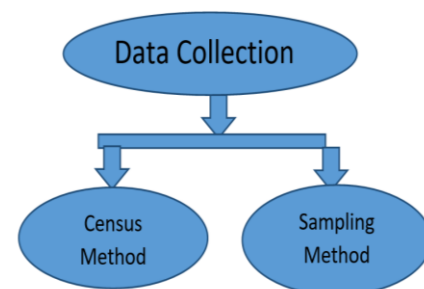The term statistical inference is concerned with drawing inference about the population on the basis of the data collected through the survey method. The most common method of data collecting is Sampling wherein an attempt is made to study the characteristics of a large population on the basis of the data collected through the samples collected from the population.
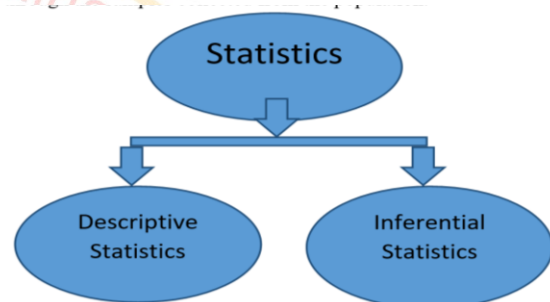
Descriptive Statistics involves arranging, summarising and prsenting set of data in such a way that a meaningful data can be produced and interpreted. Inferential Statistics on the other hand refers to the drawing of generalisations about the entire population from the sample drawn from it. The foundation of the inferential statistics is on the assumption that a sample is a true representative of the entire population and the characteristics exhibited by the sample are the characteristics of the population too.

Sampling as a tool for Data Collection and Interpretation:

The quality of a research depends on the selection of appropriate method of data collection. The researcher has to decide about the method of data collection depending on the nature of the research. There are basically 2 methods of data collection:

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Under Census method , the data about each and every element of the population is collected and analysed for the purpose of the study. The data collection about the population of the country is the best example of the Census Method.

Under Sampling method, only a part of the population is approached for the purpose of data collection and analysis. The sample is considered to be a representative of the entire population and the results exhibited by the analysis of the sample is considered to be results of the population itself.

The main aim of the reseracher is always to get the best information about all the elements of the population of the topic chosen for study but due to several reasins the Census method of Data Collection is not feasible all times.

There are various reasons due to which sample method is preferred over the Census Method:

➤ Cost Involved
➤ Speed
➤ Time Boundaries
➤ Very large Population Size
➤ Greater Scope
➤ Less Work

The process of selecting a small sample from a large size of the population is known as Sampling.The basic idea of the statistic is to extrapolate from the data collected to make general conclusions about the larger population from which the sample has been derived.Samples are the subsets of the population and are therefore always lesses in size as compared to the population.

Types of Sampling

The Sampling methods are classified into the following categories, among which the best method is chosen by the researcher according to the requirements of the study aand objectives of the research set at the onset.
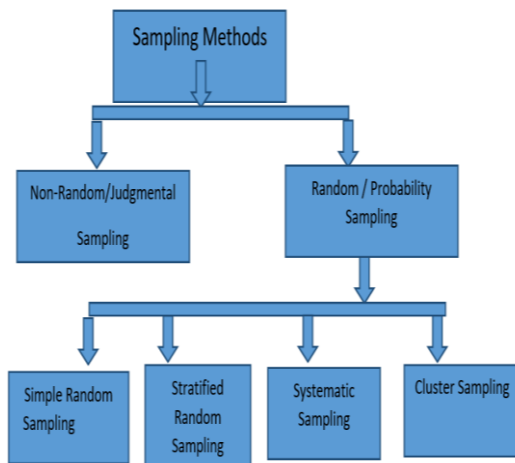
Non Random Sampling:

Non random sampling is also known as Judgemental Sampling. Under this sampling technique , the data for the purpose of analysis is collected from the samples chosen as per the convinience of the researcher.It aviods statistical anlaysis that is necessary to make probability samples. Proper care must be exercised to make the sample representative of the entire population.

For example, if a researcher is doing job satisfaction survey of the employees of the Indian Post Payment Bank, the researcher collects the data from his/ her friends/ relatives working in IPPB.Thus the sample consists of only those persons who are convineiently appraoched by the researcher.

Random Sampling:

Random Sampling is also known as Probability Sampling. Under this sampling method, each and every element of the population has equal chance of being included in the sample. It is a widely used method sampling and is percieved to be more accurate as compared to Non random Sampling method.

Simple Random Sampling.

The Simple Random Sampling is similar to the Lottery system. The selection of the sample is done with the help of the random numbers. Each and every element of the population has equal chance of being selected in the sample.

For example, The researcher is intersted in collecting the data about the average marks of all the students of a class of 100 students. The researcher is interested in collecting a sample of 10 students from 100 students. For the purpose, each and every student is given a unique roll no ranging from 1 to 100. Any 10 random numbers are chosen by the researcher and data is collected and anlaysed for the purpose of the study.Thus, each and every student of the class has equal probability of being selected without any discimination.

Systematic Sampling

Systematic Sampling is the most commonly used method of sampling. Under this method, sample is selcted from the population at a fixed interval. It means every Kth element of the population will be selected as a Sample for the purpose of the study.

For Example, Taking ahead the above example, in this case the researcher decide in advance a fixed interval (for example every 5th, 10th,15th, ……..) roll number will be chosen to be included in sample. All the students falling in the above interval range will be chosen and data will be analysed accordingly.

Stratified Sampling

The Stratified Sampling technique is more complex than the Systematic Sampling. Under this

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method, the entire population is divided into the homogenous mutually exclusive groups termed as Strata. The criteris for calssification is decided in advance. It may range from geographic location, size or demographic location etc. After the fromation of stratas, the elements are selected at random basis from each and every stratas based on predetermined criterias.

For example, The reseracher is interseted in collecting the data about the safety assumptions of the residents of a selected colony in Chandigarh. The total no of elements decided to be included in Sample is 30. For the purpose, the researcher firstly classifies the residents of the society into males, Females and Children, Each of them form a different stratas.The researcher decides to chose 10 elements from each stratas. Thus every element of the strata has equal chance of being selected.

The selection of the sample element from the strata can also be done using Systematic sampling.The researcher may also decide that every 5th element of the each strata will be included in the sample.

Cluster Sampling:

Under Cluster Sampling Method, The sample is chosen from the population by dividing the population into groups or clusters. The Cluster sampling method though appears to be similar to Stratified Sampling method, but it is quite different.Under the Stratified Sampling, the elements of the Stratas are homogenous whereas the Elements in the Clusters are not homogenous but representative of the population.

For example, the above example continues, the researcher forms the clusters of the families of the residents of the society. The family consits of males, females and Children collectively. The data choses the entire cluster as a sample for the purpose of the study. Thus instead of segregating the residents on the basis of demographic characteristics, the entire family is chosen as a cluster.

Statistical Error

Estimation done on the basis of the sample or population sometimes lead to error. These errors may be due to the error in collection process or in process of analysis of the data . For the purpose of research work analysis and interpretation, it is also important for the resercher to hav complete knowledge of the Statistical Errors.
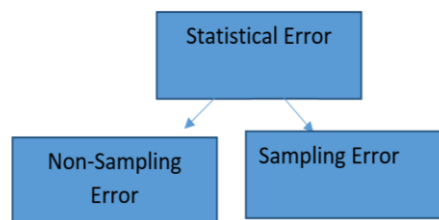
Non-Sampling Error:

Non-Sampling error occurs at the time of collection, editing and is common to both sampling and census method. For example, missing some people or double counting others, respondents giving wrong answers or not answering the questions. Such errors are not confined to sampling methods only but can occurs in Census method of data collection too.

Sampling error:

Sampling error is the difference between the value of the sample statistics and the value of the corresponding population parameter. This error occurs because of chance. Normally sampling error occurs at the time of collecting samples. There might be the chances that the sample is not the true representative of the characteristics of the population.

Estimation

The main aim of the sampling is to make the estimation of the characteristics of the entire population based on the characteristics exhibited by the samples chosen from the population. The value assigned to the population parameter based on sample is known as Estimation.

This estimation is basically of 2 types:
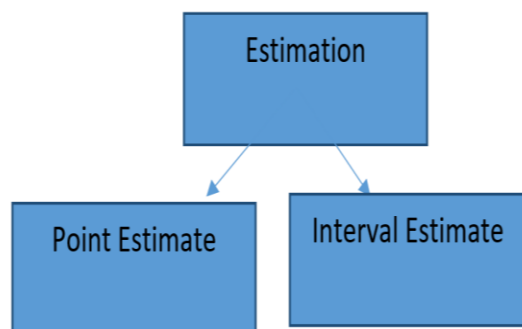
Point Estimate: Point Estimate is a single number that estimates the exact value of the population parameter. It assigns a single value to the population parameter instead of providing an interval. The sample variance can be used as a point estimator of the population variance and the sample standard deviation is the point estimate of the population standard deviation.

Interval Estimate: To overcome the problems associated with the Point Estimation, the Interval

Estimation is used by the researcher, which gives more clear idea about the characteristics of the population. An Interval Estimate is the range of values within which the actual value of the population parameter may fall. A confidence level is estimated which is an interval estimate for which there is a specified degree of confidence that the actual value of the population parameter will fall within this interval.

Summary

The thrust of the entire research process is based on the quality of the data collected and analysed. Before selecting the statistical methods to be applied to infer about any phenomenon, it is important to collect the data in an effective and efficient manner. Depending on the requirements of the research work, the method of data collection (either the Census or Sample Method) should be decided. Various methods of sampling such as the Random, Systematic, Stratified or cluster should be kept in mind while making a choice of the best sampling method. The important point to be considered in Sampling is that the efforts should be made to select an appropriate sample that exhibits the maximum characteristics of the population. The application of the Statistical tools on the sample statistics may provide a point estimate or interval estimate depending on the requirement of the research. The Statistical errors should also be given due consideration by the researcher.

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