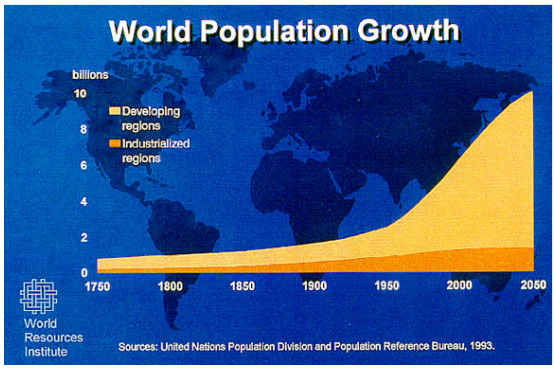
1 Statistics - Scope and Development

Introduction

Decision making is one of the highest forms of human activities. Every day we make decisions that may be personal, business related or of some other kind. Usually these decisions are made under conditions of uncertainty. Many times the situations or problems we face in the real world have no precise or definite solution. Statistical methods help us to make scientific and intelligent decisions in such situations. In recent years, the growth of statistics has made itself felt in almost every phase of human activity. Statistics no longer consists merely of collection of data and their presentation in charts and tables. It is now considered the science of inferences on observed data and the entire problem of making decisions in the face of uncertainty. This covers considerable ground since uncertainties are met when we flip a coin, when a dietician experiments with food additives, when an actuary determines life insurance premiums, when a quality control engineer accepts or rejects manufactured products, when a teacher compares the abilities of students, when an economist forecast trend, when a newspaper predicts an election result and so forth.



It would be presumptuous to say that statistics in its present state of development can handle all situations involving uncertainties, but the new techniques are constantly being developed and modern statistics can, provide the framework for taking at these situations in a logical and systematic fashion. The beginning of mathematics of statistics may be found in mid-eighteenth century studies in probability motivated by interest in game of chance. Thus the scholars began to apply probability theory to actuarial problems to some aspects of social

sciences. By this century it found application in all phases of human endeavour that in some way involve an element of uncertainty or risk.

Like almost all fields of study, statistics has two aspects, Theoretical and Applied. Theoretical or Mathematical Statistics deals with development, derivations and proof of statistical theorems, formulai, rules and laws. Applied statistics involves the application of those theorems, formulai, rules and laws to solve real world problems. Broadly speaking, applied statistics can be divided into two areas, Descriptive Statistics and Inferential Statistics. Descriptive statistics consists of methods for analysis of data and the area that deals with decision making procedure is referred to as inferential statistics.

1.1 History of Statistics

The word Statistics have been derived from Latin word "Status" or the Italian word "Statista". The meaning of these words is "Political State" or a Government. Shakespeare used a word Statist in his play Hamlet (1602). In the past, the statistics was used by rulers for official purposes. Even though application of Statistics was very limited, the rulers and kings needed information about lands, agriculture, commerce, population of their states to assess their military potential, their wealth, taxation and other aspects of Government.

Sir Ronald Aylmer Fisher.

Gottfried Achenwall used the word 'statistik' at German University in 1749 which means political science of different countries. In 1771, W. Hooper (Englishman) used the word 'statistics' in his translation of *Elements of Universal Erudition* written by Baron B.F Bieford. In his book, statistics has been defined as the science that teaches us what is the political arrangement of all the

modern states of the known world. There is a big gap between the old statistics and the modern statistics, but old statistics is also used as a part of the present statistics.

During the 18th century English writers have used the word statistics in their works. A lot of work has been done in the end of the nineteenth century.

At the beginning of the 20th century, William S Gosset developed the methods for decision making based on a small set of data. During the 20th century several statisticians were active in developing new methods, theories and application of statistics. The advent of electronic computers is certainly a major factor in the development of modern statistics. **Sir Ronald Aylmer Fisher is known as father of modern statistics.**

1.2 Definition of Statistics

1. "Statistics can be defined as the collection, presentation and interpretation of numerical data." - Croxton and Cowden.
2. "Statistics are measurement, enumerations or estimates of natural or social phenomena, systematically arranged to exhibit their inner relation." -Conner.
3. "The science of Statistics is essentially a branch of applied mathematics and can be regarded as a mathematics applied to observational data." - R.A Fisher.
4. "Statistics means aggregate of facts affected to marked extent by multiplicity of causes, numerically expressed, enumerated or estimated according to a reasonable standard of accuracy, collected in a systematic manner for a predetermined purpose and placed in relation to each other." - Horace Secrist

This definition points out some essential characteristics of statistics. These

characteristics are:

(i) **Statistics are the aggregates of facts.** It means, a single figure is not statistics. For example, national income of a country for a single year is not statistics but the same for two or more years is statistics.

(ii) **Statistics are affected by a number of factors.** For example, sale of a product depends on a number of factors such as its price, quality, competition, the income of the consumers, and so on.

(iii) **Statistics must be reasonably accurate.** Wrong figures, if analysed, will lead to erroneous conclusions. Hence, it is necessary that conclusions must be based on accurate figures.

(iv) **Statistics must be collected in a systematic manner.** If data are collected in a haphazard manner, they will not be reliable and will lead to misleading conclusions. It is collected with a pre-determined purpose.

(v) **Statistics should be placed in relation to each other.** If one collects data unrelated to each other, then such data will be confusing and will not lead to any logical conclusions. Data should be comparable over time and over space.

1.3 Functions of Statistics

1. **Statistics simplifies complexity**

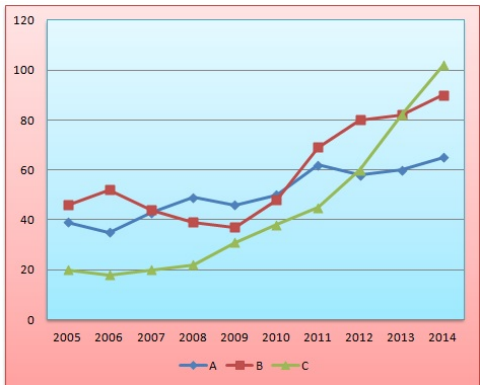
   The complex mass of data are made simple and understandable with the help of statistical methods.

2. **Statistics presents facts in a definite and precise form**

   Statistics presents statements of facts in a precise, quantitative and definite form.

3. **Statistics provides comparison**

Statistics provides a number of suitable methods of comparison between present and past values and hence able to predict future.



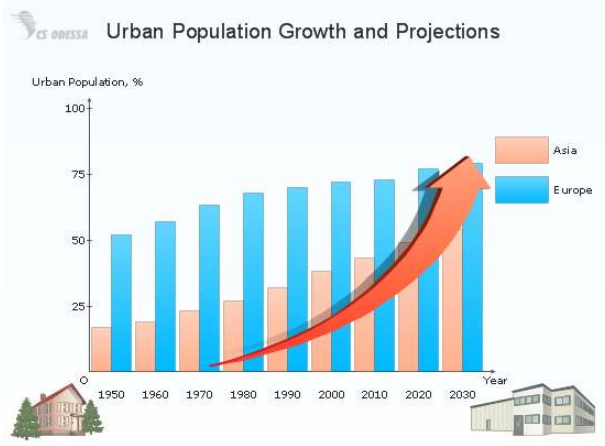
4. **Statistics enlarges human knowledge and experience**

   Statistics makes most of our vague and indefinite opinions, clear and definite.

5. **Statistics helps in formulating policies, testing of hypotheses and forecasting future events**

   Important policies, decision making and forecasting in business, economics, finance, industry, etc are taken on the basis of statistical methods.

1.4 Scope and importance of Statistics



1. **Statistics and Planning :** Statistics is an indispensable tool in planning the modern age. Because of the complexities and uncertainties, planning is essential for solving the complex problem in various walks of life.

2. **Statistics and Economics:** Statistical data and techniques of statistical analysis such as time series analysis and demand analysis are immensely useful in solving problems in Economics .

3. **Statistics and Industry:** In industry, Statistics is widely used in quality control. In production engineering, to find out whether the product is confirming to the specifications or not. Statistical tools, such as inspection plan, control chart, etc. are highly useful.

4. **Statistics and Mathematics:** Statistics is intimately related to Mathematics. Statistical techniques are the outcomes of wide applications of Mathematics.

5. **Statistics and Medical Science:** In medical science the statistical tools for collection, presentation and analysis of observed facts relating to causes and incidence of disease and the result of application of various drugs and medicines are of great importance.

6. **Statistics, Psychology and Education :** In Education and Psychology, Statistics has found wider applications such as, determining (or to determine) the reliability and validity of a test, measuring intelligence quotient, factor analysis, etc.

7. **Statistics and Management Studies :** Statistical analysis is frequently used in providing information for making decisions in the field of marketing, production, finance, banking, investment, purchase and accounting.

Activity

Prepare a report regarding the functions and importance of statistics in daily life by reading the features and reports in news papers and magazines.

1.5 Limitations of Statistics

(i) There are certain phenomena or concepts where Statistics cannot be used. For example, beauty, intelligence and courage cannot be quantified. Statistics has no place in all such cases where quantification is not possible.

(ii) Statistics reveals the average behaviour, the normal or the general trend. Statistics does not study individual items but deals with aggregate. For example, one may be misguided when told that the average depth of a river from one bank to the other is four feet. There may be some points in between where its depth is far more than four feet.

(iii) Since statistics are collected for a particular purpose, such data may or may not be relevant or useful in other situations or cases. For example, secondary data (i.e., collected by a person) need not be useful for another person.

(iv) Statistics are not 100 per cent precise as in Mathematics. Those who use Statistics should be aware of this limitation

Misuse of Statistics

The misuse of Statistics is the main cause of discredit to this science and has led to public distrust in Statistics. The various reasons of misuse are:

(i) Sources of data not given.

(ii) Defective data.

(iii) Unrepresentative sample.

(iv) Inadequate sample.

(v) Unfair Comparisons.

(vi) Unwanted conclusions.

(vii) Inappropriate statistical tools.

1.6 Some applied areas of Statistics

Actuarial Science

Actuarial science is the discipline that applies mathematical and statistical methods to assess risk in the insurance and the finance sectors. Actuaries are professionals who are qualified in this field. In many countries, actuaries must demonstrate their competence by passing a series of rigorous professional examinations. Actuarial science includes a number of interrelating subjects, including Probability, Mathematics, Statistics, Finance, Economics, Financial Economics, and Computer Programming. Historically, actuarial science used deterministic models in the construction of tables and premiums. The science has gone through revolutionary changes during the last 30 years due to the proliferation of high speed computers and the union of stochastic actuarial models with modern financial theory (Frees 1990).

Biostatistics

Biostatistics (sometimes referred to as Biometry or Biometrics) is the application of Statistics to a wide range of topics in Biology. The science of Biostatistics encompasses the design of biological experiments, especially in medicine, agriculture and fishery; the collection, summarization, and analysis of data from those experiments; and the interpretation of, and inference from, the results. A major branch is Medical Biostatistics, which is exclusively concerned with medicine and health.

Agricultural Statistics

The agricultural investigations are based on the application of statistical methods and procedures which are helpful in testing hypotheses using observed data, in making estimations of parameters and in predictions. The application of statistical principles and methods is necessary for effective practice in resolving various problems that arise in the many branches of agricultural activity. Because of the variability inherent in biological and agricultural data, knowledge of statistics is necessary for their understanding and interpretation. Numerous activities in agriculture are very different from each other, resulting in different branches of agricultural science like: field crop production, vegetable production, horticulture, fruit growing, plant protection, livestock, veterinary medicine, agricultural mechanization, water resources, agricultural economics, etc.

Activity

List out the various branches of statistics related to different disciplines.

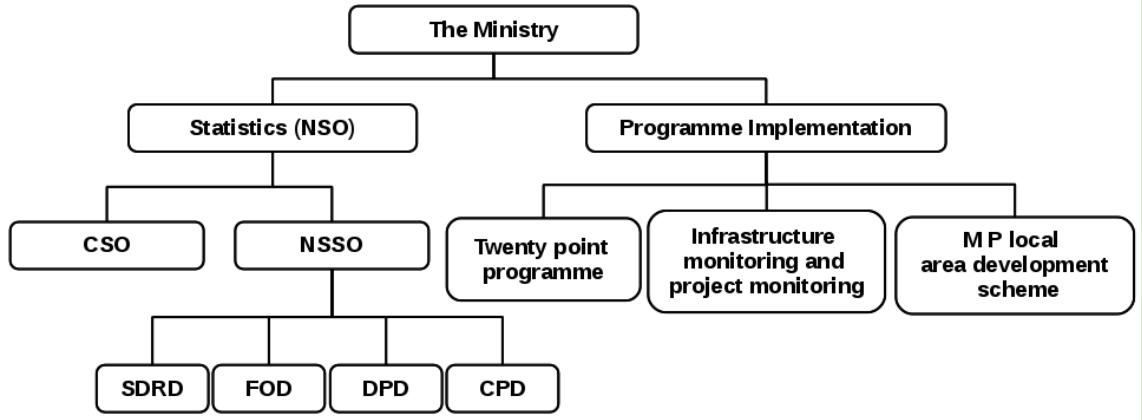
1.7 Official Statistics

Official Statistics are statistics published by government agencies or other public bodies such as international organizations. They provide quantitative or qualitative information on all major areas of citizens' lives. Official Statistics make information on economic and social development accessible to the public, allowing the impact of government policies to be assessed, thus improving accountability.

The Ministry of Statistics and Programme Implementation (MOSPI) came into

existence as an Independent Ministry in 1999 after the merging of the Department of Statistics and the Department of Programme Implementation.

The Ministry has two wings, Statistics and Programme Implementation.



- SDRD - Survey Design and Research Division
- FOD - Field Operations Division
- DPD - Data Processing Division
- CPD - Co-ordination and Publication Division

The Statistics Wing called the National Statistical Office(NSO) consists of the Central Statistical Office (CSO), the Computer Centre and the National Sample Survey Office (NSSO).

Central Statistical Office (CSO)

The Central Statistical Office which is one of the two wings of the National Statistical Organisation (NSO) is responsible for co-ordination of statistical activities in the country and for evolving and maintaining statistical standards. Its activities include compilation of National Accounts; conduct of Annual Survey of Industries and Economic Censuses, compilation of Index of Industrial Production as well as Consumer Price Indices. It also deals with various social statistics, training, international cooperation, Industrial Classification, etc.

The CSO is headed by a Director-General who is assisted by 5 Additional Director-Generals looking after the National Accounts Division, Social Statistics Division, Economic Statistics Division, Training Division and the Coordination and Publication Division.

CSO is located in the Sardar Patel Bhawan, Parliament Street, New Delhi. The Industrial Statistics Wing of CSO is located in Kolkata. The Computer Centre also under the CSO is located in R K Puram, New Delhi.

National Sample Survey Office (NSSO)

The National Sample Survey Organisation, now known as National Sample Survey Office, is an organization under the Ministry of Statistic of the Government of India. It is the largest organisation in India, conducting regular socio-economic surveys. It was established in 1950.

NSSO has four divisions:

1. Survey Design and Research Division (SDRD)
2. Field Operations Division (FOD)
3. Data Processing Division (DPD)
4. Co-ordination and Publication Division (CPD)

The Programme Implementation Wing has three Divisions, namely,

(i) Twenty Point Programme

(ii) Infrastructure Monitoring and Project Monitoring

(iii) Member of Parliament Local Area Development Scheme.

Besides these three wings, there is National Statistical Commission created through a Resolution of Government of India (MOSPI) and one autonomous Institute, viz., Indian Statistical Institute declared as an institute of National importance by an Act of Parliament.

Know your progress

Discuss the important statistical organizations (offices) in India.

Indian Statistical Institute (ISI)

Prof. P.C. Mahalanobis

Indian Statistical Institute (ISI), a unique institution devoted to the research, teaching and application of statistics, natural sciences and social sciences. Founded by Prof.Prasanta Chandra Mahalanobis in Kolkata on 17th December, 1931.He is known as father of Indian statistics. The Indian Statistical Institute publishes Sankhya, the Indian Journal of Statistics.

In recognition of the notable contributions made by Prof.P.C.Mahalanobis in the fields of economic planning and statistical development in the post independent era, the Govt. of India has decided to designate 29th June every year, coinciding with his birth anniversary, as Statistics Day in the category of special day to be celebrated at the national level. The Day is celebrated by holding seminars, discussions and competitions to highlight the importance of official statistics in national development.

Economics & Statistics Department

The Directorate of Economics & Statistics, Government of Kerala is the nodal agency of the State responsible for the systematic collection, compilation, analysis, interpretation and dissemination of statistics relating to various sectors of Kerala Economy.

The Directorate of Economics & Statistics is the nerve centre of the State statistical system. Director is the technical and administrative head of the Department. Being the statistics authority of the State the director functions as the authority for the collection, processing and dissemination of all statistical data relating to the State economy.

Besides the Directorate there are 14 District Offices, each headed by a Deputy Director with the exception of Wayanad. The Deputy Director in the District Offices is assisted by one District Officer, one or more Additional District Officers, one Price Supervisory Officer and one or two Research Officers. At taluk level, there is a Taluk Statistical Office, which is the lowest statistical unit in the State. There are at present 61 Taluk Statistical Offices, each under the control of a Taluk Statistical Officer.

Activity

Visit the nearest economics and statistics department and prepare a detailed report regarding their functions.

Let us sum up

Statistics are all around us. Without statistics we couldn't plan our budgets, pay our taxes, enjoy games to their fullest, evaluate classroom performance, etc. In this chapter we discussed the history ,importance,development,scope and some definitions of statistics . Statistics is applied in all walks of life.Various branches of statistics are explained here .We have seen the functions and roles of the ministry of statistics and programme implementation and the famous Indian Statistical Institute in Kolkatta. We also introduced the Department of Economics and Statistics of the state.

Learning outcomes

After transaction of this unit, the learner:-

- explains the history, definitions and scope of Statistics.
- recognises the importance of Statistics in various fields.
- compares different branches of Statistics.
- illustrates the functions of MOSPI, CSO, NSSO, ISI and Department of Economics and Statistics of Kerala.

Evaluation Items

1. ″ Statistics can be defined as the collection presentation and interpretation of numerical data″. This definition is given by:
   a) R.A Fisher **b)** Horace Secrist
   c) Croxton and Crowden **d)** Conner.

2. Who is known as father of Modern Statistics ?
   a) Conner **b)** R.A Fisher
   c) Mahalanobis **d)** Gosset

3. The discipline that applies mathematical and statistical methods to assess risk in the insurance and finance industries is called
   a) Bio statistics **b)** Agricultural statistics
   c) Actuarial Statistics **d)** Production Statistics

4. The Central Statistical Office is located in:
   a) Mumbai **b)** Kolkatta
   c) New Delhi **d)** Chennai

5. The largest organisation in India conducting regular socio-economic surveys is
   a) CSO **b)** NSSO
   c) ISI **d)** NASA

6. Indian Statistical Institute (ISI), is founded by:
   a) P.C. Mahalanobis **b)** R.A fisher
   c) Horace Secrist **d)** C. R.Rao

7. The Indian Statistical Institute (ISI) is situated in :
   a) Kolkatta **b)**Bangaluru
   c) Chennai **d)** Pune

8. National Statistics Day is celebrated on :
   a) June 1 **b)** june 29
   c) july 4 **d)** july 29

9. .....is known as the father of Indian Statistics.
   a) R.A Fisher **b)** S.P Gupta
   c) C.R. Rao **d)** P.C. Mahalanobis

10. The journal published by Indian Statistical Institute (ISI) is
    a) Statistica **b)** Sankhya
    c) Sample surveys **d)** Census

11. Name the nerve centre of Kerala state statistical system.

12. ″ In this century statistics found application in all phases of human endeavour″ . Comment on the statement.

13. How will you critically approach the definition of statistics given by Horace Secrist?

14. Examine the scope of statistics in various fields.

15. ″ The number of accidents is lower in foggy weather than on clear days.Hence it is safe to drive in fog.″ Do you agree with the statement ? Why ?

16. Explain the importance of Statistics in the following branches of study
    a) Acturial science **b)** Bio statistics **c)** Agricultural Statistics

17. Write short notes on the following :
    a)CSO **b)** NSSO **c)** ISI

18. What are the Divisions of NSSO?
19. Give some misuses of Statistics.
20. Write a short note on the Directorate of Economics and Statistics of Government of Kerala.

Answers:

1) c 2)b 3)c 4)c 5)b 6)a 7)a 8)b 9)d 10)b