

---

## Lesson 1

### Statistics: Meaning, Scope, Functions and Importance

---

#### Objectives of the lesson:

To aware the students about:

- Meaning and Definition, and Characteristics of Statistics;
- Nature of Statistics;
- Scope & Types of Statistics;
- Limitations of Statistics;
- Functions of Statistics; and
- Importance of Statistics

#### **STATISTICS: MEANING AND DEFINITION, AND CHARACTERISTICS**

In olden days, statistics meant the data in relation to the activities of the state collected for official purpose; but gradually it gained broader meaning, because of its wider applicability to various problems apart from the state activity. The word statistics means the "numerical statements as well as statistical methodology".

Statistics in common parlance is used to connote the characteristics of a data set for example the GDP of a country is 9%. Data is a collection of related observations; a data set is a collection of data and data point refers to a single observation. Raw data fails to yield meaningful insights about the data, it is processed to fall "in a formation" yielding meaningful insights into data. Statistics provides the tools & methods required to collect, organize, summarize, present and analyze data. This essentially allows us to interpret data and aids in Decision making.

Different authors have defined statistics differently. The word 'Statistics' is used in two senses, viz., singular and plural. In a narrow sense and plural sense, statistics denotes some numerical data (statistical data). In a wide and singular sense statistics refers to the statistical methods. Therefore, these have been grouped under two heads: "Statistics as data" and "Statistics as method".

**Statistics as Data:**

"Statistics are numerical statement of facts in any department of enquiry placed in relation to each other". (Bowley)

"By statistics we mean quantitative data affected to a marked extent by multiplicity of cause". (Yule and Kendall)

"By statistics we mean aggregates of facts affected to a marked extent by multiplicity of causes, numerically expressed, enumerated or estimated according to reasonable standard of accuracy, collected in a systematic manner for a predetermined purpose and placed in relation to each other." (H. Secrist)

The definition given by Secrist is quite comprehensive and exhaustive. It throws more light on the characteristics of statistics and covers different aspects as well. Accordingly, statistics possesses following characteristics:

1. Statistics are aggregate of facts: This means that a single or isolated fact, though numerically stated, cannot be called as statistics. Statistics deals with groups, but not individual items.
2. Statistics are affected to a marked extent by a multiplicity of causes: Quantitative data or statistical data are influenced by a number of factors. Though, in physical sciences; it is possible to isolate the effect of various factors on an item, because the effect of one cannot be measured numerically. But, in Social sciences, e.g. economics, history, sociology, etc., a variable is affected by many factors. For instance, the fall in sales of a commodity is affected by a number of factors like; supply, demand, market conditions, general recession in trade, storage facility, currency circulation, import, export, competition in market, consumer taste, etc.
3. Statistics are numerically expressed: We know that numerical data alone constitute statistics. The qualitative data e.g. honesty, beauty, intelligence, etc., which cannot be measured numerically are not statistics. However, if they are expressed by giving certain scores (marks) as numerical standards; they can be called as statistics.

4. Statistics should be enumerated or estimated: The numerical data pertaining to any field of enquiry can be obtained either by enumeration (by actual counting) or by estimation. If the field of enquiry is not large, enumeration (actual counting) can be conducted. If the field of enquiry is wide and large; enumeration is out of question, and in such cases, data can be estimated.
5. Statistics should be collected with reasonable standard of accuracy: A reasonable standard of accuracy is needed in both enumeration and estimation. For instance, if the weights of students are being measured, fractions of kilogram (say  $1/10^{\text{th}}$  or  $1/20^{\text{th}}$ ) can be ignored.
6. Statistics should be collected in a systematic manner for a pre-determined purpose: The data should be collected in a systematic manner through some suitable plan. If not, there will be waste of time, energy and money. The purpose of data collection must be decided in advance, and the investigator must be aware of the purpose. If the object is not known to the investigator, it is possible that he may collect unnecessary data, which may not be of any use while ignoring necessary data. Thus, without a pre-determined purpose, the collected data may not yield the desired results.
7. Statistics should be placed in relation to each other: Statistical data are mostly collected for the purpose of comparison. In order to make valid comparison, the data should be homogeneous, i.e., they should relate to the same phenomenon or subject.

**Statistics as Method:**

In view of AL Bowley, "Statistics may be called the science of counting." He also stated that "Statistics may rightly be called the science of averages." Further, "Statistics is the science of the measurement of social organism as a whole in all its manifestation."  
(AL Bowley)

"Statistics is a body of methods for making decisions in the face of uncertainty". (Wallis and Roberst)

"Statistics may be defined as the collection, presentation analysis and interpretation of numerical data." (Croxtton & Cowden)

Croxton and Cowden have given a simple definition of statistics. This definition is clear and concise. The data are collected to study a particular problem. The collected data in mass may be converted in the form of diagrams, graphs etc. According to this definition, there are four stages: Collection of data, Presentation of data, Analysis of data and interpretation of data. However, one more stage may be added and that is the organization of data. There can be five stages of statistical methods; viz. Collection of data, Organization of data, Presentation of data, Analysis of data, and Interpretation of data.

### **NATURE OF STATISTICS**

Statistical methods are inductive in nature, because generalizations result from individual observation. Generalizations made after a statistical investigation show that they are true on the average. They do not describe the behavior of individuals but show typical behavior of all the items. There is greater stability in masses than individual items. The statistical generalizations provide estimates of the characteristic behavior of populations but not of individual person.

**Purpose:** The real purpose of statistical methods is to make sense out of facts and figures, to prove the unknown, and to cast light upon the situation. The ultimate end of statistical research is to enable comparison to be made between past and present results with a view to ascertaining the reasons for changes which have taken place and the effects of such changes on the future. The statistical methods are employed as a tool for comparison between past and present events to throw light on the reasons to changes, effects of changes and plans for future. That is, statistics is viewed not only as a mere device for collecting numerical data but as a means of sound techniques for their handling, analyzing and drawing valid inferences from them. This is so because statistics helps in drawing conclusions from facts affected by a multiplicity of causes in any department of enquiry.

**Statistics as Science:** Before analyzing this It is very important to understand as to what is a science.

Science is basically "accumulated and accepted knowledge that has been systematized and formulated with reference to the discovery of general truth or operation of general

law". In other words, science is a body of systematized knowledge. Any branch of knowledge can be called a science if it possesses the following characteristics:

- Laws of science should be based on cause and effect relationship.
- Its knowledge should be systematic and its methods should be logical.
- Being a systematized body of knowledge based on certain principles, science is capable of general application.
- Its laws should be capable of forecasting the future of action of a phenomenon.
- Its principles and laws have a high degree of precision.

Characteristics of a science are the observation of certain facts, the selection and classification of relevant material, and the using of these as a basis for generalization. Then it becomes possible to formulate laws which are universally true under specified conditions and which can be applied to the analysis of new situations. Science is an organized theoretical knowledge, empirically derived, critically tested and generalized into laws, principles and theories. Keeping in view the above characteristics, we find that all of them are present in statistics.

It is said that "Science without statistics bears no fruit; statistics without science has no root". All the concepts of science are formulated, tested or modified with the help of statistics. It explains the facts. As a science, the statistical method is a part of the general scientific method and is based on the same fundamental ideas and processes.

**Statistics as Art:** Art is defined as "skill, dexterity, or the power of performing certain actions, acquired by experience, study or observation". Art has following characteristics:

- Art does not describe facts, but, examines merits and demerits and tells the way to achieve the desired result.
- Art is a system or rules for the attainment of a given end.
- Art teaches us how to do things.
- Art is a practical application of a set of rules or principles to practice.
- As other social sciences, it deals with human beings. The behavior of human beings cannot be measured accurately as those of sciences.

Statistics possesses all these important characteristics and so it may be concluded that it is an art. By science we can know a thing; by art we can do that thing. Statistics is regarded as an art of applying the science of scientific method. Statistics as an art, gives us solutions of various problems with the help of index numbers, central tendencies etc. Art helps us with ways and means of handling data to draw proper conclusions. On these bases, statistics can be regarded as an art. Thus, statistics is both science and art.

### SCOPE AND TYPES OF STATISTICS

Population or a universe refers to the whole & a sample refers to a part of that whole or universe. Data collected by observing all units comprising the universe is termed as a Census.

Statistics is broadly classified in two categories: (i) Descriptive statistics, and (ii) Inferential statistics.

**Descriptive statistics:** Descriptive statistics includes statistical methods that facilitate decision making under conditions of uncertainty; Statistical methods refer to methods used to analyze, interpret & draw inference from statistical Data and aid in Decision-making. Statistical methods have applications in all fields' viz. business, economics, biology, medicine, agriculture, psychology, engineering and education. The aspects covered in descriptive statistics are detailed below.

1. Collection of data: The first step of an investigation is the collection of data. Careful collection is needed, because further analysis is based on this. There are different methods of collection of data (census, sampling, primary, secondary etc.) and they must be reliable. If the collected data are faulty, results will also be faulty. Therefore, the investigator must take special care in collection.
2. Organization of data: A large mass of figures that are collected from a survey frequently needs organization. The collected data must be edited very carefully so that the omissions, inconsistencies, irrelevant answers and wrong computations in the returns from a survey may be corrected or adjusted. After the data have been edited the next step is to classify them. The task of the

statistician is the organization of the figures in such a form that their significance, for the purpose in hand, may be appreciated, that comparison with masses of similar data may be facilitated, and that further analysis may be possible. This is done through classification and tabulation. Classification refers to the determination of various class, categories or group heads in which the whole data shall be distributed and tabulation refers to actual sorting and placing of the data in well-designed and systematic tables according to a given mode of classification.

3. **Presentation of data:** The collected data are generally in an unintelligible form and need to be classified and tabulated before they can be analyzed. The mass data collected should be difficult to understand and analyze. Therefore, the collected data are to be presented in tabular or diagrammatic or graphic form. The data presented in a systematic order will facilitate further analysis.
4. **Analysis of data:** After the presentation of data, the next step is to analyze the presented data. Analysis includes condensation, summarization, conclusion, etc., through the means of measures of central tendencies; dispersion, skewness, kurtosis, correlation, regression, etc.
5. **Interpretation of data:** Figures do not speak for themselves. The duty of the statistician is not complete with mere collection and analysis of data. But, valid conclusions must be drawn on the basis of analysis. A high degree of skill and experience is necessary for the interpretation. Correct interpretation leads to valid conclusion.

**Inferential statistics:** Inferential statistics finds application in situations where census is not feasible owing to constraints of time & money. The Data gathered from observing a sample of the population is used to make generalizations and draw inferences about the population. Drawing Inferences about a population based on the limited values observed from a Sample carries an inherent risk of drawing wrong conclusions about the population.

Inferential Statistics provides tools for quantifying the chances of a wrong inference being drawn and be sure of the reliability of the inferences. A study of the concepts of Probability & probability distributions is made towards this end.

Descriptive Statistics & Inferential Statistics as major divisions of Statistics can also be described with the help of following table:

Divisions of Statistics	Steps Involved	Scope of Activities	
Descriptive Statistics	1. Collection	<ul style="list-style-type: none"> <li>• Collection of data relevant to the problem.</li> <li>• Design of Experiment determines the kind of Data required to be collected.</li> <li>• Methods for collection of Data for Physical &amp; Social Sciences differ.</li> <li>• Sample size determines the Quality of result.</li> </ul>	<ul style="list-style-type: none"> <li>• Highlights the Characteristics of Data</li> <li>• Facilitates Comprehension of Data.</li> <li>• Facilitates in Analysis &amp; Interpretation</li> </ul>
	2. Organization	<ul style="list-style-type: none"> <li>• Recording, Sorting &amp; Classification of Data according to Objectives.</li> </ul>	
	3. Presentation	By using <ul style="list-style-type: none"> <li>• Tables</li> <li>• Graphs</li> <li>• Diagrams</li> <li>• Figures</li> </ul>	
	4. Analysis	Using: <ul style="list-style-type: none"> <li>• Measures of Central Tendency, Dispersion, Skewness &amp; Kurtosis.</li> <li>• Statistical tools of Regression &amp; Correlation to determine the degree of relationship between two data sets.</li> <li>• Index Numbers in situations where measures of Central tendency cannot be deployed owing to the differences in units of measurement.</li> <li>• Trend determination using Time Series Analysis involving examination of past performance.</li> <li>• Forecasting using past trends.</li> </ul>	
	5. Interpretation	Drawing valid conclusions on the basis of analysis.	
Inferential/ Inductive Statistics		Consists of methods used for drawing inferences about the population based on the values observed from samples.	



## LIMITATIONS OF STATISTICS

Statistics and its technique are widely used in every branch of knowledge. But, is not a magical device that may give solutions to every problem. Thus, statistics too has its own limitations. W.I. King rightly says, "Science of statistics is the most useful servant, but only of great value to those who understand its proper use". The scope of statistics is very wide and it has great utility; but these are restricted by following limitations.

1. Statistics does not deal with individual items. It deals with groups or aggregates only. The scope of statistics lies outside the study of individual fact. The per capita income is obtained by dividing the total income by the total population. The per capita income does not reveal the poverty of individuals. King states, "Statistics from the very nature of the subject cannot and never will be able to take into account individual cases." Statistics proves inadequate, where one wants to study individual cases. Thus it fails to reveal the true position.
2. Statistics deals with quantitative data only. It is numerical statement of facts. Statistics deals with only the quantitative data. For example, per capita income, population growth, etc. can be studied, by statistics; but qualitative aspects such as honesty, intelligence, poverty, efficiency, blindness, deafness, etc., cannot be studied directly. It may be possible if they are converted into numerical facts. Some phenomenon cannot be quantitatively measured; e.g. honesty, resourcefulness, integrity, goodwill etc. If we convert this type of data into quantitative form, comparison is possible.
3. Statistics may mislead to wrong conclusion in the absence of details. If figures are given without details, we may arrive at wrong and misleading conclusions. For example, profit of two firms A and B is Rs. 50,000 and Rs. 60,000, which indicates that firm B is better than A. But, we can't say that this efficiently in the absence of relative comparable figures like, investment or sales.
4. Statistical laws are true only on averages. Statistical Methods are suitable for application in scenarios where there is no control over the variability in data. Variability in data can be controlled in the Physical sciences but no such control can be exercised on data relating to business, economics or Social Sciences.

5. Statistics does not give entire information: Statistics simplifies complicated data. Statistical methods are simply the methods used in describing volume and nature of data, and also in research. Before using the data, the background of the data may be studied. Hence, statistics should not be considered as the best attack for every problem.
6. Statistical methods aid decision making under uncertainty but do not eliminate uncertainty, hence these cannot be solely relied for deciding. Careless and inept use of statistical methods leads to misleading results.
7. Comparison becomes impossible if Statistical data are not uniform or homogeneous: Comparison is one of the important characters of statistical data. Uniform and homogeneous data can be compared. Unequal or un-comparable data will direct to wrong and misleading results.
8. Statistics is liable to be misused: Statistics is a good tool to an expert, like a sharp knife which is a good tool to a gardener; but it is a bad tool to a baby, who is likely to be hurt by it. Bowley stated "Statistics only furnishes a tool though imperfect, which is dangerous in the hands of those who do not know its use and deficiencies." Hence statisticians must know the use and limitations of statistics. Only then they can make use of it to get fruitful results and avoid dangerous, wrong and misleading results.

### **FUNCTIONS AND IMPORTANCE OF STATISTICS**

Statistics is a tool in the hands of mankind to translate complex facts into simple and understandable statements of facts. Since the end of the 19th century, the theory of statistics has improved remarkably. Due to universal applicability and use, the science of statistics has grown immeasurably. It is impossible to find any sphere of human activity, where statistics does not creep in. According to Bowley, "Knowledge of statistics is like knowledge of foreign language or of algebra: it may prove of use at any time under any circumstances." It is useful in many fields like: Planning, States' assignments and working, Economics, Business, Accounting, Finance and Auditing, Education, Astronomy, Research etc.

Statistics has universal applicability. All activities are connected with the statistical data. The functions of statistics are as follows:

1. **Statistics simplifies complexity:** Human mind cannot understand a large number of facts and figures fit anyone time. Therefore, the important function of statistical methods is to simplify the complex data into diagrammatic and graphic representation, averages and dispersion, etc. The huge masses of data can be converted into a picture, a diagram, etc., which are easier to understand. For instance, we cannot remember the individual marks scored by 50 students; but it is easy to remember the average marks of the students in a single figure, say 75%.
2. **It provides definiteness of information:** One of the important functions of statistics is to present statements in a precise and definite form. Numerically expressed conclusions are more convincing. Because of this definiteness, the application of statistical methods has been increased and has attained popularity in various sciences.
3. **It helps in comparing data:** Comparison is one of the main functions of statistics. Statistics helps in comparing the data with respect to time and location. It also helps us to compare one phenomenon with the other. People are greatly interested in relative figures rather than absolute figures. By comparison one can easily appreciate the significance of a series of figures, when compared with other figures of the same kind. The various means of comparisons are ratios, averages, rates, coefficient, etc.
4. **Statistics enlarges individual knowledge and experiences:** According to Bowley, proper function of statistics, indeed, is to enlarge individual experience. One can easily grasp ideas from a condensed form of statistics, converted from mass. For example, say that the cost of living in India has increased. To know the extent of the increase in the cost of living, we must have a clear idea about the rise in price, which affects different income groups; we must also ascertain the rise in prices of consumer goods etc. Statistics enables one to understand clear ideas.

5. Statistics helps the functioning of Government: Statistics is essential for the proper administration of a country. It provides information needed for the efficient conduct of government business. The importance of statistics in the administration of a country is greatly increased in the present times. The government uses statistics to have an understanding before implementing schemes; *e.g.*, old age pension, ration schemes, welfare schemes, etc.
6. Useful in studying relationships: The nature and extent of relationships between different data can be measured by coefficient of correlation, coefficient of association, regression etc.
7. Useful in forecasting: The statistical technique for extrapolation is highly useful for forecasting future events. It helps in forecasting the future tendency of a given phenomenon. Statistics helps in making reasonably good forecasts.
8. It is useful in formulation and testing of hypothesis: Statistical methods are helpful in formulating, testing hypothesis, and also in developing new theories. For instance, we can verify the law of supply with the help of statistics. Like that, the success or failure of new theories can be known easily with the help of statistical data. For example, statistics helps us to measure the effects of monetary controls on price level. It provides guidance in the formulation of new policies and theories at all stages and the drawing of plans in all fields. It enables to measure the results on the implementation of plans and theories and give suggestions from time to time.

### **SUMMARY**

Statistics has become an integral part of our daily lives. Every day, we are confronted with some form of statistical information through newspapers, magazines and other forms of communication. Such statistical information has become highly influential in our lives. Statistics can be considered as numerical statements of facts which are highly convenient and meaningful forms of communication. The subject of statistics is primarily concerned with making decisions about various properties of some populations of interest such as stock market trends, unemployment rates in various sectors of industries, demographic shifts, interest rates, inflation rates over the years and so on.

Statistical conclusions help us in formulating specific policies and attitudes with respect to diverse areas of interest.

Statistics is a science as well art. It deals with numbers or figures describing the state of affairs of various situations with which we are generally and specifically concerned. To a layman, it often refers to a column of figures, or perhaps tables, graphs and charts relating to areas such as population, national income, expenditures, production, consumption, supply, demand, sales, imports, exports, births, deaths, accidents, and so on. To ensure that our conclusions are meaningful, it is necessary to subject our data to scientific analyses so that rational decisions can be made. Hence, the field of statistics is concerned with proper collection of data, organizing this data into manageable and presentable form, analyzing and interpreting the data into conclusions for useful purposes. According to this definition, the area of statistics incorporates the following five elements.

Statistics is a tool in the hands of mankind to translate complex facts into simple and understandable statements of facts. Its techniques are widely used in every branch of knowledge. But, is not a magical device that may give solutions to every problem. Thus, statistics too has its own limitations.

### **REVIEW QUESTIONS**

1. What is statistics? Discuss the meaning and scope of Statistics.
2. What are the characteristics that Statistics possesses?
3. "Statistics is a science of counting." Comment and give comprehensive definition.
4. "Statistics is said to be both a science and an art." Why?
5. Explain the functions and limitations of statistics with the help of suitable examples.
6. Discuss the limitations of statistics. What are the causes of distrust of statistics?
7. What are the uses and limitations of statistics? Discuss its importance.
8. "Statistics cannot be used as a blind man uses a lamp-post for support instead of illumination". Comment.

9. "The science of statistics is the most useful servant; but only of great value to those who understand its proper use". Comment.
10. Statistics is a body of methods for making wise decisions in the face of uncertainty." Comment on the statement bringing out clearly how does statistics help in business decision-making.

#### **SUGGESTED READINGS**

- Statistical Methods: SP Gupta
- Fundamentals of Statistics: DN Elhance
- Statistics: BN Gupta
- Statistics: RP Hooda
- Fundamentals of Statistics: KN Nagar