

CHAPTER

1

Introduction

1.1 INTRODUCTION

The word “Statistics” have been derived from the Latin word status or the Italian word statista, both meaning a political state. The naturalists, the biologist, the astronomers, the administrators, the businessmen, and the economists all make use of statistical methods and facts. Its scope has become so wide today that few statisticians, if any, are expert in all branches.

Definitions:

A.L. Bowley defines “Statistics may be called the science of counting”.

At another place he defines “Statistics any be called the science of averages”.

According to King “The science of statistics is the method of judging collective, natural or social phenomenon from the result obtained from the analysis of enumeration or estimates”.

Boddington has defined “Statistics as the science of estimate and probabilities”.

1.2 HISTORICAL PERSPECTIVE

It is a well known fact that statistics had its origin in statecraft and roots in Mathematics brought about the development in the probability theoretic approach to statistics. The important contributions in this field are given by Pascal, Fermat, Bernoulli, Moivre, Laplace, Gauss and Quetlet. Also some prominent mathematician and statistician of the 19th century namely, Galton, Pearson and Fisher contributed their works on correlation and regression.

1.3 APPLICATIONS OF STATISTICS

- 1. To the Governance of Public bodies :** These are the days of planning and any plan, to be successful, must be based on statistics. An estimate of the revenue and expenditure for the ensuing year is necessary for the successful running of the Government machinery.
- 2. In Business and Commerce :** A manufacturer in order to be successful should make a study of the seasonal changes in the demand of his goods and the rates of interest for borrowing.



FACTS : TO THE POINT

- ▶ H. Secrist define statistics as “the aggregate of facts, affected to a marked extent by multitude of cases, numerically expressed, estimated according to a reasonable standard of accuracy, collection in a systematical manner for a predetermined purpose and placed in relation with each other.”
- ▶ Achenwall ‘the Father of statistics’ in 1749 defined statistics as the political science of several centuries.
- ▶ Term Statistics is used in two different senses. Singular form and plural form.
- ▶ Inferential statistics involve those statistical procedures which are used to draw an inference about the conditions or characteristics of a large population by studying attributes of some small samples drawn from that population randomly.
- ▶ The statistics used in collecting data about economics, educational, social and political matters is known as applied statistics.
- ▶ The statistics used to make predictions after analysing the data available, is called predictive statistics.

Insurance companies in deciding upon the premium to be charged or the annuities to be granted have to consider the mortality of sickness etc.

3. **In Medical Sciences :** Statistical methods are necessary in finding the effectiveness' of medicines and drugs for the prevention and cure of disease.
4. **In Agricultural Research :** Much ingenuity and statistical knowledge is required in the design and analysis to test the effect of different types of manures, levels of irrigation and varieties of Crops.
5. **In Meteorology :** Whether forecasting depends on statistical methods.
6. In advantageous in education, anthropometry and higher sciences.

1.4 CHARACTERISTICS OF STATISTICS

1. Statistics is the aggregate of facts.
2. Statistics is numerically expressed.
3. Statistics is usually affected by multiplicity of causes and not by single cause.
4. Statistics must be related to some field of inquiry.
5. Statistics should be capable of being related to each other. So the some cause and effect relationship can be established.
6. The reasonable standard of accuracy should be maintained in statistics.

1.5 LIMITATION OF STATISTICS

1. Statistical laws are held to be true on the average and in the long run.
2. Statistics can be used to analyse only collective matters not individual events.
3. It is applicable only to quantitative data.
4. Statistical results are ascertained by samples. If the selection of samples is biased, errors will accumulate and results will not be reliable.
5. The greatest limitation of statistics is that only one who has an expert knowledge of statistical methods can efficiently handle statistical data.

1.6 INTRODUCTION TO BIOSTATISTICS

Statistics has wide application in almost all sciences—social as well as physical such as biology, medicines, agriculture, veterinary, economics, psychology, ethnology, business management etc. It plays a major role in bioscience because data of bioscience are of a variable nature. It is very difficult to draw a concrete distribution from biological experiments because of inherent differences between two individuals. Homozygous twins are even not exactly same in physiology and behaviour.

Most of the happening in life science depends upon counting or measurements. Plants and animals obtained by any hybridization experiment agree with Mendel's Law or not, can only be concluded by statistical test, *i.e.*, χ^2 test or low blood pressure has no meaning values it is expressed in numbers.

Blood pressure, pulse rate, Hb%, rate of reproduction, rate of transpiration action of a drug on individuals or a group etc. Varies not only from person to person but also from group to group. The extent of this variability in a character in by way of chance, *i.e.*, biological or normal is revealed by statistical methods.

1.7 BIO-STATISTICS

It is obvious that bio-statistics deals with the data collected in the field of biology and life sciences. Bio-statistics is simply the application of statistical methods to the solution of biological problems. It is sometimes also called biometrics. It involves collection, classification, analysis and interpretation of the numerical facts so as to draw scientific conclusions or to make effective decisions.

1.7.1 HISTORY OF BIOSTATISTICS

1. The Belgian astronomer and Mathematician Adolphe Quetelet used statistical methods for the first time to the problem of biology, medicine and sociology and developed statistical theory as a general method of research, applicable to any observational sciences.
2. Francis Galton, first cousin of Charles Darwin, is known as the 'Father of Biostatistics and Eugenics'. He made important contributions in the fields of heredity, eugenics and anthropometry.
3. Karl Pearson applied statistical methods in the demonstration of natural selection and laid the foundation for the descriptive and correlational statistics.
4. Ronald A. Fisher contributes to small sample theory that are used in almost all field of science.

1.8 APPLICATIONS AND USES OF BIO-STATISTICS**1. In physiology and anatomy :**

- (i) To define what is normal or healthy in a population and to find limits of normality in variables.
- (ii) To find the difference between the means and proportions of normal at two places or in different periods.
- (iii) To find out correlation between two variables X and Y as height and weight.

2. In Pharmacology:

- (i) **To find out the action of drug**– a drug is given to animals and humans to observe the change produced are due to the drug or by chance.
- (ii) To compare the action of two different drugs or two successive dosages of the same drug.
- (iii) To find out the relative potency of a new drug with respect to a standard drug.

3. In Medicine:

- (i) To compare the efficiency of a particular drug. For this, the percentage of cured and died in the experiment and control groups.
- (ii) To find out an association between two attributes such as cancer and smoking.
- (iii) To identify signs and symptoms of a disease or syndrome.
Cough and typhoid is found by chance and fever is found in almost every case.

4. In Community Medicine and Public health :

- (i) **To test usefulness of sera and vaccines in the field**– The percentage of attacks or deaths among the vaccinated subjects is compared with that among the unvaccinated ones to find whether the difference observed is statistically significant.
- (ii) **In epidemiological studies**– The role of causative factors is statistically tested.
- (iii) In public health, the measures adopted are evaluated.

1.9 SCOPE OF BIO-STATISTICS

Use of statistical methods are constantly increasing in biological and medical sciences. The development of biological theories are closely associated with statistical methods. Heredity, one of the recent branches of biology is mainly based on biostatistics. Therefore for the students of biology the knowledge of biostatistics is a must.

The important points are as follows:

- Population genetics is concerned with studying genetic structure of populations and changes occurring in it over generations.
- Statistical methods are used in molecular biology and bioinformatics for sequence analysis of DNA and RNA molecules and amino acid sequencing in proteins from different specimens.

- Correlation and regression analysis are used as basic determinants of cell physiology and chi-square tests are used in cell population studies in the physiological experiments.
- Multivariate analysis is useful in the estimation of the effect of various variables factors on a particular cell, function of a system or an endocrine gland.
- Biomass refers to the total mass of living material in a given locality.
- The efficiency of a newly manufacturing drug or injection is tested by using the t-test or test of significance.
- Biostatistics is used in drug development to cure diseases and to determine people's reaction to those drugs through null hypothesis.
- Everything in medicine be it research, diagnosis, treatment, epidemiology, use of treatment techniques or percentage of success depends on data collected through counting or measurement. This is known as medical statistics or quantitative medicine.

**EXERCISE 1.1**

1. What do you understand by the term 'Statistics'?
2. Discuss the application of "Bio-Statistics".
3. Mention the scope of Bio-Statistics.
4. Explain the limitation of 'Statistics'.
5. What do you understand by 'Error'?
6. Mention the scope of Biometrics.

