1. **What is Statistics and its relationship with other disciplines. Difference between Descriptive and Inferential Statistics.**

Statistics is the discipline that concerns the collection, organization, analysis, interpretation, and presentation of data. [1]

Statistics can be used in different fields such as [2]:

1. **Economy:** Any part of Economics cannot proceed without Statistics. May it be demand, supply, wages, interest, prices, profits, rents savings, investments, unemployment etc. Index Numbers and various laws such as law of consumption, of returns or distribution of incomes and profits are often used in Economics for the measurement of correlation, analyzing demand and supply, forecasting through regression, interpolation and time series analysis.
2. **Planning:** Planning is mainly a part of Economics. To go for an economic plan in a country, the data about population, consumption, prices, investments, saving, incomes and expenditure has to be known and then analyzed for demand forecasting using various statistical methods. A plan cannot be successful if its analysis is not undertaken properly, also since adequacy of data cannot be proved without Statistics.
3. **Business and Commerce**: These are the activities such as, trading, manufacturing, banking, transportation, mining, insurance or such other activities, those are undertaken for making profits. Statistics helps us to great extent in planning, analyzing and executing the plans. To analyze the plans, we have to use methods of statistics such as probability or forecasting by regression, time series or interpolation and Economic barometers (Index numbers).
4. **State Administration**: Various department of a government use Statistics for their benefits and proper success of the departments held.
5. **Physical and Natural Sciences:** In physical and natural sciences like Physics, Chemistry, Engineering, Botany, Astronomy, Zoology and Medicine etc. the Statistics is of immense importance these days.
6. **Social Sciences:** Statistics has made much impact on Social Sciences and is of immense use in these also. These include subjects like History, Political Science, Education, Psychology, Sociology and Logic etc. Even in Mathematics, many theories have been drawn from statistics.

Moreover, it exists two branches of Statistics for understanding and drawing meaningful conclusions from data which are [3]:

1. **Descriptive Statistics:** Descriptive statistics is a term given to the analysis of data that helps to describe, show and summarize data in a meaningful way. It is a simple way to describe our data and it is very important to present our raw data in effective/meaningful way using numerical calculations or graphs or tables. This type of statistics is applied to already known data.
2. **Inferential Statistics:** In inferential statistics, predictions are made by taking any group of data in which you are interested. It can be defined as a random sample of data taken from a population to describe and make inferences about the population. Any group of data that includes all the data you are interested in is known as population. It basically allows you to make predictions by taking a small sample instead of working on the whole population.

Differences between these two branches are:

* + - Descriptive Statistics gives information about raw data which describes the data in some manner, meanwhile Inferential Statistics makes inferences about the population using data drawn from the population;
    - Descriptive Statistics helps in organizing, analyzing, and to present data in a meaningful manner, meanwhile Inferential Statistics allows us to compare data, and make hypotheses and predictions;
    - Descriptive Statistics is used to describe a situation, instead Inferential Statistics allows us to compare data, and make hypotheses and predictions;
    - Descriptive Statistics is used to describe a situation, meanwhile Inferential Statistics is used to explain the chance of occurrence of an event.

1. **Describe the concepts of Population, Sample Attribute, Variable, Level of measurement and Dataset.**
   1. **Population [4]:** In statistics, a population is a set of similar items or events which is of interest for some question or experiment. A statistical population can be a group of existing objects or a hypothetical and potentially infinite group of objects conceived as a generalization from experience. A common aim of statistical analysis is to produce information about some chosen population.
   2. **Sample [5]:** A sample refers to a smaller, manageable version of a larger group. It is a subset containing the characteristics of a larger population. Samples are used in statistical testing when population sizes are too large for the test to include all possible members or observations. A sample should represent the population as a whole and not reflect any bias toward a specific attribute.
   3. **Attribute [6]:** An attribute refers to the quality of a characteristic. The theory of attributes deals with qualitative types of characteristics that are calculated by using quantitative measurements. So, attributes refer to the characteristics of the item under study.
   4. **Variable [7]:** In statistical research, a variable is defined as an attribute of an object of study. Choosing which variables to measure is central to good experimental design. Variables are generally divided into two categories
      1. **Quantitative variables:** When you collect quantitative data, the numbers you record represent real amounts that can be added, subtracted, divided, etc. There are two types of quantitative variables:
         1. **Discrete variables (or integer variables):** Counts of individual items or values;
         2. **Continuous variables (or ratio variables):** Measurements of continuous or non-finite values.
      2. **Categorical variables:** Represent groupings of some kind. They are sometimes recorded as numbers, but the numbers represent categories rather than actual amounts of things. There are three types of categorical variables:
         1. **Binary (or dichotomous variables):** Yes or no outcomes;
         2. **Nominal:** Groups with no rank or order between them;
         3. **Ordinal:** Groups that are ranked in a specific order.

* **Level of measurement [8]:** Level of measurement, also known as scale of measurement, refers to the process of categorizing data based on the characteristics and properties of the data. It is important in Statistics because it helps determine the appropriate statistical methods and tests that can be used to analyze the data. There are four levels of measurement (or scales) to be aware of: nominal, ordinal, interval, and ratio. Each scale builds upon the last, meaning that each scale not only “ticks the same boxes” as the previous scale, but also adds another level of precision.
  1. **Nominal scale:** Categorizes variables according to qualitative labels (or names). These labels and groupings don’t have any order or hierarchy to them, nor do they convey any numerical value.
  2. **Ordinal scale:** Categorizes variables into labeled groups, and these categories have an order or hierarchy to them.
  3. **Interval scale:** Is a numerical scale which labels and orders variables, with a known, evenly spaced interval between each of the values.
  4. **Ratio scale:** Is exactly the same as the interval scale, with one key difference: The ratio scale has what’s known as a “true zero”.
* **Dataset [9]:** A data set (or dataset) is a collection of data. In the case of tabular data, a data set corresponds to one or more database tables, where every column of a table represents a particular variable, and each row corresponds to a given record of the data set in question.

1. **Briefly describe the main sampling methods**

When you conduct research about a group of people, it’s rarely possible to collect data from every person in that group. Instead, you select a sample, which is the group of individuals who will actually participate in the research. To draw valid conclusions from your results, you have to carefully decide how you will select a sample that is representative of the group as a whole. This is called a sampling method.

There are two primary types of sampling methods that you can use in your research:

* 1. **Probability sampling:** involves random selection, allowing you to make strong statistical inferences about the whole group. Probability sampling means that every member of the population has a chance of being selected. It is mainly used in quantitative research and it is used to produce results that are representative of the whole population. There are four main types of probability sample:
     1. **Simple random sampling:** every member of the population has an equal chance of being selected. To conduct this type of sampling, you can use tools like random number generators or other techniques that are based entirely on chance.
     2. **Systematic sampling:** Is similar to simple random sampling, but it is usually slightly easier to conduct. Every member of the population is listed with a number, but instead of randomly generating numbers, individuals are chosen at regular sampling;
     3. **Stratified sampling:** Involves dividing the population into subpopulations (called strata) based on the relevant characteristic;
     4. **Cluster sampling:** involves dividing the population into subgroups, but each subgroup should have similar characteristics to the whole sample. Instead of sampling also individuals from each subgroup, you randomly select entire subgroups.
  2. **Non-probability sampling:** Involves non-random selection based on convenience or other criteria, allowing you to easily collect data. In a non-probability sample, individuals are selected based on non-random criteria, and not every individual has a chance of being included. Non-probability sampling techniques are often used in exploratory and qualitative research, in which the aim is to develop an initial understanding of a small or under-researched population. There are five types of non-probability sampling:
     1. **Convenience sampling:** Includes the individuals who happen to be most accessible to the researcher;
     2. **Voluntary response sampling:** Similar to a convenience sample, a voluntary response sample is mainly based on ease of access. Instead of the researcher choosing participants and directly contacting them, people volunteer themselves;
     3. **Purposive sampling:** This type of sampling, also known as judgement sampling, involves the researcher using their expertise to select a sample that is most useful to the purposes of the research.
     4. **Snowball sampling:** If the population is hard to access, snowball sampling can be used to recruit participants via other participants;
     5. **Quota sampling:** Relies on the non-random selection of a predetermined number or proportion of units.

1. **Briefly describe the main experiment designs**

In Statistics, the experimental design or the design of experiment (DOE) is defined as the design of an information-gathering experiment in which a variation is present or not, and it should be performed under the full control of the researcher. This term is generally used for controlled experiments. These experiments minimize the effects of the variable to increase the reliability of the results. [11]

There are different types of experimental designs of research. They are:

* 1. **Pre-experimental Research Design:** In this method, a group or various groups are kept under observation, after some factors are recognized for the cause and effect. This method is usually conducted in order to understand whether further investigations are needed for the targeted group. This method is classified into three types, namely:
     1. Static Group Comparison
     2. One-group Pretest-posttest Experimental Research Design
     3. One-shot Case Study Experimental Research Design
  2. **True-experimental Research Design**: This is the most accurate form of experimental research design as it relies on the statistical hypothesis to prove or disprove the hypothesis. It is the only method that establishes the cause and effect relationship within the groups. The factors which need to be satisfied in this method are:
     1. Random variable
     2. Variable can be manipulated by the researcher
     3. Control Groups (A group of participants are familiar with the experimental group, but the experimental rules do not apply to them)
     4. Experimental Group (Research participants where experimental rules are applied)
  3. **Quasi-Experimental Research Design:** Is similar to a true experimental design, but there is a difference between the two. In a true experiment design, the participants of the group are randomly assigned. So, every unit has an equal chance of getting into the experimental group. Instead, in a quasi-experimental design, the participants of the groups are not randomly assigned. So, the researcher cannot make a cause or effect conclusion. Thus, it is not possible to assign the participants to the group.

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