

# Business Statistics — What and Why ?

## INTRODUCTION

The word “Statistics” is very popularly used in practice. It conveys a variety of meanings to people many of which are inaccurate or, at the very least, misleading. The average person conceives of ‘statistics’ as column of figures, zig-zag graphs or tables like statistics of production, consumption, per capita income, imports, exports, crimes, divorce, share prices, etc. Such statistics are quite commonly found in newspapers, journals, reports and one can also hear them on radio, television, classroom lectures, etc. For example, one may find statements like ‘The production of foodgrains is expected to increase from 230.78 m. tonnes in 2007-08 to 233.88 m. tonnes in 2008-09; the per capita net national product has increased from Rs.15,881 in 1999-00 to Rs. 40,141 in 2008-09. The Planning Commission has opted for an average economic growth of 9 per cent per annum during the Eleventh Five Year Plan period (2007-2012) from 7.6 per cent in the 10th plan. The population of India for the year 2001 is 102.7 crore.

In addition to meaning numerical facts, ‘statistics’ also refers to a subject, just as ‘mathematics’ refers to a subject, as well as symbols, formulae and theorems and ‘accounting’ refers to principles and methods as well as to accounts, balance sheets and income statements. In this sense, Statistics is a body of methods of obtaining and analysing data in order to base decisions on them. It is a branch of scientific methods used in dealing with phenomena that can be described numerically either by count or by measurement. *Thus, the word statistics refers either to quantitative information or to a method of dealing with quantitative information.*

The methods by which statistical data are analysed are called *statistical methods*, although the term is sometimes used more loosely to cover the subject ‘Statistics’ as a whole. The mathematical theory which is the basis of these methods is called the *theory of statistics* or *mathematical statistics*. Statistical methods are applicable to a very large number of fields—economics, sociology, anthropology, business, agriculture, psychology, medicine, education—all lean heavily upon statistics. Numerous books have been written on business statistics, agricultural statistics, industrial statistics, medical statistics, educational statistics, psychological statistics and other specific areas of application. It is true, of course, that these diversified fields demand somewhat different and specialized technique in particular problems, yet the fundamental principles that underlie the various methods are identical regardless of the field of application. This will become evident to the reader if he realizes that *statistical methods in general are nothing but a refinement of everyday thinking*. They are specially appropriate for handling data which are subject to variation that cannot be fully controlled by experimental method and for which we can have only a fraction of the totality of observations which may exist.

It should be noted at the very outset that Statistics is usually not studied for its own sake ; rather, it is widely employed as a tool—and a highly valuable one—in the analysis of problems in natural, physical and social sciences. In the latter area, statistics often assumes its greatest importance in the study of economics and business. Statistical methods are used by governmental bodies, private business firms, and research agencies as an indispensable aid in (1) forecasting, (2) controlling, and (3) exploring.

Statistical methods range from the most elementary descriptive devices which may be understood by the common man to those complicated mathematical procedures which can be apprehended only by the expert theoreticians. The purpose of this text is to discuss the fundamental principles and techniques of Business Statistics in simple and easily comprehensible manner without going into the highly mathematical aspects of the subject.

## STATISTICS DEFINED

There have been many definitions of the term 'Statistics'—indeed scholarly articles have carefully collected together hundreds of definitions, some have defined Statistics\* as statistical data (plural sense) whereas others as statistical methods (singular sense). A few definitions are examined in the following paragraph.

## STATISTICAL DATA

Quantitative or numerical information may be found almost everywhere in business, industries, economics and many other areas. It is probably more common to refer to data in quantitative form as *statistical data*. But not all numerical data is statistical and hence it is necessary to examine a few definitions of Statistics to understand the characteristics of statistical data.

Webster defined statistics as "*the classified facts relating the condition of the people in a State especially those facts which can be stated in numbers or in tables of numbers or in any tabular or classified arrangements.*"

The above definition is too narrow as it confines the scope of statistics to only such facts and figures which relate to the conditions of the people in a State.

Yule and Kendall defined statistics as : "By statistics we mean quantitative data affected to a marked extent by multiplicity of causes."

This definition is less comprehensive than the one given by Prof. Horace Secrist who defined statistics as follows :

"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 pre-determined purpose and placed in relation to each other.*"

This definition clearly points out certain characteristics which numerical data must possess in order that they may be called statistics. They are as follows :

1. *Statistics are aggregate of facts.* Single and isolated figures are not statistics for the simple reason that such figures are unrelated and cannot be compared. For example, a single figure relating to production, sale, birth, death, employment, purchase, accident, etc., cannot be regarded statistics although aggregates of such figures would be called statistics because of their comparability and relationship as part of a common phenomenon.

2. *Statistics are affected to a marked extent by multiplicity of causes.* Generally speaking, facts and figures are affected to a considerable extent by a number of forces operating together. For example, statistics of production of rice are affected by the rainfall, quality of soil, seeds and manure, method of cultivation, etc. It is very difficult to study separately the effect of these forces on the production of rice. The same is true of statistics of prices, imports, exports, sales, profits, etc. In the experimental sciences like Physics and Chemistry it is possible to isolate the effect of various forces on a particular event. Ways and means were also being devised in 'Statistics' for segregating the effects of various forces on an event. However, it has proved to be a difficult task in statistical studies of phenomena which are influenced by a complex variety of factors many of which are not measurable.

---

\* "Statistics is the use of data to help the decision maker reach better decisions."

3. *Statistics are numerically expressed.* All statistics are numerical statements of facts, i.e., expressed in numbers. Quantitative statements such as 'The population of India is rapidly increasing' ; or 'The production of wheat is not sufficient ; or 'Textile industry is getting sick' do not constitute statistics. The reason is that such statements are vague and one cannot make out anything from them. On the other hand, the statement that the population of India increased from 846.30 million in 1991 to 1003.24 million in 2001 is a statistical statement.

4. *Statistics are enumerated or estimated according to reasonable standards of accuracy.* Facts and figures about any phenomenon can be derived in two ways, viz., by actual counting and measurement or by estimate. Estimate cannot be as precise and accurate as actual count or measurement. For example, an estimate that two lakh College and University teachers participated in a recent strike does not mean exactly two lakh ; it may be a few hundreds or thousands more or less. On the other hand, if we count the number of employees in an organisation and say that there are 60 employees ; this figure would be 100% accurate. In many cases 100% accuracy of numbers may be difficult to attain. The degree of accuracy desired largely depends upon the nature and object of the enquiry. For example, in measuring heights of persons even inches are important whereas in distance between two places, say, Delhi and Mumbai, even metres can be ignored. Hence, in many statistical studies mathematical accuracy cannot be attained. However, it is important that reasonable standards of accuracy should be attained, otherwise numbers may be altogether misleading.

5. *Statistics are collected in a systematic manner.* Before collecting statistics, a suitable plan of data collection should be prepared and the work carried out in a systematic manner. Data collected in a haphazard manner would very likely lead to fallacious conclusions.

6. *Statistics are collected for a pre-determined purpose.* The purpose of collecting data must be decided in advance. The purpose should be well defined and specific. A general statement of purpose is not enough. For example, if the objective is to collect data on prices it would not serve any useful purpose unless one knows whether he wants to collect data on wholesale or retail prices and what are the relevant commodities in view.

7. *Statistics should be placed in relation to each other.* If numerical facts are to be called statistics, they should be comparable. Statistical data are often compared period-wise called chronological comparison or regionwise called geographical comparison. For instance, the per capita income of India for the year 2009-10 may be compared with that of earlier years or with the per capita income of other countries, say U.S.A., U.K., Japan, etc. Valid comparisons can be made only if the data are homogeneous, i.e., relate to the same phenomenon or subject and only likes are compared with likes. It would be meaningless to compare the sales of a small shop with the sales of a big departmental store.

In the absence of the above characteristics numerical data cannot be called statistical and hence, "*all statistics are numerical statements of facts but all numerical statements of facts are not statistics.*"

## STATISTICAL METHODS

The large volume of numerical information gives rise to the need for systematic methods which can be used to organise, present, analyse and interpret the information effectively. The term statistics has been defined differently by different writers. A few definitions are examined below.

Prof. A.L. Bowley has given three definitions. At one place he says, "*Statistics may be called the science of counting.*" This definition is too narrow because it covers only one aspect of the science, namely, the collection of data. Other aspects like presentation, analysis, interpretation, etc., are completely ignored.

At another place Bowley says, "*Statistics may be called the science of averages.*" This definition also is not satisfactory because averages are only one of the devices used in statistical analysis. The other devices like variation, skewness, correlation, etc., are not at all covered by this definition.

Still another definition given by the same author is "*Statistics is the science of the measurement of social organism, regarded as a whole in all its manifestations.*" This definition also is not satisfactory because it confines the scope of statistics only to sociology, i.e., man and his activities. Bowley himself recognized this when he remarked, "Statistics cannot be confined to any one science."

Boddington defines statistics as "*the science of estimates and probabilities.*" This definition also is unacceptable because estimates and probabilities are only a part of statistical methods.

Croxtton and Cowden have given a very simple and concise definition of statistics. In their view, "*Statistics may be defined as a science of collection, presentation, analysis and interpretation of numerical data.*" This definition clearly points out four stages in a statistical investigation, namely : (i) collection of data, (ii) presentation of data, (iii) analysis of data and (iv) interpretation of data.

However, to the above stages one more stage may be added and that is the organisation of data. Thus, statistics may be defined as *the science of collection, organisation, presentation, analysis and interpretation of numerical data.*

According to the above definition, there are five stages in a statistical investigation :

1. *Collection.* Collection of data constitutes the first step in a statistical investigation. Utmost care must be exercised in collecting data because they form the foundation of statistical analysis. If data are faulty, the conclusions drawn can never be reliable. The data may be available from existing published or unpublished sources or else may be collected by the investigator himself. The firsthand collection of data is one of the most difficult and important tasks faced by a statistician. Therefore, like all scientific pursuits, the investigator must take into account whatever data have already been collected by others. This would save the investigator from foreseeable pitfalls, unnecessary labour and duplication of efforts.

2. *Organization.* Data collected from published sources are generally in organized form. However, a large mass of figures that are collected from a survey frequently needs organisation. The first step in organizing a mass of data is *editing*. The collected data must be edited very carefully so that the omissions, inconsistencies, irrelevant answers and wrong computation in the returns from a survey may be corrected or adjusted. After the data have been edited the next step is to *classify* some common characteristics possessed by the items constituting the data. The last step in organization is *tabulation*. The object of tabulation is to arrange the data in columns and rows so that there is absolute clarity in the data presented.

3. *Presentation.* After the data have been collected and organized they are ready for presentation. Data presented in an orderly manner facilitates statistical analysis.

4. *Analysis.* After collection, organization and presentation the next step is that of analysis. A major part of this text is devoted to the methods used in analysing the presented data, mostly in a tabular form. Methods used in analysing the presented data are numerous ranging from simple observation of data to complicated, sophisticated and highly mathematical techniques. However, in this text only the most commonly used methods of statistical analysis are included.

5. *Interpretation.* The last stage in statistical investigation is interpretation, i.e., drawing conclusions from the data collected and analysed. The interpretation of data is a difficult task and necessitates a high degree of skill and experience. If the data that have been analysed are not properly interpreted, the whole object of the investigation may be defeated and fallacious conclusions drawn. Correct interpretation will lead to a valid conclusion of the study and thus can aid in decision-making.

## **STATISTICS : SCIENCE OR ART**

Whether Statistics is a science or an art is often a subject of debate. Science refers to a systematised body of knowledge. It studies cause and effect relationship and attempts to make generalisations in the form of scientific principles or laws. It describes facts objectively and avoids vague judgements as good

method. Science, in short, is like a lighthouse that gives light to the ships to find out their own way but does not indicate the direction in which they should go. Art, on the other hand, refers to the skill of handling facts so as to achieve a given objective. It is concerned with ways and means of presenting and handling data, making inferences logically and drawing relevant conclusions.

While a century ago there were some misgivings among natural scientists as to whether statistics had the right to be recognised as a distinct science, now almost *all sciences statistical*. This suggests that the design of scientific experiments and the evaluation of their results makes use of principles and practices growing out of the science of statistics. However, statistics as a science is not similar to exact sciences like Physics, Chemistry, Zoology, etc. This is because statistical phenomena are generally affected by multiplicity of causes which cannot always be measured accurately. In other words, the science of statistics by its very nature is less precise than the natural sciences. It is science only in a limited sense, viz., as a specialised branch of knowledge. More appropriately, statistics may be regarded as a scientific method because it is really a tool which can be used in scientific studies. Wallis and Roberts have rightly remarked that "Statistics is *not a body of substantive knowledge but a body of methods for obtaining knowledge*."

If science is knowledge, then art is action. Looking from this angle statistics may also be regarded as an art. It involves the application of given methods to obtain facts, derive results, and finally to use them for devising action.

## FUNCTIONS OF STATISTICS

1. It presents facts in a definite form.
2. It simplifies mass of figures.
3. It facilitates comparison.
4. It helps in formulating and testing hypothesis.
5. It helps in prediction.
6. It helps in the formulation of suitable policies.

1. *Definiteness*. Numerical expressions are convincing and, therefore, one of the most important functions of statistics is to present general statements in a precise and definite form. Statements or facts conveyed in exact quantitative terms are always more convincing than vague utterances. Statistics present facts in a precise and definite form and thus help proper comprehension of what is stated. Consider, for example, a statement sex ratio (*i.e.*, number of females per 1000 males) is going up in India. The reader would not have a clear idea of the situation from this statement. But if we say the sex ratio has gone up from 926 in 1991 to 933 in 2001, it conveys a definite meaning. Similarly, statement like 'There is a lot of unemployment in India', 'the population of India is growing at a very fast rate', 'the prices of various commodities are rising', 'the number of students seeking admission to professional courses is increasing', etc. hardly convey any worthwhile information as they do not specify the numerical dimensions involved.

2. *Condensation*. Not only does Statistics present facts in a definite form but it also helps in condensing mass of data into a few significant figures. In a way, statistical methods present a meaningful overall information from the mass of data. Thus, it is impossible for one to form a precise idea about the income position of the people of India from a record of individual incomes of the entire population. However, the figure of per capita income can be easily remembered by everyone.

3. *Comparison*. Unless figures are compared with others of the same kind they are often devoid of any meaning. For example, if we say that the production of Maruti Udyog Ltd. has increased considerably shall not be meaningful unless some comparison of figures is made. But the statement there has been an increase from 200 cars a day in Sept. 1988 to more than 4,000 cars a day in Jan. 2009-2010 definitely indicates the increasing trend in production. Maruti Udyog has grown global and shall be exporting to European and other markets.

4. *Formulating and Testing Hypothesis.* Statistical methods are extremely useful in formulating and testing hypothesis and to develop new theories. For example, hypothesis like whether chloromycetin is effective in preventing typhoid, whether the credit squeeze is effective in checking price increase, whether students have benefited from the extra coaching, etc., can be tested by appropriate statistical tools.

5. *Prediction.* Plans and policies of organisations are invariably formulated well in advance of the time of their implementation. A knowledge of future trends is very helpful in framing suitable policies and plans. Statistical methods provide helpful means of forecasting future events. For example, if a businessman has to decide how much he should produce in 2015, he would like to know the expected sales for that year. He may use his subjective judgment and make a guess. However, a better method for him would be to analyse the sales data of the past years or arrange a statistical survey of the market to obtain necessary data for estimating the sales volume for the year 2015.

6. *Formulation of policies.* Statistics provide the basic material for framing suitable policies. For example, it may be necessary to decide how much oil a nation should import in 2015, the decision would depend upon the expected internal production and the likely demand for oil in 2015. In the absence of information regarding the estimated domestic output and demand for oil the decision on imports cannot be made with reasonable accuracy.

Robert W. Burgess has beautifully summed up the functions of statistics as "*The fundamental gospel of statistics is to push back the domain of ignorance, rule of thumb, arbitrary or premature decisions, traditions and dogmatism and to increase the domain in which decisions are made and principles are formulated on the basis of analysed quantitative facts.*"

## SCOPE OF STATISTICS

The scope of statistics is so vast and ever-increasing that not only it is difficult to define but also unwise to do so. The use of Statistics has permeated almost every facet of our lives. It is a tool of all sciences indispensable to research and intelligent judgment and has become a recognized discipline in its own right. There is hardly any field whether it be trade, industry or commerce, economics, biology, botany, astronomy, physics, chemistry, education, medicine, sociology, psychology, or technology where statistical tools are not applicable. In fact, the greatest victory of mankind of the 20th century, that of landing of Apollo 11 on the moon, would not have been a success in the absence of statistical help. The applications of statistics are so numerous that it is often remarked "*Statistics is what statisticians do*". Governments, businessmen and individuals collect statistical data required to carry out their activities efficiently and effectively. Let us examine a few fields in which Statistics is applied.

### (i) Statistics and State

Since ancient times the ruling kings and chiefs have relied heavily on statistics in framing suitable military and fiscal policies. Most of the statistics such as that of crimes, military strength, population, taxes, etc., that were collected by them were a by-product of administrative activity. In recent years the functions of the State have increased tremendously. The concept of a State has changed from that of simply maintaining law and order to that of a welfare State. Statistical data and statistical methods are of great help in promoting human welfare. Statistics today are not exclusively a by-product of administrative activity—the State collects statistics on several problems. These statistics help in framing suitable policies. All Ministers and departments of the Government whether they be Finance, Transport, Defence, Railways, Food, Commerce, Post and Telegraph or Agriculture, depend heavily on factual data for their efficient functioning. For example, the Transport Department cannot solve the problem of transport in Delhi unless it knows how many buses are operating at present, what is the total

requirement and therefore, how many additional buses be added to the existing fleet. Not only during peace times but during days of war also statistics are indispensable. In fact it is impossible to fight a war successfully in the absence of factual data about enemy strength.

Statistics are so significant to the State that the government in most countries is the biggest collector and user of statistical data. Such data is of immense help to many institutions and research scholars who further process it and arrive at useful conclusions which help in decision-making.

## (ii) Statistics in Business and Management

The use of statistical methods in the solution of business problems dates almost exclusively to the 20th century. Applications of statistics pervade virtually every area of activity in business and industry such as production, financial analysis, distribution analysis, market research, research and development, manpower planning and accounting. The main focus of this text is to discuss various statistical techniques that are indispensable in analysing and solving business problems and hence the justification for the book to be called "*Business Statistics*".

With the growing size and ever-increasing competition, the problems of business enterprise are becoming complex. Prior to Industrial Revolution when production was in the handicraft stage, individual business was small and the production was carried out on a very small scale mainly to cater local needs. The management of such a business enterprises was very much different from the present management of a large-scale business. The information needed by the executives was much less extensive than at present. The market was close at hand, the customers were, for a large part, personal friends of the owner of the business and an elaborate analysis of the market was not needed. The businessman just by asking some questions from his customers could find out what they thought of his product and what they wanted to buy. The manager of a business, who was usually also the owner, worked in the shop with his employees. The number of employees used to be very few and the owner knew them personally and, therefore, records of personnel data were not needed. Similarly, production records were not needed because he knew what progress of work was being made daily in the shop. Any facts he needed could be learnt from direct observation; in fact, most of what he required was in his mind. Thus the owner was directly engaged in all the areas of business activity like sale, purchase, production, finance, accounting, etc.

Under the present system where production is carried out on a large-scale, most of the goods are manufactured in anticipation of consumer demand. Producers and consumers are strangers to each other because it is almost impossible for the producer to know personally thousands and lakhs of consumers. The fact about consumer preferences and desires are not so easy to obtain or so simple to understand as in the earlier system. But since production is carried on in anticipation of demand, such information becomes more important than ever before. It is no longer possible for the owner to see how things are going and to remember each and every aspect of the business. It is also difficult for him to know all his employees personally. Hence with the trend towards large organisation, it has become necessary for the executives to rely more and more on elaborate information systems instead of their intuition or mere observations. And it is here that statistical data and statistical methods play a very significant role. Availability of factual data about the operations of the business is as essential as the availability of raw materials to a manufacturing plant or goods to a retail establishment.

Through the aid of statistical reports, the executive can gain a summary picture of current operations which, improves his factual basis for making valid decisions affecting future operations. The following are some major activities of a typical, large and progressive organisation which would indicate how statistics helps in the efficient discharge of various activities.

1. *Marketing.* Statistical analysis are frequently used in providing information for marketing decisions. In the field of marketing, it is necessary first to find out what can be sold and then to evolve a *suitable strategy so that goods reach the ultimate consumer. A skilful analysis of data on population, purchasing power, habits of people, competition, transportation cost, etc., should precede any attempt to establish a new market.* Often such analysis will present difficulties which must be properly met before actually attempting to place goods in the market. The analysis may reveal that in certain areas where one thought of big market potential, there hardly exists any scope.

In retail stores, wholesale houses and sales departments and manufacturing concerns, statistical records and analysis enable one to determine in advance, at a small cost, much that would be very costly if determined by actual experience.

In building up and maintaining an extensive market, it is important to keep accurate records of its present and potential geographic distribution. Analysis of sales in relation to the distribution of population and purchasing power are especially important in establishing sales territories routing salesman and in order to know where to advertise and where to push sales.

2. *Production.* In the field of production, statistical data and statistical methods play a very important role. The decision about what to produce, how much to produce, when to produce, for whom to produce is based largely on facts analysed statistically.

Statistical tools are also of immense help in quality control, optimum inventory level and in dealing with labour problems, etc. Production manager looks at quality control data to decide when to make adjustments in a manufacturing process.

3. *Finance.* The Financial Managers in discharging their finance function efficiently depend heavily on statistical analysis of facts and figures. Financial forecasts, breakeven analysis and investment decisions under uncertainty are but part of their activities. In the last three decades, sophisticated models dealing with inventories, cash balances and so on have been developed and applied. These models involve application of several statistical concepts. The area of security analysis is also highly quantitative.

4. *Banking.* Banking institutions have found it increasingly necessary to establish departments within their organisations for the purpose of gathering and analysing information, not only regarding their own operations, but on general economic conditions and on every line of business in which they might be directly or indirectly interested. Probably the banks, more than any other individual business, feel the direct effects of the conditions in every type of business and need to be constantly informed as to the trends in every line of activity. Its reserves are influenced by money markets which are not local but which are national or international ; its funds are influenced not only by the business conditions in the immediate vicinity but also by the conditions of business in areas far distant.

In making loans, banks have to be particularly careful that they do not lend too much money when business is dangerously inflated. In almost every period of hard times some banks have failed because they did not correctly analysed the general business situation or the conditions in individual concerns which had over-expanded.

In all the problems mentioned above, the bankers use the objective analysis furnished by statistics and then temper their decisions on the basis of qualitative information.

5. *Investment.* Statistics greatly assists investor in making clear and valued judgement in his investment decision in selecting securities which are safe and which have the best prospects of yielding a good income. Such investigations assist in determining whether to buy, to sell or to do neither. On the basis of these statistical guides investors purchase securities when they are low, hold them for a few years until they are high and then sell them and hold the proceeds until they can again buy at low figures. In this way, without any marginal purchases but by buying outright high grade dividend-paying securities, investors have built up substantial fortunes with relatively little risk.

The investment banker is one of the greatest users of statistics—he must accurately distinguish between good and bad securities. To do so, he should not only have a clear understanding of the present situation of the money and security markets and a definite knowledge of the actual conditions in the different industries but also have a fairly clear conception of what will be the most probable future conditions in various industries.

6. *Purchase.* The purchase department in discharging its functions makes use of statistical data to frame suitable purchase policies such as from where to buy, how much to buy, at what time to buy and at what price to buy.

7. *Accounting.* Statistical methods are also employed in accounting. In particular, the auditing functions makes frequent application of statistical sampling and estimation procedures, and the cost account uses regression analysis. The accountant collects data on historical costs in the course of auditing a company's financial records.

8. *Control.* The management control process combines statistical and accounting methods in making the overall budget for the coming year—including sales, material, labour and other costs, and net profits and capital requirements. It usually maintains a standard cost system for controlling costs, and setting prices of products.

9. *Credit.* The credit department performs statistical analysis to determine how much credit to extend to various customers. In the formulation of future credit policy the characteristics of those who have paid and those who have defaulted are kept in mind.

10. *Personnel.* The personnel department frames personnel policies based on facts. It makes statistical studies of wage rates, incentive plans, cost of living, labour turnover rates, employment trends, accident rates, employee grievances, performance appraisal, training programmes, etc. Such studies help the personnel department in the process of manpower planning.

11. *Research and Development.* Many big organisations have research and development departments which are primarily concerned with finding out how existing products can be improved; what new product lines can be added and how the optimal use of resources made. In the absence of factual data it is almost impossible to carry out fruitful research and development programmes.

### (iii) Statistics and Economics

In the year 1890 Prof. Alfred Marshall, the renowned economist observed that "*Statistics are the straw out of which I, like every other economists, have to make bricks.*" This proves the significance of statistics in economics. Economics is concerned with the generation and distribution of wealth as well as with the complex institutional set-up concerned with the consumption, saving and investment of income. Statistical data and statistical methods are of immense help in the proper understanding of the economic problems and in the formation of economic policies. In fact, these are the tools and appliances of an economists's laboratory. For example, what to produce, how to produce and for whom to produce—these are the questions that need a lot of statistical data in the absence of which it is not possible to arrive at correct decisions. Statistics of production help in adjusting the supply of demand; Statistics of consumption enable us to find out the way in which people of different strata of society spend their income. Such statistics are very helpful in knowing the standard of living and taxable capacity of the people. In the field of exchange we study markets, laws of prices based on supply and demand, cost of production, banking and credit instruments, etc. What shall be the price of a particular commodity if its supply increases or decreases? What price should a monopolist charge in order to reap the maximum profit?—these are questions which can best be answered with the help of the statistics. In fact, statistics are the very foundation stone of the theory of exchange. In distribution,

too, statistics plays a vital role. How the national income is to be calculated and how it is to be distributed, these are the questions which cannot be answered without statistics. In reducing disparities in the distribution of income and wealth, statistics are of immense help. Similarly in solving problems of rising prices, growing population, unemployment, property, etc., one has to rely heavily on statistics. In fact, most of the economic policies would be a leap in the dark in the absence of appropriate statistical information.

Statistical methods help not only in formulation appropriate economic policies but also in 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 efficacy of such methods in attaining the desired goal. Statistical techniques play such an important role in the field of economics that in 1926, R.A. Fisher complained of "*the painful misapprehension that statistics is a branch of economics.*"

In recent years *econometrics* which comprises the applications of statistical methods to the theoretical economic methods is widely used in economic research. Statistical methods of sampling are useful for collecting the basic data of economic studies. Statistical methodology also indicates the reliability of the data and the significance to be attached to them. The derivation of demand functions, the field in which the applications of econometrics was first made, continue to be of major interest to economists. Similarly, the production functions, cost functions and the consumption functions present many difficult problems in the analysis of which statistical tools are of immense use.

Thus, economists today are no longer satisfied to theorize in abstract terms. Instead they utilize the excellent data now available to build a sound factual foundation for their reasoning. Some of the applications of statistics in economics are as follows :

1. Measures of gross national product and input-output analysis have greatly advanced overall economic knowledge and opened up entirely new fields of study.
2. Financial statistics are basic in the fields of money and banking short-term credit, consumer finance and public finance.
3. Statistical studies of business cycles, long-term growth and seasonal fluctuations serve to expand our knowledge of economic instability and to modify them from time to time.
4. Studies of competition, oligopoly and monopoly require statistical comparisons of market prices, cost and profits of individual firms.
5. Statistical surveys of prices are essential in studying the theories of prices, pricing policy and price trends, as well as their relationship to the general problem of inflation.
6. Operational studies of public utilities require both statistical and legal tools of analysis.
7. Analysis of population, land economics and economic geography are basically statistical in their approach.
8. In solving various economic problems such as poverty, unemployment, disparities in the distribution of income and wealth, statistical data and statistical methods play a vital role.

In fact, the concept of planning so vital for growth of nations would not have been possible in the absence of data and proper statistical analysis there of.

#### **(iv) Statistics and Physical Sciences**

The physical sciences, especially astronomy, geology and physics were among the fields in which statistical methods were first developed and applied, but until recently these sciences have not shared the 20th century developments of statistics to the same extent as the biological and social sciences. Currently, however, the physical sciences seem to be making increasing use of statistics, especially in astronomy, chemistry, engineering, geology, meteorology and certain branches of physics.

**(vi) Statistics and Natural Sciences**

Statistical techniques have proved to be extremely useful in the study of all natural sciences like biology, medicine, meteorology, zoology, botany, etc. For example, in diagnosing the correct disease the doctor had to rely heavily on factual data like temperature of the body, pulse rate, blood pressure, etc. Similarly, in judging the efficacy of a particular drug for curing a certain disease experiments have to be conducted and the success or failure would depend upon the number of people who are cured after using the drug. In botany—the study of plant life—one has to rely heavily on statistics in conducting experiments about the plants, effect of temperature, type of soil, etc. In fact, it is difficult to find any scientific activity where statistical data and statistical methods are not used.

**(vi) Statistics and Research**

Statistics is indispensable in research work. Most of the advancement in knowledge has taken place because of experiments conducted with the help of statistical methods. For example, experiments about crop yields and different types of fertilisers and different types of soils or the growth of animals under different diets and environments are frequently designed and analysed with the help of statistical methods. Statistical methods also affect research in medicine and public health. In fact, there is hardly any research work today that one can find complete without statistical data and statistical methods. Also it is impossible to understand the meaning and implications of most of the research findings in various disciplines of knowledge without having at least a speaking acquaintance with the subject to statistics.

**(vii) Statistics and Other Uses**

We have discussed above the significance of statistics in some important fields. Besides these, statistics are useful to various institutions such as bankers, brokers insurance companies, auditors, social workers, labour unions, trade associations and chambers of commerce. The banks have to make a very careful study of the cash requirements otherwise they may find they are short of cash and their existence is at stake. Similarly, the premium rates of the life insurance companies are based upon very careful study of the expectation of life.

Statistics are immensely useful to politicians and their supporters. They want to find out the prospects of winning the election and the efforts required for it. By sampling a certain percentage of voters prior to election, one can work out the percentage of votes the candidates is likely to receive in the election. The estimated percentage can then be used to decide, for example, whether a greater campaign is required to assure the candidate's victory.

These references to statistical applications are not intended to be exhaustive, but they simply suggest the diversity of applications of the underlying methods and ideas of statistics. In fact the applications of statistics are so numerous that statistics today has risen from the science of statecraft to the science of universal applicability. It is instrumental in enhancing human welfare and is such a master-key that enables to solve the problems of mankind almost in every field. Most of the people make use of statistics consciously or unconsciously in taking decisions. Statistical knowledge is in fact essential for a good citizen. H.G. Wells was right when he said '*Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.*'

It must be remembered that the *statistical approach, though universal in its underlying ideas, must be tailored to fit the peculiarities of each concrete problem to which it is applied. It is dangerous to apply statistics in cookbook style, using the same recipes over and over, without careful study of the ingredients of each new problem.*

Also the reader must understand that statistics is not a dry, abstract and unrealistic pursuit followed by a small group of highly trained mathematicians, but rather a vitally important part of the economic and business life of the community. The usefulness of statistics to the reader depends to a great extent on his ability to use his imagination in applying the various statistical tools to his own particular situation.

## STATISTICS AND THE COMPUTER

It may be interesting to note that the development of statistics has been closely related to the evolution of electronic computing machinery. Statistics is a form of data processing, a way of converting data into information useful for decision-making. Processing of 'raw data' is extensively required in the application of many statistical techniques. Statistical theory is generally expressed in the form of mathematical equations. However, the applications of this theory requires processing of real data.

As statistical theories become more complex, it becomes increasingly difficult to perform the calculations needed to apply these theories. Hence, in one sense the development of statistical theory and electronic computers reinforce each other. As statisticians devise new ways of describing and using data of decisions, computer scientists respond with newer more efficient ways of performing these operations. Conversely, with the evolution of more powerful computing techniques, people in statistics are encouraged to explore new and more sophisticated methods of statistical analysis. The computers can process large amounts of data quickly and accurately. This is a great benefit to businesses and other organisations that must maintain records of their operations. The computer brings efficient data processing to familiar operations such as payroll calculations, inventory management and airline reservation system. With the advancement in computer technology more and more people coming in direct contact with computers. New microprocessors have made the home computer a reality for both work and entertainment. It may be pointed out that the output from a computer is only as good as the data input ("Garbage in, garbage out" is the popular saying). This warning applies equally to statistical analysis. Statistical decisions based on data are no better than the data used.

## LIMITATIONS OF STATISTICS

Despite the usefulness of statistics in many fields, impression should not be carried that statistics are like magical devices which always provide the correct solution of problems. Unless the data are properly collected and critically interpreted there is every likelihood of drawing wrong conclusions. Therefore, it is also necessary to know the limitations and the possible misuses of statistics. The following are the important limitations of the science of statistics :

1. *Statistics does not deal with isolated measurement.* Not all quantitative data are statistical. Isolated measurements are not statistical. Data are statistical when they relate to measurement of masses, not statistical when they relate to an individual item or event as a separate entity. For example, the wage earned by an individual worker at any one time, taken by itself, is not a statistical datum but taken as a part of a mass of information, it may be a statistical data. It should be noted that the wages of one worker over a period of time, being a series of wages, can be used statistically.

2. *Statistics deals only with quantitative characteristics.* Statistics are numerical statements of facts. Such characteristics as cannot be expressed in numbers are incapable of statistical analysis. Thus, qualitative characteristics like honesty, efficiency, intelligence, blindness and deafness cannot be studied directly. However, it may be possible to analyse such problems statistically by expressing them numerically. For example, we may study the intelligence of boys on the basis of the marks obtained by them in an examination.

3. *Statistical results are true only on an average.* The conclusions obtained statistically are not universally true; they are true only under certain conditions. This is because statistics as a science is less exact as compared to natural sciences.

4. *Statistics is only a means.* Statistical methods furnish only one method of studying a problem. They may not provide the best solution under all circumstances. Very often it may be necessary to supplement the conclusions arrived at by the help of statistics with the other methods that may be used to study a problem. It should be carefully noted that statistics is only a means and not an end. It analyses the facts and throws light on the real situation. In deciding a course of action it may be necessary to take into account the country's culture, religions, philosophy, personal, political or other non-quantitative considerations. Exclusive dependence on statistics may lead to fallacious conclusion in many situations.

5. *Statistics can be misused.* The greatest limitation of statistics is that it is liable to be misused. The misuse of statistics may arise because of several reasons. For example, if statistical conclusions are based on incomplete information, one may arrive at fallacious conclusions. Thus the arguments that drinking beer is bad for longevity since 99% of the persons who take beer die before the age of 100 years is statistically defective, since we are not told what percentage of persons who do not drink beer and die before reaching that age. Statistics are like clay and they can be moulded in any manner so as to establish right or wrong conclusion. Moreover, any Tom, Dick and Harry cannot deal with statistics. It requires experience and skill to draw sensible conclusions from the data ; otherwise, there is every likelihood of wrong interpretations. Also statistics cannot be used to full advantage in the absence of proper understanding of the subject to which it is applied.

### Distrust of Statistics

By distrust of statistics we mean lack of confidence in statistical statements and statistical methods. It is often believed that "Statistics can prove anything." "There are three types of lies—lies, damn lies and statistics—wicked in the order of their naming." The following three main reasons account for such notions being held by people about statistics :

1. Figures are convincing and, therefore, people are easily led to believe them.
2. They can be manipulated in such a manner as to establish foregone conclusions.
3. Even if correct figures are used, these may be presented in such a manner that the reader is misled. For example, note the following statement : "The profits of firm A are Rs. 80 crore for the year 2009-10 and that of firm B Rs. 98 crore for the same period." On the basis of this information only one would form the opinion that firm B is better than firm A. However, if we examine the amount of capital invested in both the firms, the quality or work done, etc., we might reach a different conclusion.

It should be noted that statistics neither proves anything nor disproves anything. It is only a tool. If properly used, tools can do wonders and, if misused, can be disastrous. The same is true of statistical tools. If used properly, they help in taking wise decisions and if misused they can do more harm than good. But the fault does not lie with the science of statistics as such.

### PROBLEMS

1-A. Answer the following questions, each question carries one mark :

- (i) What is business statistics ?
- (ii) Give any two uses of statistics.
- (iii) Can statistics prove anything ?
- (iv) Comment : Figures do not lie but liars figure.
- (v) Can single and isolated figures be called statistics ?
- (vi) What are the limitations of business statistics ?
- (vii) Why there is lot of distrust about statistics ?
- (viii) Is statistics science or art ?
- (ix) How statistics are useful to managers ?
- (x) Is comparison of statistical data desirable ?

4. *Statistics is only a means.* Statistical methods furnish only one method of studying a problem. They may not provide the best solution under all circumstances. Very often it may be necessary to supplement the conclusions arrived at by the help of statistics with the other methods that may be used to study a problem. It should be carefully noted that statistics is only a means and not an end. It analyses the facts and throws light on the real situation. In deciding a course of action it may be necessary to take into account the country's culture, religions, philosophy, personal, political or other non-quantitative considerations. Exclusive dependence on statistics may lead to fallacious conclusion in many situations.

5. *Statistics can be misused.* The greatest limitation of statistics is that it is liable to be misused. The misuse of statistics may arise because of several reasons. For example, if statistical conclusions are based on incomplete information, one may arrive at fallacious conclusions. Thus the arguments that drinking beer is bad for longevity since 99% of the persons who take beer die before the age of 100 years is statistically defective, since we are not told what percentage of persons who do not drink beer and die before reaching that age. Statistics are like clay and they can be moulded in any manner so as to establish right or wrong conclusion. Moreover, any Tom, Dick and Harry cannot deal with statistics. It requires experience and skill to draw sensible conclusions from the data ; otherwise, there is every likelihood of wrong interpretations. Also statistics cannot be used to full advantage in the absence of proper understanding of the subject to which it is applied.

### Distrust of Statistics

By distrust of statistics we mean lack of confidence in statistical statements and statistical methods. It is often believed that "Statistics can prove anything." "There are three types of lies—lies, damn lies and statistics—wicked in the order of their naming." The following three main reasons account for such notions being held by people about statistics :

1. Figures are convincing and, therefore, people are easily led to believe them.
2. They can be manipulated in such a manner as to establish foregone conclusions.
3. Even if correct figures are used, these may be presented in such a manner that the reader is misled. For example, note the following statement : "The profits of firm A are Rs. 80 crore for the year 2009-10 and that of firm B Rs. 98 crore for the same period." On the basis of this information only one would form the opinion that firm B is better than firm A. However, if we examine the amount of capital invested in both the firms, the quality or work done, etc., we might reach a different conclusion.

It should be noted that statistics neither proves anything nor disproves anything. It is only a tool. If properly used, tools can do wonders and, if misused, can be disastrous. The same is true of statistical tools. If used properly, they help in taking wise decisions and if misused they can do more harm than good. But the fault does not lie with the science of statistics as such.

### PROBLEMS

1-A. Answer the following questions, each question carries one mark :

- (i) What is business statistics ?
- (ii) Give any two uses of statistics.
- (iii) Can statistics prove anything ?
- (iv) Comment : Figures do not lie but liars figure.
- (v) Can single and isolated figures be called statistics ?
- (vi) What are the limitations of business statistics ?
- (vii) Why there is lot of distrust about statistics ?
- (viii) Is statistics science or art ?
- (ix) How statistics are useful to managers ?
- (x) Is comparison of statistical data desirable ?

## 14 Business Statistics

1-B. Answer the following questions, each question carries **four** marks :

- (i) Explain some important functions of statistics.
  - (ii) With the help of few examples point out the role of statistics in Business and management.
  - (iii) How statistics and computers are related ?
  - (iv) "Statistics is the foundation of sound decision-making". Elucidate giving suitable examples.
  - (v) What are the limitations of statistics ?
2. Define statistics. How does it help a manager ?
  3. How far can statistics be applied for business and management decisions ? Discuss briefly bringing out limitations, if any. [MBA, Delhi Univ., 2001]
  4. What is statistics ? How do you think the knowledge of statistics is essential in management decisions. Illustrate your answer through examples.
  5. Are statistical methods likely to be of any use to a marketing firm ? Illustrate your answer with some typical marketing problems and the statistical techniques to be used there. [MBA, Roorkee Univ., 2000, MBA, Delhi Univ., 2002, 2007]
  6. Comment on the following statements :
    - (i) "Figures do not lie but liars figure."
    - (ii) "The science of statistics is a most useful servant but only of great value to those who understand its proper use."
    - (iii) "Statistics is the science of averages." [MBA, HPU, 2004]
  7. "Statistics is a body of method for making wise decisions in the face of uncertainty." Comment on the statement bringing out how clearly does statistics help in business decision-making. [MBA, Osmania Univ., 2006]
  8. "There are three kinds of lies : lies, damn lies and statistics." Comment on this statement and point out the limitations of statistics.
  9.
    - (a) "Statistics is all-pervading." Elaborate.
    - (b) "Statistics is what statisticians do." Examine critically.
  10. "Statistics are numerical statements of facts but all facts numerically stated are not statistics." Comment upon the statement.
  11. How will you explain in brief the meaning of statistics to a layman ?
  12. Define statistics, and statistical methods. Explain the uses of statistical methods in modern business organizations. [MBA, Vikram Univ., 2005]
  13. Critically examine the following statements :
    - (a) "Statistics can prove anything."
    - (b) "Statistics only furnishes a tool, necessary though imperfect."
    - (c) Explain how statistics plays an important role in management planning and decision-making.
  14. Discuss briefly the applications of business statistics pointing out their limitations, if any.
  15. Describe the main areas of business and industry where statistics are extensively used. [MBA, Delhi Univ., 2007]
  16. "Statistics are like clay of which you can make a God or Devil as you please." In the light of this statement discuss the uses and limitations of statistics.
  17. With the help of a few examples explain the role of statistics as a managerial tool.
  18. "Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." Comment. Also give two examples of how the science of statistics could be of use in managerial decision-making. [MBA, HPU, 2005]
  19. Whether the statements are *true* or *false* : (i) Statistics are affected to marked extent by a multiplicity of causes, (ii) No volume of statistics can replace the knowledge and experience of executives.
  20. "Statistics is a method of decision-making in the face of uncertainty on the basis of numerical data and calculated risks." Comment and explain with suitable illustration.
  21. "Statistical Methods are most dangerous tools in the hands of the inexperts." Examine this statement. How are statistics helpful in business and industry ? Explain.
  22.
    - (a) Define statistics. Discuss its applications in the management of business enterprises. What are its limitations, if any ? [MBA, Jodhpur Univ.; MBA, HPU, 2007]
    - (b) "Without adequate understanding of statistics, the investigator in social sciences may frequently be like the blind man groping in a dark closet for a black cat that is not there." Comment.

23. (a) Explain the utility of statistics as managerial tool. Also discuss its limitations.  
 (b) "Modern statistical tools and techniques are basically important for improving the quality of managerial decisions." Explain this statements and discuss the role of statistics in planning and control of business. [MBA, HPU, 2008]
24. What role does Business Statistics play in the management of a business enterprise? Examine its scope and limitations.
25. "The fundamental gospel of statistics is to push back the domain of ignorance, rule of thumb, arbitrary or premature decisions, traditions and dogmatism and to increase the domain in which decisions are made and principles are formulated on the basis of analysed quantitative facts." Explain the statement with the help of a few business examples.  
 [MBA, Osmania Univ., 2002]
26. "Quantitative tools and techniques are basically important for improving the quality of managerial decisions." Examine the statement and discuss the role of quantitative techniques in planning and control of business activity.  
 [MBA, KU, 2009]

\*\*\*\*\*