STATISTICS IN EDUCATION

Concept of Statistics, Stages of statistical study, Tools and Scope of Statistics

What is Statistics?

Even to a layman this should not be a difficult question. If asked to define Statistics, we can expect a layman to say that Statistics is something like a store of quantitative information. Yes, it is true. Statistics means quantitative information or quantification of the facts and findings. But, how do we get quantitative information? There must be a system, method or technique to collect quantitative information. Also, statistical information may be a raw information. It needs to be classified, tabulated or it needs to be systematically presented. One must learn the system of presentation and classification of data. Also, there must be a set of methods and techniques to condense the data. May be, we find averages or percentages. And above all, there must be a set of methods or techniques on the analysis and interpretation of quantitative information. A student of Economics has to study all these methods and techniques to understand and master the subject matter of Statistics.

Thus, unlike a layman, a student of Economics cannot relax taking Statistics just as a pool of quantitative information. Instead he is also to look into the methods or techniques relating to its collection, classification, presentation, analysis as well as interpretation.

In view of such a vastness of the subject matter, Statistics is defined both in singular sense and plural sense, as under:

STATISTICS- A PLURAL NOUN

In its plural sense, Statistics refers to information in terms of numbers or numerical data, such as Population Statistics, Employment Statistics, Statistics concerning Public Expenditure, etc. However, any numerical information is not Statistics. Example: Ram gets ? 100 per month as pocket allowance is not Statistics (it is neither an aggregate nor an average) whereas average pocket allowance of the students of Class X is ? 100 per month, or there are 80 students in Class XI compared to just 8 in Class XII of your school are Statistics.

The following table shows a set of data which is Statistics, and another set which is not Statistics. The figures used are hypothetical.

Data which are not Statistics	Data which are Statistics
(i) A cow has 4 legs.	(i) Average height of the 26-plus male people in India is 6 feet compared to 5 feet in Nepal.
(ii) Ram has 200 rupees in his pocket.	(ii) Birth rate in India is 18 per thousand compared to 8 per thousand in USA.
(iii) A young lady was run over by a speeding truck at 100 km per hour.	(iii) Over the past 10 years, India has won 60 test matches in cricket and lost 50.

Thus: All Statistics are data, but all data are not Statistics.

Definition In its plural sense, this is how Statistics is defined by different authors:

"Statistics are numerical statements of facts in any department of enquiry placed in relation to each other. " -Bowley

"By Statistics we mam quantitative data affected to a marked extent by multiplicity of causes." -Yule and Kendall

Features or Characteristics of Statistics in the Plural Sense or as Numerical Data

Main characteristics of Statistics in terms of numerical data are as follows:

(1) Aggregate of Facts: A single number does not constitute Statistics. No conclusion can be drawn from it. It is only the aggregate number of facts that is called Statistics, as the same can be compared and conclusions can be drawn from them. For example, if it is stated that there are 1,000 students in our college, then it has no statistical significance. But if it is stated that there are 300 students in arts faculty, 400 in commerce faculty and 300 in science faculty in our college, it makes statistical sense as this data conveys statistical information. Similarly, if it is stated that population of India is 121 crore or that the value of total exports from India is ? 18,49,429 crore, then these aggregate of facts will be termed as Statistics. It can, therefore, be concluded 'All Statistics are expressed in numbers but all numbers are not Statistics'.

(2) Numerically Expressed: Statistics are expressed in terms of numbers. Qualitative aspects like 'small' or 'big'; 'rich' or 'poor'; etc. are not called Statistics. For instance, to say, Irfan Pathan is tall and Sachin is short, has no statistical sense. However, if it is stated that height of Irfan Pathan is 6 ft and 2-inches and that of Sachin is 5 ft and 4-inches, then these numerical will be called Statistics.

(3) Affected by Multiplicity of Causes: Statistics are not affected by any single factor; but are influenced by many factors. Had they been affected by one factor alone then by removing that factor they would lose all their significance. For instance, 30 per cent rise in prices may have been due to several causes, like reduction in supply, increase in demand, shortage of power, rise in wages, rise in taxes, etc.

(4) Reasonable Accuracy: A reasonable degree of accuracy must be kept in view while collecting statistical data. This accuracy depends on the purpose of investigation, its nature, size and available resources.

(5) Placed in Relation to each other: Such numerical alone will be called Statistics as are mutually related and so comparable. Unless they have the quality of comparison they cannot be called Statistics.

For example, if it is stated "Ram is 40 years old, Mohan is 5 ft tall, Sohan has 60 kg of weight", then these numbers will not be called Statistics, as they are not mutually related nor subject to comparison. However, if the age, height and weight of all the three are inter. related, then the same will be considered as Statistics.

(6) Pre-determined Purpose: Statistics are collected with some pre. determined objective. Any information collected without any definite purpose will only be a numerical value and not Statistics. If data pertaining to the farmers of a village is collected, there must be some pre-determined objective. Whether the Statistics are collected for the purpose of knowing their economic position, or distribution of land among them or their total population, or for any other purpose, all these objectives must be pre-determined.

(7) Enumerated or Estimated: Statistics may be collected by enumeration or the same be estimated. If the field of investigation is vast, the procedure of estimation may be helpful. For example, 1 lakh people attended the rally addressed by the Prime Minister in Delhi and 2 lakh in Mumbai. These Statistics are based an estimation. As against it, if the held of enquiry is limited, the enumeration method is appropriate. For example, it can be verified by enumeration whether 20 students are present in the class or 10 workers are Working in the factory.

(8) Collected in a Systematic Manner: Statistics should be collected in a systematic manner. Before collecting them, a plan must be prepared. No conclusion can be drawn from Statistics collected in haphazard manner. For instance, data regarding the marks secured by the students of a college without any reference to the class, subject, examination or maximum marks, etc., will lead to no conclusion.

In short, it can safely be concluded that "all numerical (cannot be called Statistics but all statistics are called numerical data."

STATISTICS- A SINGULAR NOUN

In the singular sense, Statistics means science of Statistics or statistical methods. It refers to techniques or methods relating to collection, classification, presentation, analysis and interpretation of quantitative data.

Definition:

"Statistics may be defined as the collection, presentation, analysis and interpretation of numerical data." -Croxton and Cowden

"Statistics is the science which deals with the collection, classification and tabulation of numerical facts as a basis for the explanation, description and comparison of phenomena." --Lovitt

"Statistics is the science which deals with the methods of collecting, classifying, presenting, comparing and interpreting numerical data collected to throw some light of any sphere of enquiry. " -Seligman

STAGES of STATISTICAL STUDY

Studying Statistics as a singular noun implies the knowledge of various stages of statistical study. These stages are:
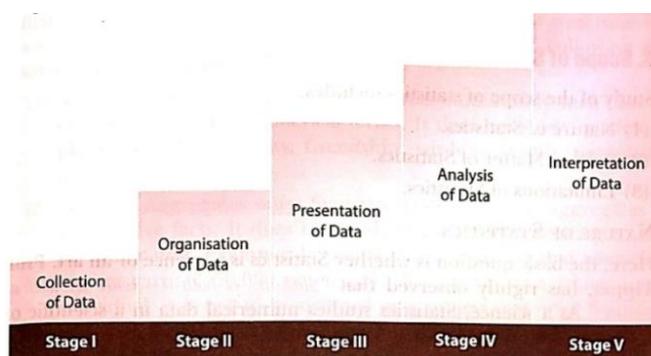
Obviously, at the first stage, we collect statistical data. Second, we organise the data in some systematic order. Third, we present the data in the form of graphs, diagrams or tables. Fourth, we analyse the data in terms of averages or percentages. Fifth, and finally, we interpret the data to find certain conclusions.

STATISTICAL TOOLS

Each stage of the statistical study involves the use of certain standard techniques or methods. These techniques or methods are called statistical tools. Thus, there are statistical tools used for the collection of data, like the 'Sample' and 'Census' techniques. Array of data and tally bars are the standard techniques used for organisation of data. Tables, graphs and diagrams are the well-known statistical tools for the presentation of data.

Stages of Statistical Study and the Related Statistical Tools

Stages	Statistical Study	Statistical Tools
Stage I	Collection of Data	Census or Sample Techniques
Stage II	Organisation of Data	Array of Data and Tally Bars
Stage III	Presentation of Data	Tables, Graphs and Diagrams
Stage IV	Analysis of Data	Percentages, Averages, Correlation and Regression Coefficients
Stage V	Interpretation of Data	Magnitude of Percentages, Averages and the Degree of Relationship between different economic variables

Averages and percentages are the commonly used techniques for the analysis of data. Interpretation of data is often done in terms of the magnitude of averages, percentages or coefficient of correlation/ regression. The following table gives an overall view of the various stages of statistical study and the related sets of statistical tools.

Scope of Statistics

Study of the scope of statistics includes:

(1) Nature of Statistics.

(2) Subject Matter of Statistics.

(3) Limitations of Statistics.

NATURE OF STATISTICS

Here, the basic question is whether Statistics is a science or an art. Prof. Tippet, has rightly observed that "Statistics is both a science as well an arts". As a science, Statistics studies numerical data in a scientific or systematic manner. As an art, Statistics relates to quantitative data to the real life problems. By using statistical data, we are able to analyse an understand real life problems much better than otherwise. Thus, the problem of unemployment in India is more meaningfully analysed when the size of unemployment is supported with quantitative data.

SUBJECT MATTER 0F STATISTICS

Subject matter of statistics includes two components: Descriptive Statistics and Inferential Statistics.

Descriptive Statistics: Descriptive Statistics refers to those method which are used for the collection, presentation as well as analysis I, data. These methods relate to such estimations as measurement; central tendencies, (average mean, median, mode), 'measurement of dispersion' (mean deviation, standard deviation, etc.), 'measurement of correlation', etc. Example: Descriptive statistics is used when you estimate average height of the secondary students in your school Likewise, descriptive statistics is used when you find that marks ' science and mathematics of the students in all classes are intimately related to each other.

Inferential Statistics: Inferential Statistics refers to all such methods by which conclusions are drawn relating to the universe or population on the basis of a given sample. (In Statistics, the term universe or population refers to the aggregate of all items or unit relating to any subject. For example, if your class teacher estimates average weight of the entire class (called universe or population) 0 the basis of average weight of only a sample of students of the class he is using inferential statistics.

LIMITATIONS of STATISTICS

In modern times, Statistics has emerged to be of crucial significance in all walks oflife. However, it has certain limitations. Thus, writes Newsome that, "Statistics must be regarded as an instrument of research of great value but barring severe limitations which are not possible to overcome." Following are some notable limitations of Statistics;

(1) Study of Numerical Facts only: Statistics studies only such facts as can be expressed in numerical terms. It does not study qualitative phenomena like honesty, friendship, wisdom, health, patriotism, JUSUCC, etc.

(2) Study of Aggregates only: Statistics studies only the aggregates of quantitative facts. It does not study statistical facts relating to any particular unit. Example: It may be a statistical fact that your class teacher earns ? 50,000 per month. But, as this fact relates to an individual, it is not to be deemed as a subject matter of Statistics. However, it becomes a subject matter of Statistics if we study income of school teachers across all parts of the country, for purpose of finding regional differences in income.

(3) Homogeneity of Data, an essential Requirement: To compare data, it is essential that statistics are uniform in quality. Data of diverse qualities and kinds cannot be compared. For example, production of food grains cannot be compared with the production of cloth. It is because Cloth is measured in metres and food grains in tonnes. Nevertheless, it is possible to compare their value instead of the volume.

(4) Results are True only on an Average: Most statistical findings are true only as averages. They express only the broad tendencies. Unlike the laws of natural sciences, statistical observations are not error-free. They are not always valid under all conditions, For instance, if it is said that per capita income in India is ? 50,000 per annum, it does not mean that the income of each and every Indian is ? 50,000 per annum. Some may have more and some may have less.

(5) Without Reference, Results may Prove to be Wrong: In order to understand the conclusions precisely, it is necessary that the circumstances and conditions under which these conclusions have been drawn .are also studied. Otherwise, they may prove to be wrong.

Example: In the business of cloth, profits earned during three years may be ? 1,000, ? 2,000 and ? 3,000 respectively. On the other hand, in the paper business profits earned during the same three years may be ? 3,000, ? 2,000 and ? 1,000 respectively. Thus, the average profit in both the businesses comes to ? 2,000 per annum. It may lead to the conclusion that both the businesses have similar economic status, but it may not be true. We may actually find that whereas cloth-business is making progress, paper-business is on the decline.

(6) Can be used only by the Experts: Statistics can be used only b those persons who have special knowledge of statistical methods. Those who are ignorant about these methods cannot make sensible use of statistics. It can, therefore, be said that data in the hands of an unqualified person is like a medicine in

the hands of a quack who may abuse it, leading to disastrous consequences. In the words of Yule and Kendall, "Statistics method are most dangerous tool of the hand of an expert."

(7) Prone to Misuse: Misuse of Statistics is very common. Statistics may used to support a pre-drawn conclusion even when it is absolutely false. It is usually said, "Statistics are like clay by which you can make a god or a devil, as you please" Misuse of statistics is indeed its greatest limitation.