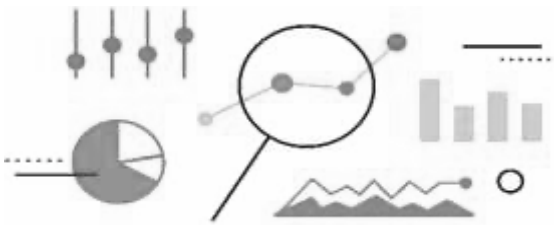
FREQUENCY DISTRIBUTION TABLES AND GRAPHS

Concepts Covered

- Introduction to data handling and statistics
- Organizing data
- Introduction to frequency
- Grouped frequency distribution
- Bar graph
- Pie chart (or a circle graph)
- Histogram
- Frequency polygon
- Some applications of graphs

What is Data?

The word data means the collection of information in the form of numerical figures or a set of given facts. Data is a collection of numbers gathered to give some information.
Data is a collection of facts, such as numbers, words, measurements, observations or even just descriptions of things. For example:
(a) Runs made by Virat Kohli in the last 25 one day (ODI) matches.
(b) The number of wickets taken by Jasprit Bumrah in the last 20 T-20 matches.
(c) The number of students in a class and their roll numbers.



What is Statistics?

Statistics is a branch of mathematics which deals with the study of collection, analysis, interpretation, presentation and organization of data. Some examples are:
(i) To find the average marks obtained by each student in a class with total number of students as 50. The average value obtained is called the statistics of the data.
(ii) Increase in the population of a country in the last decade.
(iii)The total number of employed people in a city and their average income.
There are two important concepts involved in statistics and they are: (i) uncertainty and (ii) Variation.

Uncertainty

This term is used when the outcome of an experiment is not fixed. For example: It is unknown that it will rain tomorrow or not , so there is a state of uncertainty. Whenever the term uncertainty comes in the picture, indirectly we will have to deal with probability.

Variation

Variarion is a relation between a set of values of one variable and a set of values of other variables (increase or decrease in one variable with respect to the other variable).

Types of Data

There are two types of data:

(i) Raw Data:

When some data is collected and presented randomly, then it is called Raw Data. A collection of observations gathered initially is called raw data or the data obtained from direct observation is called raw data. In other words, Data mostly available to us in an unorganized form is called raw data. The marks obtained by 10 students in a monthly test are an example of raw data also known as ungrouped data.

(ii) Grouped Data:

When the same data is classified into groups, then it is called Grouped Data. To present the data in a more meaningful way, we condense the data into a convenient number of classes or groups.

Organization of Data

Data available to us is in an unorganized form called raw data. To draw meaningful inferences, we need to organize the data systematically.
For example, the following data shows the number of children in 16 families: 1 1 2 3 3 2 1 1 2 2 2 1 3 3 2 3. Make the frequency table for the data.

No. of Children	Tally Marks	Frequency
1	𝍸	5
2	𝍸 |	6
3	𝍸	5

Frequency gives the number of times that a particular entry occurs.

Understanding of Data

Tally Marks: Tally marks are the symbolic representation of the occurrence of an observation in a particular table.
Frequency: The number of times a particular observation occurs in the given data is called the frequency of the observation.
Class Interval: Large Data is classified into Grouped Data (Class Interval) 1 – 10; 1 → lower limit,
10 → upper limit.

Class Interval	Tally Marks	Frequency
80 – 100	𝍸	5
100 – 120	||||	4
120 – 140	𝍸 |	6
Total		15

Frequency gives the number of times that a particular entry occurs.

Frequency Distribution

Frequency distribution is used to organize the collected data in a tabular form. i.e. way of presenting grouped data that exhibits the values of the variable and corresponding frequencies is called a frequency distribution. For example: The data could be marks obtained by students, temperatures of different cities, scores of all the participating teams in a cricket tournament etc.

Types of Frequency Distribution

(i) Ungrouped Frequency Distribution: In this type of distribution, the frequency of each item is represented as a single data value rather than groups of data values.

(ii) Grouped Frequency Distribution: When the collected data is large, it is recommended that the observations must be grouped into intervals and then list these intervals in the frequency distribution table. The intervals in the grouped frequency distribution are called **class intervals.** For example: Each of the groups 0 - 10, 10 - 20, 20 - 30, etc. is called a class Interval. Common observation will belong to the higher class; for example, 30 will belong to 30 – 35 (not 25 – 30). Similarly, 45 will belong to 45 – 50 (not 40 – 45). This difference between the upper-class limit and lower-class limit is called the width or size of the class interval.

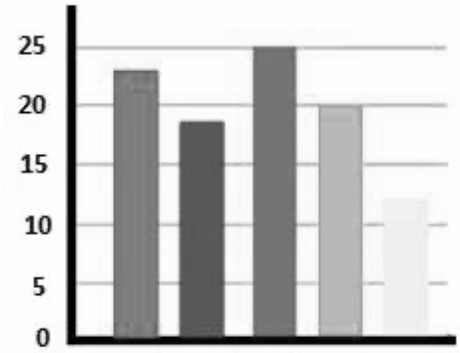
Frequency Distribution Graphs

This is another way to show data that is in the form of graphs and it can be done by using a frequency distribution graph. The graphs help us to understand the collected data in an easier way. The graphical representation of a frequency distribution can be shown by using the following types of graphs:

- **Bar Graphs:** Bar graphs represent data using rectangular bars of uniform width along with equal spacing between the rectangular bars.
- **Histograms:** A histogram is a graphical presentation of data using rectangular bars of different heights. In a histogram, there is no space between the rectangular bars.
- **Pie Chart:** A pie chart is a type of graph that visually displays data in a circular chart. It records data in a circular manner and then it is further divided into sectors that show a particular part of data out of the whole part.
- **Frequency Polygon:** A frequency polygon is drawn by joining the mid-points of the bars in a histogram. A frequency polygon is almost identical to a histogram, which is used to compare sets of data or to display a cumulative frequency distribution. It uses a line graph to represent quantitative data.

Graphs

Graphs are visual representations of data collected. The purpose of the graph is to show the numerical facts in visual form so that they can be understood clearly and easily.
Favorite color of 100 students of Class VIII
Scale: 1 unit = 5 students along Y axis

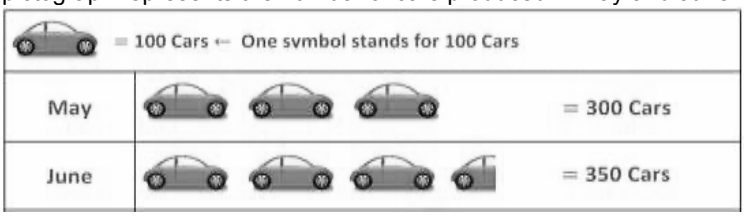


Favorite Color	Number of Students
	23
	19
	25
	20
	13

Types of Graphs

Pictograph

It represents data through appropriate pictures. Generally, the same type of symbols or pictures is used to represent data. Each picture and symbols are used to represent a certain value and it is clearly mentioned in the graph. The given pictograph represents the number of cars produced in May and June.

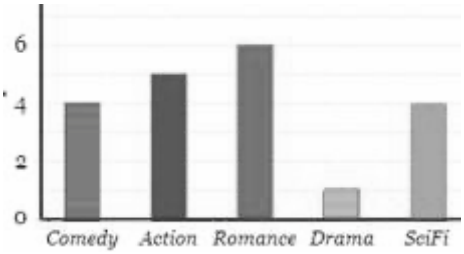


A Bar Graph

A display of information using bars of uniform widths, them heights being proportional to the respective values. For example:

Comedy	Action	Romance	Drama	SciFi
4	5	6	1	4

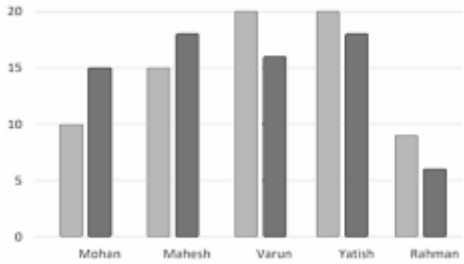
Table: Favorite Type of Movie
We can show that on a bar graph like this:



Double Bar Graph

A bar graph showing two sets of data simultaneously. It is useful for the comparison of the data.
For example: A class teacher prepared a report card of unit test-I (out of 20) and unit test-II (out of 20) of 5 students.

Students	Mohan	Mahesh	Varun	Yatish	Rahan
Test 1	10	15	20	20	9
Test 2	15	18	16	18	6



He displayed the information in the double bar graph in the parent teacher meeting to visualize the performance of the students.

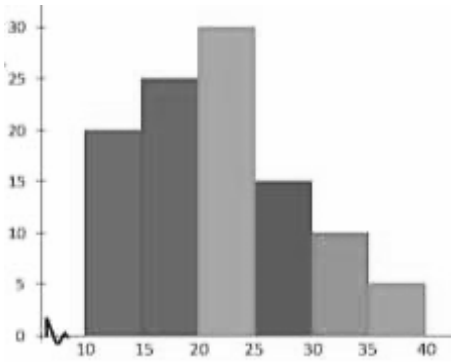
Check Your Concept - 1

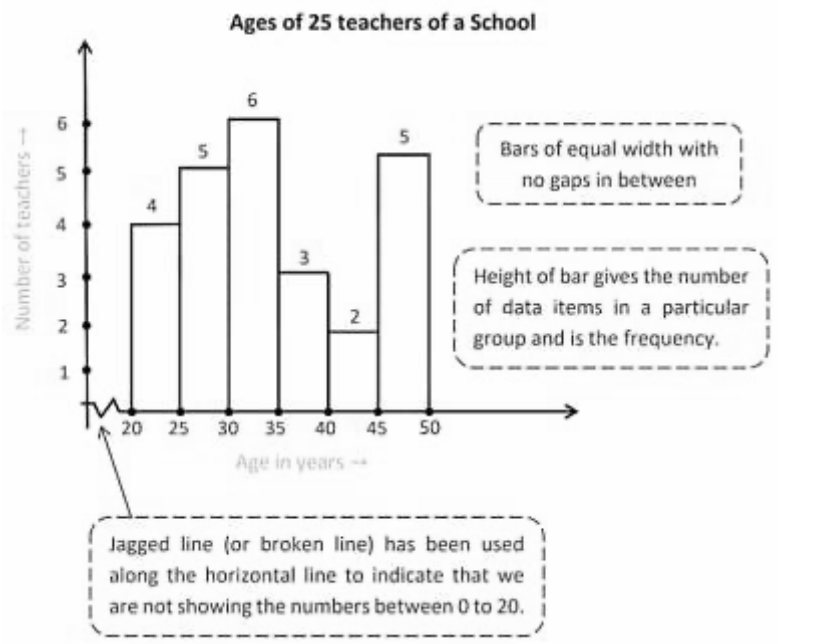
(i) Double bar graphs display _____ sets of data simultaneously:
(A) 4 (B) 3
(C) 2 (D) 1
(ii) Pictorial representation of data using symbols is known as?
(A) Bar Graph (B) Pictograph
(C) Pie Chart (D) None of these
(iii) If 20–30 is the class interval of grouped data, then the lower-class limit is:
(A) 50 (B) 30
(C) 20 (D) 10

Histogram

The graphical representation of data in a manner, such that the height of bars shows the frequency of class interval and also there is no gap between the bars as there is no gap between the class-intervals is called a histogram.
(1) X-Axis in the histogram represents the Class Intervals.
(2) Y-Axis in the histogram represents the frequencies.
Construct a histogram for the frequency distribution table below:

Interval	10-15	15-20	20-25	25-30	30-35	35-40
Frequency	20	25	30	15	10	5





This Jagged line is also called as **'Kink'.**

What is Pie Chart?

It is also called a circle graph. A circle graph shows the relationship between a whole and its parts. The whole circle divided into sectors. The size of each sector is proportional to the activity or information it represents.
The pie chart below shows the time spent by a child in a day.

Activity	Sleep	School	Play	Homework	Others
Time	8	6	3	4	3

In the above graph, the proportion of the sector for hours spent in sleeping

$$= \frac{\text{Number of Sleeping Hours}}{\text{Whole Day}} = \frac{8}{24} = \frac{1}{3}$$

So, this sector is drawn as 1/3rd part of the circle. Similarly, the proportion of the sector for hours spent in School.

Drawing Pie Chart

- **Take the total value of all the items equal to 360°.**
- **Convert each component of the data into degrees using the formula.**
  Degree of any component = $\frac{\text{Component value}}{\text{Total value}}$ × 360°
- **Draw a circle with appropriate radius. Mark the angles at the center of the circle and draw the sectors.**

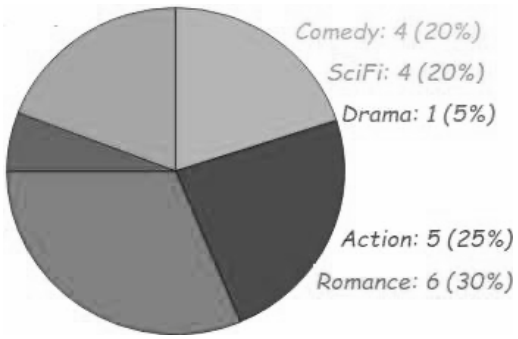
Example:

Imagine you survey your friends to find the kind of movie they like best:

Comedy	Action	Romance	Drama	SciFi
4	5	6	1	4

- First, put your data into a table (like above), then add up all the values to get a total:
- Next, divide each value by the total and multiply by 100 to get a percent:
- Now to figure out how many degrees for each "pie slice" (correctly called a circle sector.)

Comedy	Action	Romance	Drama	Sci-Fi	Total
4	5	6	1	4	20
20%	25%	30%	5%	20%	100%
$\frac{4}{20}$ × 360° = 72°	$\frac{5}{20}$ × 360° = 90°	$\frac{6}{20}$ × 360° = 108°	$\frac{1}{20}$ × 360° = 18°	$\frac{4}{20}$ × 360° = 72°	360°

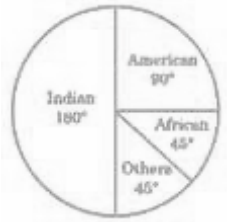


Solved Examples

(1) Define the following terms:
Observations, Raw data, Frequency of an observation, Frequency distribution, Discrete frequency distribution, grouped frequency distribution, Class interval
Solution: (i) Observations:
Observation is the value at a particular period of a particular variable.
(ii) Raw data:
Raw data is the data collected in its original form.
(iii) Frequency of an observation:
Frequency of an observation is the number of times a certain value or a class of values occurs.
(iv) Frequency distribution:
Frequency distribution is the organization of raw data in table form with classes and frequencies.
(v) Discrete frequency distribution:
Discrete frequency distribution is a frequency distribution where sufficiently great numbers are grouped into one class.
(vi) Grouped frequency distribution:
Grouped frequency distribution is a frequency distribution where several numbers are grouped into one class.
(vii) Class-interval:
Class interval is a group under which large number of data is grouped to analyse its Range and Distribution.

(2) Define Histogram?
Solution: Histogram is a graphical representation of data, if data represented in manner of class-interval.

(3) The following pie chart depicts the percentage of students, nationwide. What is the percentage of…?
(i) Indian students
(ii) African students



Solution: (i) Percentage of Indian students = $\frac{180}{360}$ x 100 = **50%**
(ii) Percentage of African students = $\frac{45}{360}$ x 100 = **12.5%**

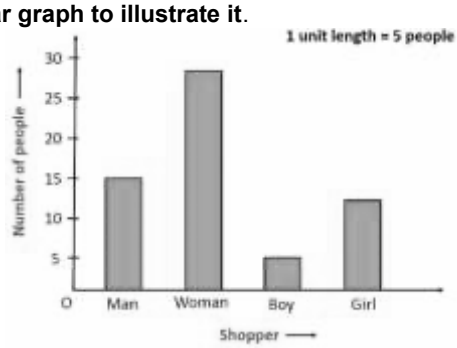
(4) What gives the number of times a particular entry occurs?
Solution: Frequency distribution table gives the number of times a particular entry occurs.

(5) For which of these would you use a histogram to show the data:
(a) The number of letters for different areas in a postman's bag.
(b) The height of competitors in athletics meet.
(c) The number cassettes produced by 5 companies.
(d) The number of passengers boarding trains from 7.00 a.m. to 7.00 p.m. at a station.
Give reason for each.
Solution: Since, Histogram is a graphical representation of data, if data represented in manner of class-interval. Therefore, for case (b) and (d), we would use a histogram to show the data, because in these cases, data can be divided into class-intervals.
In case (b), a group of competitions having different heights in athletics meet.
In case (d), the number of passengers boarding trains in an interval of one hour at a station.

(6) The shoppers who come to a departmental store are marked as: man (M), woman (W), boy (B) or girl (G). The following list gives the shoppers who came during the first hour in the morning.
W G B W W W G B W W M G G M M W W W W G B M W B G G M W W M M W W W M W B W G M W W W W G W M M W M W G W M G W M M G W.
Make a frequency distribution table using tally marks. Draw a bar graph to illustrate it.
Solution: The frequency distribution table is as follows:

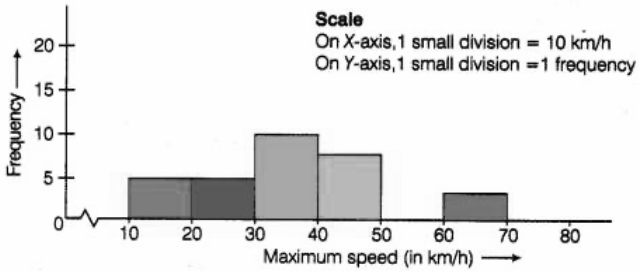
Shopper	Tally Marks	Number of shoppers
W	𝍸 𝍸 𝍸 𝍸 𝍸 III	28
M	𝍸 𝍸 𝍸	15
B	𝍸	5
G	𝍸 𝍸 II	12
	Total	60

The illustration of data by bar-graph is as follows:



(7) The top speeds of thirty different land animals have been organized into a frequency table. Draw a histogram for the given data.

Maximum Speed (km/h)	Frequency
10-20	5
20-30	5
30-40	10
40-50	8
50-60	0
60-70	2



Solution: Histogram is a type of bar diagram, where the class intervals are shown on the horizontal axis and the heights of the bars (rectangles) show the frequency of the class interval, but there is no gap between the bars as there is no gap between the class intervals.

(8) The weights (in kg) of 30 students of a class are: 39, 38, 36, 38, 40, 42, 43, 44, 33, 33, 31, 45, 46, 38, 37, 31, 30, 39, 41, 41, 46, 36, 35, 34, 39, 43, 32, 37, 29, 26.
Prepare a frequency distribution table using one class interval as (30 – 35), 35 not included.
(i) Which class has the least frequency?
(ii) Which class has the maximum frequency?

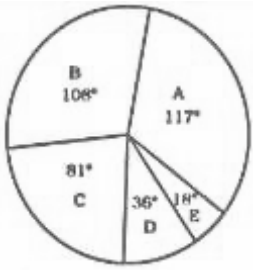
Solution: At first, we must arrange the weights (in kg) of 30 students of a class in an ascending order.
26, 29, 30, 31, 31, 32, 33, 33, 34, 35, 36, 36, 37, 37, 38, 38, 38, 39, 39, 39, 40, 41, 41, 42, 43, 43, 44, 45, 46, 46. Now, we will draw the frequency table of the given data.

Class Interval	Tally Marks	Frequency
25-30	||	2
30-35	𝍸 ||	7
35-40	𝍸 𝍸 |	11
40-45	𝍸 ||	7
45-50	||	3
Total		30

(i) Class first has the least frequency.
(ii) Class third has the maximum frequency.

(9) Shoes of the following brands are sold in Nov. 2007 at a shoe store. Construct a pie chart for the data.

Brand	Number of Pair of Shoes Sold
A	130
B	120
C	90
D	40
E	20



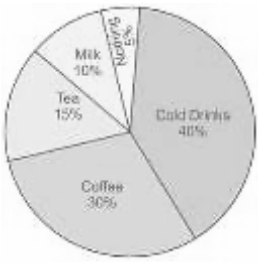
Solution: We have, Total number of pairs of shoes sold = 130 + 120 + 90 + 40 + 20 = 400
Central angle of pie chart for each brand:

A = $\left(\frac{130}{400}\right)$ x 360° = 117° B = $\left(\frac{120}{400}\right)$ x 360° = 108°

C = $\left(\frac{90}{400}\right)$ x 360° = 81° D = $\left(\frac{40}{400}\right)$ x 360° = 36°

E = $\left(\frac{20}{400}\right)$ x 360° = 18°

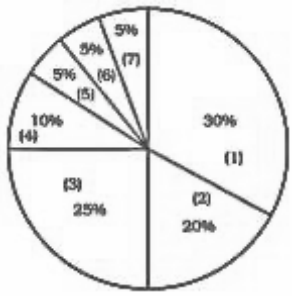
(10) A survey was carried out to find the favorite beverage preferred by a certain group of young people. The following pie chart shows the findings of this survey. From this pie chart answer the following:
(i) Which type of beverage is liked by the maximum number of people.
(ii) If 45 people like tea, how many people were surveyed?



Solution: (i) Cold drink is liked by the maximum number of people.
(ii) We have, 45 people like tea
So, let total number of people surveyed be x, 45 = ($\frac{15}{100}$) × x ⇒ 45 = 0.15x
x = 300; So, the total number of people surveyed is 300.

(11) A financial counselor gave a client this pie chart describing how to budget his income. If the client brings home Rs. 50,000 each month, how much should he spend in each category?

(i) Housing **(ii) Food (including eating out)**
(iii) Car loan and maintenance **(iv) Utilities**
(v) Phone **(vi) Clothing**
(viii) Entertainment



Solution: We have, Total money spent on 7 categories = Rs.50,000; So,

(i) Money spent on Housing = $\left(\frac{30}{100}\right)$ × 50,000 = Rs.15,000

(ii) Money spent on Food (including eating out) = $\left(\frac{20}{100}\right)$ × 50,000 = Rs.10,000

(iii) Money spent on Car Loan and Maintenance = $\left(\frac{25}{100}\right)$ × 50,000 = Rs.12,500

(iv) Money spent on Utilities = $\left(\frac{20}{100}\right)$ × 50,000 = Rs.10,000

(v) Money spent on Phone = $\left(\frac{5}{100}\right)$ × 50,000 = Rs.2,500

(iv) Money spent on Clothing = $\left(\frac{5}{100}\right)$ × 50,000 = Rs.2500

(vii) Money spent on Entertainment = $\left(\frac{5}{100}\right)$ × 50,000 = Rs.2,500

(12) In the time-table of a school, periods allotted per week to different teaching subjects are given below: Draw a pie chart for this data.

Subject	Hindi	English	Maths	Science	S. St.	Computer	Sanskrit
Periods	7	8	8	8	7	4	3

Solution: Total number periods allotted = 7 + 8 + 8 + 8 + 7 + 4 + 3 = 45

Periods Central angle of pie chart for each subject,

Hindi = $\left(\frac{7}{45}\right)$ x 360° = 56°

English = $\left(\frac{8}{45}\right)$ x 360° = 64°

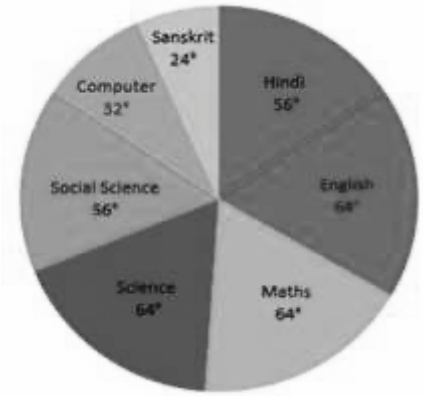
Maths = $\left(\frac{8}{45}\right)$ x 360° = 64°

Science = $\left(\frac{8}{45}\right)$ x 360° = 64°

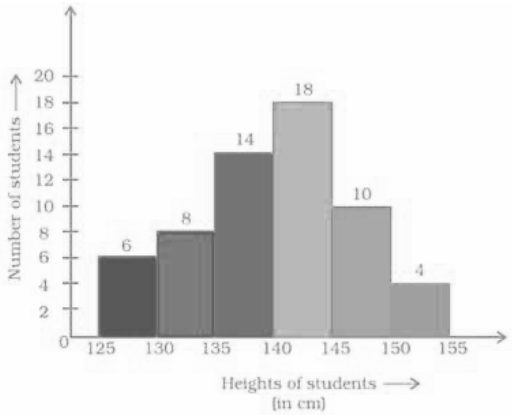
Computer = $\left(\frac{7}{45}\right)$ x 360° = 32°

Sanskrit = $\left(\frac{3}{45}\right)$ x 360° = 24°

Social Science = $\left(\frac{7}{45}\right)$ x 360° = 56°



(13) Look at the histogram below and answer the questions that follow.
(i) How many students have height more than or equal to 135 cm but less than 150 cm?
(ii) Which class interval has the least number of students?
(iii) What is the class size?
(iv) How many students have height less than 140 cm?



Solution: (i) By observing the given histogram, Students have height more than or equal to 135 cm but less than 150 = 14 + 18 + 10 = 42

(ii) 150 - 155 has the least number of students i.e., 4.

(iii) The difference between the upper and lower limit of a class interval is called the size of the class interval.
Size = upper limit - lower limit = 130 – 125 = 5

(iv) By observing the given histogram, Students have height less than 140 cm are = 6 + 8 + 14 = 28

Exercise

FILL IN THE BLANKS

(1) Data available in an unorganized form is called _____ data.
(2) In the class interval 20–30, the lower-class limit is _____.
(3) In the class interval 26–33, 33 is known as _____.
(4) The range of the data 6, 8, 16, 22, 8, 20, 7, 25 is _____.
(5) A pie chart is used to compare _____ to a whole.
(6) _____ is used to find the value of the mode graphically.
(7) The difference between the upper and lower limit of a class interval is called the _____ of the class interval.
(8) The sixth-class interval for a grouped data whose first two class intervals are 10–15 and 15–20 is _____.
(9) The information collected in term of numbers is called _____.
(10) The number of times a particular observation occurs in a given data is called its _____.
(11) When the data are large, they can be arranged in groups and each group is known as _____ or _____.
(12) A table showing the frequencies of various observations or class intervals of a given data is called a _____.
(13) The range of the data - 9, 8, 4, 3, 2, 1, 6, 4, 8, 10, 12, 15, 4, 3 is _____.

TRUE OR FALSE

(1) In a pie chart a whole circle is divided into sectors.
(2) The central angle of a sector in a pie chart cannot be more than 180°.
(3) Sum of all the central angles in a pie chart is 360°.
(4) In a pie chart two central angles can be of 180°.
(5) In a pie chart two or more central angles can be equal.
(6) If the fifth-class interval is 60–65, fourth class interval is 55–60, then the first-class interval is 45–50.
(7) The class size of the class interval 60–68 is 8.
(8) The sum of deviations from the mean is always zero.
(9) Quartiles divides the data into three equal parts.
(10) Percentiles divides the series into hundred equal parts.

OBJECTIVE TYPE QUESTION

(1) The height of a rectangle in a histogram shows the
(A) Width of the class (B) Upper limit of the class
(C) Lower limit of the class (D) Frequency of the class

(2) A geometric representation showing the relationship between a whole and its parts is a
(A) Pie Chart (B) Histogram
(C) Bar Graph (D) Pictograph

(3) In a pie chart, the total angle at the center of the circle is
(A) 180° (B) 360°
(C) 270° (D) 90°

(4) Listed below are the temperature in °C for 10 days. -6, -8, 0, 3, 2, 0, 1, 5, 4, 4.
What is the range of the data?
(A) 8°C (B) 13°C
(C) 10°C (D) 12°C

(5) In a frequency distribution with classes 0-10, 10-20 etc., the size of the class intervals is 10. The lower limit of fourth class is
(A) 40 (B) 50
(C) 20 (D) 30

(6) Data collected in a survey shows that 40% of the buyers are interested in buying a particular brand of toothpaste. The central angle of the sector of the pie chart representing this information is
(A) 120° (B) 150°
(C) 144° (D) 40°

(7) Monthly salary of a person is Rs.15000. The central angle of the sector representing his expenses on food and house rent on a pie chart is 60°. The amount he spends on food and house rent is
(A) Rs. 5000 (B) Rs. 2500
(C) Rs. 6000 (D) Rs. 9000

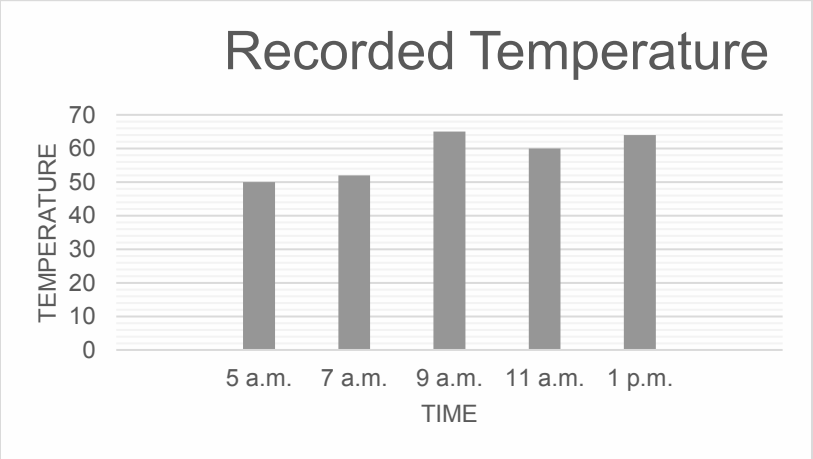
(8) The following pie chart represents the distribution of proteins in parts of a human body. What is the ratio of distribution of proteins in muscles to that of proteins in bones?
(A) 3:1 (B) 1:2
(C) 1:3 (D) 2:1

(9) A graph showing two sets of data simultaneously is known as
(A) Pictograph (B) Histogram
(C) Pie Chart (D) Double Bar Graph

(10) Size of the class 150-175 is
(A) 150 (B) 175
(C) 25 (D) -25

(11) Tally marks are used to find
(A) Class Intervals (B) Range
(C) Frequency (D) Upper Limit

Direction (Q.12 to Q.16): The graph in figure depicts the temperature recorded at difference times of a day of a particular city. Observe the graph and select the correct answer for the given four alternatives



(12) Maximum temperature was recorded at
(A) 5 a.m. (B) 7 a.m.
(C) 9 a.m. (D) 1 p.m.

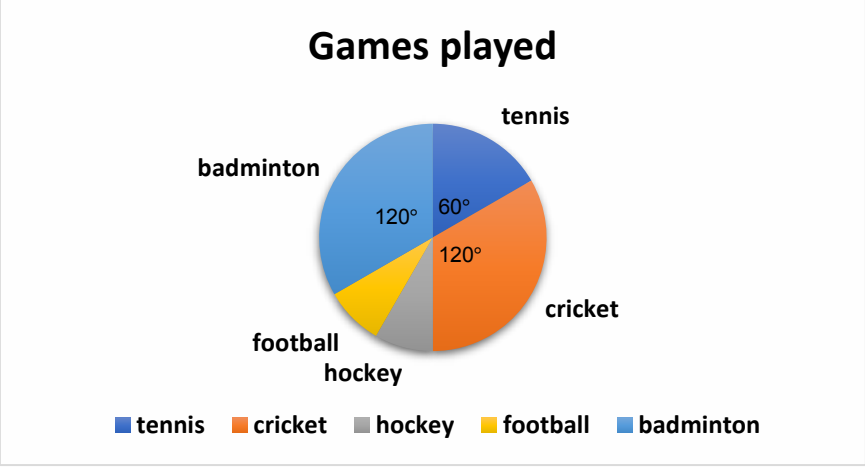
(13) 60^{o} temperature was recorded at
(A) 9 a.m. (B) 1 p.m.
(C) 11 a.m. (D) 9 p.m.

(14) The ratio of maximum temperature to Minimum temperature is
(A) 5: 7 (B) 13: 10
(C) 12: 13 (D) 7: 5

(15) Difference of 1-degree temperature was between
(A) 7 a.m. and 9 a.m. (B) 9 a.m. and 11 a.m.
(C) 9 a.m. and 1 p.m. (D) 11 a.m. and 1 p.m.

(16) The % change in temperature from 5 a.m. to 7 a.m. is
(A) 10% (B) 20%
(C) 30% (D) 4%

Direction (Q.17 to Q. 22): The adjoining pie chart depicts the games played by 1500 students of a school. Each student plays only one game. Examine this graph and choose the correct answer.



(17) Which game is liked least?

(A)Tennis (B) Hockey
(C) Cricket (D) Football

(18) How many students play tennis?

(A) 250 (B) 500
(C) 425 (D) 200

(19) What percentage of students play badminton?

(A) 33% (B) 13%
(C) 33. 31% (D) 30%

(20) The ratio of the students who plays tennis to those who play cricket is

(A) 2: 1 (B) 1: 2
(C) 1: 1 (D) 1: 3

(21) Which of the following is a characteristic of a mean?

(A) The sum of deviations from the mean is zero
(B) It minimises the sum of squared deviations
(C) It is affected by extreme scores
(D) All of the above

(22) If mean and mode of a data are 6 and 10 respectively then it's median will be:

(A) 1.5 (B) 5.3
(C) 7.33 (D) 16

Answer Key

CHECK YOUR CONCEPT

(1) **(i)** C **(ii)** B **(iii)** C

FILL IN THE BLANKS

(1) Raw
(2) 20
(3) Upper Class Limit
(4) 19
(5) Parts
(6) Histogram
(7) Size / Width
(8) 35-40
(9) Data
(10) Frequency
(11) Class / Class Interval
(12) Frequency Distribution Table
(13) 14

TRUE OR FALSE

(1) True
(2) False
(3) True
(4) True
(5) True
(6) False
(7) True
(8) True
(9) False
(10) True

OBJECTIVE TYPE QUESTION

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
(D)	(A)	(**B**)	(B)	(D)	(C)	(B)	(D)	(D)	(C)	(C)
(12)	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**
(C)	(C)	(B)	(C)	(D)	(A)	(A)	(C)	(B)	(D)	(C)