



Introduction to Statistics

1.1 Meaning of Statistics

The term *statistics* is derived from the Latin word *status*, Italian word *statista*, and the German word *statistic*. The meaning of each word is a *political state*. In old days, the ruling chiefs needed information regarding the military strength, population etc. for framing military and fiscal policies. Therefore, statistics in those days was considered to be a *science of statecraft, or science of kings*. In modern days, statistics is not only helpful to the state for administration, but is of considerable use to the economists, managers, scientists, research workers, businessmen, bankers, brokers, insurance companies etc.

The word *statistics* can be used as both the plural and singular sense. Statistics in its plural sense, called *statistical data*, are the information about a process or phenomenon or activity expressed in numbers. For example, statistics of births, deaths, exports, imports, prices, quantities etc. are statistical data. Statistics in its singular sense, called *statistical methods*, is the scientific methods of handling statistical data to draw valid conclusions regarding the process under consideration. Thus, statistics refers either to quantitative information or to a method of dealing with quantitative information.

1.2 Definitions of Statistics

Statistics has been defined by different authors from time to time. Some of them are defined in singular sense while others in plural sense.

1.2.1 Statistics in Singular Sense

A. L. Bowely defined statistics in the following ways:

- i) Statistics is defined as the science of counting.

ii) Statistics is defined as science of average.

Boddington has defined "Statistics as the science of estimates and probabilities". However, none of the above definitions is adequate.

Perhaps the best definition seems to be one given by Croxton and Cowden. According to him "Statistics may be defined as the science which deals with the collection, presentation analysis and interpretation of numerical data.

This definition is simple but comprehensive. It indicates the following four stages in a statistical inquiry.

- a) **Collection of Data:** For any statistical investigation, the data must be collected at first. Analysis and interpretation all are dependent upon the data collected.
- b) **Presentation of Data:** Next Step is to present them systematically so that they can be presented in the tabular form, diagrammatical form and graphical form.
- c) **Analysis of Data:** The statistical tools such as average, dispersion, correlation etc. can be used for the analysis of the data. Analysis always depends upon the nature of the data and the purpose of the inquiry.
- d) **Interpretation of Data:** The last step of the statistical enquiry is to interpret the result on the basis of analysis. It implies to draw the valid conclusion from the data which has been analyzed.

1.2.2 Statistics in Plural Sense

Webster defined statistics as "classified facts representing the condition of the people in a state" especially those facts which can be stated in numbers or in tables of numbers or classified arrangement.

A.L. Bowley defined statistics as "numerical statement of facts in any department of enquiry placed in relation to each other." But both definitions are narrow. They confined the area of statistics to the affairs of the state.

A more comprehensive definition is given by Prof. Horace Secrist. According to him *"By statistics we mean aggregate of facts, affected to a marked extent by multiplicity of causes, numerically expressed, enumerated or estimated according to reasonable standards of accuracy, collected in a systematic manner for a predetermined purpose, and placed in relation to each other."* Hence, all the numerical statements of facts are to be called statistics, the following characteristics must be satisfied.

- a) **Statistics are aggregate of facts:** Single or isolated figures do not constitute statistics because they are unrelated and cannot be compared with each other. For example, Mr. A earns Rs.10,000 a month, would not constitute statistics although it is a numerical statement where as ‘the monthly earnings of Mr. A, Mr. B, and Mr. C are respectively Rs.10000, Rs.12000 and Rs.15000’ constitute statistics.
- b) **Statistics are affected to a marked extent by multiplicity of causes:** Facts and figures are generally affected by a large number of causes. For example, statistics of production of wheat is affected by various factors such as amount of rainfall, quality of soil, amount of fertilizers used, method of cultivation employed etc.
- c) **Statistics are numerically expressed:** All statistics are expressed quantitatively. Qualitative statements such as ‘the population of Nepal is increasing’, or ‘the production of food grain is not sufficient’, or ‘Nepal is a developing country’ do not constitute statistics. On the other hand, the statement that “In 1981 the population of Nepal was 15 million compared to 11.5 million in 1971” constitutes statistics.
- d) **Statistics are enumerated or estimated according to reasonable standards of accuracy:** The quantitative information regarding a process can be acquired either by actual counting and measurement or by estimation. Estimates are not as accurate as actual counting or measurements. In many statistical studies 100% accuracy is rare. The degree of accuracy required depends upon the nature and purpose of study. For example, in measuring height of students even $(1/10)^{\text{th}}$ cm is material where as in measuring the distance between Kathmandu and Pokhara, even fraction of a kilometer can be neglected.
- e) **Statistics are collected in a systematic manner:** In order to collect statistics, a suitable plan should be prepared and then work should be carried out in a systematic manner.
- f) **Statistics are collected for a pre-determined purpose:** The purpose of collecting statistics should be decided in advance. The purpose should be well defined and specific.
- g) **Statistics are placed in relation to each other:** In order the numerical statements to be statistics, they must be comparable. The valid comparisons can be made only if the numerical statements are

related to some process. It would be meaningless to compare the weight of elephants with the weight of men.

Thus *“all statistics are the numerical statements of facts but all the numerical statements of facts are not statistics.”*

1.2.3 Statistical Methods

Statistical methods may be defined as the methods of collection, organization, presentation, analysis, and interpretation of numerical data. Thus there are five stages in a statistical investigation.

- a) **Collection of data:** The first step in statistical investigation is to collect the data. As the collection of data is the basis for statistical investigation care must be taken to collect reliable data.
- b) **Organization of data:** A large mass of collected data are organized by editing, classifying, and tabulating them.
- c) **Presentation of data:** After the data have been collected and organized, we present them by diagrams or graphs to facilitate analysis.
- d) **Analysis of data:** The data presented in tabular form is analyzed by observing or using mathematical techniques. Here the most common methods of statistical analysis like measures of central tendency, measures of variation, regression analysis etc are included.
- e) **Interpretation of data:** Finally, the conclusions are drawn on the basis of the data collected and analyzed. A high degree of skill and experience are required for the interpretation of data. Correct interpretation will lead to a valid conclusion of the study and thus can aid one in suitable decision making.

Thus statistical methods may be regarded as *“a method of decision-making in the face of uncertainty on the basis of numerical data and calculated risks.”* This is the modern concept of statistics.

1.3 Scope of Statistics

1.3.1 Statistics in Planning

Modern age can be considered as the age of planning. No work without well planning can be successful. So, most of the organizations are resorting to plan for efficient work and for formulating policy decision. The successfulness of the planning depends upon the correct and sound analysis of statistical data.

1.3.2 Statistics in Business and Management

In old days, the business firms were so small that the owner of the firm might act as stores manager, accountant, salesman etc. It was possible for him to contact personally with the customers and know exactly what they wanted from him. With expansion of the business firms in size it has become almost impossible for the owner to contact personally with a large number of customers. So a manager is called upon to plan, organize, supervise and control the operation of business firm.

In recent years, a modern business firm face a much greater degree of uncertainty regarding future operations than it did when the size of the firm was small. Most of the production is in anticipation of demand. In fact, business runs on estimates and possibilities. Hence the firm may not be able to make profits unless a very careful study of the market is made. The study of market can be made in a better way with the help of statistics and statistical methods. These days, statistical methods have provided the businessman or manager with one of his most valuable tools for decision making. Thus the statistical methods are very much useful in the various business activities like production, sale, purchase, finance, accounting, and product research, quality control etc.

The sufficient quantitative information regarding the various business activities mentioned above can be collected with the help of statistical methods. This information can be of great help in formulating suitable policies. The manager can extract suitable information from the collected data and use in making decisions.

1.3.3 Statistics in Economics

Statistical data and statistical methods are of great help in:

- a) **The proper understanding of the economic problems:** Economic problems like volume of trade, output of industries, wages, prices, bank deposits etc. can be expressed in numbers. Naturally the study of economic problems regarding the production and the distribution of wealth and income can effectively be made by statistical tools.
- b) **The formulation of economic policies:** Regarding the production, questions may arise: what to produce? how to produce? for whom to produce?, these questions need data to have the correct answers. Statistics of production help in adjusting the supply to demand.

In the field of exchange the questions may arise. What will be the price of a particular item if its supply increases or decreases?

What should be the price a monopolist change in order to get a maximum profit? These questions can be answered by statistics.

Statistics of consumption enable us to find out the way in which people of different strata of society spend their income. Such information is very helpful in knowing the standard of living and the capacity of the people for paying the tax.

In the case of distributions how the national income is to be calculated and distributed, statistics plays a prominent role. In reducing disparities in the distribution of income and wealth, statistics are of immense help. In solving the problems of rising prices, growing population, unemployment, poverty etc, one has to rely heavily on statistics.

- c) **The evaluation of the effectiveness of economic policies:** Statistical methods help not only in formulating suitable economic policies but also evaluating their effect. For example, in order to check the ever-growing population, if emphasis has been placed on the family planning methods, one can ascertain statistically the effectiveness of such methods in achieving the desired goal.
- d) **The development of economic theory:** Apart from economic policy, the development of economic theory has also been facilitated by the use of statistics.

The complexity of modern economic organization presents many difficult problems like the derivation of demand functions, production functions, cost functions, and consumption functions.

In order to solve such difficult problems, *econometrics*, the application of statistical methods to the theoretical economic method is widely used in recent years. Statistics are used increasingly not only to develop new economic concepts but also to test the old ones.

Apart from business and economics, statistical methods are extensively used in biology, medicine, agriculture, psychology, education, research and in other social sciences.

1.4 Limitations of Statistics

If the data are not properly collected and interpreted there is possibility of drawing wrong conclusions. The main limitations are:

- a) **Statistics does not deal with individuals:** In statistics we study the aggregate of facts but not the individuals. For example: the height of Mr. X is 165 cm has no meaning in statistics where as the average height of students in a class is 165 cm has statistical relevance.
- b) **Statistics deals only with quantitative characteristics:** The qualitative characteristics like honesty, intelligence, efficiency etc. which cannot be expressed in numbers are not directly studied by statistics. However, it is possible to analyze such problems statistically by expressing them in numbers. For example we can study the intelligence of students on the basis of their test grades.
- c) **Statistical results are true only on an average:** In statistical work 100% accuracy is rare. The laws of statistics are true only on an average, so they are not universally applicable as the laws of physics, chemistry and mathematics.
- d) **Statistics is only one of the methods of studying a problem:** Statistical methods do not provide the best solution under all conditions. It is, sometimes, desirable to study a problem in the light of country's culture, religion, and philosophy. Statistics cannot be of much help in studying such problems unless they are supplemented by other evidences.
- e) **Statistics can be misused:** The misuse of statistics may be due to various reasons. If statistical conclusions are based on incomplete information one may arrive at fallacious conclusions. Statistics can be easily manipulated so as to draw one's own suitable conclusions. Moreover, the layman cannot deal with statistics because it requires experience and skill to draw sensible conclusions from the data. Statistics cannot be used to full advantage without proper understanding of the subject to which we are going to apply it. Consequently the possibility of mass popularity of such a useful science is limited.

Exercise - 1

1. Explain the term “Statistics”. What are the limitations of science of statistics? *(T.U. 2071 old)*
2. Define statistics and explain its use in business. *(T.U. 2058)*
3. What do you understand by statistics? Discuss its limitations.
4. In what ways can statistics be of service to a manager?
5. What are the characteristics of statistical data? Explain. *(T.U. 2059)*