Representation of data and representative values

After studying this lesson, you can get a good understanding of:

- representing data using tables and pie charts.
- finding the range of a distribution of data.
- finding the representative values such as the mode, the median and the mean in a distribution of data.

27.1 Pie charts

You have already learnt how to represent data using bar graphs and picture graphs. Another method of representing data is the pie chart. Here the data is represented within a circle. All the data is represented by a full circle or by 360°. The number representing each type will be shown by a sector of the circle.

The angle of each sector is calculated by considering the fact that all the data is represented by 360°.

Example 1

40 children in Grade 8 were asked about the games they like most. The result is given in the table on page 71. Show this information in a pie chart.
<table>
<thead>
<tr>
<th>Game</th>
<th>Number of children who like the game</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cricket</td>
<td>25</td>
</tr>
<tr>
<td>Volleyball</td>
<td>10</td>
</tr>
<tr>
<td>Football</td>
<td>05</td>
</tr>
</tbody>
</table>

Let us first find the angle of the sector which represents one game. $360^\circ$ represent the total number of children.
i.e. 40 children are represented by $360^\circ$.

$\therefore$ The angle representing 25 children who like cricket

$$= \frac{360^\circ}{40} \times 25$$

$$= 225^\circ$$

Similarly,
The angle representing 5 children who like football

$$= \frac{360^\circ}{40} \times 5$$

$$= 45^\circ$$

The angle representing 10 children who like volleyball

$$= \frac{360^\circ}{40} \times 10$$

$$= 90^\circ$$

Now let us represent this information in sectors of a circle.

When representing data in a pie chart, it is easy to compare ★ each data with the total data.
★ each data with the others.

But if the types of data are more, then the angles of the sectors become smaller and hence it is difficult to represent them.

Representing data using sectors of a circle is called representing data in a **pie chart**.
Example 2

The pie chart given below shows how 36 invitees at a party had their meals.

Calculate the number of people who had each type.

<table>
<thead>
<tr>
<th>Type of meal</th>
<th>Angle of the sector</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>String hoppers</td>
<td>90°</td>
<td>$\frac{90^\circ}{360^\circ} \times 36 = 9$</td>
</tr>
<tr>
<td>Noodles</td>
<td>60°</td>
<td>$\frac{60^\circ}{360^\circ} \times 36 = 6$</td>
</tr>
<tr>
<td>Hoppers</td>
<td>80°</td>
<td>$\frac{80^\circ}{360^\circ} \times 36 = 8$</td>
</tr>
<tr>
<td>Rice</td>
<td>130°</td>
<td>$\frac{130^\circ}{360^\circ} \times 36 = 13$</td>
</tr>
</tbody>
</table>

Exercise 27.1

(1) In a bookshop there are tissue papers in the shades of blue, green, red and yellow. 60 children selected the shades they liked, to make kites. Information regarding the colours they selected is given in the table.

<table>
<thead>
<tr>
<th>Colour</th>
<th>No. of children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>25</td>
</tr>
<tr>
<td>Green</td>
<td>20</td>
</tr>
<tr>
<td>Red</td>
<td>10</td>
</tr>
<tr>
<td>Yellow</td>
<td>5</td>
</tr>
</tbody>
</table>

Show this data in a pie chart.

(2) Monthly expenses of a person is given in the sketch on page 73. Find the angle of each sector and represent the data in a pie chart.
(3) The results of 720 students who sat an examination are shown below. Represent this information in a pie chart.

| Passes | 60 |
| Passes | 100 |
| Passes | 120 |
| Passes | 400 |
| Passes | 40 |

(4) The time allocated to each programme on television in a day is given in the pie chart.
(i) What is the value of the angle of the sector which represents dancing?
(ii) Express this time as a percentage of the total time of telecasting.

<table>
<thead>
<tr>
<th>Candidate</th>
<th>No. of votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neshan</td>
<td>72</td>
</tr>
<tr>
<td>Malith</td>
<td>36</td>
</tr>
<tr>
<td>Roshan</td>
<td>30</td>
</tr>
<tr>
<td>Ravi</td>
<td>06</td>
</tr>
</tbody>
</table>

(5) In an election for the selection of a prefect of a school, the number of votes obtained by each candidate is given in the table. Represent this data in a pie chart.

(6) The table shows how a pupil spends his day.

(i) What are the steps you should take to represent this information in a pie chart?
(ii) Find the angle of the sector for each type of activity.
(iii) Represent this in a pie chart.
27.2 Representing data using tables

You have learnt earlier how to tabulate data and represent them using graphs.

When certain numbers occur repeatedly in a given set of data it is convenient to tabulate by grouping them.
For example, If 10 students have got the following marks for a test
3, 5, 2, 4, 3, 6, 7, 5, 4, 5
they can be tabulated as follows.

<table>
<thead>
<tr>
<th>Mark</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

Here, you can observe clearly that 2 students have got 3 and 4 marks each, 3 students have got 5 marks each and so on. The second column, which gives the number of students is called the frequency column. This is a better way of tabulating such data.

When a collection of data is grouped and tabulated with the frequency such a table is called a frequency distribution.

Example 3

Marks obtained by 50 students for a school based assessment are given below. Tabulate these marks, in a frequency table.

4 3 5 4 3 5 5 4 3 6
5 4 5 3 4 4 5 5 7 4
3 4 3 4 5 4 3 6 1 3
6 3 2 6 6 3 5 2 7 5
7 1 7 6 5 8 6 4 3 5

<table>
<thead>
<tr>
<th>Marks</th>
<th>Tally Marks</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>III III I</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>III III I</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>III III II</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>III II</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>/////</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>I</td>
<td>1</td>
</tr>
</tbody>
</table>
Exercise 27.2

(1) The weights of 30 students in a class, to the nearest kilogramme are given below. Show this information in a suitable table.

\[
27\ 26\ 27\ 30\ 32\ 33\ 30\ 26\ 30\ 33\ 28\ 29\ 30\ 32\ 33\ 31\ 30\ 36\ 28\ 27\ 32\ 30\ 27\ 30\ 31\ 32\ 30\ 27\ 28\ 33
\]

(2) The heights of 24 students in Grade 8, to the nearest centimetre are given below. Prepare a table using tally marks.

\[
135\ 136\ 135\ 135\ 137\ 137\ 138\ 135\ 137\ 140\ 140\ 141\ 140\ 140\ 139\ 139\ 138\ 139\ 138\ 138\ 139\ 139\ 138\ 138\ 139\ 139\ 138
\]

(3) 20 people who have applied for a post in a certain institution faced an interview. Following are the marks obtained by each of them.

\[
1\ 5\ 4\ 6\ 7\ 8\ 1\ 3\ 5\ 5\ 5\ 6\ 7\ 8\ 9\ 5\ 6\ 4\ 2\ 3
\]

Prepare a table with tally marks for this data.

(4) Weighing one kilogramme at a time, 30 kg of lime fruits were weighed and the number of fruits in each kg was noted and are shown below.

\[
17\ 15\ 19\ 22\ 19\ 26\ 17\ 18\ 20\ 17\ 18\ 15\ 24\ 18\ 17\ 17\ 17\ 17\ 20\ 17\ 18\ 21\ 15\ 16\ 17\ 24\ 17\ 17\ 21\ 18
\]

Prepare a frequency table for this data.

27.3 The range of a collection of data

When getting information using data, it is important to have an idea about the distribution of that data.

Given below are the marks obtained by a group of Grade 8 students for two subjects for the last term test.

Mathematics: 80, 65, 72, 43, 51, 30, 86, 25
Science: 38, 62, 70, 45, 36, 41, 50, 65

Accordingly for Mathematics,

highest mark = 86
lowest mark = 25

the difference between the highest mark and the lowest mark = 86 – 25

= 61
For Science

highest mark = 70

lowest mark = 36

the difference between the highest marks and the lowest marks = 70 – 36

= 34

Here the distribution of marks in the two subjects are different. For Mathematics it is higher than for Science.

In a collection of data, the difference between the highest value and the lowest value is called the **range**.

Accordingly, the range for Mathematics is 61 and the range for Science is 34.

### 27.4 Representative value

If you were asked about the ages of the students in your class, what will be your answer? Most of the students are 13 years old, but there may be students of age 12 or 14 years. Therefore, we must select an answer which will represent all the students. As most of the students are 13 years old, the answer may be 13 years. A value used to represent a collection of data is called a representative value.

### 27.5 Mode

The number of coconuts plucked from 10 trees in an estate is as follows.

2, 3, 1, 4, 3, 5, 3, 2, 1, 4

Here the number of coconuts plucked from most number of trees is 3. This is called the mode.

In a collection of data, the value that occurs for most number of times is called the **mode** of the distribution.

**Example 4**

The table gives the shoe sizes of 40 children in Grade 8. Find the mode of this distribution.

From the table, you can see that most of the children use size 5. Therefore, the mode is 5.

**Example 5**

Given below are the number of loaves of bread sold in a shop during 20 days. Find the mode of this data distribution.

33 42 35 34 28 43 52 64 42 33

34 27 33 45 32 42 23 22 20 31
To find the mode, we have to find the number of loaves of bread sold during most number of days. Both 42 and 33 appear 3 times each in this data. Accordingly, it has two modes. They are 42 and 33. Accordingly, distributions which have two modes are called as bimodal distributions. There can be even more than 2 modes in a distribution of data.

27.6 Median

Think, that the students in your class stand in a row according to their heights. When standing in this manner, the height of the student in the middle can also be taken as a representative value for the height of a child in your class. This is called the median of the heights of the children in your class.

When a collection of data is arranged in ascending order or in descending order, the value in the middle is called the median of the distribution.

The figure shows how 13 students are made to stand according to their heights.

![Diagram showing students standing in order]

When one from each end is removed, the one in the middle will remain. The height of this child gives the median height of 13 students.

If there is an even number of students, there will be two students in the middle. Then the median can be obtained by adding the two heights and dividing the answer by 2.

Example 6

Given below are the marks obtained by 25 students in a test. Find the median of the marks.

\[23, 20, 15, 17, 32, 48, 13, 21, 24, 36, 33, 20, 43, 14, 37, 31, 41, 47, 39, 20, 16, 35, 24, 34, 30\]

When the marks are arranged in ascending order, it is

\[13, 14, 15, 16, 17, 20, 20, 21, 22, 23, 24, 24, 30, 31, 32, 33, 34, 35, 36, 37, 39, 41, 43, 47, 48\]

As there are 25 terms, the middle is the 13th one. This can be obtained by, \[\frac{25+1}{2}\]

\[13^{th}\text{ value.}\]

\[\therefore \text{The median} = 30\]
Example 7

The number of packets of milk sold in 20 days in a milk bar are given below. Find the median of the given data.

46 47 49 46 48 45 45 43 43 43
44 42 45 44 44 42 41 48 47 44

Let us show this information in a frequency table.

When data is represented in a frequency table, they are arranged in ascending order.

<table>
<thead>
<tr>
<th>No. of packets of milk</th>
<th>No. of days (frequency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>1</td>
</tr>
<tr>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>43</td>
<td>3</td>
</tr>
<tr>
<td>44</td>
<td>4</td>
</tr>
<tr>
<td>45</td>
<td>3</td>
</tr>
<tr>
<td>46</td>
<td>2</td>
</tr>
<tr>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>48</td>
<td>2</td>
</tr>
<tr>
<td>49</td>
<td>1</td>
</tr>
</tbody>
</table>

To find the median we have to find the number of packets of milk relevant to the 10th and 11th, as the number of scores is 20.

The number of packets of milk corresponding to the 10th score = 44
The number of packets of milk corresponding to the 11th score = 45

∴ The median = \( \frac{44 + 45}{2} \) = 44.5

When there are even number of scores the median obtained, sometimes may not be a number in the given data.

27.7 Mean

You will remember, how the average of the total marks is obtained in the term test. This is obtained by dividing the total marks by the number of subjects. This is also a representative value. This is called the mean.

The mean of a collection of data is obtained by dividing the sum of all the scores in the collection by the number of scores in the collection of data.

Example 8

The table shows the attendance of Grade 8A students during the 5 days of a week. Find the mean attendance of the children.

Total attendance in the week = 38 + 41 + 35 + 40 + 39
= 193

No. of days = 5

∴ The mean attendance per day = \( \frac{193}{5} \) = 38.6
Example 9

The frequency table shows the information about the number of match-sticks in 30 boxes of matches. Find the mean number of match-sticks in a match-box.

According to the given information there are two boxes with 47 matches, 5 boxes with 48 matches, and so on. To find the total number of match-sticks in the boxes, we have to take the products $47 \times 2$, $48 \times 5$ and so on. To make the calculations easy, we add another column to this table.

Taking the number of match-sticks as $x$ and the number of boxes as $f$, let us complete the table.

<table>
<thead>
<tr>
<th>No. of match-sticks</th>
<th>No. of boxes of matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>48</td>
<td>5</td>
</tr>
<tr>
<td>49</td>
<td>6</td>
</tr>
<tr>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td>51</td>
<td>6</td>
</tr>
<tr>
<td>52</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of matches ($x$)</th>
<th>No. of boxes ($f$)</th>
<th>$fx$</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>2</td>
<td>94</td>
</tr>
<tr>
<td>48</td>
<td>5</td>
<td>240</td>
</tr>
<tr>
<td>49</td>
<td>6</td>
<td>294</td>
</tr>
<tr>
<td>50</td>
<td>7</td>
<td>350</td>
</tr>
<tr>
<td>51</td>
<td>6</td>
<td>306</td>
</tr>
<tr>
<td>52</td>
<td>4</td>
<td>208</td>
</tr>
</tbody>
</table>

$\sum f = 30$

The total number of boxes, i.e. the sum of the column ‘$f$’ is 30. This is written as $\sum f$.

$\sum f = 30$

The total number of matches, i.e. the sum of the column ‘$fx$’ is 1492. This is written as $\sum fx$.

$\sum fx = 1492$

To find the mean number of matches in a box, the total number of matches must be divided by the number of boxes.

Mean $= \frac{\sum fx}{\sum f} = \frac{1492}{30}$

$= 49.73$

When a collection of data is represented as a frequency distribution, then the mean can be calculated using $\frac{\sum fx}{\sum f}$. 
Exercise 27.3

(1) Find the mode, the median and the mean of each of the following.

(i) 5, 4, 7 8, 3, 6, 2
(ii) 3, 4, 8, 4, 6, 8, 3
(iii) 20, 23, 24, 28, 34, 38, 43
(iv) 3.5, 4.8, 3.2, 6.8, 7.7, 4.9
(v) 12.7, 28.4, 47.3, 62.7, 73.8

(2) The height in centimetres of 5 children are given below. Find their median height.

177.2, 175.3, 174.8, 179.1, 176.5

(3) The mean weight of 5 children who had come to a clinic is 44 kg. The mean weight of 3 other children is 40 kg. Find the mean weight of the 8 children.

(4) The mean mark for 8 subjects of a student is 73. Find the total marks he obtained for all 8 subjects.

(5) The mean weight of 8 students is 42 kg. When another student joined them, the mean weight of 9 students is 43 kg. Find the weight of the student who joined later.

(6) The mean mark of 52 students was calculated as 52. In this calculation 63 marks obtained by a student was entered as 93 due to an oversight. Correct this mistake and calculate the correct mean.

(7) Illustrate the given data in a stem and leaf diagram.

27 43 49 52 53 54 52 24 42 57
42 50 51 52 52 57 41 40 32 36

Find,

(i) the mode  
(ii) the median
(iii) the mean  
(iv) the range

of the above data.
(8) This frequency distribution shows the heights (to the nearest centimetre) of 25 students.

<table>
<thead>
<tr>
<th>Height to the nearest centimetre</th>
<th>No. of students (frequency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>112</td>
<td>2</td>
</tr>
<tr>
<td>113</td>
<td>3</td>
</tr>
<tr>
<td>114</td>
<td>5</td>
</tr>
<tr>
<td>115</td>
<td>6</td>
</tr>
<tr>
<td>116</td>
<td>3</td>
</tr>
<tr>
<td>117</td>
<td>4</td>
</tr>
<tr>
<td>118</td>
<td>2</td>
</tr>
</tbody>
</table>

(i) Find the mode, the median and the mean of the heights of the students.

(ii) How many students are taller than or equal to 116 centimetres?

Summary

★ Representing data using a sector of a circle is called representing data in a pie chart.

★ Angle of each sector is calculated by considering the total data equivalent to 360°.

★ When data is grouped and represented with the frequency in a table it is called a frequency distribution.

★ The difference between the highest value and the lowest value of a collection of data is called its range.

★ The most frequent value in a collection of data is called its mode.

★ The value in the middle of a collection of data, when arranged in ascending or descending order is called the median.

★ The mean of a collection of data is obtained by dividing the sum of the collection of data by the total number of data in the collection.

★ When data is given in a frequency distribution, the mean is obtained by using \( \frac{\sum fx}{\sum f} \).