

## Introduction

The word 'statistics' seems to have been derived from the Latin word 'Status' or Italian word 'Statista' or the German word 'Statistik' or the French word 'Statistique', each of which means a political state. It is not a new discipline, but is as old as the human society. In good old days, the term statistics was applied to a branch of statecraft—science of statecraft. As such, the term statistics was applied to mean facts and figures which were needed by the State in its day to day life. Statistics was regarded as a by-product of administrative activities of the State. Now statistics is usually not studied for its own sake (as a separate branch), but statistics is employed as a tool in solving or analysing the problems of the State.

### Origin

In ancient times the scope of statistics was primarily limited in keeping the records of the population in regard to age and sex-wise, birth, death, property, wealth, etc., of a country. This knowledge was used as a tool to know the man-power and also to fix taxes and levies. Statistics in the past was a by-product of administrative activity of the State. The State or the Government collected statistics for administrative purposes, and as such statistics was regarded as 'the Science of Kings' or 'the Science of Statecraft'. Many people contributed to the development of statistics.

Sixteenth century astronomy contributed to the growth of statistics. Tycho Brave (1554 to 1661) discovered valuable facts regarding the movements of stars and planets and compiled records to make predictions of eclipses and positions. J. Kepler made a detailed study of the information collected by Brave, analysed and thus found three laws relating to the planetary movements. These laws gave a basis to Newton for the discovery of the Law of Gravitation.

Seventeenth century Captain John Graunt of London (1620-1674) known as "the father of the vital statistics", made a systematic study of the births and deaths. During this period, Edmund Halley prepared the first life-table from the data collected by Sir William Petty (1623-1687). He also prepared mortality tables and analysed them. This led to the idea of life insurance and the first Life Insurance Institution was founded in London in 1698.



Eighteenth century, Sussimileh (1707-1767) found out the natural order of physiocratic School; i.e., "ratio of births and deaths remains constant" and gave statistical explanations to the theory. J. Bernoulli (1654-1705) discovered the law of large numbers. Laplace (1749-1827) published the monumental work on the "theory of probability" in 1782. Later on prominent mathematicians like Lagrange, Gauss, Lexis, Charlier, Quetlet and others further contributed to the theory of probability.

Francis Galton (1822-1921) pioneered the study of "Regression Analysis". S. Jevons (1835-1882) who is known as "the father of index numbers" developed the technique of analysis of time series. Karl Pearson (1857-1936) pioneered the study of Correlation Analysis. His Chi-square test of Goodness of Fit is the most important of the tests of significance in statistics. Sir Ronald A. Fisher, (1890-1962), who is called "the Father of Statistics" drew many solid conclusions from statistical data. He applied statistics to many fields—genetics, psychology, education, biometry, etc., and propounded many concepts and tests. Movo described him as "*Real giant in the development of the theory of statistics.*"

The development of modern statistics started after Industrial Revolution. A.J. Wickens said "Statistics of a sort can, of course, be traced back to ancient times, but they have flowered since the Industrial Revolution. Beginning in the 19th century, statistical records were developed to describe the society of that era, and to throw light on its economic and social problems. No doubt, they influenced the course of men's thinking then, and even in some instances, may have led to new policies and new laws, but primarily their uses were descriptive. Increasingly in the 20th century, and especially since World War I, statistics have been used to settle problems, and to determine course of action."

### **Growth**

In the present age, statistics is regarded as one of the most important tools for taking decisions. All the branches of science make use of statistics. Statistics helps in forming suitable policies, as such it is being used in all the fields. In science, statistics is freely used. In research work, it has got its own status as a tool of research. Thus in every situation there is a demand for statistics. The sampling techniques further reduce the cost of statistics. This is because by studying a part of the population, the characteristics of the whole population can be known. Thus the increasing demand and decreasing cost of statistics give way to growth.

In all the countries of ancient culture, where history has been written, proofs are available that they had a system of collection of data. Statistics is now regarded as one of the most dependable tools for taking decisions



in the midst of uncertainty. Before going into the importance and functions of statistics we have to consider two important factors which have contributed to the tremendous growth and development of statistics: (i) Increased demand for statistics and (ii) Decreasing cost of statistics.

(i) **Increased demand for Statistics:** Statistics is indispensable to any government for the efficient conduct of administration, formulation of sound policy and its effective implementation. A government also collects information which helps to evaluate the strength and weaknesses of its economy and adjust the tax structure accordingly. This was the reason for describing statistics as the "Science of Kings" or "Science of Statecraft". All branches of economics like production, consumption, exchange and distribution are described, compared and correlated with the help of statistics.

Planning and control are the twin-babies of management. Whenever we think of a plan we have to think of statistics. Planning cannot be devised without statistics. In this technically advanced and competitive world, a producer has to make a number of decisions such as what to produce, where to produce, how to produce, where to sell, at what price to sell etc. Such decisions depend upon sound forecasting and forecasting cannot be made without statistics. Prof. Marshall observed that "Statistics are the straw out of which I, like any other economist, have had to make bricks". Statistics helps in formulating suitable policies and as such its need is increasingly felt in all the fields. A businessman needs information on daily demand of the products, seasonal changes in demand, prices of competitive products etc. All these problems are resolved in the light of factual information and hence the need for statistics.

(ii) **Decreasing cost of statistics:** Statistical techniques have improved so greatly that it is not now necessary to investigate all the items in any group from which we may wish to collect information. Instead, we can carry out a survey, say, of a population, by merely investigating a fraction (= sample). Fisher sums up the advantages of sampling techniques over complete census in just four words: **Speed, Economy, Adaptability and Scientific Approach.** In a sample survey, there is reduction in the cost of collection of the information, administration, training etc. Thus the cost and the time required for the collection of data go down appreciably. Again, with the availability of electronic machines, calculators, computers etc. the cost of analysing data has considerably gone down. The theory of sampling and various designs of experiments and statistical quality control have contributed towards lowering the cost of collection and analysis of statistical data.

### Meaning

In olden days, statistics meant the data in relation to the activities of the state collected for official purposes; 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".

#### Definition

Different authors have different definitions of statistics from time to time. A definition aims at laying down the meaning, the scope and the limitations of a subject. The very aim may not be fulfilled, if there are many definitions. But to have a clear idea, one should study at least a few definitions. 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 methods".

#### Statistics as Data

Some definitions of statistics as statistical data (numerical data) are:

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

—Bowley

The above definition gives importance to numerical aspects and provides comparative study of figures.

"Classified facts respecting the conditions of the people in a State.....especially those facts which can be stated in numbers or in any other tabular or classified arrangements".

—Webster

This definition reveals that only numerical terms can be termed as statistics; non-numerical facts cannot be processed statistically. This narrows down the scope of statistics as inadequate for modern times, because he defines statistics and restricts it to the condition of the people of the state—social science. But statistics embraces all sciences—social science, natural science, etc.

"By statistics we mean quantitative data affected to a marked extent by multiplicity of cause".

—Yule and Kendall

This definition refers to numerical data affected by a multiplicity of causes. For example, the price of a commodity depends on a number of factors—supply, demand, competition in the market, circulation of money, etc. This definition is also incomplete, as it does not possess all the characteristics of statistics.

"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



This definition is quite comprehensive and exhaustive. It throws more light on the characteristics of statistics and covers different aspects as well. We adopt this definition quite safely. Thus, the definition given by Secrist makes it clear that statistics (or numerical data) should possess the 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. For instance, one accident, one birth, one death, etc., cannot be called as statistics. But the aggregate of figures relating to accidents, births, deaths, etc., over different times or places can be called statistics. This is because the study goes in relation to each other and is capable of comparison.

A single accident is not statistics. But the total number of accidents of a city during a month or a quarter or half-year is statistics. The total of accidents in the city during a month can be compared with those of the previous months to know whether the accidents have decreased or increased. This can also be compared with other cities.

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. Social sciences—economics, history, sociology, etc.—are affected by many factors. Statistics is most commonly used in social sciences. 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. One cause alone cannot be said to be responsible to given data. For instance, the fall in sales of a commodity is affected by a number of factors—supply, demand, market condition, general recession in trade, storage facility, currency circulation, import, export, competition in market, consumer taste, etc. It is not possible to single out one cause. All these factors acting jointly will determine the factors responsible for the decline of sales.

3. Statistics are numerically expressed. Numerical data alone constitute statistics. Students can be classified very good, good, average, poor, etc., on the basis of their performance in tests. But they are in qualitative expressions and are not statistics. In particular, the qualitative characteristics—honesty, beauty, intelligence, etc., which cannot be measured numerically are not statistics. If they are expressed by giving certain scores (marks) as numerical standards, then they can be called as statistics. Another example is beauty competition of girls; if ranks are assigned, then the quantitative measure of beauty of the girls can be regarded 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. For instance, in the B. Com. class there are 60 students; this is a case of enumeration. (We count the number of students). At the same time we may say that 1,00,000 people attended the Independence Day Celebration; it is a case of estimation (approximation).

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  $1/10$ th or  $1/20$ th) can be ignored; when measuring the distance from Madras to Kanyakumari, fraction of a kilometre can easily be ignored. No hard and fast rule can be laid down for all cases. Hence mathematical accuracy cannot be attained in statistical studies.

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. For instance, when we collect the income data from rich people, ignoring the poor, it will only inflate the national income data. 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. For instance, weights of the boys in a class are to be compared with the corresponding weights of boys in another class. But it would be meaningless to compare the height of the students with the height of trees.

Thus the definition of statistics given by Prof. Horace Secrist is regarded as best as it is exhaustive. It brings out all characteristics which statistical data should possess.

#### Statistics as Methods

The term statistics in this context has been defined differently by different authors. A few definitions are given below:

1. "Statistics may be called the science of counting."



It covers only one aspect, i.e., counting. But in many cases, we collect data by making estimates. The other aspects classification, tabulation, etc., have been ignored. As such, the definition is inadequate and incomplete.

2. "Statistics may rightly be called the science of averages."

– A.L. Bowley

It is no doubt that averages are widely used to summarise the collected data. The average is not the only one device. The other devices like diagram, graph, correlation coefficient, etc., have not been included. This definition is also incomplete.

3. "Statistics is the science of the measurement of social organism as a whole in all its manifestation."

– A.L. Bowley

The definition limits the scope to sociological field only – that of man and his activities and therefore the definition is inadequate.

A.L. Bowley who himself realised the limitations, remarked that "Statistics cannot be confined to any one science."

4. "Statistics is the science of estimates and probabilities."

– Boddington

This definition is narrow, as the other methods like enumeration, classification, analysis, etc., have been ignored. Therefore, this definition narrows down the scope of the science of statistics.

5. "Statistics is a body of methods for making decisions in the face of uncertainty".  
– Wallis and Robergt
6. "Statistics may be defined as the collection, presentation analysis and interpretation of numerical data."  
– Croxton & 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 organisation of data. Thus, there are five stages :

(a) **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.

(b) **Organisation of data.** A large mass of figures that are collected from a survey frequently needs organisation. 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



8

the data have been edited the next step is to classify them. The task of the statistician is the organisation 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.

(c) **Presentation of data:** The collected data are generally in an unintelligible form and need to be classified and tabulated before they can be analysed. For example, the investigator is interested to know the average income of 1000 families of a village. The mass data collected should be difficult to understand and analyse. 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.

(d) **Analysis of data.** After the presentation of data, the next step is to analyse the presented data. Analysis includes condensation, summarisation, conclusion, etc., through the means of measures of central tendencies, dispersion, skewness, kurtosis, correlation, regression, etc.

(e) **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.

Seligman's definition is also similar to that of Croxton and Cowden. He defines, "Statistics is the science which deals with the methods of collecting, classifying, presenting, comparing and interpreting numerical data collected to throw some light on any sphere of enquiry."

According to Ya-Lun-Chou, "Statistics is a method of decision-making in the face of uncertainty on the basis of numerical data and calculated risks." Thus, future course of events can be forecast through the interpretation of data. According to Wallis, "Statistics is a body of methods for making wise decisions in the face of uncertainty."

### Nature

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



## Importance, Functions, Limitations

### Importance

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, "A knowledge of statistics is like a knowledge of foreign language or of algebra : it may prove of use at any time under any circumstances." We shall discuss how it is useful in other fields.

### Statistics in States

Statistics is essential for a country. It supplies essential information to run a government. In olden days, statistics was regarded as the 'science of kings'. Different policies of government are based on statistics. Statistics is of great help in promoting human welfare. The aim of every State is to promote the welfare of the people. Before adopting any welfare scheme, the state refers to statistics for a decision. The State may accept or reject a policy on the basis of statistics. Periodical collection of data relating to population, national wealth, agriculture, exports, imports, education, crime, etc., are the main guidelines to the government for a good administration. Therefore, it is rightly said, "statistics are the eyes and ears of the State." In all the countries, the government is the single, but biggest collector and user of statistics. Moreover, all the departments of government depend upon statistics for efficient functioning. The major collectors of statistics in India are the Central Statistical Organisation, National Sample Survey Organisation, etc.

### Statistics in Economics

Statistics is an indispensable tool in all the aspects of economic study. The problems in economics cannot be studied without the use of statistics. But even to understand the problems, statistical analysis is a must. Through statistics, we are also to have a clear idea over the economic problem. Economics is a social science. One problem of economic



may be due to many reasons. Experimental method of study will not solve the problem. This is because economic problems deal with multiple causes. As such, statistical methods are much useful to study a problem. Almost all economic laws are based on the study of collected statistical data. The problems are required to be solved statistically.

Various laws of economics can be tested as to their correctness, by analysing the collected data. The laws of economics always refer to statistics, in order to prove their accuracy. The statistician has to prove to what extent the economic theories hold good in actual life. The wider use of application of economics, is not possible without the knowledge of statistics. There is no field of economics without applying the science of statistics. Marshall says, "Statistics is the straw out of which, I like every other economist, to make the bricks." The importance of statistics in economics has resulted in a new branch of study called Econometrics.

Econometrics is a relatively new branch of study developed mostly in the period after the Second World War. The increasing interaction of mathematics and statistics with economics led to the development of a new discipline called Econometrics. It is dependent upon Economic Theory, Statistical Methods and Mathematical Techniques. Econometrics aimed at making Economics a more realistic, precise, logical and practical science. Econometric models based on sound statistical analysis are used for maximum exploitation of the available resources.

### Statistics in Business

The bigger the concern, the greater is the need for statistics. In good old days, business was confined to limited units, when production was in handicraft stage. But today business people have to face cut-throat competition and similar problems. These problems will be solved through statistical analysis. To know if the losses were due to under or overstocking, untimely purchases, inexact estimates, uneconomic prices, etc., a businessman analyses the problems with the help of statistics. Statistics to a great extent helps business to make maximum profits. A trader estimates the demand of his products. He decides the quality and quantity of goods to be produced. All the activities of the business are concentrated and helped by statistics. If the estimates of demand are correct, the businessman makes good profits; if underestimated, he loses the chances of making profits; if overestimated, he finds it difficult to push the products; but simply blocks the finance in stocks. Boddington observes, "The successful businessman is the one, whose estimate most closely approaches the accuracy." Therefore by looking to the statistics of past years, he predicts a good estimate for the future.



In the words of Ya-Lin-Chou, "In business, statistics has already made radical changes in maintaining and improving output quality, in selecting and promoting personnel, in efficient use of materials, in projecting long-term capital requirements and forecasting sales, in estimating consumers' preferences, and in various other phases of business research and management. It is not an exaggeration to say that to-day nearly every decision in business is made with the aid of statistical data and statistical methods."

A promoter is greatly helped with statistics. By analysing the situations through collected statistics, the promoter decides the location of business, financial resources, marketing of the products, availability of labourers, etc. For all these activities statistics is the guide. King says, "Statistics is like clay of which you can make a God or Devil as you please." Ya-Lin-Chou says, "Statistics is a method of decision-making in the face of uncertainty on the basis of numerical data and calculated risks." Therefore careful study of statistical data and their analysis will open the doors of success in business.

### **Statistics in Astronomy**

Astronomers were the first who made recordings of the movements of heavenly bodies and studied the eclipse and astronomical issues on the basis of statistics. The astronomers relied on estimation in many cases and later on the estimation was corrected into a precise idea with the help of statistics.

### **Statistics in Education**

Statistics is widely used in education. Research has become a common feature in all branches of activities. Statistics is necessary for the formulation of policies to start new courses, consideration of facilities available for new courses, etc. There are crores of people engaged in research work to test the past knowledge and evolve new knowledge; and these are possible only through statistics.

### **Statistics in Accounting and Auditing**

To-day the science of statistics touches every subject. As such, a paper on statistics has been made compulsory in the C.A. and I.C.W.A. Examinations.

In accounting, exactness is there. For decision-making purposes, so much precision is not essential; but decision may be taken on the basis of approximation. The current assets are generally valued on the basis of current values. The correction of values of current assets is made on the basis of the purchasing power of money or the current value of it (charging depreciation); the corrected value is in keeping with the current value, through the use of price indices, which are based on the collection of statistics. A study of correlation analysis between profits and dividends will enable one to know the trend of future profits.

In auditing, sampling techniques are commonly followed. Voluminous transactions cannot be audited or examined, because of the limitation of finance, staff, etc. An auditor may look into the rate of error in the past years. He will also conduct pilot audit to find the new rate of error. On the basis of error, the auditor determines the sample size of the books to be audited.



### Statistics in Research

Statistical methods and statistical data are indispensable in research work. For instance, experiments about crop yields, crop yields on different types of fertilisers and on different types of soil etc. are studied with the help of statistics to devise ways of increasing the yield. In the field of medicine and health programme, statistical methods are used to know the effectiveness of new discovered medicines and method of treatment. Market researches extensively depend upon statistical methods in drawing conclusions. One can say with confidence that there is hardly any research finding without statistics.

### Statistics in Planning

Whenever we think of a plan, we have to think of statistics. Modern age is an age of planning. Today efficient planning is a must for almost all countries, particularly the developing economies for their economic development and in order that planning is successful, it must be based on a correct and sound analysis of complex statistical data. Various plans that have been prepared for the economic development of a country have also made use of the statistical material available about various economic problems. National Sample Survey was primarily started to collect statistical data for use in planning in India. Not only plans of economic development are constructed on the basis of statistical data but the success that a plan achieves is also measured best by the use of statistical apparatus. Even for making decisions concerning the day-to-day policy of a country, an accurate statistical knowledge of the age and sex-wise composition of the population is imperative for the government. Preparation of detailed plans without the assistance of statistics is just unthinkable.

## FUNCTIONS OF STATISTICS

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

1. **Simplifies complexity.** Human mind cannot understand a large number of facts and figures at any one 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 60 students; but it is easy to remember the average marks of the students in a single figure, say 65%.

W.I. King observes, "It is for the purpose of simplifying these unwieldy masses of facts that statistical science is useful. It reduces them to numerical totals and averages which may be abstractly handled like any other mere



numbers. It draws pictures and diagrams to illustrate general tendencies and thus in many ways adapts these groups of ideas to the capacity of our intellects."

2. **Is Definite.** 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. For instance, the production of paddy is expected to increase from 5,000 tons in 1975 to 6,000 tons in 1996. It gives a definite information.

3. **Helps to compare.** 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. Boddington says, "The object of statistics is to enable comparison to be made between the past and the present results, with a view to ascertaining the reasons for changes, which have taken place and the effect of such changes in the future." 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. For instance, the literacy rate in India stood at 36.17 in 1981 as against 29.45 in 1971.

4. **Enlarges individual experiences.** Statistics enlarges human knowledge and experience. According to Bowley, "The 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. In statistical study, vague and indefinite ideas become clear and definite. It is a master key to solve the problems of human life. It enables persons to understand and measure the actions of people.

5. **Formulates and tests hypothesis.** Statistical methods are helpful to develop new theories. It is also helpful in formulating and testing hypothesis. 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 a rise in interest rate on savings and investment. 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.



6. Tests the laws of other sciences. Statistics helps in testing the laws of physical sciences and social sciences. A law, before its truthfulness is tested and made acceptable through statistical proofs. The correctness of laws of different categories can only be tested with help of statistical techniques.

7. Foresees future courses. 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. Studies relationship. The extent of relationships between different data can be measured. Coefficient of correlation, coefficient of association, regression, etc., are the measures through which we measure the functional relationship. Demand and supply relationship, price and production relationship, income and consumption relationship, etc., can easily be studied with the help of statistics.

9. Helps the Government. Statistics has been termed as the beginning as the science of kings. Statistics is essential for the proper administration of a country. It provides pieces of 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. The use of statistical data and statistical techniques is so wide that almost all ministries and departments have separate statistical units. Thus there is a great need of statistics in the affairs of the State.

### LIMITATIONS OF STATISTICS

As a developing science, statistics and its technique are widely used in every branch of knowledge. Statistics is not a magical device, which gives solutions to problems. Educated and uneducated, rich and poor people are making use of statistics in their day to day life. But it 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 its limitations. Following are the important limitations of statistics:

1. Statistics does not deal with individual items. Statistics 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. Statistics 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. According to Prof. Horace Secrist, "Some phenomenon cannot be quantitatively measured; honesty, resourcefulness, integrity, goodwill, all important in industry as well as in life, are generally not susceptible to direct statistical measurement." If we convert the qualitative data into quantitative data, comparison is possible. For example, the intelligence of a student can be measured by his rank or marks scored.

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, two businessmen X and Y have an average profit of Rs. 1,200 per month during three months. We can say that they are equally efficient, because they are making the same average profits. Their profits are as follows :—

|              | X                        | Y                         |
|--------------|--------------------------|---------------------------|
| First month, | Rs. 800                  | Rs. 1,800                 |
| Second month | 1,000                    | 1,000                     |
| Third month  | 1,800                    | 800                       |
|              | $\frac{3600}{3} = 1,200$ | $\frac{3,600}{3} = 1,200$ |
| Average      | 1,200                    | 1,200                     |

From the above, we can come to the conclusion that X is more efficient than Y. X's business is progressing, while Y's business is declining. So without details we may come to a wrong conclusion.

4. Statistical laws are true only on averages. Laws of physical sciences are perfect. But statistical laws are not so perfect as the laws of physics or chemistry. Statistical results are true only on the average. For instance, population statistics say that the span of life in India is 45. It does not mean that all men die at the age of 45. It is only the average age at death. Statistical laws are based on the theory of probability. According to W.I. King, "Statistics largely deals with averages and these may be made up of individual items radically different from each other." Statistics are the means and not a solution to the problem.

5. Statistics does not reveal the entire story. Statistics simplifies complicated data. Before using the data, the background of the data may be studied. Marshall says, "Statistics are the straw, out of which, I like every other economist to have to make bricks." According to Croxton, "It must not be assumed that statistical method is the only method for use in research; neither should this method be considered the best attack for every problem." Statistics are the means and not a solution to the problem.



6. Statistical data should be uniform and homogeneous. Comparison is one of the important characters of statistical data. Uniform and homogeneous data can be compared. Unequal or uncomparable data will direct to wrong and misleading results.

7. Statistics is liable to be misused. It is the most important limitation of statistics. According to Bowley, "Statistics only furnishes a tool though imperfect, which is dangerous in the hands of those who do not know its use and deficiencies." W.I. King states, "Statistics are like clay of which you can make a God or Devil as you please." He remarks, "Science of Statistics is the useful servant, but only of great value to those who understand its proper use." 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. 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. It will be of great help only if it is utilized by an expert.

#### DISTRUST OF STATISTICS