XI - Chapter 4.1

Data Visualization using Statistical Graphs

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Learning Objectives

After completing this chapter, students will be able to: [a]

- Explain the purpose and importance of data visualization in statistical analysis.

- Identify and describe different types of statistical graphs such as bar graphs, histograms, scatter plots, and pie charts.

- Interpret information presented in various types of graphs and understand their appropriate use cases.

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[a]Unit 4: Data Visualization

1 Introduction

Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. We have covered it in detail in the previous chapter.

2 What is a Graph?

A graph can be a pictorial representation or a diagram that represents data or values in an organized manner. The points on the graph often represent the relationship between two or more things. The data is represented in the form of lines or curves drawn on the coordinated points, and it shows there is a relation between the quantities. There are some algebraic and coordinate geometry principles which apply in drawing the graphs.

Graphs consist of two main axes — the horizontal axis known as the X-axis and the vertical axis called the Y-axis. These two axes are drawn at right angles to each other. Their point of intersection is referred to as the Origin and is denoted by 0.

On the X-axis, all points to the right of the origin represent positive values, while those to the left represent negative values. Similarly, on the Y-axis, positions above the origin indicate positive values, and those below indicate negative values.

Together, the X-axis and Y-axis divide the plane into four quadrants, forming what is known as the coordinate plane. The X-axis runs horizontally, and the Y-axis runs vertically.

2.1 Coordinates on the Graph

- Move to the right along the X-axis for positive values.

- Move to the left along the X-axis for negative values.

- Move upward along the Y-axis for positive values.

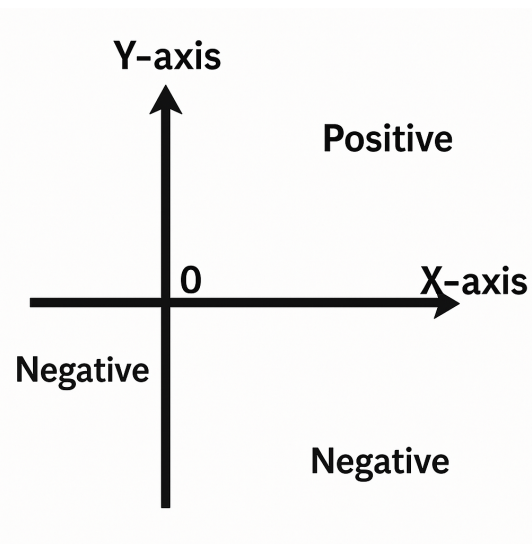- Move downward along the Y-axis for negative values.

Figure 1: This is also known as the X and Y-axis graph chart.

3 Need for Data Visualisation

Data Visualisation helps us understand complex data patterns, trends, and relationships quickly and effectively. Instead of reading large tables of numbers, visualisations like bar graphs, histograms, pie charts, and scatter plots make data easier to interpret.

4 Importance of Data Visualisation

- Helps identify patterns and trends easily
- Makes comparisons between data sets simple
- Enables quick decision-making
- Communicates information clearly and effectively
- Useful in fields like business, science, research, and education

5 Data Visualisation using Statistical Graphs

Statistical graphs are tools that represent quantitative data visually. They are used to summarize large data sets and make sense of numerical information.

Common statistical graphs include:

- Bar Graph
- Histogram
- Pie Graph
- Scatter Plot
- Line Plot

Each of these graphs represents data differently and serves specific purposes.

6 Types of Graphs

6.1 Bar Graph

A **bar graph** uses rectangular bars to represent data values. The length or height of each bar shows the quantity.
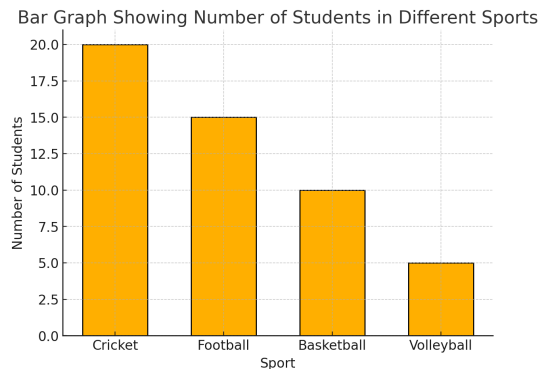
Types of Bar Graphs:

- Vertical Bar Graph
- Horizontal Bar Graph
- Grouped or Clustered Bar Graph
- Stacked Bar Graph

Example: Number of students in different sports.
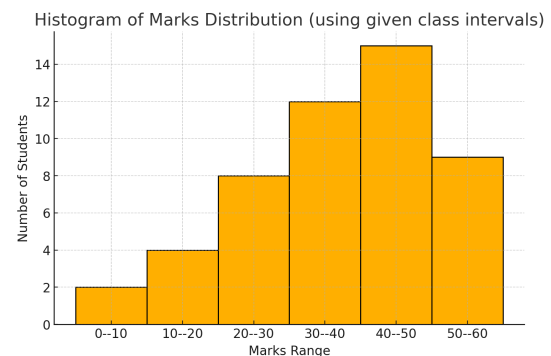
Table 1: Data table for a bar graph

Sport	No. of Students
Cricket	20
Football	15
Basketball	10
Volleyball	5

Key Points:

- Bars must be of equal width

- Bars are separated by equal gaps

- The x-axis represents categories, and the y-axis represents quantities

(a) Bar graph based on the data in table 1

(b) Histogram based on the data table 2

Figure 2

6.2   Histogram

A **histogram** is similar to a bar graph but is used for continuous numerical data divided into intervals (classes). It shows the frequency distribution of a dataset.

Example: Marks obtained by 50 students.

Table 2: Data table for Histogram

Marks Range	No. of Students
0–10	2
10–20	4
20–30	8
30–40	12
40–50	15
50–60	9

Key Points:

- Bars touch each other (no gaps) to show continuity

- The area of each bar represents frequency

- Useful for identifying distribution shapes (normal, skewed, etc.)

6.3   Pie Graph (Pie Chart)

A **pie chart** represents data as parts of a whole using sectors of a circle. Each sector's angle corresponds to the proportion of that category.

Formula:

$$\text{Angle} = \frac{\text{Category Value}}{\text{Total Value}} \times 360°$$

Example: Time spent by a student in a day.

Table 3: Data table for a pie chart

Activity	Hours
Study	8
Sleep	7
Play	3
Others	6
Total	**24**

Key Points:

- Total angle = 360°

- Each sector represents a category's percentage share

- Useful for showing proportional data

Calculated Angles:

- Study: $(8/24) \times 360 = 120°$

- Sleep: $(7/24) \times 360 = 105°$

- Play: $(3/24) \times 360 = 45°$

- Others: $(6/24) \times 360 = 90°$
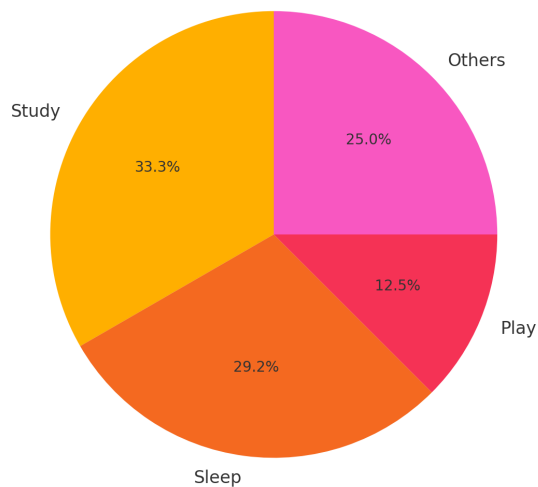
Daily Time Distribution of Activities

Figure 3: Pie Chart

6.4   Scatter Plot

A **scatter plot** displays the relationship between two numerical variables using points on a graph.

Example: Study hours vs marks of students.

Study Hours	Marks
2	40
3	45
4	55
5	65
6	75

Key Points:

- Each point represents one data pair (x, y)

- Helps identify correlations (positive, negative, or none)

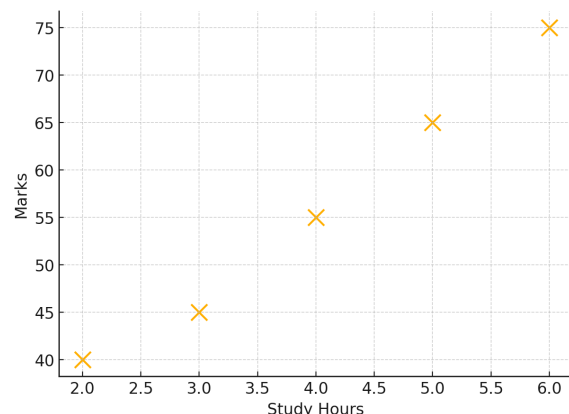- Used in statistics, economics, and research

Figure 4: Scatter plot (Study hours vs marks)

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6.5   Line Plot

A *line plot*, also called a *line graph*, displays data points connected by straight lines. It is particularly useful for showing changes over time or the progression of a measured quantity. Line plots help the reader see trends, peaks, dips and overall patterns in continuous or sequential data.

When to use a line plot

Line plots are most appropriate when:

- the data are **continuous** or ordered (for example, time-series data);

- you want to show **increase or decrease** over an interval;

- you need to **compare** multiple series on the same axes (optional);

- you want to highlight **trends, peaks, and troughs**.

Example: Study hours across days

Below is a small dataset showing study hours recorded across six days. The table and its corresponding line plot are placed side-by-side for easy comparison.

Table 4: Study hours (example data)

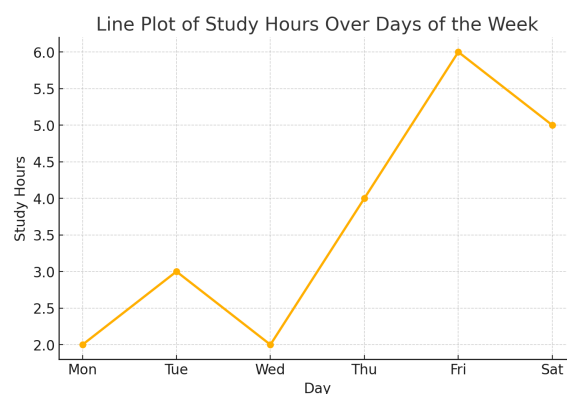| Day	Study Hours
Mon	2
Tue	3
Wed	2
Thu	4
Fri	6
Sat	5

Figure 5: Line plot of study hours across days

Interpretation

From the line plot we can observe:

- A small increase from Monday (2 hours) to Tuesday (3 hours), followed by a dip on Wednesday.

- A steady rise on Thursday and a peak on Friday (6 hours).

- A slight fall on Saturday (5 hours).

Line plots make such temporal or ordered changes easy to spot at a glance. If you want, multiple series (for example, study hours for several students) can be plotted on the same axes to compare trends directly.

7 Comparison Table of Graph Types

Graph Type	Data Type	Appearance	Key Feature	Example Use
Bar Graph	Categorical	Separate bars	Comparison between groups	Students in clubs
Histogram	Continuous	Touching bars	Frequency distribution	Marks distribution
Pie Graph	Categorical	Circular sectors	Proportion of categories	Monthly expenses
Scatter Plot	Continuous	Dots on x-y plane	Relationship between variables	Height vs Weight

8 Applications of Data Visualisation

- Business dashboards (sales performance)

- Research and experiments (scientific data)

- Educational data (student performance)

- Government statistics (population, economy)

- Engineering and robotics (sensor data visualisation)

Summary

- Data Visualisation helps represent data visually for easy understanding.

- Common statistical graphs include Bar Graphs, Histograms, Pie Charts, and Scatter Plots.

- Each type is suitable for specific kinds of data and analysis.

Exercise

A. Fill in the Blanks

1. In a bar graph, bars are drawn with _ _ _ _ _ gaps between them.

2. A histogram represents _ _ _ _ _ data.

3. The total angle of a pie chart is _ _ _ _ _ _.

4. Scatter plots are used to find _ _ _ _ _ between two variables.

B. True or False

1. Histogram bars are separated by equal gaps.

2. Pie charts show the proportion of data categories.

3. Bar graphs are used for continuous data.

4. Scatter plots are used for categorical data.

C. Short Answer Questions

1. Define data visualisation.

2. Differentiate between a bar graph and a histogram.

3. How is a pie chart constructed?

4. Explain the purpose of a scatter plot.

D. Practical Exercise

1. Draw a bar graph showing monthly sales of a shop.

2. Plot a histogram for the marks obtained by students.

3. Create a pie chart showing percentage of time spent in daily activities.

4. Plot a scatter graph showing height vs weight of students.