1. Data presentation: Data presentation refers to the process of organizing, summarizing, and visually representing data in a format that is easy to understand and interpret.

2. Ways of data presentation: We can summarize the raw data in the following ways,

a. Frequency distribution

- Classification
- Tabulation

b. Graphical representation

3. Classification: Classification is the process of arranging data in homogeneous groups or classes on the basis of some common characteristics present in data. The class must be mutually exclusive and exhaustive.

For example, Gender (Male, Female), Religion (Muslim, Hindu, Buddhist, Christian)

4. Tabulation: After forming various classes, the data set is represented to condense raw data in various classes of a table. This is tabulation.

For example, the table of number of workers in garments factory according to their age groups,

Age (in years)	***Number of workers***
10-20	40
20-30	65
30-40	45
40-50	30
50-60	12
60-65	8
Total	200

5. Frequency distribution: A frequency distribution of a data set is a listing of classes or categories and their frequencies. It is a statistical tabulated representation of the number of occurrences of each class/category.

A frequency distribution assumes mainly two different forms depending on the character/types of data.

i. Frequency distribution of qualitative data

ii. Frequency distribution of quantitative data

6. Relative frequency: The relative frequency for a particular category/class is the ratio of the frequency of that category to the total number of observations.

$$\boldsymbol{RF_{Category} = \frac{Frequency_{Category}}{Sum\ of\ all\ frequencies}}$$

Blood type	Frequency	Relative frequency
O	14	14/40=0.35
A	10	10/40=0.25
B	10	0.25
AB	6	0.15
Total	40	1.00

Interpretation: Based on the table, it is evident that O type owners constitute 35% of the total students, followed by A type owners at 25%, B type owners at 25%, and AB type owners at only 15%. The most common blood type among students is O, while the least common type is AB.

7. Percentage frequency: Relative frequency×100

8. Steps of constructing frequency distribution table: The process of constructing a frequency distribution table involves the following steps:

a) ***Choose the Number of Classes:*** Decide on the number of classes we want to use in the frequency distribution. It should be appropriate to capture the variation in the data while avoiding too many or too few classes. To decide the number of classes we can use the formula $k = \sqrt{\boldsymbol{n}}$. Here, $k = numer\ of\ classes, n = number\ of\ observations$

b) ***Calculate Class Width/Interval:*** Divide the range by the number of classes to determine the width of each class interval. That is,

$$\boldsymbol{Class\ Interval = \frac{(High\ value - Low\ value)}{k}}$$

c) Set individual class limits.

d) ***Tally and Count Data:*** Count the number of data points that fall within each class interval and tally them.

e) ***Calculate Frequency:*** Record the frequency of data points in each class, which represents the number of occurrences within that interval.

9. A manager of certain computer selling company selling company wants to study the computer selling behavior in his company. The following data give the number of computers sold by the company for a sample of 40 days

39	**37**	**43**	**27**	**59**	**30**	**34**	**41**	**35**	**49**
78	**58**	**48**	**64**	**34**	**54**	**37**	**70**	**65**	**36**
69	**54**	**53**	**21**	**24**	**57**	**49**	**33**	**42**	**57**
62	**41**	**75**	**71**	**37**	**40**	**60**	**47**	**29**	**39**

Summarize these data into frequency and relative distributions chosen a suitable class interval and write the interpretation.

10. Mr. XYZ, Chairman of ABC department, is interested in studying the typical weight of student of his department. The chairman randomly selected 60 students from his department and recorded the weights (kg) which are given below,

53.2	**61.7**	**51.7**	**61.8**	**46.7**	**57.4**	**51.6**	**51.8**	**49.9**	**66.4**
67.4	**51.6**	**45.9**	**52.8**	**61.9**	**71.4**	**38.8**	**56.8**	**54.2**	**57.7**
46.1	**51.2**	**44.7**	**67.8**	**56.4**	**58.8**	**41.2**	**48.7**	**49.2**	**58.0**
53.8	**53.4**	**48.2**	**51.0**	**36.2**	**53.4**	**49.8**	**53.6**	**55.6**	**51.5**
46.6	**45.4**	**63.2**	**46.8**	**54.2**	**52.2**	**73.4**	**46.7**	**59.2**	**42.5**
74.6	**61.7**	**58.5**	**43.9**	**68.4**	**40.2**	**57.5**	**55.3**	**63.7**	**57.5**

Summarize these data into frequency and relative distributions chosen a suitable class interval and write the interpretation.

*** What do you mean by data representation? Why do you need represent statistical data?

*** What are the methods/way of representing raw data?

*** What is meant by classification?

*** Illustrate the following terms in connection with a frequency table: Class, Class interval, Frequency, Relative frequency, Cumulative frequency.

*** What do you mean by a frequency distribution? Explain various steps of constructing a frequency distribution.

11. Graphical presentations: Graphical presentations, also known as data visualizations or charts, are visual representations of data that allow us to quickly and easily understand patterns, trends, and relationships within the data. Graphical presentations use various types of charts, graphs, and plots to convey information in a visually appealing and easy-to-interpret manner.

Importance:

i. Graphs are more attractive than tables of data and make a clear impression in mind.
ii. A graph gives a bird's eye view of the entire data.
iii. Easy comparison could be made among two or more data sets.
iv. The pattern of the distribution can be explained.

Limitations:

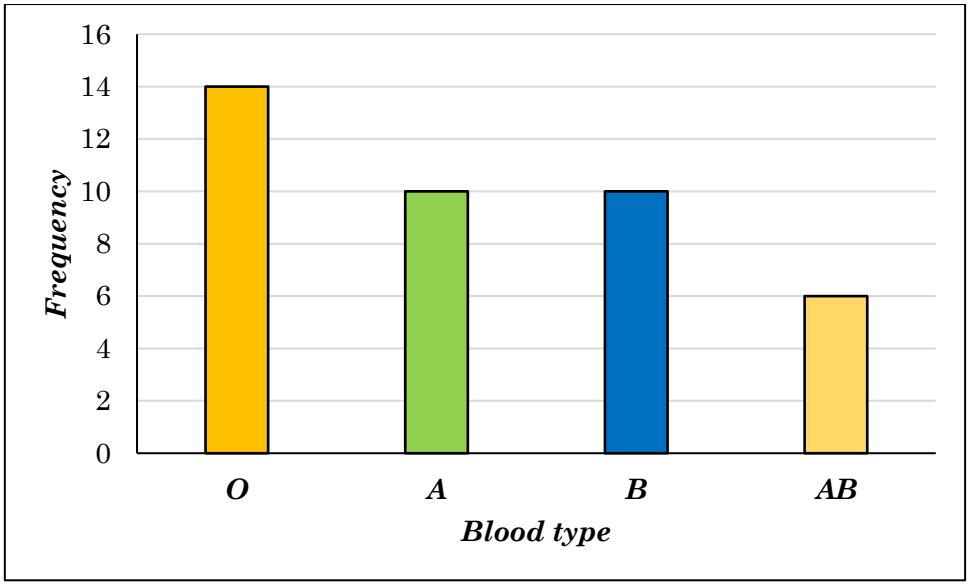
i. Amount of detail is reduced.
ii. We cannot always compute precise estimates from graphs.

12. Graphs of Qualitative data: Two common methods for graphically displaying qualitative data are "Bar chart" and "Pie chart".

a) ***Bar chart:*** A bar chart displays the distinct categories of the qualitative data on a horizontal axis and the frequencies (or, relative frequencies or percentage frequencies) of those categories on a vertical axis.
b) ***Pie chart:*** Pie charts represent data as slices of a circle, where each slice corresponds to a portion of the whole. They are ideal for showing proportions and percentages.

13. How to construct bar chart:

a) Draw a horizontal axis and label the categories below the line at regularly spaced interval.
b) Draw a vertical axis and label the scale using frequency.
c) Draw a rectangular bar above each category label whose height equals the frequency of that category. **The bars are the same width and do not touch each other.**
d) Label the horizontal axis with variable name and vertical axis with frequency.



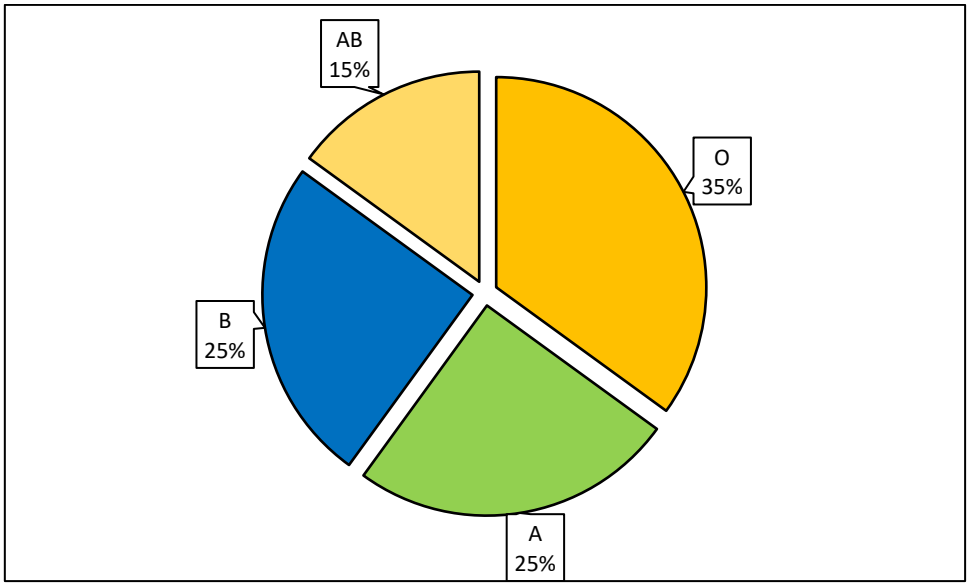
14. <u>How to construct pie chart:</u>

a) Draw a circle to represent the whole data set.

b) For each category, calculate the "slice" size. A circle has 360 degrees. So, $\boldsymbol{Slice\ size = 360 \times RF}$

c) Dividing the circle into slices according to their sizes.

d) Label the slices with the distinct categories and their relative frequencies.



15. Histogram: A histogram is a graphical representation of a data set that displays the distribution of numerical data. Histograms have both merits and demerits as a data visualization tool:

Merits (Advantages) of Histograms:

a) ***Easy Interpretation:*** Histograms provide a visual and intuitive representation of data distribution, making it easy to understand the frequency and patterns within the data.
b) ***Data Distribution:*** Histograms reveal the shape of the data distribution, such as whether it is symmetric, skewed, bimodal, or multimodal, which helps in identifying underlying patterns.
c) ***Central Tendency and Spread:*** Histograms allow you to quickly assess measures of central tendency (mean, median) and spread (range, variability) of the data.
d) ***Outlier Detection:*** Outliers, which are data points significantly different from others, can be easily identified in a histogram as they fall outside the typical range.
e) ***Comparison:*** Histograms allow for easy visual comparison of multiple data sets or distributions, aiding in making informed decisions.

Demerits (Disadvantages) of Histograms:

a) ***Data Loss:*** Histograms summarize data within intervals, leading to a loss of precision.
b) ***Continuous Data Limitation:*** Histograms are better suited for discrete and continuous data, and may not be as informative for categorical data.
c) ***Not Ideal for Small Data Sets:*** Histograms are most effective for visualizing larger data sets. For small data sets, the patterns may not be as clearly evident.

16. How to construct histogram:

i. Draw a horizontal axis and mark the distinct value or class boundaries.
ii. Draw a vertical axis and mark the frequencies.
iii. Draw a rectangle above each class whose height equals the frequency of that class.
iv. Label the rectangles with distinct values or class boundaries such that each distinct value or class mark is centered under its rectangle.
v. Label the horizontal axis with the name of the variable and the vertical axis with "Frequency".

17. The provided data represents the ages of 40 individuals who have physical disabilities. 47, 54, 58, 63, 41, 68, 71, 37, 56, 66, 49, 60, 45, 67, 50, 38, 72, 55, 42, 59, 39, 65, 70, 43, 52, 73, 61, 44, 69, 57, 74, 62, 48, 53, 36, 64, 75, 40, 51, 46.

a) Construct frequency table.
b) Draw histogram.

18. <u>Histogram vs Bar diagram:</u> Histograms and bar charts are both graphical representations of data, but they have distinct differences in terms of their purposes, data types, and visual characteristics. Here are four key differences between histograms and bar charts:

The differences between histogram and bar graph can be drawn clearly on the following grounds:

a) Histogram refers to a graphical representation; that displays data by way of bars to show the frequency of numerical data. A bar graph is a pictorial representation of data that uses bars to compare different categories of data.
b) A histogram represents the frequency distribution of continuous variables. Conversely, a bar graph is a diagrammatic comparison of discrete variables.
c) Histogram presents numerical data whereas bar graph shows categorical data.
d) The histogram is drawn in such a way that there is no gap between the bars. On the other hand, there is proper spacing between bars in a bar graph that indicates discontinuity.

19. Frequency polygon: Frequency polygon is a line graph of class frequency plotted against class mid-point. It is used to depict the distribution of continuous or grouped data and provides a visual representation of the shape and pattern of the data.

20. Merits (Advantages) of Frequency Polygon:

- ***Smooth Visualization:*** Frequency polygons provide a smoother and more continuous representation of the data distribution compared to histograms, making it easier to identify trends and patterns.
- ***Easy Comparison:*** Frequency polygons allow for the easy comparison of multiple data sets or distributions within the same graph. Overlapping frequency polygons can reveal similarities or differences between data sets.
- ***Identifying Central Tendency:*** The central peak or mode of the data distribution is clearly visible in a frequency polygon, making it easier to identify the most common values

21. Demerits (Disadvantages) of Frequency Polygon:

- ***Less Intuitive:*** Frequency polygons may be less intuitive for individuals who are not familiar with the concept of connecting midpoints with line segments, as compared to the simplicity of histograms or bar charts.
- ***Data Loss:*** Like histograms, frequency polygons summarize data within intervals, leading to a loss of precision.
- ***Subjectivity in Line Drawing:*** The visual appearance of a frequency polygon can vary based on the way the lines are drawn. Different interpretations can lead to different impressions of the data distribution.
- ***Difficulty in Handling Discrete Data:*** Frequency polygons are more suitable for continuous or grouped data. Handling discrete data in a frequency polygon may require additional considerations.

22. How to construct:

i. Draw a horizontal axis and mark the midpoints on it. Consider one additional class with zero frequency at each end and mark their midpoints.
ii. Draw a vertical axis and mark the frequencies on it.
iii. Plot a point above each midpoint at a height equal to the frequency of that class.
iv. Connect the consecutive points with straight lines.
v. Label the horizontal axis with the name of the variable and the vertical axis with "Frequency" (or, "Relative frequency").

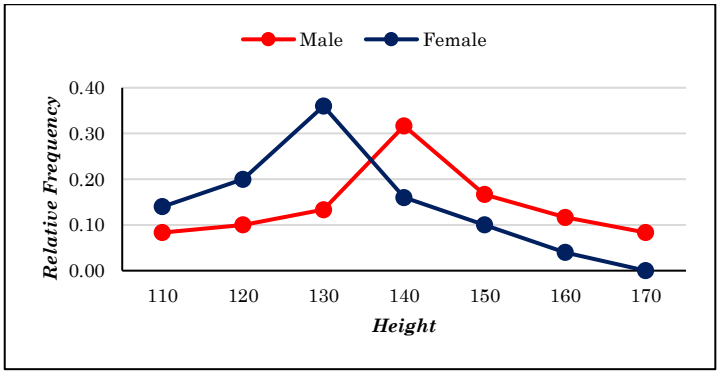
23. The provided data represents the ages of 40 individuals who have physical disabilities.
47, 54, 58, 63, 41, 68, 71, 37, 56, 66, 49, 60, 45, 67, 50, 38, 72, 55, 42, 59, 39, 65, 70, 43, 52, 73, 61, 44, 69, 57, 74, 62, 48, 53, 36, 64, 75, 40, 51, 46.

a) Construct frequency table.
b) Calculate relative frequency.
c) Draw line graph using frequency.
d) Draw line graph using relative frequency.

***** The histogram and the frequency polygon are equally good techniques for presenting frequency distributions.**

***** The histogram is more often used when single distribution is presented, while frequency polygon is largely used for comparison of two or more distributions.**

Height (in cm)	Male	Female	RF Male	RF Female
105-115	5	7	0.08	0.14
115-225	6	10	0.10	0.2
225-135	8	18	0.13	0.36
135-145	19	8	0.32	0.16
145-155	10	5	0.17	0.1
155-165	7	2	0.12	0.04
165-175	5	0	0.08	0
Total	60	50	1	1



*** If we connect the consecutive points with smooth curve, then it is called frequency curve.

24. Cumulative frequency curve or Ogive: A cumulative frequency curve, also known as an ogive, is a graphical representation used in statistics to show the cumulative frequency of data points in a dataset. The ogive provides insights into the distribution of data and allows for visualizing the cumulative percentage or cumulative frequency of values below a certain threshold.

25. How to construct:

i. Draw a horizontal axis and mark the upper boundaries on it.

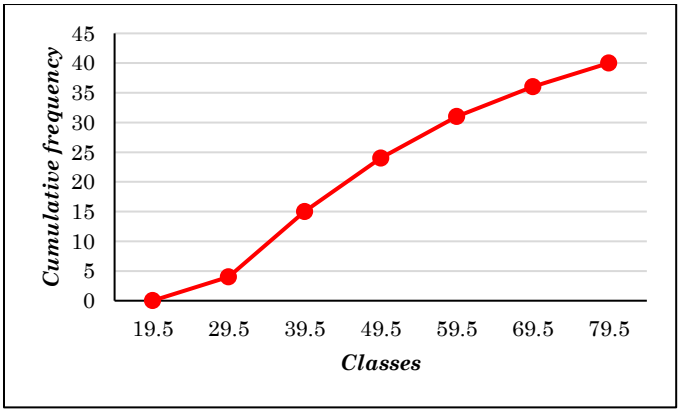
ii. Draw a vertical axis and mark the cumulative frequencies.

iii. Plot a point above each upper boundary at a height equal to the cumulative frequency of that class.

iv. Plot one additional point above the lower boundary for the first class at a height of zero.

v. Connect the consecutive points with lines.

Classes	Upper limit	Freq.	CF
	19.5	0	0
19.5-29.5	29.5	4	4
29.5-39.5	39.5	11	15
39.5-49.5	49.5	9	24
49.5-59.5	59.5	7	31
59.5-69.5	69.5	5	36
69.5-79.5	79.5	4	40



*** **Relative frequency:** The relative frequency for a particular category is the ratio of the frequency of that category to the total number of observations.

$$RF = \frac{Frequency}{Total\ number\ of\ observations}$$

*** **Percentage frequency:** $Relative\ frequency \times 100$

Overall solution based on question no 10:

Here, number of observations = 60

Largest observation = 74.6, and smallest observation = 36.2

Approximate classes = $\sqrt{60} = 7.75 \approx 8$

Approximate class width = $\frac{(74.6-36.2)}{8} = 4.8 \approx 5$

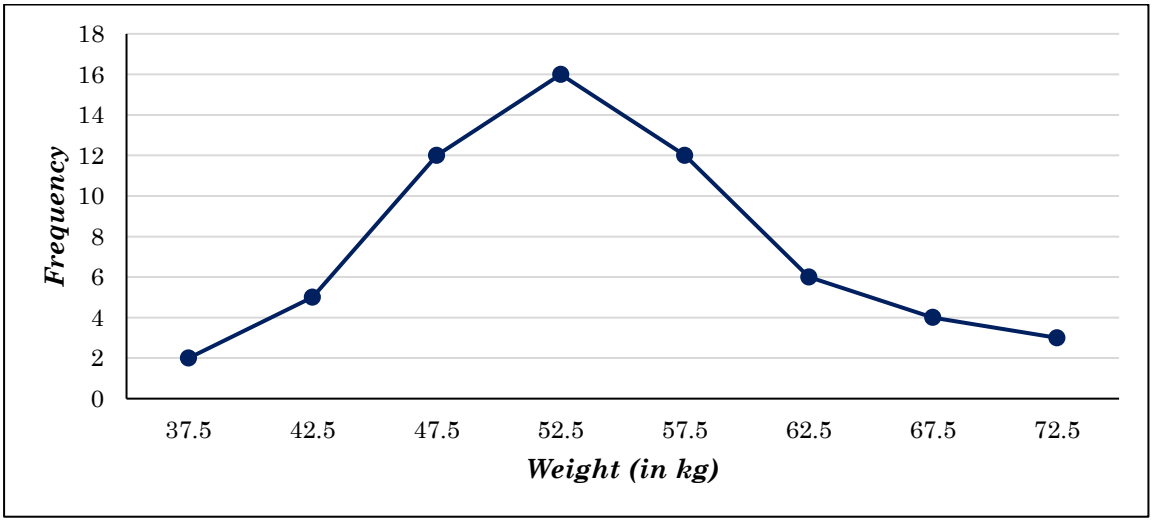
Then our classes will be,

$$35-40, 40-45, 45-50, 50-55, 55-60, 60-65, 65-70, and\ 70-75$$

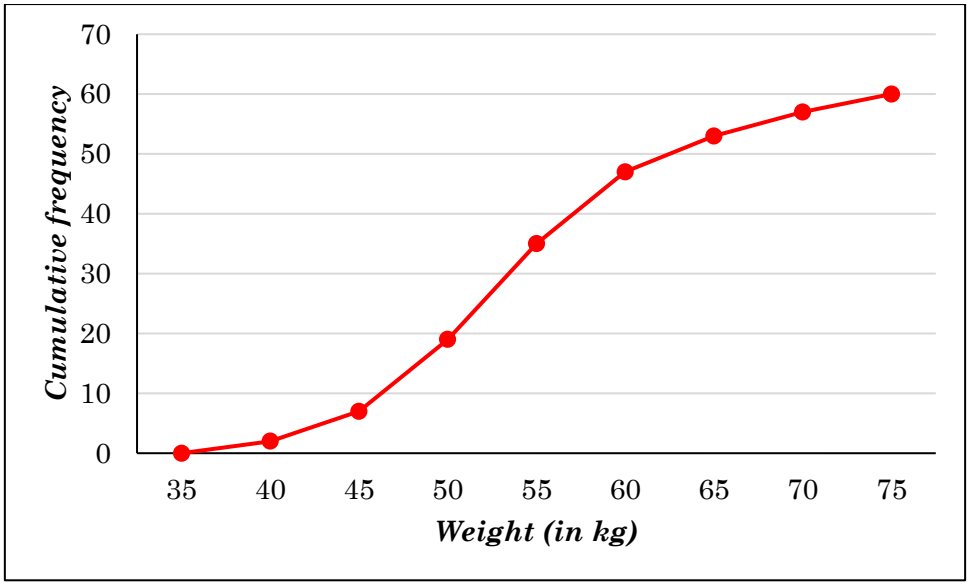
Class (weight in kg)	Mid value	Tally	Frequency	Relative Frequency	Cumulative frequency
35-40	37.5	||	2	0.033	2
40-45	42.5	𝍸 |||	5	0.083	7
45-50	47.5	𝍸 𝍸 ||	12	0.200	19
50-55	52.5	𝍸 𝍸 𝍸 |	16	0.267	35
55-60	57.5	𝍸 𝍸 ||	12	0.200	47
60-65	62.5	𝍸	6	0.100	53
65-70	67.5	||||	4	0.067	57
70-75	72.5	|||	3	0.050	60
Total			n=60	1.00	

a) **Histogram:**

b) **Frequency Polygon:**



c) **Ogive curve:**


70
60
50
40
30
20
10
0
Cumulative frequency
35
40
45
50
55
60
65
70
75
Weight (in kg)

Stem and Leaf Plot:

Example 1:

39	37	43	27	59	30	34	41	35	49
78	58	48	64	34	54	37	70	65	36
69	54	53	21	24	57	49	33	42	57
62	41	75	71	37	40	60	47	29	39

Construct a stem and leaf plot.

Solution: The data ranged from 22 to 79. Because these observations are two-digit numbers, we use the first digit (tens) as the stem and the second digit (ones) as the leaf. We obtain the following stem and leaf plot:

Stem	Leaf
2	7 1 4 9
3	9 7 0 4 5 4 7 6 3 7 9
4	3 1 9 8 9 2 1 0 7
5	9 8 4 4 3 7 7
6	4 5 9 2 0
7	8 0 5 1

After arranging the leaves in order from smallest to largest, the stem and leaf plot finally given in below figure

Stem	Leaf
2	1 4 7 9
3	0 3 4 4 5 6 7 7 7 9 9
4	0 1 1 2 3 7 8 9 9
5	3 4 4 7 7 8 9
6	0 2 4 5 9
7	0 1 5 8

Key: 2|1 represents 21

Figure: Stem and leaf plot for ….

Example 2:

The following are the exam scores of 50 students

30.8	30.9	32.0	32.3	32.6	31.7	30.4	31.4	32.7	31.4
30.1	32.5	30.8	31.2	31.8	31.6	30.3	32.8	30.6	31.9
32.1	31.3	32.0	31.7	32.8	33.3	32.1	31.5	31.4	31.5
31.3	32.5	32.4	32.2	31.6	31.0	31.8	31.0	31.5	30.6
32.0	30.4	29.8	31.7	32.2	32.4	30.5	31.1	30.6	31.5

Construct a stem and leaf plot.

Solution: The scores in the data set range from 29.8 to 33.3. Because of these scores are three-digit numbers, we use the first two digit of each number as the stem and third digit as the leaf. We obtain the following stem and leaf plot,

Stem	Leaf
29	8
30	8 9 4 1 8 3 6 6 4 5 6
31	7 4 4 2 8 6 9 3 7 5 4 3 6 0 8 0 5 7 1 5
32	0 3 6 7 5 8 1 0 8 1 5 4 2 0 2 4
33	3

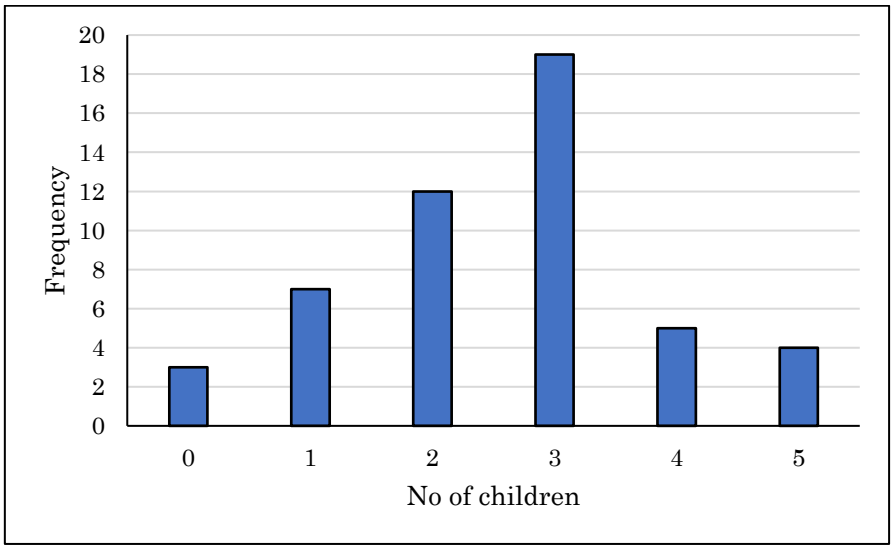
After arranging the leaves in order from smallest to largest, the stem and leaf plot is displayed in below figure,

Stem	Leaf
29	8
30	1 3 4 4 5 6 6 6 8 8 9
31	0 0 1 2 3 3 4 4 4 5 5 5 5 6 6 7 7 7 8 8 9
32	0 0 0 1 1 2 2 3 4 4 5 5 6 7 8 8
33	3

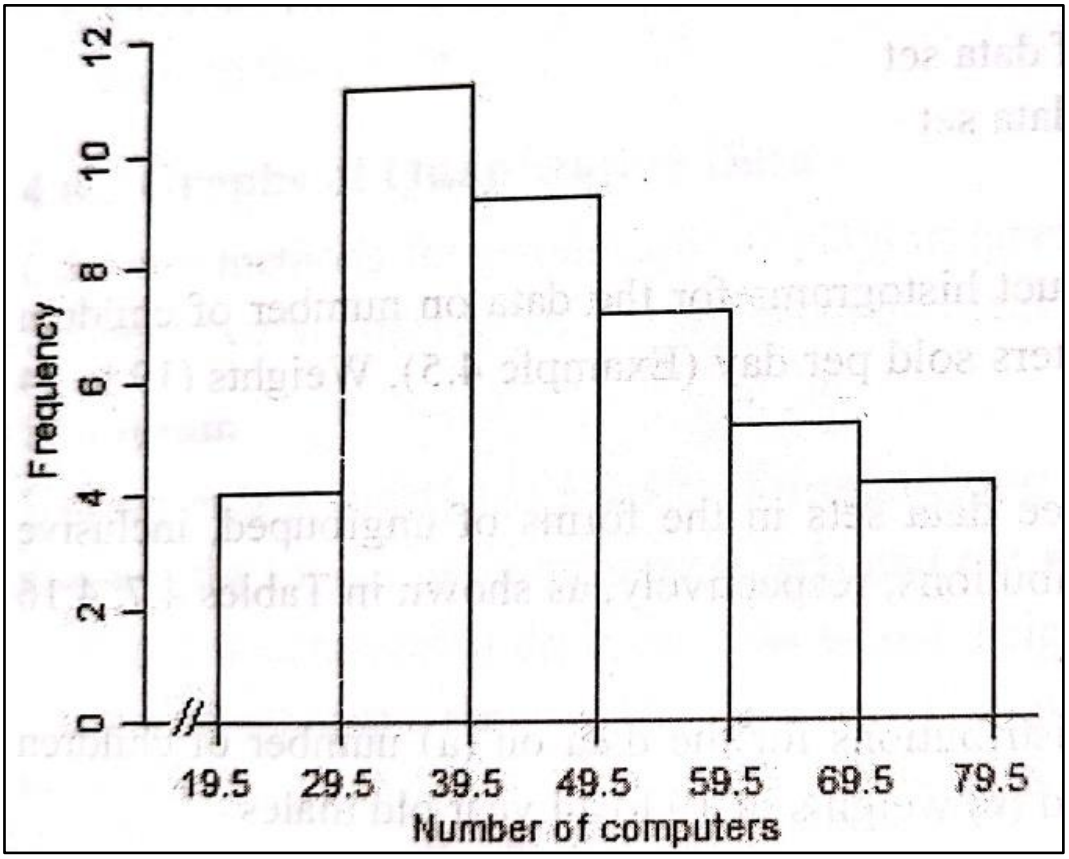
Key: 29|8 represents 29.8

Weight (in KG)	Midpoint	Frequency	Relative frequency	Cumulative frequency	Relative Cumulative freq.
35-40	37.5	2	0.033		
40-45		5	0.083		
45-50	47.5	12			
50-55				35	
55-60		12			
60-65		6			
65-70		4			
70-75		3	0.050		

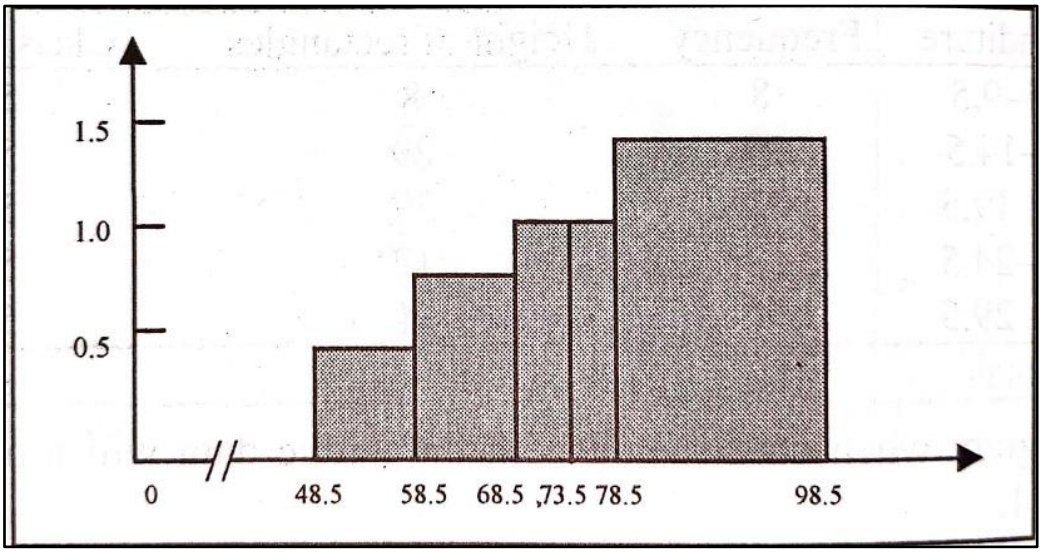
No of children	f_i
0	3
1	7
2	12
3	19
4	5
5	4



Computer sold	Class Boundary	f_i
20-29	19.5-29.5	4
30-39	29.5-39.5	11
40-49	39.5-49.5	9
50-59	49.5-59.5	7
60-69	59.5-69.5	5
70-79	69.5-79.5	4



Expenditure	f_i	**Class width**	**Height of rectangles/ Frequency density**
48.5-58.5	4	10	$\frac{4}{10} = 0.4$
58.5-68.5	8	10	0.8
68.5-73.5	5	5	1
73.5-78.5	5	5	1
78.5-98.5	28	20	1.4



	Eye Condition		
Gender	Near Sighted	Far Sighted	Need Bifocals
Male	12	40	12
Female	12	48	36

Practice:

a) The quiz scores of 13 students from the CSE department of BracU are as follows:

$$17, 8, 12, 19, 14, 6, 10, 15, 7, 18, 11, 16, 9$$

i) Construct the frequency distribution table using appropriate class interval.

ii) Draw Histogram, Frequency polygon, and Ogive curve

iii) Determined the Number of Students with Scores greater than or equal 13? (Hints: Ogive curve)

b) Construct the frequency distribution for below data:

$$27, 14, 9, 22, 18, 6, 25, 12, 30, 8, 19, 5, 29, 11, 20$$

And, draw the histogram, frequency polygon and ogive curve.

c) Utilizing the dataset from (b), create a frequency polygon representing relative frequencies.

d) Why do we need to group data in the form of a frequency table? Explain.

Ans: In summary, grouping data into a frequency table enhances data clarity, simplifies complex datasets, facilitates visualization, enables efficient analysis, and promotes effective communication among researchers and analysts.

e) The following data give the results of a sample survey. The letters A, B, and C represent the three categories.

$$A, B, B, A, C, B, C, C, C, A, C, B, C, A, C, C, B, C, C, A$$

i. Prepare a frequency distribution table.

ii. Calculate the relative frequencies and percentages for all categories.

iii. What percentage of the elements in this sample belong to category B?

iv. What percentage of the elements in this sample belong to category A or C?

v. Draw a bar graph for the frequency distribution.

f) Difference between frequency polygon and histogram.

Ans:

1) Several frequency distributions can be plotted on the same axis as frequency polygon. However, in the case of a histogram, we must have a separate graph for each distribution.

2) Frequency polygon is a continuous curve and it is easy to determine the scope and rate of change estimates. This is not possible in the case of a histogram.