Futuristic Trends in Management

Chapter: Prologue of Statistics in Management

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1 INTRODUCTION

According to a layman, 'Statistics' indicates the numerical information expressed in quantitative terms. Statistics is nothing but information. This information may describe observations of objects, subjects, activities, phenomena, or regions of space. Statistics deals with data. Information and data have no limits as to their reference, coverage, and scope. As data and information is the common field of work in both micro-level and macro-level so statistics is applicable for both macro-level and micro-level. For example: at the macro-level, statistics is applied in gross national product, shares of agriculture, manufacturing, and services in GDP (Gross Domestic Product). Similarly, at the micro level, individual firms, howsoever small or large, use statistics on their operations. The annual reports of different companies including IT sectors contain variety of data on sales, production, expenditure, inventories, capital employed, and other activities to get the meaningful information. These data and information collected by employing scientific survey techniques both in macro-level and micro-level are considered as important in the field of study, research, business and management. This is the reason why a student used to learn statistics more intimately as a subject of study like mathematics, chemistry, physics, economics, and others. Statistics is thus a discipline, which scientifically deals with data and information, and is often known as the science of data. In dealing with statistics as data, statistics has grown proper methods of collecting, presenting, summarizing, and analyzing data to give meaningful information.

2. BASIC DEFINITION OF STATISTICS

In the introduction part, the word 'statistics' is used in two senses: plural and singular. In the plural sense, it means to a set of figures or data. In the singular sense, statistics means to the whole body of tools that can be used to collect data, organize and interpret them and, finally, to draw meaningful conclusions that can be used. It is important to note that both the aspects of statistics are significant if the quantitative data are to fulfill their purpose. If the statistics, as a subject, is insufficient and consists of improper methodology, it will be very difficult to know the right information that can be extracted from the data the information they contain. Similarly, if our collected data are defective or that they are insufficient or improper, we could not reach the right conclusions even though our subject is well established. That's why it is important to define the "statistics" in a meaningful way. Here the author has shown some well-established definition of statistics. These are:

According to A.L. Bowley, the statistics can be defined as the science of :

- Counting
- Averages
- Measurement

According to Boddington the statistics can be defined as the science of estimates and probabilities.

W.I. King has defined statistics as the science of statistics used for judging phenomena collectively from the results obtained by the analysis or enumeration or collection of estimates.

According to *Seligman* statistics deals with the methods used for collection, classification, presentation, comparison and interpretation numerical data got from enquiry.

Spiegal defines the statistics by indicating its importance in decision-making particularly under uncertainty. According to him, statistics is concerned with scientific method for collecting, organizing, summarizing, presenting and analyzing data as well as drawing valid conclusions and making reasonable decisions on the basis of such analysis.

As par Prof. *Horace Secrist*, Statistics is nothing but the aggregate of facts that can be affected by different causes and can be applied to fulfill numerous demands.

Now if we will go through the above definitions, we can get the major characteristics of statistics. The major characteristics of statistics can be said as:

- **Statistics are the aggregates of facts.** It means a single figure is not the statistics. For example, the annual income of a nation for one calendar year is not statistics but the same for more years can be considered as statistics.
- **Factors may affect the statistics**. For example, the sale of i-phone-11 will depend on many factors such as its features, Camera quality, storage capacity, price, and so on.
- **Statistical data must be reasonably accurate.** The analysis of wrong data may lead to erroneous conclusions. For that reason, it is required to make conclusions based on accurate figures.
- **Systematic data collection in statistical may give proper information**. Statistical data collected in a random way are not at all reliable and may mislead to frame conclusions.
- **Statistical informations are collected in a systematic manner for a pre-determined purpose.**
- **Statistical data are comparable.** This means the data collected in statistics are correlated to each other. The non-correlated or non-comparable data may cause confusion to make any logical decision.

3. TYPES OF STATISTICAL DATA

Statistical data can be considered as the basic raw material of statistics in order to get some important information. Statistical Data are correlated to an activity of our interest, a phenomenon, a real-life problem, or a situation in practical life. Statistics is derived as a result of the process of observation an event, measurement of experiment, or counting of data set. Thus the data collected statistically, therefore, refer to that facet of a problem state that can be viewed, measured, quantified, included, or classified. Any object-subject phenomenon or activity that generates valid data through statistical process is termed as a variable. In other words, a variable is one that has a degree of variability when successive measurements are noted or taken down. In statistics, data are classified into two categories: quantitative data and qualitative data. This data are classified on the basis of characteristics that are measured and quantified.

3.1 Quantitative data: Quantitative data are those that can be quantified in definite units of measurement. These data are related to real measurement. This indicates that the quantitative data refer to characteristics whose successive measurements yield quantifiable observations. Depending on the nature of the data got from measurement, quantitative data can be further classified as continuous and discrete data. In this sense, a variable may be a continuous variable or a discrete variable.

(i) Continuous Data: Continuous Data represents the numerical value of a continuous variable. A continuous variable is the one that can be assumed any values between any two points on a line segment, thus representing an interval of values. Though the values are close to each other and quite precise still these are distinguishable. For examples such as weight, length, height, thickness, velocity, temperature, tensile strength, etc., are considered as the continuous variable. Thus, the data collected on the basis of these properties are called continuous data. It may be considered that a continuous variable follows the finest unit of measurement. "Finest" is taken in the sense that it permits measurement to the maximum degree of precision.

(ii) Discrete data: Discrete data can be assumed as the values that depends on discrete variable. A discrete variable is the variable whose outcomes are

measured in fixed numbers. Such data are essentially countable data. These are obtained from a method of counting, such as the number of items holding or not holding a certain characteristic. The number of peoples roaming in a park daily, the incoming trains at a railway station , and the imperfact items in a consignment received for sale, are all examples of discrete data.

3.2 Qualitative data indicates the quality of a subject or an object. These data are qualitative in nature when its inspections are explained and recognized in terms of having a certain attribute in discrete manner. These data are further categorized as rank data and nominal.

(i) **Nominal data:** These are the practical outcome of classification into two or more categories of items or units comprising a population or a sample according to some specific characteristics. For example, Classification of students according to sex (as females or males), of workers according to skill (as unskilled, skilled, and semi-skilled), and of employees according to the level of education (as Secondary, Higher secondary, undergraduates, and post-graduates), are considered as the result of nominal data. Given any such basis of grading, it is always possible to allocate each item to a definite class and make a summation of items associated with each class. The count data so procured are called nominal data.

(ii) **Rank data**: Rank data on the other hand, are the result of assigning ranks to the specify order in terms of the integers such as 1, 2, 3... n. Ranks data can be assigned according to the level of performance in a test, a contest, a competition, an interview, or a show. For example, the candidates appearing in an interview may be assigned ranks in integers such as 1, 2 …so on depending on their performance in the interview.

3.3 Basic Data: Basic data could be seen as of two types, viz., secondary data and primary data. These are:

(i) **Secondary data:** The secondary data are used to exist either in the form of published or unpublished. Thus these are the identifiable secondary source. For example: data in a newspaper or in books are all secondary data. Because these

data are collected by someone else earlier and these are in the form of published data.

(ii) Primary data: These data are the data collected for the first time from the primary source applying personal experience. For this reason, primary data are fresh data. These are also known as raw data. These data provides the first hand information. Primary data may be collected through interview, experiment, survey, etc. Primary data are usually gathered from the main source—where the data originally arises from and are considered as the best kind of data in research.

4. TYPES OF STATISTICS

Two types of statistics are there. These are: descriptive statistics and inferential statistics. The term **descriptive statistics** gives out with collecting, summarizing, and simplifying data, which are otherwise quite bulky and capacious. It seeks to reach this in a manner that significant conclusions can be willingly drawn from the data. Descriptive statistics may thus be considered as comprising methods of publishing and highlighting the latent characteristics exist in a set of numerical data. It not only simplifies an understanding of the data and systematic reporting thereof in a manner; and also makes them manageable to further discussion, analysis, and interpretations.

The first step in any scientific examination is to collect data relevant to the problem in hand. When the scientific examination correlates to natural sciences, data collection process becomes an integral part of the examination itself. In fact, the very manner in which an experiment is designed, determines the kind of data it would need and/or produce. The problem of identifying the nature and the kind of the appropriate data is thus naturally bent on as soon as the design of experiment is decided. It is feasible in the case of natural sciences. In the case of social sciences, where the required data are often gathered through a questionnaire from a number of precisely chosen respondents, the problem is not that simply resolved. For one thing, framing the questionnaire itself is a critical primary issue. For another, the number of respondents to be obtained for data assembles and the criteria for selecting them have their own indications and significance for the quality of outcomes obtained. Further, the data have been accumulated; these are collected, organized, and presented in the form of proper tables to make them clear and reliable. Wherever required, figures, diagrams, charts, and graphs are also utilized for better presentation of the data. For the meaningful tabular and graphic demonstration of data, the raw data should be properly classified, analyzed, and studied in accordance with the objectives of investigation.

A well fairy and acute data classification facilitates easy description of the hidden data properties by means of the concise summary. These comprise estimation of central tendency, dispersion, and kurtosis, which build the necessary scope of descriptive statistics. These include a large part of the subject matter of any basic textbook on business statistics, and thus they are being considered in that order here as well.

Inferential statistics, also known as explicit statistics, indicates beyond describing a given problem circumstances by means of collecting, summarizing, and meaningfully representing the related data. Instead, it includes several methods that are used for depiction inferences, or making specific, about a entirety of observations on the basis of knowledge about a part of that entirety. The entirety of observations about which an inference may be depicted is called a population or a universe. The part of entirety or totality, which is noticed for data collection and analysis to obtain knowledge about the population, is called a sample.

The desired information about a given population of our interest; may also be gathered even by observing all the units comprising the population. This total scope of observation is called census. Obtaining the desired value for the population through census is not always practical and realizable or various reasons. Apart from time and money, concerns making the census operations exclusive, observing each individual unit of the population with reference to any data property may at times embroil even destructive testing. In such cases, undoubtedly, the only option available is to engage the partial or incomplete information collected through a sample for the purpose. This is strictly what inferential statistics works. Thus, getting a particular advantage from the sample information and using it for sketching an inference about the whole population underlies the subject matter of inferential statistics. Consider a situation in which one is needed to know the average body weight of all the college students in a given area during a particular year. A quick and normal way to do this is to note the weight of only 500 students, from out of a total strength of, say, 10000, or an unknown total strength, take the average, and use this average based on incomplete weight data to indicate the average body weight of all the college students. In a different situation, one may have to do this exercise again for some future year and use the quick evaluate of average body weight for a differentiation. This may be required, for example, to check whether the weight of the college students has undergone a notable change over the years compared.

Inferential statistics assists to check the risks engaged in reaching inferences or informations about an unknown population on the basis of sample survey. For example, a review of a sample of five battery cells drawn from a given lot may disclose that all the five cells are in quite good condition. This information may be utilized to utter that the entire lot is good enough to purchase or not.

Since this inference is based on the review of a sample of limited number of cells, it is equally probable that all the cells in the lot are not in order. It is also possible that all the items that may be listed in the sample are doubtful. This may be utilized to understand that the entire lot is of doubtful quality, whereas the fact may require be otherwise. It may, thus, be observed that there is always a thread of an inference about a population being improper when based on the knowledge of a limited sample. The liberation from such situations lies in judging such risks. For this, statistics provides the necessary processes. The risks on quantifying in statistics, the term "chances of decision" has accepted on the basis of incorrect sample information. This needs an understanding of the what, why, and how of probability and probability distributions to provide ourselves with methods of picturing statistical inferences and analyzing the degree of credibility of these inferences.

5 SCOPE OF STATISTICS IN BUSINESS

Apart from the methods comprising the scope of descriptive and inferential branches of statistics, statistics also contains the methods of dealing with a few other matter of specific nature. Since these methods are necessarily descriptive in nature, they have been talked over here as part of the descriptive statistics. These are essentially concerned with the following:

(i) It often becomes requisite to test how two paired data sets are correlated. For example, we may have data on the purchase of a product and the expenditure incurred on its advertisement for an identified number of years. Given that purchase and advertisement expenditure are correlated to each other, it is convenient to inspect the nature of relationship between the two and quantify the degree of that relationship. As this requires proper statistical methods, these falls under the ken of what we call regression and correlation analysis.

(ii) Situations ensue quite often when we need averaging (or totaling) of data on prices and/or quantities revealed in different units of measurement. For example, price of book may be quoted per unit and that of cold-drink per bottle. Since general methods of totaling and averaging do not embed to such price/quantity data, special techniques required for the objective are developed under index numbers.

(iii) Many a time, it becomes essential to test the past performance of an activity with a view to determining its future scope. For example, when involved in the generation of a commodity, monthly product sales are an important measure of testing the performance. This needs the compilation and analysis of relevant sales data over the time. The more complex the activity, the more diversed the data requirements. For profit, maximizing and future sales planning, predicts of likely sales growth rate is important. This requires meaningful collection and analysis of past sales data. All such concerns handle the past data under time series analysis.

(iv) Achieving the most likely future determines on any aspect(s) relating to a business or economic task has indeed been involving the minds of all concerned. This is particularly significant when it correlates to product sales and demand, which work for the necessary basis of production scheduling and planning. The regression, correlation, and time series analyses together bloom the basic methodology to work in meaningful way. Thus, the study of methods and strategies of obtaining the likely determines on business/economic

variables includes the domain of what we do under business overview.

Keeping in line the significance of inferential statistics, the area of statistics may finally be reword as consisting of statistical methods which make possible decision making under conditions of chance. Though the term statistical process is often used to enclose the subject of statistics as a whole, but sometimes it indicates a method by which statistical data are collected for making a decision.

Though generic in nature and multipurpose applications, statistical methods have come to be largely used, especially in all matters concerning business and economics. The statistics is also being increasingly used in biology, medicine, agriculture, psychology, and education. The scope of application of the statistical methods has started opening and expanding in a number of social science disciplines as well. Even a political scientist observes them of increasing importance for testing the political characteristics and it is; of course, no astound to realize even historians statistical data, for history is basically past data presented in certain genuine layout.

6. SIGNIFICANCE OF STATISTICS IN BUSINESS

There are three vital purposes in any business enterprise in which the statistical methods are convenient. These are as follows:

- **Operational Planning:** This may relate to either special projects or to the recurring activities of a business over a enumerate period of time.
- **The setting up of standards:** This may describe to the size of employment, volume of sales, determination of quality norms for the industrial product, records for the daily output, and so forth.
- **The function of control:** This requires examination of actual production achieved against the norm or target or goal set earlier. In case the production has failed to achieve the goal, it gives remedial steps so that such a shortage does not arise again.

It is important to note that although these three functions-planning of operations, setting standards, and control-are distinct, but in reality they are very much connected.

Different authors have explained the significance of Statistics in business. For example, Croxton and Cowden have shown various uses of Statistics in business such as budgetary planning and control, project planning, inventory planning and control, marketing, quality control, production and personnel administration. Within these they have described certain areas where Statistics is very important. Another author, Irwing W. Burr, dealing with the place of statistics in an industrial organization, identifies a number of areas where statistics is vastly functional. These are: demand of the customer, market review, inspection, purchasing, production, development design and specification, costs, management control, sales and complaints, inventory and maintenance, packaging and shipping, industrial engineering and research.

Statistical methods emerging in the course of business operations are diverse. As such, one may highlight some of the more important areas to emphasis the relevance of statistics to the business world. In the production areas in business, for example, statistical methods can be used in various ways.

Statistical quality control methods are used to confirm the quality of the products. By this way the defective or substandard goods can be identified and reject accordingly. The target of the business can be set on the basis of prediction of sale,

which are done by applying statistical method of forecasting. Analysis of sales affected against the goals set earlier would specify the shortage in achievement, which may be on account of several causes: such as

(i) Unrealistic Targets

(ii) Poor performance of the Salesmen's

(iii) High market competition

(iv) Low quality of company's product, and so on.

Another important issue in business where statistical methods can be used is personnel management. Here, one is aware of the salary, promotion and performance appraisal of individual employee for maintain personal business management. Here the concept of productivity is considered as an important factor. On the basis of quantifying of productivity, the productivity bonus is rewarded to the employees. Comparisons of wages and productivity are deal with in order to confirm increases in industrial productivity.

Statistical methods could also be used to find out the efficacy of a specific product, say, drug or medicine. For example, a pharmaceutical company has developed a new drug or medicine for the cancer patients. Before launching it on commercial purpose, it needs to specify the effectiveness of this drug. It undertakes an investigation involving the formation of two comparable groups of cancer Patients. One group is given this new drug or medicine for a specified period and the other one is dealt with the usual medicines. Results of both the cases are maintained for the specified period of time. This result is then analyzed to identify if there is any notable difference in the recovery of the two groups. If the difference is really notable statistically, then only the new medicine is launched commercially.

7. LIMITATIONS OF STATISTICS

Statistics has a number of limitations; some of them are as follows:

- The concept of statistics is applicable for data or informations that can be quant. The statistics cannot be applied for the case where data cannot be quantified, example, beauty, intelligence, courage, etc. Statistics has no place in all such cases as quantification is not possible.
- Statistics deals with the average measurement. An application of the 'average' concept if applied to an individual or a particular measurement may give wrong results. For example, one may be misguided when said that the average depth of a river from one bank to the other is ten feet, when there may be some points in between where its depth is far more than or less than ten feet. On this interpretation, one may enter those points having greater depth, may face problem.
- Since statistical data are collected for a certain purpose, such data may not be applicable or helpful in other situations or cases. For example, the marks of a student may not be useful for a farmer.
- All the laws in statistics are not exact. That's why statistics is not 100 per cent correct or accurate.
- The users of statistics should be aware of the error and limitation. Otherwise wrong interpretations may hamper the result.
- In statistical surveys, sampling is generally utilized as it is practically not possible to consider all the units or elements consist of the universe. The results may not be appropriate as far as the universe is concerned. Moreover, different survey reports on the basis of same size of sample but different sample units may give different results.
- In statistical correlation between two or more variables is studied, but such a correlation does not show cause and effect relationship. It simply indicates the similarity or dissimilarity in the change of the variables. In such cases, it depends on the user to interpret the results carefully.
- A notable limitation of statistics is that it may not disclose all relevant information of a certain phenomenon. There may be some background information that statistics does not cover. The user of Statistics has to be well informed and should interpret probable outcome by keeping in mind all other aspects.

8. SUMMARY & CONCLUSION

In general we can define that ‘Statistics’ is the numerical information expressed in quantitative terms. According to various study report, statistical data have no limits according to their scope, coverage, and applications. Statistics in business management can be used both in micro-level and macro-level. For example, the annual reports of many companies used to contain business related data such as the target, employment, productions, marketing and other activities. Here we will get the involvement of both macro-level statistics and micro-level statistics. These data are extremely important to run a business properly and efficiently. Wrong statistical data may lead to monetary loss or it may hamper the overall growth of the company. This is the reason why the statistics is important in the field of business. Here the author has just given a massage to all the stakeholders of companies to use proper statistics for the growth of their business.