Fundamentals of Economic Statistics

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1

ECONOMIC STATISTICS : DEFINITION AND SCOPE

Research is paramount to testify certain theories propounded by physical or social scientists by various methods available at that time. The evolution of methods, tools, procedures and techniques over time is a continuous process. Theory and experiments go hand in hand with each other either to complement each other or to provide sound basis for conceptual frame work. Thus, theoretical and empirical endeavours abound literature. It is the enguinty, intelligence and need of the experimenters, researchers, scientists, teachers and policy makers to select one which is best suited under different conditions and assumptions. No doubt, experiments shall generate data, theories shall be put forward, laws shall be enunciated and proclaimed to probe into Nature's wonders to make the life of common man easy and comfortable. This endeavour has given birth to many branches of science and social science. Economic Statistics in one of them.

Economic Statistics deals with economic data collection, recording and classifying them, making of graphs and diagrams, and then describes the pattern, changes and impact over time and space, possibly describing relationships between different economic variables, which helps policy makers and planners to take decisions to set on course the economy of a country.

The economists have contributed a lot in developing different models covering widespread fields of economic life embracing a variety of economic problems. During the times of Historical schools it was a burning problem whether the study should be based on data or on some presupposed laws, axioms and statements. But for the sake of exact, systematic,

valid, objective, accurate and repetitive study, approach and efforts should be as far as possible, scientific and based on experiments or on sound observation over time by many to give the theory (law) universal acceptance. In exact sciences there is very little scope of deviation while the same exactness cannot be expected in social sciences as the subjects are human beings and experiments are conducted in uncontrolled situations. Thus, the assertions, decisions, inferences may vary some times to larger extent. To reduce such variations attempts are made to make use of statistical techniques which are governed by probability laws thus encompassing possibility of uncertainty by making use of error terms in various models.

No doubt Prof. Irving Fisher first of all developed his quantity theory of money with the help of data. Prof. Oskar Lange remarked "Attempts at a quantitative approach to the laws (relations) of which economic theory speak, by means of statistical methods go back much further" In fact to verify economic laws and governmental policies statistical methods are main contributions. In 1926, Prof. Ragner Frisch, a Norwegian economist and statistician, first of all named this science "Econometrics". The expression "Biometrics" guided him to name this way as biometrics was used to name the field of biological studies employing statistical methods. In 1931 'Econometric Society was founded as the necessity of econometric work had become popular. Since then econometric work has encompassed and embraced almost each sphere of Economics. Totally different science emerged and many economists and statisticians defined the term Econometrics in many ways. Prof. G. Tintner has defined "It (econometrics) consists of the application of mathematical economic theory and statistical procedures to economic data in order to establish numerical results in the field of economics and to verify economic theorems". Prof. Goldberger has defined econometrics as, "A social science in which tools of economic theory, mathematics and statistics are applied to economic phenomenon". Prof. O. Lange defined it as, "Econometrics is the science which deals with the determination of statistical methods of concrete quantitative laws occurring in economic life". According to Samulson, Koopman and Stone, "Econometrics may be defined as the quantitative analysis of actual economic phenomenon based on the concurrent development of theory and observations, related by appropriate methods of inference". Actually, "It is the application of statistical inference on economic theory expressed in appropriate model under certain assumptions and conditions to provide quantitative measures for easy and conveinent comprehension". The statistical methods over the years are becoming sophisticated and complex to tackle different kinds of models under different conditions and data availability. However,

the results can be obtained through fast computers which were otherwise very difficult or to some extent impossible. Thus main aim of Econometrics is to develop, test and modify economic relationship among different variables and to give quantitative character by using statistical procedures for making rational decisions. That way, Econometrics is different from Economic Statistics since as Prof. Tintner remarked "The study of economic institutions, especially of the legal framework of economic activity, is also a useful procedure in economic research. An institutionalist study of banking system, trade union organization, *etc.* may give us great insight into nature of these phenomena and enable us to understand certain economic features of a given society. Econometrics can not claim a monopoly as a method of economic research". Following remarks by Prof. R. Frish in 1933 from the opening editorial of 'Econometrics' give a clear idea of the scope, limitations and method of econometrics.

"But there are several aspects of the quantitative approach to economics, and no single one of these aspects, taken by itself, should be confounded with econometrics. Thus, econometrics is by no means the same as economic statistics. Nor is it identical with what we call general economic theory, although a considerable portion of this theory has definite quantitative character. Nor should econometrics be taken as synonymous with the application of mathematics to economics. Experience has shown that each of these three viewpoints, that of statistics, economic theory, and mathematics, is a necessary, but not by itself sufficient, condition for a real understanding of the quantitative relations in modern economic life. It is the unification of all three that is powerful. And it is this unification that constitutes econometrics."

The remarks of Prof. Frish clearly indicates that econometrics is the unification of statistics, economic theory and mathematics. However, when we translate economic theory into mathematical form, it gives rise to Mathematical Economics which is quite different from Econometrics and Economic Statistics.

Mathematical Economics present, state and analyse economic theory in terms of mathematical symbols and analysis. Actually, there is no difference between economic theory and Mathematical Economics as both of them express the same relationship in different languages; economic theory is verbal form which is expressed in Mathematical form (symbols) in Mathematical Economics. Another important point in Mathematical Economics is that the various economic relationships are put in an exact form in mathematical exposition and treated as such for analysis and deriving solutions. In other words, no term (*e.g.* error) is considered for the relationships (*e.g.* functions) in Mathematical

Economics and also estimates of the coefficients of relationships are not provided in numerical form as done in econometric work.

The basic ingredient for Econometrics is data which for Mathematical Economics, is the mathematical transformation of economic theory. Economic Statistics is appropriate, valid, accurate and reliable data collection through sample surveys by defining and explaining different economic terms to avoid ambiguity and confusion. Economic Statistician conducts and guides the whole process of data collection, recording, editing and classifying which can be reported or published to be used by others. Different data banks are also developed and stored in computers for its retrival. Thus, the building blocks of any econometric study are made by economic statistician. Idealy, this should be the case, however data collection and econometric analysis is done by experimenter himself which some times may lead to faulty conclusions as the data collected may not be proper as per definition of economic theory.

Another important aspect in Economic Statistics is the construction of different indices which act as barometers for any economy. Comparisons can be made of different economies or the same economy at different times. Welfare of the people can be compared through cost of living index whole sale price index (WPI), HDI, GDI, *etc.* are many such examples where the concepts of Economic Statistics are used with great advantage.

The analysis of time-series, actually was undertaken with economic statistics as base where in decomposition of time-series took place but now-a-days because of new procedures and advent of computers, time-series analysis has assumed different proportion but its roots are still in economic statistics. This has largely helped in forecasting and predicting certain economic variables which has provided necessary input to policy makers and planners to great extent.

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2

INTRODUCTION TO STATISTICS

What is statistics ?

The word ‘statistics’ has been derived from the Latin word ‘status’ or the German 'statistik’ both of which means a ‘political state’. The word statistics is used in both singular and plural sense. In plural sense it is used to refer some numerical statements of facts or quantitative information pertaining to a phenomenon. For example number of students in a college, male and female students, married and unmarried or undergraduates and postgraduates, statistics of production figures of various industries. As a singular form the term ‘statistics’ is used to describe the subject that refers to the statistical techniques or methods of collecting, compiling, presenting, analyzing and interpreting quantitative data. Statistics is usually not studied for its name sake, but it is useful as an invaluable tool or scientific method in the analysis of various problems in the natural as well as social sciences. Statistics have today assumed the greatest importance in the study of Economic Statistics.

In Economic Statistics the main aim of statistics is to enable comparison between past and present results with a view to determine the causes for changes which have taken place and the effect of such changes in the future also. Statistics aims at describing, analyzing, classifying and extracting salient features of a mass quantitative data. Thus according to Croxton and Cowden "statistics may be defined as a science which deals with the methods of collection, classification, presentation, comparing and interpreting numerical data to throw light on any sphere of enquiry."

Scope of Statistics

Today the scope of statistics has become considerably wider than what was in the past. Long ago statistics was conceived as a state craft only. But nowadays, it has become a universally applicable scientific method. Statistics covers all fields of study in which we have to deal with quantitative data or even qualitative data which is changed into quantitative one. Almost all branches of science in which various laws are to be verified on the basis of some numerical facts necessitate the study of statistical techniques. Thus, statistics is essential whenever there is a need to study quantitative characteristics and various statistical methods provide scientific measurement of numerical changes in complex groups and judging collective phenomena. Its scope is, therefore, very extensive and its application is almost universal so far as quantitative characteristics of study are concerned particularly to economists, businessmen and scientists. We give below some of the uses of statistics in economics.

Role of Statistics in Economics

It is almost impossible to find a problem in the field of economics which does not require an extensive use of statistical data. One can realise the importance and use of statistics in all branches of economics. Any economic study such as production function, per capita income*, etc.* can easily be measured from statistical methods. Since various economic problems such as level of income, production, employment, demand, supply, consumption, prices*, etc.* involve facts that are capable of being expressed numerically so these are best suited to statistical treatment. An appropriate statistical approach applied to any economic problem not only leads to its correct description but also suggest the method by which it is to be tackled. Thus statistics is indispensable in many branches of economics. So, one can conclude that an economist ought to know how to handle numerical data within his field *i.e.* how to collect, present, describe and analyse statistical data and draw inferences therefrom.

Economic Statistics

Economic Statistics may be defined as methods of collecting, presenting, analyzing and interpretation of economic data. It pertains to descriptive and general statistical methods used and applied specifically to economic quantitative data. Economic statistics thus refer to knowledge of statistical techniques which are useful in the economic studies. In real sense Economic Statistics is not much different from general statistical methods as may be necessary to analyze the quantitative data. So one may use the term Economic Statistics for the subject

called as statistical methods for economics or economists. Economic Statistics thus confine to those statistical methods/techniques which are relevant for treating economic data for grouping, modelling, forecasting and estimation of economic relationships.

Limitations of Statistics

Although statistics is being used/ applied in almost all areas of human knowledge and widely applied in a variety of disciplines such as business, economics and research yet it suffers from the following limitations :

1. Statistics deals only with aggregates and not with individual measurements. So the study of individual measurements have no meaning in statistics. Hence, statistical study is applicable to only these problems when they relates measurement of masses. For example, production of, say wheat crop in a particular year does not carry any meaning in statistical terms unless we have production figures of wheat crop in previous years or we have production of some other crops in the same year with which production of wheat crop can be compared.
2. Statistics deals with quantitative characteristics and not qualitative characteristics. Thus the characteristics which cannot be expressed numerically like honesty, efficiency, intelligence, health conditions etc cannot be analyzed directly statistically. These characteristics can be statistically dealt with only if some quantitative value can be assigned with some logical criterion.
3. Statistical conclusions/ results are true only on an average. So what is true for a group of individuals / items may not be true for an individual in drawing statistical conclusion.
4. Statistical results are not universally true *i.e.* they are true under certain conditions. This is because statistical results are approximate and not mathematically exact.
5. Statistical interpretations require a high degree of skill and understanding. So, in order to get meaningful results it is necessary that data be collected and analyzed properly and critically interpreted by some experienced / trained persons otherwise it may lead to fallacious conclusions.
6. Major 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 can arrive at fallacious conclusions. The argument that drinking wine is harmful for longevity because 99% of persons who take wine die before they reach the age of 100 years is statistically defective because it has not been compared with

what percentage of people who do not drink wine die before reaching the age of 100 years. Hence statistical conclusions may be highly misleading.

Some Basic Statistical concepts

Prior to a detailed study of statistics it is essential to understand the following basic statistical concepts.

Population/Universe : A population in statistical terms is the totality of things under consideration or aggregate of units under study. In other words, a set of collection of objects pertaining to a phenomenon of statistical inquiry is termed as 'population' or 'universe' *e.g.* group of students in a college, yield of wheat crop in various fields in a village, population of incomes of various college teachers in a university*, etc.* The individual items in the population are termed as elementary units or members of the population.

Finite population : A population/universe with finite/countable number of members is known as finite population *e.g.* population of smokers in a city, population of heights of various students in a class, population of prices of various commodities in particular market.

Infinite Population : If number of members/units in a population are not countable or infinite it is known as infinite population *e.g.* number of trees in a forest, population of pressures at various points in the atmosphere.

Hypothetical Population : It is an abstract population *e.g.*, in tossing of coin, number of heads. We don't know how many times it has been tossed in past and will be tossed in future.

Sample : A finite subset of a population, units of which are taken by specified procedure to represent that population is known as sample. Alternately a sample is the fraction of a universe. For example if someone is interested to study the income pattern of various workers in a factory where there are 5000 workers then if we select only 500 numbers out of entire population of 5000 numbers for the purpose of our study then this number of 500 workers constitute a sample. From this sample study, statistical inferences may be drawn regarding the whole population. So one must be very careful in selecting the sample. The sample may be drawn in such a way that it is true representative of the population. So sample should be drawn in a such a way that each member/ unit of the population has equal chance of being selected. Such a representative sample is known as random sample.

Parameter : Any statistical measure for population like population

mean, population standard deviation*, etc.* computed from population observations is known as parameter. For example if there are 50 students in a class having different heights and if average of heights of all students is calculated, it is known as parameter. In short, parameters are descriptive measures of a population or universe or are constants of population.

Statistic : A measure that describes any characteristic of a sample is called statistic *e.g.* sample mean, sample variance etc are statistics. Thus, the term statistic is used for the descriptive measure of a sample.

Parameter is a constant for the population under statistical investigation while statistic varies from sample to sample Conventionally, parameters are denoted by Greek letters *e.g.* μ for mean, σ for standard deviation*, etc.* while statistics are denoted by Roman letters *e.g.* $\overline{X}$ for sample mean, 'S' for sample standard deviation*, etc.*

In statistical analysis, statistical inferences are drawn or determine (estimate) parameters from statistics (calculated from observed sample data). Hence, if the sample is a good representative of the parent population, statistic provides a good estimate of the corresponding parameter of the population.

Variable : Any characteristic which assumes different values (varies) from time to time, place to place or individual to individual is called a variable. Alternately, a variable is a quantity which varies from one individual observation to another within a given range of values *e.g.* heights, weights, ages of a group of persons, daily rainfall at a certain place, temperature during different hours of a day, production of wheat crop in different years etc are all variables.

The particular numerical value of a variable is known as variate. Depending upon the type of values, a variable can be termed as :

Discrete Variable : A variable that can assume only integral values (whole numbers) and cannot be measured but counted is called discrete variable *e.g.* number of books in a library, number of farmers in a village, number of children per family, number of plants per plot*, etc.* are discrete variables.

Continuous Variable : A variable which can take any numerical value within a certain range and can be measured is known as continuous variable *e.g.* height of various students in a class, production of wheat crop in different years of a state, sale of a particular commodity in different months of a year*, etc.* are some examples of continuous variable.

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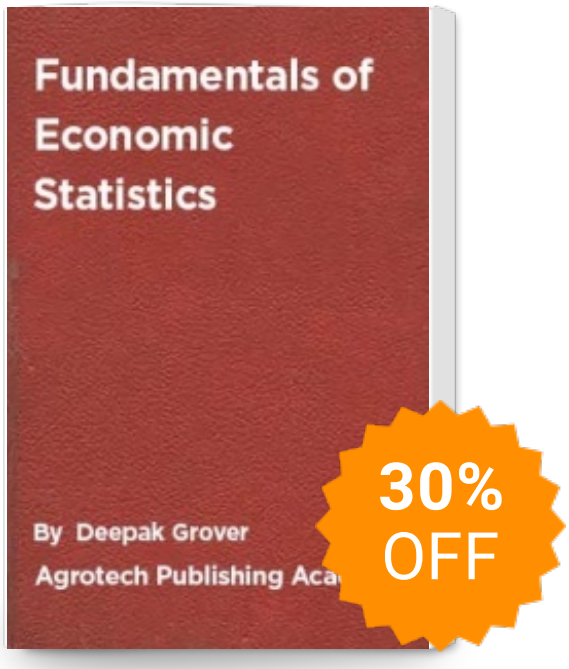

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