**Chapter 1**

**Probability and Statistics**

**Introduction and Descriptive Statistics**

**Introduction**

In the modern world of computers and information technology, the importance of statistics and probability is very well organized by all discipline. Statistics has originated as a science of statehood and found applications slowly and steadily in agriculture, engineering, economics, commerce, biology, medicine, industry, planning, education and so on. As on date there is no other human work of life, where statistics can not applied.

Probability and statistics are concerned with events, which occur by chance. Examples include occurrence of accidents, errors of measurements, production of defective and non defective items from a production line, and various games of chance, such as drawing a card from a well-mixed deck, flipping a coin, or throwing a symmetrical six-sided die. In each case, we have some knowledge of likelihood of some possible result, but we can not predict with certainty the outcome of any particular trial.

**Definition of statistics**

"Statistics may be defined as the science of collection, presentation, analysis and interpretation of numerical data from the logical analysis." It is clear that the definition of statistics by Croxton and Cowden is the most scientific and realistic one.

**Descriptive Statistics**

The branch of statistics devoted to the summarization and description of the data (population or sample) is called descriptive statistics. It is used to organize and describe the characteristic of a collection of data in tabular, graphical or numerical form. Descriptive statistics has no hypothesis and does not analyze data.

**Inferential statistics**

If it may be too expensive to obtain or it may be impossible to acquire every measurement in the population, then we will want to select a sample of data from the population and use the sample to infer the nature of population. The branch of statistics which is used to draw inferences about the population of data from a sample data drawn from the population is called inferential Statistics. It is also known as sampling statistics.

**Application of Statistics in engineering**

An engineer is someone who solves problems of interest to society by the efficient application of scientific principles. Engineers accomplish this by either refining an existing product or process or by designing a new product or process that meets customer's needs. The engineering, or scientific, method is the approach to formulating and solving these problems. The steps in the engineering method are as follows:

1. Develop a clear and concise description of the problem.

2. Identify, at least tentatively, the important factors that affect this problem or that may play a role in its solution.

3. Propose a model for the problem, using scientific or engineering knowledge of the phenomenon being studied. State any limitations or assumptions of the model.

4. Conduct appropriate experiments and collect data to test or validate the tentative

model or conclusions made in steps 2 and 3.

5. Refine the model on the basis of the observed data.

6. Manipulate the model to assist in developing a solution to the problem.

7. Conduct an appropriate experiment to confirm that the proposed solution to the problem is both effective and efficient.

8. Draw conclusions or make recommendations based on the problem solution.

**Functions of statistics**

1. Statistics simplifies complexity
2. Statistics present fact in a definite form
3. Statistics facilitates comparisons
4. To help in formulations of policies
5. Statistics helps in forecasting
6. Statistics helps in formulating and testing hypothesis

**Limitation of Statistics**

1. Statistics does not deal with individuals
2. Statistics does not study qualitative phenomena
3. Statistical laws are not exact
4. Statistics is only a means
5. Statistics is liable to be misused

**Pictorial Representation of Data (Pie-Chart, Histogram and Ogive Curves)**

**Pie Diagram (Circular diagram or Angular Diagram)**

Pie Diagram is used for depicting the components of a single factor. In such diagram both the total and the component parts or sectors can be shown. The area of a circle is proportional to the square of its radius. It is divided in to different sectors by radial lines such that the area of each of the sectors representing the component value of the total value.

**Procedure of construction of Pie chart**

1. Compare the total value of a variable to 3600. Then find the angle corresponding to the component value of the total ie

Angle corresponding to component value = (3600 /total value)\* given value

1. Draw a circle of appropriate radius. For a single pie chart the radius may be any value, which makes the chart attractive. However, two or more pie charts at a time the radii of circles of the pie charts must be proportional to the square root of their total value, ie

**r1 : r2**

3. Take any radius as base line and draw and angle represented by the first component at centre using protractor. Similarly draw other sectors to represent remaining component values.

4. Shade each sector differently by lines, dots or with different colors

**Limitations of Circular Diagram**

1. Negative data (profit or loss) can not be shown in pie chart.
2. If there are more than six component pie diagram is not suitable
3. Pie diagram are less effective than other (i.e.bar ) due to difficulty in comparing the areas of the sectors

Example 1. Express the following using Angular diagram.­­­­­­­­­­

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Item | Food | Clothing | Housing | Fuel | Education | Miscellaneous |
| %Expenditure | 50 | 15 | 10 | 5 | 10 | 10 |

Solution: Angle at the centre of circle = 3600, total value = 3600

Let x = ((360/100)\*x)0 =(3.6 \* x)0

|  |  |  |
| --- | --- | --- |
| Item | % of expenditure | Values in angle = (3.6\*x) |
| Food | 50 | 1800 |
| Clothing | 15 | 540 |
| Housing | 10 | 360 |
| Fuel | 5 | 180 |
| Education | 10 | 360 |
| Miscellaneous | 10 | 360 |
| Total | 100 | 3600 |

Example 2.The number of B.E. students in two colleges A and B are given below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | No of students | | | |
| College | Civil | Computer | Electronics | Industrial |
| A | 40 | 60 | 50 | 30 |
| B | 60 | 80 | 50 | 50 |

Compare the student's number with the help of angular diagram.

Solution: Number of students in college A is 180. The angle at the centre of circle is 3600.

Total Value = 3600 and 180 % = 360, Then x= ((360/180)\*x)0 = (2\* x)0

Number of students in college B =240 then x = ((360/240)\*x)0 = (1.5\*x)0 [ 240 % =3600]

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| For college A | | | | For college B | | | |
| Program | No of students | (in0) | Cum0 | Program | No of students | (in0) | Cum0 |
| Civil | 40 | 800 | 800 | Civil | 60 | 90 | 90 |
| Computer | 60 | 1200 | 2000 | Computer | 80 | 120 | 210 |
| Electronics | 50 | 1000 | 3000 | Electronics | 50 | 75 | 285 |
| Industrial | 30 | 600 | 3600 | Industrial | 50 | 75 | 360 |
| Total | 180 |  | | | 240 |  | |
| Square root | 13.41 | 15.49 |  | |
| Ratio of circle | 1 | 1.16 |  | |

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Pie chart of the BE students in two colleges A and B