

# CHAPTER 14



At the end of the chapter, students should be able to represent collected data in the following form:

- a. Data array
- b. Frequency distribution
- c. Pictogram
- d. Pie chart
- e. Bar chart
- f. Line chart
- g. Histogram
- h. Frequency polygon

## I. Data Representation

This is the preparation or organization of the collected data so that analysis of the data and conclusion may be easily drawn. It is necessary because when the raw data are collected, they may be quite large and may not even make meaning to the users.

### Data Array

This is an arrangement of data in either ascending order of magnitude (from the lowest to the highest value) or descending order of magnitude (from the highest to the lowest value). It is the easiest systematic organisation of the raw data.



### Worked Example 1



Below are the heights (in metres) of 10 short students in the SS1 class of a secondary school.

|      |      |      |      |      |
|------|------|------|------|------|
| 1.20 | 1.09 | 1.31 | 1.11 | 1.05 |
| 1.13 | 1.55 | 1.01 | 1.34 | 1.15 |

Arrange their heights in:

- (a) Ascending order of magnitude.
- (b) Descending order of magnitude.

### Solution

(a)

|      |      |      |      |      |
|------|------|------|------|------|
| 1.01 | 1.05 | 1.09 | 1.11 | 1.13 |
| 1.15 | 1.20 | 1.31 | 1.34 | 1.55 |

(b)

|      |      |      |      |      |
|------|------|------|------|------|
| 1.55 | 1.34 | 1.31 | 1.20 | 1.15 |
| 1.13 | 1.11 | 1.09 | 1.05 | 1.01 |



### Worked Example 2

The following scores marked over ten were obtained when a class of 25 were given a Mathematics test.

|   |   |   |   |   |
|---|---|---|---|---|
| 3 | 5 | 2 | 9 | 6 |
| 1 | 3 | 3 | 4 | 1 |
| 5 | 2 | 4 | 5 | 8 |
| 4 | 7 | 3 | 5 | 6 |
| 6 | 4 | 6 | 9 | 7 |

- (a) Arrange the scores in ascending order of magnitude.
- (b) Arrange the scores in descending order of magnitude.
- (c) Which score appears least?

### Solution

- (a) 1, 1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 4, 5, 5, 5, 5, 6, 6, 6, 6, 7, 7, 8, 9, 9
- (b) 9, 9, 8, 7, 7, 6, 6, 6, 5, 5, 5, 5, 4, 4, 4, 4, 3, 3, 3, 3, 2, 2, 1, 1
- (c) 8

## Exercise 1

1. Given the Mathematics examination score of a class as shown below:

|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| 10% | 50% | 30% | 50% | 60% |
| 70% | 20% | 40% | 60% | 70% |
| 40% | 50% | 30% | 50% | 40% |
| 80% | 40% | 60% | 40% | 30% |
| 50% | 70% | 20% | 80% | 50% |
| 60% | 10% | 30% | 50% | 60% |

- (a) Arrange the scores in ascending order of magnitude.
- (b) Arrange the scores in descending order of magnitude.
- (c) Which score appears most?
2. The data below are the heights jumped by 15 senior students during the inter-house high jump competition.

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 1.23 m | 1.03 m | 1.11 m | 1.3 m  | 1.3 m  |
| 1.31 m | 1.35 m | 1.41 m | 1.09 m | 1.07 m |
| 1.24 m | 1.13 m | 1.36 m | 1.17 m | 1.13 m |

- (a) Arrange the heights jumped in ascending order of magnitude.
- (b) Arrange the heights in descending order of magnitude.

3. The data below are the sizes of shoes produced by a shoe industry.

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|
| 39 | 45 | 40 | 42 | 43 | 42 | 40 | 39 |
| 42 | 43 | 41 | 40 | 42 | 42 | 42 | 42 |
| 41 | 40 | 43 | 41 | 40 | 43 | 41 | 40 |
| 43 | 44 | 44 | 44 | 42 | 45 |    |    |

- (a) Rearrange the sizes of the shoes in ascending order of magnitude.
- (b) Rearrange the sizes of the shoes in descending order of magnitude.
- (c) Which size was produced most?

4. The data below are the ages (in years) of 36 students in a class.

|    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|
| 11 | 14 | 14 | 13 | 14 | 13 | 13 | 12 | 16 |
| 14 | 12 | 16 | 12 | 12 | 14 | 13 | 11 | 15 |
| 11 | 13 | 12 | 15 | 11 | 13 | 13 | 14 | 11 |
| 15 | 11 | 15 | 14 | 13 | 16 | 15 | 13 | 12 |

Rearrange the ages in:

- (a) Ascending order of magnitude.  
(b) Descending order of magnitude.

5. Below are the grades obtained by some candidates in a Mathematics examination.

A = Excellent      B = Credit

C = Merit      D = Pass

E = Weak pass      F = Fail

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| A | D | D | E | B | B |
| B | F | B | D | F | F |
| D | A | E | F | B | A |
| D | E | D | C | A | B |
| E | A | E | D | D | D |

- (a) Arrange the grades obtained in ascending order of magnitude.
- (b) Arrange the grades obtained in descending order of magnitude.
- (c) Which grade was/were most obtained?
- (d) Which grade(s) was/were least obtained?

## II(a) Frequency Distribution

A frequency distribution also known as a frequency table is a tabular arrangement of data that tells us how many times a given data appears in a distribution. The data when in numerical form are arranged in their order of magnitude. It consists of three basic columns.

- i. Number / item column
- ii. Tally column and
- iii. Frequency column

However, the number of columns may be increased depending on what further information is required. The three fundamental steps required to follow while constructing a frequency distribution are as follows:

**First step:** While dealing with numbers, like scores, weights, sizes, prices, ages, etc. List the lowest to the highest under the number column. While dealing with months of the year, list from January to December. With the days of the week, you may list from Monday to Sunday and while dealing with items like food stuffs, cars, etc. list them as they appear.

**Second step:** Here, the tally column will be used for tallying the numbers or items in the distribution. It is done by placing strokes against a number or item each time it appears in the distribution. For easy counting, when there are four strokes against a given distribution, the fifth stroke is done horizontally. For example ////.

**Third step:** At this point, count the number of strokes under the tally column to find out if all the items have been picked. For example, if there are 55 items in the distribution, there must be 55 strokes. After being sure that there are no mistakes, the number of strokes against each item is carefully counted and written down as the frequency of the items under the frequency column.



## Worked Example 3

### Worked

#### Example 3

The data below are the first test scores of 45 newly admitted SS1 students in a secondary school.

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 2 | 5 | 0 | 6 | 2 | 7 | 5 |
| 3 | 0 | 3 | 1 | 7 | 4 | 3 | 4 | 7 |
| 5 | 4 | 6 | 2 | 3 | 2 | 4 | 8 | 4 |
| 1 | 2 | 0 | 6 | 5 | 5 | 6 | 5 | 5 |
| 4 | 8 | 6 | 1 | 4 | 1 | 5 | 0 | 7 |

- Prepare a frequency table for the data above.
- Which score appeared most?
- Which score appeared least?

**n**

- First step:** Identify the lowest and the highest score in the distribution. Lowest score = 0; Highest score = 8. Then list the scores from the lowest to the highest under the column labelled “score” as shown in Table 14.1.

**Table 14.1**

| Score ( $x$ ) | Tally     | Frequency |
|---------------|-----------|-----------|
| 0             |           | 4         |
| 1             | ///       | 5         |
| 2             | ///       | 5         |
| 3             |           | 4         |
| 4             | /// /     | 7         |
| 5             | /// / / / | 9         |
| 6             | ///       | 5         |
| 7             |           | 4         |
| 8             | //        | 2         |

**Second step:** Under the column labelled “tally” mark a stroke each time you encounter a score in the distribution. For example, starting with 1 which is the first score, mark a stroke against 1 under the tally column, moving along on the first row of the distribution, the next score will be 5, mark a tally against 5 under the tally column. Continue in this way until all the scores in the distribution have been picked by tallying. When there are four strokes at a score, the fifth stroke is marked across the four existing ones as shown in Table 14.1.

**Third step:** Count the number of strokes under the tally column to find out if you have tallied all the 45 scores in the distribution. If there are 45 strokes against each score, write that down against the score under the frequency column as shown in Table 14.1.

- (b) The score that appeared most is 5 because it appeared 9 times.
- (c) The score that appeared least is 8 because it occurred twice.



## Worked Example 4

**Worked**

### Example 4

The data below are the ages of 50 students who were newly admitted into SS1 in a senior secondary school.

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 11 | 12 | 13 | 12 | 11 | 14 | 13 | 13 | 13 | 14 |
| 13 | 13 | 12 | 13 | 14 | 11 | 14 | 14 | 12 | 14 |
| 12 | 11 | 13 | 13 | 12 | 14 | 13 | 14 | 14 | 13 |
| 13 | 12 | 11 | 13 | 13 | 13 | 15 | 13 | 14 | 13 |
| 12 | 13 | 12 | 14 | 11 | 13 | 14 | 12 | 15 | 13 |

- (a) Prepare a frequency table for the data above.  
 (b) What percentage of the students were 15 years old?

### Solution

(a)

**Table 14.2**

| Age (x) | Tally               | Frequency (f) |
|---------|---------------------|---------------|
| 11      | /// /               | 6             |
| 12      | /// / / /           | 10            |
| 13      | /// / / / / / / / / | 20            |
| 14      | /// / / / / / /     | 12            |
| 15      | //                  | 2             |

(b)  $\frac{2}{50} \times 100 = 4\%$

## II(b) Frequency Distribution for Grouped Data

Just as we have learnt how to prepare a frequency distribution for ungrouped data, we can also prepare a frequency distribution for grouped data, if there are as many as 40 or above data, so as to economize space and remove unnecessary details.

To prepare a grouped data frequency table, the following questions must be answered.

- How many class intervals should be provided? There is no rule on the exact number of class intervals. However, 6 to 12 may be acceptable at this level.
- What should be the width of the class interval? The width of the class interval should be a number easy to work with; for example: 5, 10, 20, etc. Also, the lower and the upper class intervals must be a multiple of the width

of the interval

while the mid point of the class interval should be a whole number. Below are the steps to be followed while constructing the frequency table for grouped data.

**Step 1:** Find the range.

**Step 2:** The range should be divided by the number of class intervals felt most appropriate. There and then, the width of the class interval is derived.

**Step 3:** With the derived width, form the lower and upper class intervals as multiples of the width.

**Step 4:** For each class interval, determine the number of occurrences by placing strokes against it. For easy counting, when there are four strokes already against a given class interval, the fifth stroke is written horizontally.

**Step 5:** At this point, count the number of strokes under the tally column to find out if all the items or scores in the distribution have been picked. For example, if there are 60 items in the distribution, there must be 60 strokes.

**Step 6:** After being sure that there are no mistakes, the number of strokes against each class interval is carefully counted and written as the frequency of the class interval under the frequency column. Just like the frequency table of the ungrouped data, the number of columns may be increased depending on what further information is required.



## Worked Example 5



### Worked

#### Example 5

The scores below are the marks obtained by 45 students in a Mathematics test

|    |    |    |    |    |
|----|----|----|----|----|
| 3  | 6  | 16 | 12 | 11 |
| 12 | 16 | 16 | 11 | 11 |
| 8  | 8  | 17 | 2  | 21 |
| 4  | 14 | 15 | 6  | 6  |
| 14 | 7  | 4  | 23 | 26 |
| 19 | 25 | 18 | 17 | 17 |
| 21 | 26 | 20 | 22 | 23 |
| 20 | 23 | 25 | 24 | 25 |
| 24 | 23 | 30 | 24 | 21 |

Prepare a frequency distribution of grouped data for the marks.



## Solution

Using the steps stipulated earlier:

**Step 1:** Range =  $30 - 2 = 28$

**Step 2:**  $28 \div 6 = 4.7 = 5$  (to the nearest whole number).

**Note:** 6 is used because I felt that the most appropriate number of class interval should be 6.

**Step 3:** Therefore, the width will be 5. The lower and upper class intervals

will be in multiples of 5 and the class interval will be as shown in the table.

**Step 4:** Determine the number of occurrences by placing strokes against each class interval.

**Step 5 and Step 6** (see table).

**Table 14.3:** Frequency distribution for the grouped data.

| Class interval | Tally | Freq. ( $f$ ) |
|----------------|-------|---------------|
| 1–5            | ///   | 4             |
| 6–10           | ///   | 6             |
| 11–15          | ///   | 8             |
| 16–20          | ///   | 9             |
| 21–25          | ///   | 15            |
| 26–30          | ///   | 3             |

Most often, the class interval would be given.



## Worked Example 6

### Worked

#### Example 6

These are the Mathematics examination scores of a class in a senior secondary school.

|    |    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|----|
| 62 | 54 | 53 | 44 | 46 | 55 | 46 | 68 | 59 | 61 | 66 |
| 54 | 39 | 48 | 47 | 56 | 50 | 35 | 40 | 30 | 46 | 44 |
| 36 | 54 | 57 | 56 | 45 | 33 | 38 | 41 | 40 | 53 | 51 |
| 45 | 48 | 34 | 36 | 46 | 43 | 63 | 63 | 57 | 51 | 52 |

Using the class intervals of 30 – 34, 35 – 39, 40 – 44, etc., construct the frequency table.



## Solution

### Table 14.4

| Class interval | Tally | Freq. ( $f$ ) |
|----------------|-------|---------------|
| 35–39          | ///   | 3             |
| 40–44          | ///   | 5             |
| 45–49          | ///   | 6             |

| Class interval | Tally | Freq. ( <i>f</i> ) |
|----------------|-------|--------------------|
| 50–54          | //    | 12                 |
| 55–59          |       | 10                 |
| 60–64          | //    | 8                  |
| 65–69          |       | 4                  |
| 70–74          | //    | 2                  |



## Exercise 2

1. The data shows the marks scored by a group of students in an examination.

|    |    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|----|
| 21 | 1  | 2  | 13 | 28 | 29 | 46 | 43 | 44 | 45 | 48 |
| 40 | 23 | 24 | 38 | 36 | 37 | 50 | 52 | 54 | 56 | 58 |
| 11 | 12 | 25 | 14 | 15 | 19 | 71 | 53 | 54 | 63 | 64 |
| 22 | 5  | 8  | 20 | 26 | 41 | 76 | 78 | 80 | 82 | 85 |
| 33 | 31 | 32 | 26 | 32 | 42 | 39 | 34 | 35 | 41 | 40 |
| 86 | 97 | 88 | 99 | 93 | 91 | 46 | 69 | 75 | 91 | 91 |

Using the class interval of 1–10, 11–20, 21–30, etc., construct the frequency table.

2. The ages (in years) of 50 teachers in a school are given below:

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 21 | 37 | 49 | 27 | 49 | 42 | 26 | 33 | 46 | 40 |
| 50 | 29 | 23 | 24 | 29 | 31 | 36 | 22 | 27 | 38 |
| 30 | 26 | 42 | 39 | 34 | 23 | 21 | 32 | 41 | 46 |
| 46 | 31 | 33 | 29 | 28 | 43 | 47 | 40 | 34 | 44 |
| 26 | 38 | 34 | 49 | 45 | 27 | 25 | 33 | 39 | 40 |

Using a most appropriate class interval, construct the grouped frequency table.

3. The data below are the weights of 72 men who participated in a cross-country competition.

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 40 | 72 | 40 | 54 | 66 | 67 |
| 71 | 53 | 65 | 64 | 89 | 80 |
| 49 | 74 | 41 | 42 | 47 | 48 |
| 73 | 46 | 88 | 43 | 68 | 81 |
| 86 | 62 | 63 | 80 | 69 | 77 |
| 61 | 72 | 82 | 95 | 78 | 96 |
| 72 | 84 | 70 | 83 | 71 | 76 |
| 85 | 87 | 71 | 75 | 90 | 91 |
| 73 | 90 | 74 | 76 | 75 | 77 |
| 79 | 84 | 70 | 92 | 79 | 78 |
| 81 | 85 | 87 | 88 | 93 | 97 |
| 83 | 86 | 82 | 94 | 89 | 98 |

Using the class interval of 40–49, 50–59, 60–69, etc., construct the frequency table.

4. The following are the ages of 50 workers in a road construction company.

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 71 | 79 | 46 | 35 | 25 | 28 | 56 | 82 | 68 | 64 |
| 93 | 95 | 78 | 43 | 58 | 72 | 50 | 98 | 62 | 63 |
| 70 | 73 | 53 | 44 | 72 | 68 | 88 | 51 | 32 | 59 |
| 72 | 73 | 40 | 55 | 52 | 61 | 96 | 67 | 82 | 72 |
| 52 | 57 | 86 | 46 | 48 | 68 | 60 | 79 | 85 | 56 |

Using class interval of 21–30, 31–40, 41–50, etc., draw a frequency table for the distribution.

5. The data below are the marks obtained by 30 students in a test.

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 6  | 1  | 1  | 7  | 6  | 23 | 3  | 14 | 12 | 17 |
| 19 | 6  | 7  | 8  | 17 | 15 | 15 | 15 | 13 | 18 |
| 11 | 16 | 11 | 16 | 13 | 19 | 12 | 5  | 14 | 18 |

Using an appropriate class interval, prepare a grouped frequency table.

### III. Pictogram

Pictogram also known as *picture diagram* is the representation of data in a picture form. It is known to attract attention and arouse interest from the learner more quickly than the ordinary number. It is necessary to note that the symbols used to represent the picture should be directly related to the data and that every pictogram must have a key.



#### Worked Example 7



Table 14.5a shows the maximum temperature of a city in the last six months of a year.

**Table 14.5a**

| July       | Aug.       | Sept.      | Oct.       | Nov.       | Dec.       |
|------------|------------|------------|------------|------------|------------|
| 15 degrees | 20 degrees | 20 degrees | 30 degrees | 35 degrees | 10 degrees |

Represent the data on a pictogram.

**Table 14.5b** Key: ● = 5 degrees

| Month | Pictogram   |
|-------|-------------|
| July  | ● ● ●       |
| Aug.  | ● ● ● ●     |
| Sept. | ● ● ● ●     |
| Oct.  | ● ● ● ● ●   |
| Nov.  | ● ● ● ● ● ● |
| Dec.  | ● ●         |



## Worked Example 8

In a class of 30 students, their teacher instructed them to list one subject they liked best from the following: Mathematics, English language, Chemistry, Biology and Physics. Below are the data.

| Maths | Phys.  | Chem. | Bio.  | Bio.  |
|-------|--------|-------|-------|-------|
| Eng.  | Maths. | Eng.  | Eng.  | Eng.  |
| Chem. | Eng.   | Bio.  | Bio.  | Eng.  |
| Eng.  | Maths. | Eng.  | Eng.  | Chem. |
| Bio.  | Eng.   | Eng.  | Maths | Bio.  |
| Eng.  | Maths  | Eng.  | Eng.  | Eng.  |

- Prepare a frequency table for the data.
- Use the frequency table to provide a pictogram.



(a) **Table 14.6a**

| Subject | Tally | Freq. ( <i>f</i> ) |
|---------|-------|--------------------|
| Maths.  |       | 5                  |
| Eng.    |       | 15                 |
| Chem.   | ///   | 3                  |
| Bio.    | /     | 6                  |
| Phys.   | /     | 1                  |

(b) **Table 14.6b**

| Subject | Pictogram |
|---------|-----------|
| Maths   |           |
| Eng.    |           |
| Chem.   | ///       |
| Bio.    |           |
| Phy.    |           |

### Exercise 3

1. In a class, each student was asked to list the fruit they liked best and the following data were obtained:

A = Apple      B = Banana

M = Mango      O = Orange

P = Pineapple

|   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|
| M | O | B | A | B | P | B | P | B | P | B |
| M | O | M | B | P | B | P | B | M | P | A |
| O | M | M | P | B | P | P | M | B | P | P |
| B | B | B | O | B | M | O | B | M | M | O |

- (a) Represent the data on a frequency table.
- (b) Form a pictogram of the frequency table.
2. Table 14.7 shows the number of mango trees planted in 5 houses in a school.

**Table 14.7**

| House | Number of mango trees |
|-------|-----------------------|
| A     | 15                    |
| B     | 10                    |
| C     | 3                     |
| D     | 7                     |
| E     | 5                     |

Represent the data on a pictogram.

3. The Ministry of Aviation of a country displaced the pictogram below on the number of aircrafts that had fatal accidents from 2004 to 2009.

**Table 14.8** Key: ✈ = 4 aircrafts

| Year | Number of aircrafts |
|------|---------------------|
| 2004 | ✈ ✈ ✈               |
| 2005 | ✈ ✈                 |
| 2006 | ✈ ✈ ✈ ✈             |
| 2007 | ✈ ✈                 |
| 2008 | ✈                   |
| 2009 | ✈                   |

Use the pictogram above to answer questions (a)–(c).

- (a) Calculate how many aircrafts had fatal accidents from 2004 to 2009.
  - (b) Which year had the least number of fatal accidents?
  - (c) Identify the year that had the most number of fatal accidents.
4. Five students named A, B, C, D and E were asked the number of bottles of soft drinks they drank last week and the following data were obtained.

**Table 14.9**

| Student | Number of bottles |
|---------|-------------------|
| A       | 5                 |
| B       | 8                 |
| C       | 3                 |
| D       | 2                 |
| E       | 2                 |

Represent the data on a pictogram.

5. After a public holiday, a sample of 40 students were randomly picked and each was asked to list one major activity he/she carried out that day and the following data were given.

**Table 14.10**

| Activity     | No. of students |
|--------------|-----------------|
| Travelling   | 10              |
| Watching T.V | 15              |
| Studying     | 8               |
| Farming      | 2               |
| Playing      | 10              |

Represent the data on a pictogram.

## IV. Pie Charts

A pie chart also known as a *circular graph* is a circle divided into sectors such

that the angles at the centre are proportional to the magnitude of the frequencies representing the items. There are two basic steps involved in drawing pie charts.

**Step 1:** Provision of the table.

The following columns should be provided on the table in the order given below.

- Score / item column.
- Frequency column: with the total of the frequencies calculated and shown at the base.
- Relative value column: where each frequency is expressed as a fraction of the total frequency.
- Sectorial angle column: at this column, each of the relative values will be multiplied by 360 so as to get the sectorial angle value of each score / item.

**Note:** The sum of the sectorial angles must be 360°.

**Step 2:** Drawing of the pie chart.

- Use a pair of compasses to draw a circle using a convenient or any given radius.
- Then, use a protractor to represent the calculated sectorial angles one after the other on the drawn circle. Write the angles of the sectors correctly and label the sectors appropriately and respectively. All the write-up must be horizontal.
- Caption the circular graph.



## Worked Example 9



### Worked

#### Example 9

Table 14.11 shows the number of outpatient cases that were diagnosed in a medical centre within a week.

**Table 14.11**

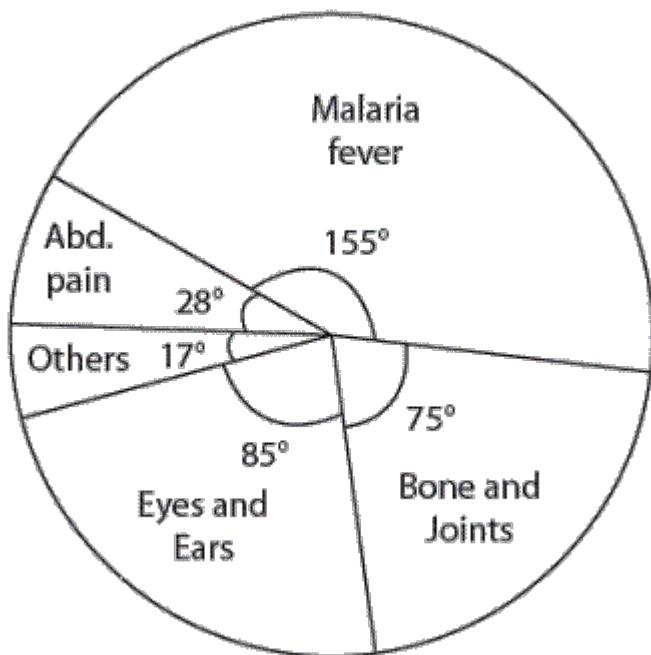
| Case            | No. of out-patients |
|-----------------|---------------------|
| Abdominal pains | 56                  |
| Malarial fever  | 310                 |
| Bone and joints | 150                 |
| Eyes and ears   | 170                 |
| Others          | 34                  |

Represent the data in Table 14.11 on a pie chart.  
Provide the table as instructed in the introduction.

**Table 14.12**

| Case            | Freq.<br>(f) | Relative<br>value | Sectorial angle                                |
|-----------------|--------------|-------------------|--|
| Abdominal pain  | 56           | $\frac{56}{720}$  | $\frac{56}{720} \times 360^\circ = 28^\circ$   |
| Malarial fever  | 310          | $\frac{310}{720}$ | $\frac{310}{720} \times 360^\circ = 155^\circ$ |
| Bone and joints | 150          | $\frac{150}{720}$ | $\frac{150}{720} \times 360^\circ = 75^\circ$  |
| Eyes and ears   | 170          | $\frac{170}{720}$ | $\frac{170}{720} \times 360^\circ = 85^\circ$  |
| Others          | 34           | $\frac{34}{720}$  | $\frac{34}{720} \times 360^\circ = 17^\circ$   |
| Total           | 720          |                   | 360°   |

Draw the pie chart using the information from Table 14.12.



**Fig. 14.1:** Pie chart on out-patients that were diagnosed in a medical centre. Table 14.13 shows the expenses incurred by a family in a month.

**Table 14.13a**

| Item          | Expenses in thousand naira |
|---------------|----------------------------|
| Education     | 3                          |
| Food stuff    | 24                         |
| Kerosene      | 8                          |
| Clothing      | 10                         |
| Hospital bill | 5                          |
| Others        | 4                          |

Draw a pie chart to illustrate the information.

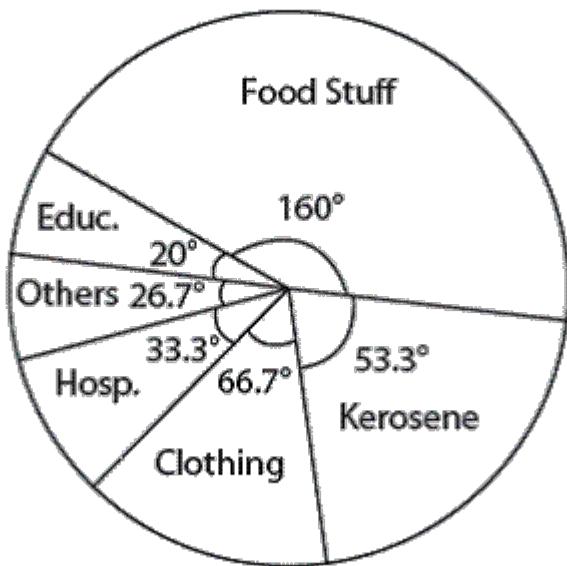
### Solution

### Solution

Table 14.13b

Table 14.13b

| Item       | Freq.<br>(f) | Relative<br>value | Sectorial angle                               |
|------------|--------------|-------------------|---|
| Education  | 3            | $\frac{3}{54}$    | $\frac{3}{54} \times 360^\circ = 20^\circ$    |
| Food stuff | 24           | $\frac{24}{54}$   | $\frac{24}{54} \times 360^\circ = 160^\circ$  |
| Kerosene   | 8            | $\frac{8}{54}$    | $\frac{8}{54} \times 360^\circ = 53.3^\circ$  |
| Clothing   | 10           | $\frac{10}{54}$   | $\frac{10}{54} \times 360^\circ = 66.7^\circ$ |
| Hospital   | 5            | $\frac{5}{54}$    | $\frac{5}{54} \times 360^\circ = 33.3^\circ$  |
| Others     | 4            | $\frac{4}{54}$    | $\frac{4}{54} \times 360^\circ = 26.7^\circ$  |
| Total      | 54           |                   | $360^\circ$                                   |

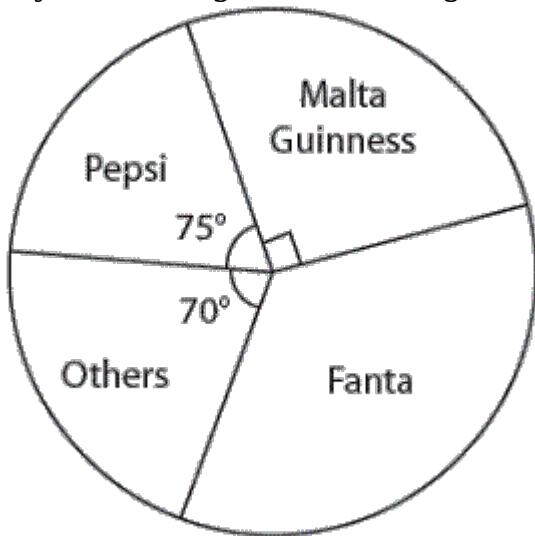


**Fig. 14.2:** Pie chart on the expenses incurred by a family in a month.



### Worked Example 11

The pie chart in Fig. 14.3 represents 24 bottles of assorted soft drinks displayed on a high table during Chibuzor's birthday party.



**Fig. 14.3:** Pie chart on 24 bottles of assorted drinks displayed on a high table during a birthday party. (a) How many bottles of the soft drinks were Malta Guinness?

- (b) What fraction of the drinks was Pepsi?
- (c) Calculate the number of bottles that were Fanta.



### Solution

(a) Given that  $360^\circ = 24$  bottles  
 $\Rightarrow 1^\circ = \frac{24}{360}$  bottles  
 $\Rightarrow 90^\circ = \frac{90^\circ \times 24}{360}$   
 $= 6$  bottles

Therefore, there were 6 bottles of Malta Guinness.

(b)  $\frac{75}{360} = \frac{15}{72} = \frac{5}{24}$

(c) Fanta  $= 360 - (65^\circ + 90^\circ + 70^\circ + 75^\circ)$   
 $= 360 - 235^\circ$   
 $= 125^\circ$

Given  $360^\circ = 24$  bottles

$\Rightarrow 1^\circ = \frac{24}{360}$  bottles

$\Rightarrow 125^\circ = \frac{24}{360} \times 125$  bottles  
 $= 8$  bottles

$\therefore$  There were 8 bottles of Fanta.

## Exercise 4

1. Thirty students were asked what they ate as lunch yesterday. The results are in Table 14.14. Draw a pie chart for the data.

**Table 14.14**

| Item      | Rice | Eba | Beans | Pounded yam |
|-----------|------|-----|-------|-------------|
| Frequency | 8    | 14  | 5     | 3           |

2. Fifty students were asked their favourite soft drinks and the following data were obtained.

**Table 14.15**

| Soft drinks     | Fanta | Sprite | Coca cola | Bitter lemon |
|-----------------|-------|--------|-----------|--------------|
| No. of students | 10    | 12     | 25        | 3            |

Represent the data on a pie chart.

3. Table 14.16 gives the budget estimate of a family for a month.

**Table 14.16**

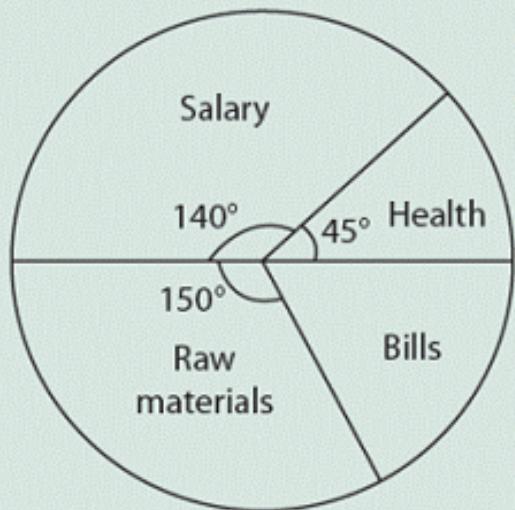
| Item     | A month (₦ thousand) |
|----------|----------------------|
| Health   | 3                    |
| Clothing | 2                    |
| Bills    | 1                    |
| Feeding  | 8                    |
| Save     | 2                    |

Represent the data on a pie chart.

4. A class of students owned mobile network phone and the make of each were identified. The results were as follows:

|         |         |         |         |         |
|---------|---------|---------|---------|---------|
| MTN     | GLO     | MTN     | STARCOM | GLO     |
| GLO     | MTN     | GLO     | MTN     | STARCOM |
| MTN     | ZAIN    | MTN     | MTN     | MTN     |
| ZAIN    | STARCOM | GLO     | GLO     | MTN     |
| MTN     | ZAIN    | MTN     | ZAIN    | STARCOM |
| STARCOM | ZAIN    | ZAIN    | MTN     | MTN     |
| GLO     | MTN     | STARCOM | MTN     | MTN     |
| MTN     | ZAIN    | MTN     | STARCOM | GLO     |
| MTN     | STARCOM | ZAIN    | MTN     | MTN     |
| MTN     | STARCOM | MTN     | GLO     | GLO     |

- (a) Prepare a frequency table for the data.
- (b) Draw a pie chart for the table.
5. The pie chart in Fig. 14.4 shows the amount of money that an employer spent on his company in a year.



**Fig. 14.4**

- (a) How much was spent on bills, if the total amount spent by the employer in a year was ₦80 003 143?
- (b) Find the amount spent on salary.
- (c) What is the ratio of the amount of money spent on bills to the amount spent on health?

## V. Bar Charts

Bar charts also known as *bar diagram* is a rectangular bar erected to show the proportion of the frequencies of items or scores being represented.

There are three basic types of bar charts:

- (i) Simple bar charts
- (ii) Widthless column bar charts
- (iii) Component bar charts

The simple and widthless column bar charts can be erected horizontally or

vertically while in component bar charts the two or more bars are arranged in one bar or differently. When the component bar charts are arranged differently, they are called *multiple bar charts*.

Steps to be followed when drawing a bar chart include:

**Step 1:** Prepare a frequency table if the given data are not in a frequency table.

**Step 2:** Select a most suitable scale.

**Step 3:** Use the chosen scale to determine the height of each rectangular bar.

**Step 4:** Draw the bars corresponding to the height of the frequencies.

**Step 5:** Ensure that the bars are separated from one another and that the spaces between adjacent bars are equal.

**Step 6:** Make sure that the erected bars are equal in width.

**Step 7:** Caption the bar chart.



## Worked Example 12

rked

### Example 12

In a class, 21 students were tested to determine their blood groups. The following distribution was observed.

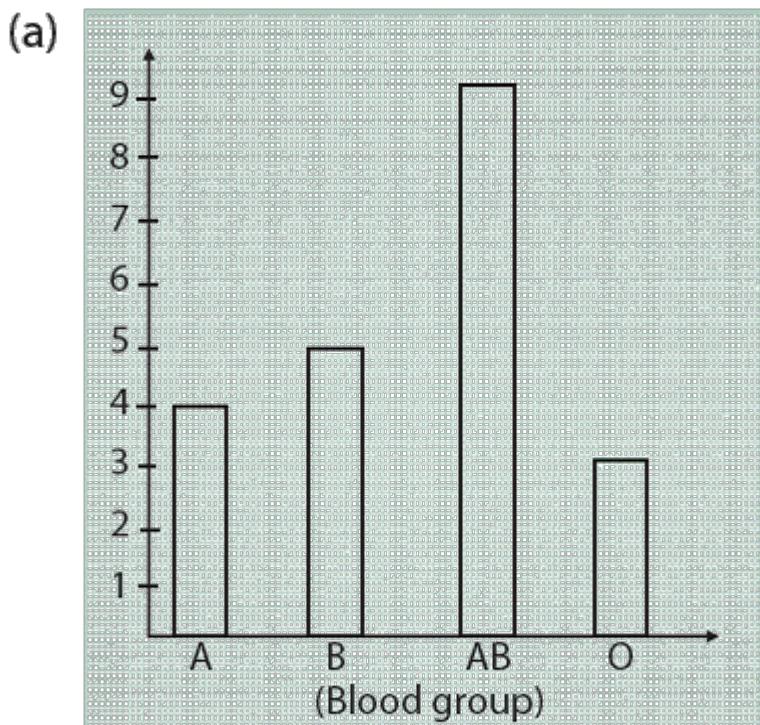
|    |    |   |    |    |    |    |
|----|----|---|----|----|----|----|
| A  | B  | B | AB | O  | AB | O  |
| AB | A  | B | AB | AB | A  | B  |
| O  | AB | B | AB | AB | A  | AB |

- Represent the data above in a frequency table.
- Use the data to draw a:
  - Vertical simple bar chart.
  - Horizontal simple bar chart.

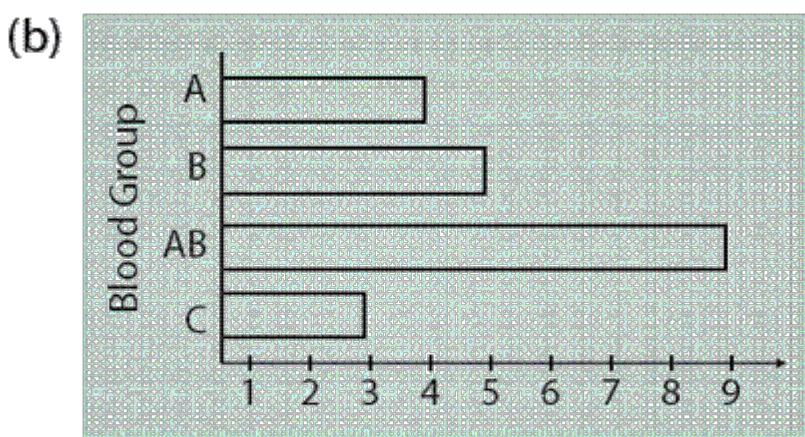


**Table 14.17**

| Blood group | Tally  | Freq. (f) |
|-------------|--------|-----------|
| A           |        | 4         |
| B           | ///    | 3         |
| AB          | ////// | 5         |
| O           | ///    | 3         |



**Fig. 14.5a:** A vertical bar chart



**Fig. 14.5b:** A horizontal bar chart



### Worked Example 13

The performance of the best three students in a scholarship examination in three papers was recorded as shown in Table 14.18.

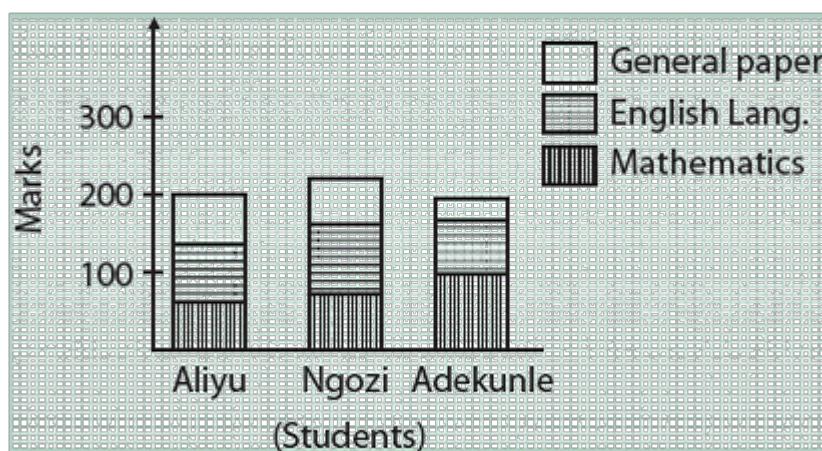
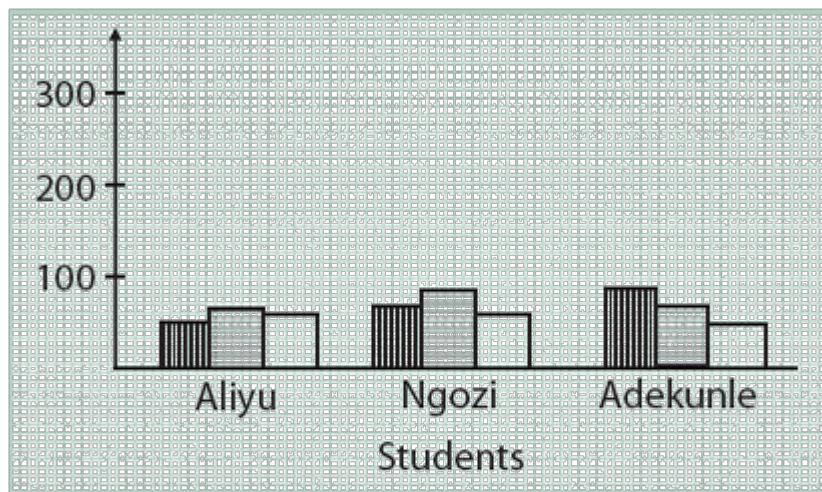
**Table 14.18a**

| Name        | Maths | English | General paper | Total |
|-------------|-------|---------|---------------|-------|
| Aliyu B.    | 60    | 75      | 65            | 200   |
| Ngozi T.    | 70    | 90      | 60            | 220   |
| Adekunle E. | 95    | 70      | 30            | 195   |

- (a) Represent the data on a component bar chart.
- (b) Represent the data on a multiple bar chart.

**Table 14.18b**

| Name        | Maths | English | General paper | Total | Scale: 100 marks = 2 cm                     |
|-------------|-------|---------|---------------|-------|---|
| Aliyu B.    | 60    | 75      | 65            | 200   | $\frac{200 \times 2}{100} = 4 \text{ cm}$   |
| Ngozi T.    | 70    | 90      | 60            | 220   | $\frac{220 \times 2}{100} = 4.4 \text{ cm}$ |
| Adekunle E. | 95    | 70      | 30            | 195   | $\frac{195 \times 2}{100} = 3.9 \text{ cm}$ |


**Fig. 14.6:** A component bar chart based on the performance of the best three students in am scholarship examination in three papers

**Fig. 14.7:** A multiple bar chart



## Exercise 5

1. The outcome of throwing a die 35 times is as shown in the distribution below:

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 1 | 3 | 4 | 3 | 1 | 1 | 1 |
| 4 | 1 | 2 | 1 | 3 | 5 | 5 |
| 5 | 6 | 5 | 6 | 1 | 4 | 1 |
| 4 | 4 | 4 | 1 | 5 | 1 | 4 |
| 2 | 6 | 5 | 4 | 3 | 5 | 3 |

- (i) Prepare a frequency table for the data.
- (ii) Use the data to draw a
- (a) Vertical simple bar chart.
  - (b) Horizontal widthless column bar chart.

2. Table 14.19 shows the expenditure made by a family in two months.

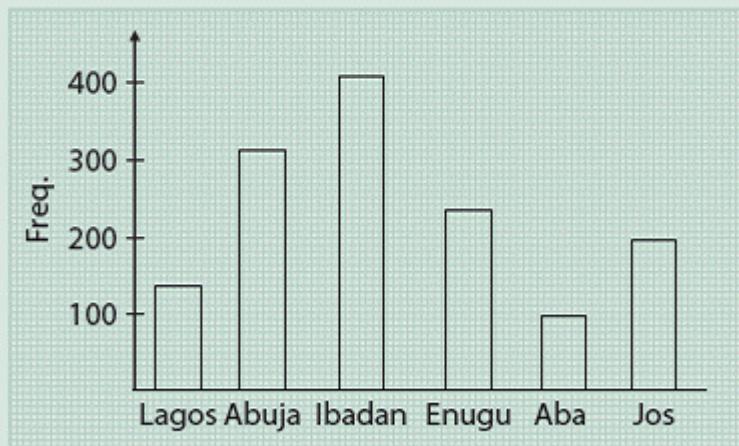
**Table 14.19**

| Item     | Amount (# thousand) |          |
|----------|---------------------|----------|
|          | November            | December |
| Health   | 13                  | 12       |
| Clothing | 12                  | 18       |
| Feeding  | 15                  | 20       |
| Bill     | 12                  | 12       |
| Save     | 10                  | 10       |

Represent the data on a

- (a) Component bar chart.
- (b) Multiple bar chart.

3.



**Fig. 14.8**

A bar chart showing the number of students that have visited the places above.

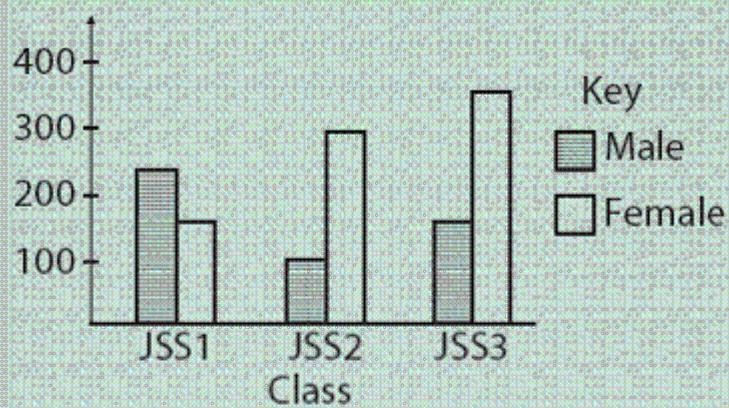
- (a) What is the caption of the bar chart?
- (b) How many students visited Lagos?
- (c) How many students are there altogether?
- (d) What fraction of the students visited Ibadan?
- (e) What is the ratio of the students that have visited Aba to those that have visited Jos?

4. During a year-end party of a secondary school, items were shared among the six classes as shown in Table 14.20.

**Table 14.20**

| Item                     | JSS1 | JSS2 | JSS3 | SS1 | SS2 | SS3 |
|--------------------------|------|------|------|-----|-----|-----|
| Crates of soft drinks    | 3    | 3    | 5    | 4   | 2   | 2   |
| Cartons of cabin biscuit | 6    | 5    | 7    | 6   | 3   | 3   |
| Packets of sweet         | 3    | 2    | 3    | 5   | 2   | 3   |

- (a) Represent the data on a component bar chart.
- (b) Represent the data on a multiple bar chart.
5. The multiple bar chart in Fig. 14.9 shows the male and female enrolment of a Junior Secondary School in a particular year.



**Fig. 14.9**

- How many students are there?
- How many male students are in JSS1 and JSS2?
- What is the ratio of male to female students in JSS3?

## VI. Line Graph

A line graph also known as a *line chart* is a graph that connects the cartesian coordinates of points by straight lines. The frequency lies on the OY axis while the scores or items lie on the OX axis. The scale of both axes may or may not be the same. If it shows the distribution of a variable as a function of time, we refer to it as *Time series*. Other examples of the line graph are *Distance-time graph* and *Frequency polygon*.

### Components of a line graph

**Caption:** The caption which may be written above or below the line graph tells us what the graph is all about.

**Labels:** The horizontal and vertical labels along the sides inform us about the kind of facts and figures the line graph is talking about.

**Scales:** The horizontal or the vertical axes which may or may not be the same tell us how much or how many items are involved. The zero point is usually written on the vertical axis.

**Points:** The points or dots are located by the coordinate derived from the table.

**Lines:** The straight lines connecting the successive points give us the estimate of the values between the points.



### Worked Example 14



### Worked

#### Example 14

Table 14.21 shows the Mathematics test scores marked over 10.

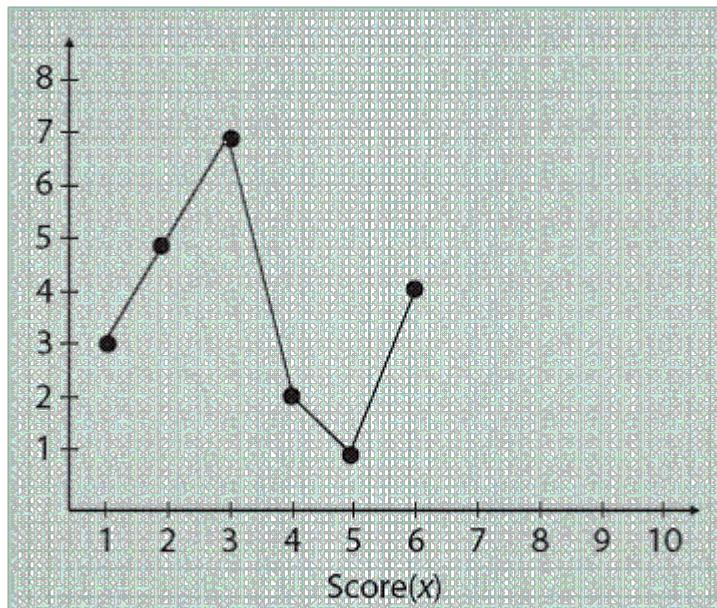
**Table 14.21**

| Score ( $x$ ) | 1 | 2 | 3 | 4 | 5 | 6 |
|---------------|---|---|---|---|---|---|
| Freq.         | 3 | 5 | 7 | 2 | 1 | 4 |

Represent the table on a line graph.



### Solution

**Fig. 14.10**

A line graph on Mathematics test scores.

## Exercise 6

- The table below shows the Mathematics scores in a class of 50 students.

**Table 14.22**

| Score ( $x$ ) | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---------------|----|----|----|----|----|----|----|----|----|----|----|
| Freq ( $f$ )  | 3  | 3  | 3  | 6  | 13 | 7  | 10 | 20 | 15 | 3  | 2  |

Draw a line graph using the above table.

2. Table 14.23 shows the ages of 50 students who were newly admitted into the Mathematics department in a university.

**Table 14.23**

| Age ( $x$ )  | 16 | 17 | 18 | 19 | 20 |
|--------------|----|----|----|----|----|
| Freq ( $f$ ) | 10 | 20 | 15 | 3  | 2  |

Prepare a line graph for the data.

3. Table 14.24 shows the weight distribution of 30 students in SS1 in a secondary school.

**Table 14.24**

| Weight (kg) | No. of students |
|-------------|-----------------|
| 50          | 3               |
| 60          | 10              |
| 70          | 12              |
| 80          | 4               |
| 90          | 1               |

Represent the data on a line graph.

4. Table 14.25 shows the ages of under 19 football players.

**Table 14.25**

| Age ( $x$ )  | 14 | 15 | 16 | 17 | 18 |
|--------------|----|----|----|----|----|
| Freq ( $f$ ) | 4  | 7  | 10 | 5  | 2  |

Draw a line graph for the above data.

5. Table 14.26 shows the number of bags of beans a farmer harvested in five consecutive years.

Draw a line graph for the above data.

**Table 14.26**

| Year                  | 2005 | 2006 | 2007 | 2008 | 2009 |
|-----------------------|------|------|------|------|------|
| No. of bags harvested | 10   | 15   | 25   | 30   | 20   |

## VII. Histogram

Histogram, like bar chart, is a set of rectangular bars erected to show the proportion of the frequencies of items being represented. The differences between histogram and bar chart are as follows:

1. Unlike bar charts, where each rectangular bar stands on its own, the histograms rectangular bars are joined together such that they have common boundaries.
2. Bar charts show the frequencies through the height of the individual bars. While in a histogram, the frequencies are given by the area of the bars, that is, both the height and width of the bars are considered.
3. While bar charts must have equal width, histogram may or may not have equal width. Uniquely, histogram is used to represent continuous-variate distribution.



## Worked example 15



Table 14.27 is the frequency distribution table of Mathematics test scores.

**Table 14.27**

|           |    |    |    |    |    |    |
|-----------|----|----|----|----|----|----|
| Score (x) | 11 | 12 | 13 | 14 | 15 | 16 |
| Freq. (f) | 4  | 6  | 10 | 12 | 7  | 2  |

Represent the above data on a histogram.



## Solution

The following columns should be provided:

\*Score column

\*Frequency column

\*Scale

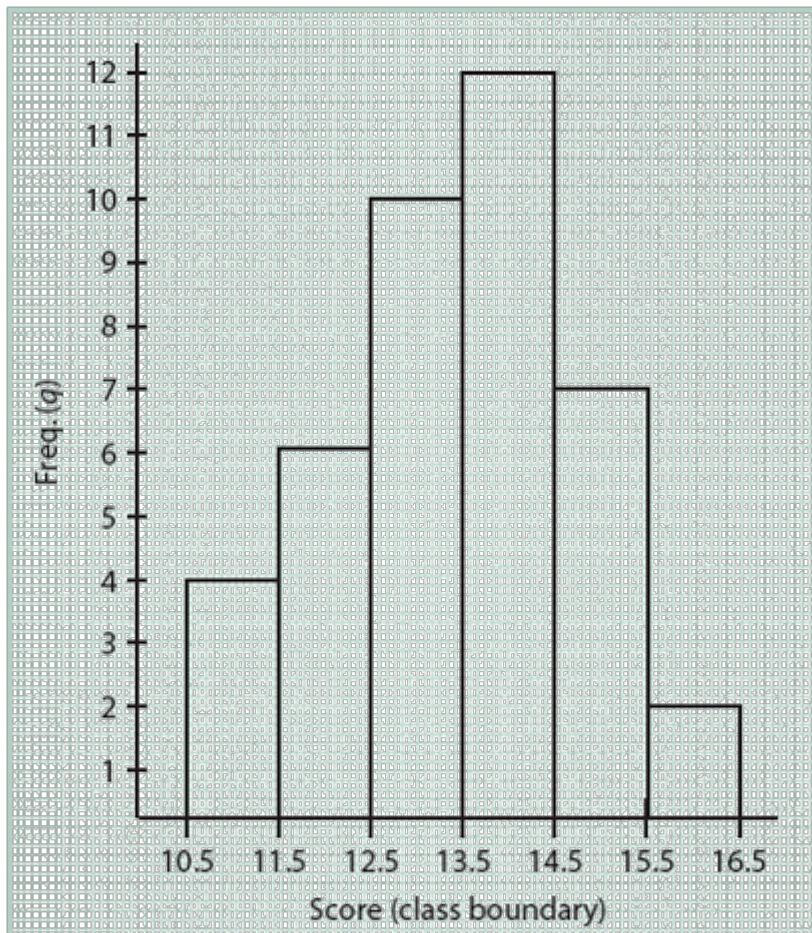
\*Boundaries (lower and upper)

While preparing the lower and upper boundaries of the scores, the following must be done as shown in Table 14.28.

- From the score in the second class which is 12, subtract the score of the first class which is 11.
- Then the difference will be 1.
- Divide the difference by 2.
- Which is 0.5.
- Subtract 0.5 from each score to obtain its lower boundary.
- Add 0.5 to each score to obtain its upper boundary as shown in Table 14.28.

**Table 14.28**

| Scores | Freq. (f) | Scale<br>1 to 1 cm | Class<br>boundaries |
|--------|-----------|--------------------|---------------------|
| 11     | 4         | 4 cm               | 10.5 – 11.5         |
| 12     | 6         | 6 cm               | 11.5 – 12.5         |
| 13     | 10        | 10 cm              | 12.5 – 13.5         |
| 14     | 12        | 12 cm              | 13.5 – 14.5         |
| 15     | 7         | 7 cm               | 14.5 – 15.5         |
| 16     | 2         | 2 cm               | 15.5 – 16.5         |



**Fig. 14.11**



### Worked Example 16

The scores below are the Mathematics marks of 45 students in a test.

|    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|
| 3  | 6  | 16 | 12 | 11 | 12 | 21 | 20 | 24 |
| 16 | 16 | 11 | 11 | 8  | 8  | 26 | 23 | 23 |

|    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|
| 17 | 2  | 21 | 4  | 14 | 15 | 20 | 25 | 30 |
| 6  | 6  | 14 | 7  | 4  | 23 | 22 | 24 | 24 |
| 26 | 19 | 25 | 18 | 17 | 17 | 23 | 25 | 21 |

- Using the class intervals of 1- 5, 6 -10, 11-15, etc., construct the frequency table.
- Use the table to construct a histogram.



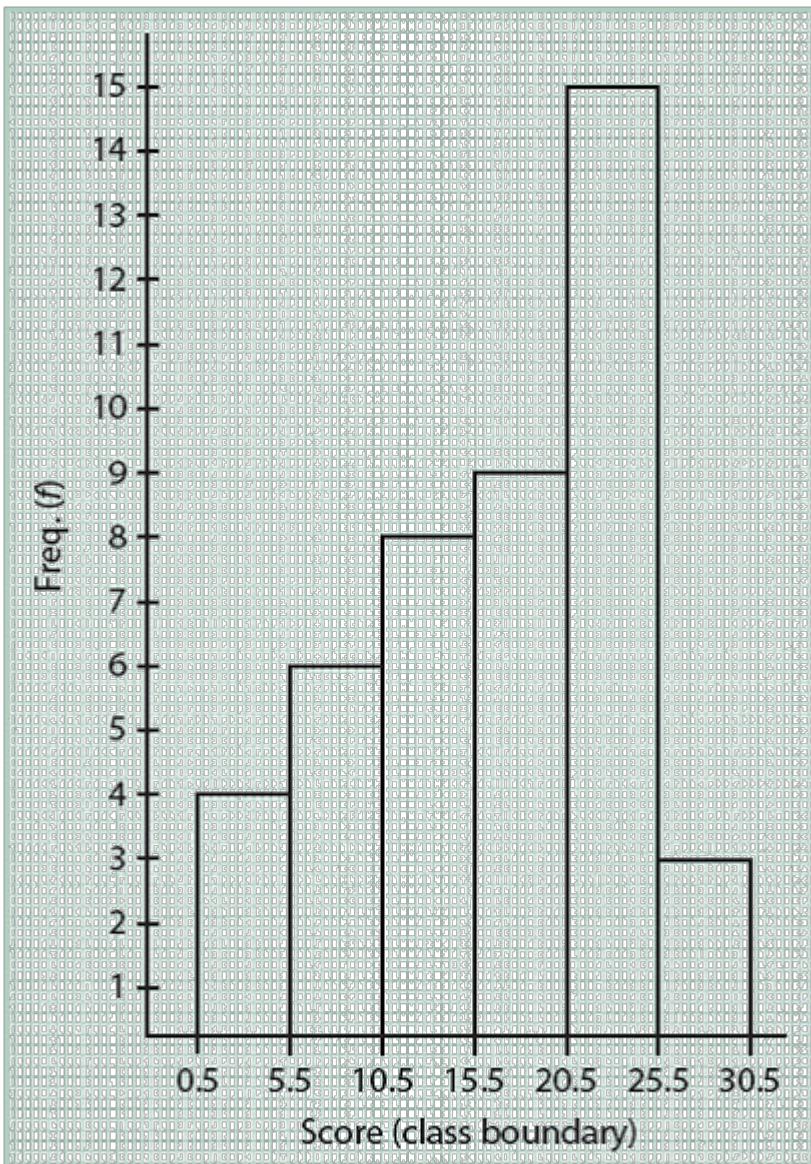
### Solution

Recall, that we have learnt how to prepare a frequency table of a grouped data in Unit 2 of this chapter. However, to construct the histogram, we need to add the class boundaries.

**Table 14.29**

| Class interval | Tally         | Freq. ( $f$ ) | Class boundary<br>LCB – UCB |
|----------------|---------------|---------------|-----------------------------|
| 1–5            |               | 4             | 0.5–5.5                     |
| 6–10           | ### /         | 6             | 5.5–10.5                    |
| 11–15          | #####         | 8             | 10.5–15.5                   |
| 16–20          | ##### /       | 9             | 15.5–20.5                   |
| 21–25          | ##### / ##### | 15            | 20.5–25.5                   |
| 26–30          | ///           | 3             | 25.5–30.5                   |

**Note:** To obtain the class boundary at the class interval, subtract 5 from 6 to give 1 Divide 1 by 2 to give 0.5. Subtract 0.5 from each lower class interval to build its lower class boundary. Add 0.5 to each upper class interval to build its upper class boundary as shown in Table 14.29. Then, draw the histogram with the information given in the grouped frequency table.



**Fig. 14.12**



### Exercise 7

1. The following table shows the frequency distribution of the ages in an extended family.

**Table 14.30**

| Ages (yrs) | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 |
|------------|------|-------|-------|-------|-------|-------|
| Freq. (f)  | 3    | 10    | 15    | 8     | 5     | 2     |

Represent the data on a histogram.

2. The following distribution shows the ages of adults in a small community whose genotypes are AA.

|    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|
| 53 | 62 | 54 | 44 | 46 | 55 | 46 | 68 | 63 |
| 66 | 59 | 61 | 54 | 39 | 48 | 47 | 56 | 57 |
| 40 | 50 | 35 | 30 | 46 | 44 | 36 | 54 | 51 |
| 45 | 57 | 56 | 33 | 38 | 41 | 40 | 53 | 58 |
| 48 | 51 | 45 | 34 | 36 | 46 | 43 | 63 | 52 |

- (a) Using a width of 5, construct the grouped frequency table.
- (b) Use the frequency table to draw a histogram.
3. In an examination, the marks scored by 50 candidates were as follows:

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 38 | 23 | 47 | 32 | 41 | 29 | 61 | 35 | 45 | 30 |
| 58 | 37 | 48 | 49 | 47 | 52 | 55 | 62 | 54 | 59 |
| 82 | 57 | 58 | 56 | 53 | 71 | 59 | 60 | 53 | 95 |
| 77 | 79 | 83 | 78 | 63 | 75 | 72 | 73 | 65 | 77 |
| 83 | 92 | 91 | 84 | 64 | 70 | 69 | 67 | 76 | 84 |

- (a) Prepare a frequency distribution using class interval 21–30, 31–40, etc.
- (b) Represent the data on a histogram. (WAEC)

4. Table 14.31 shows the distribution of marks of 100 candidates in a change of school examination.

**Table 14.31**

| Score range | No. of students |
|-------------|-----------------|
| 1 – 10      | 5               |
| 11 – 20     | 5               |
| 21 – 30     | 5               |
| 31 – 40     | 10              |
| 41 – 50     | 45              |
| 51 – 60     | 15              |
| 61 – 70     | 5               |
| 71 – 80     | 10              |

Represent the data on a histogram.

5. The following are the height distribution (in cm) of the members of a class in SS1 in a school.

**Table 14.32**

| Height range (cm) | No. of students |
|-------------------|-----------------|
| 111–120           | 10              |
| 121–130           | 12              |
| 131–140           | 15              |
| 141–150           | 8               |
| 151–160           | 5               |
| 161–170           | 2               |

Represent the data on a histogram.

## VIII. Frequency Polygon

A frequency polygon is the connection of the mid-points of the top of the histogram by a line graph. It can also be plotted against the class mark which would be eventually joined by a straight line. Traditionally, class mark with zero frequency is added one to each of the lowest and the highest existing class intervals. Hence, the name “**SEND DOWN THE RAIN**”. This led to the fact that the area bounded by the line graph and the x-axis is equal to the sum of the area of the rectangular bars of the histogram.

**Note:** It is necessary to plot the histogram before plotting the frequency polygon.



### Worked Example 17



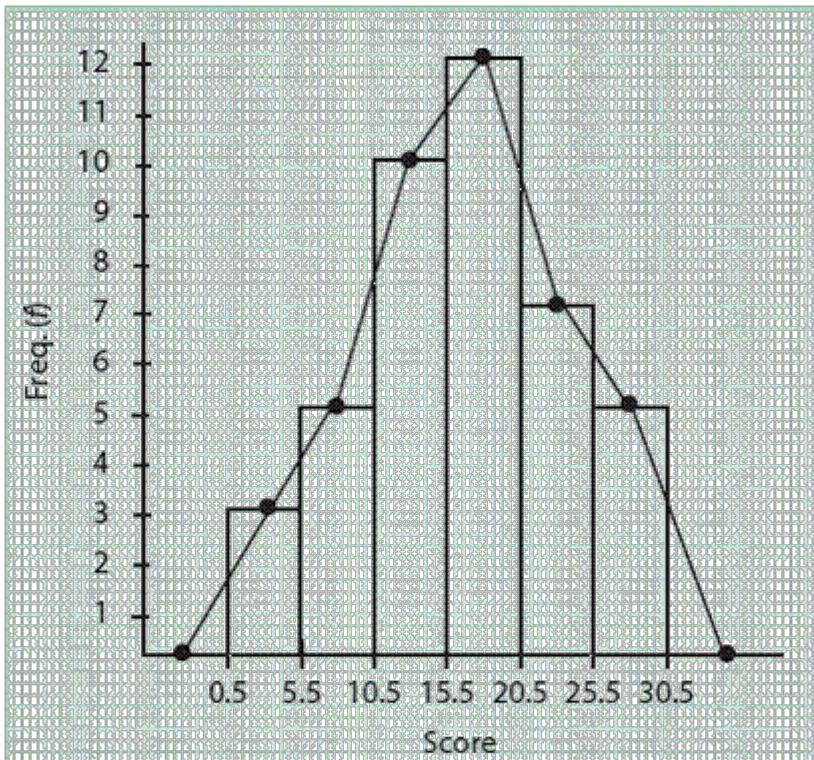
Draw a frequency polygon for the distribution of Mathematics test scores marked over 30.

**Table 14.33a**

| Class interval | Frequency |
|----------------|-----------|
| 1–5            | 3         |
| 6–10           | 5         |
| 11–15          | 10        |
| 16–20          | 12        |
| 21–25          | 7         |
| 26–30          | 5         |

**Solution****Table 14.33b**

| Class interval | Freq. ( $f$ ) | Mid point<br>(class mark) | Class boundary |
|----------------|---------------|---------------------------|----------------|
| 1–5            | 3             | 3                         | 0.5–5.5        |
| 6–10           | 5             | 8                         | 5.5–10.5       |
| 11–15          | 10            | 13                        | 10.5–15.5      |
| 16–20          | 12            | 18                        | 15.5–20.5      |
| 21–25          | 7             | 23                        | 20.5–25.5      |
| 26–30          | 5             | 28                        | 25.5–30.5      |



**Fig. 14.13**



### Worked Example 18

The table below shows the distribution of percentages of blood loss of accident victims at an emergency ward in a general hospital.

**Table 14.34a**

| Blood range (%) | 1–10 | 11–20 | 21–30 | 31–40 | 41–50 |
|-----------------|------|-------|-------|-------|-------|
| No. of patients | 3    | 10    | 15    | 8     | 2     |

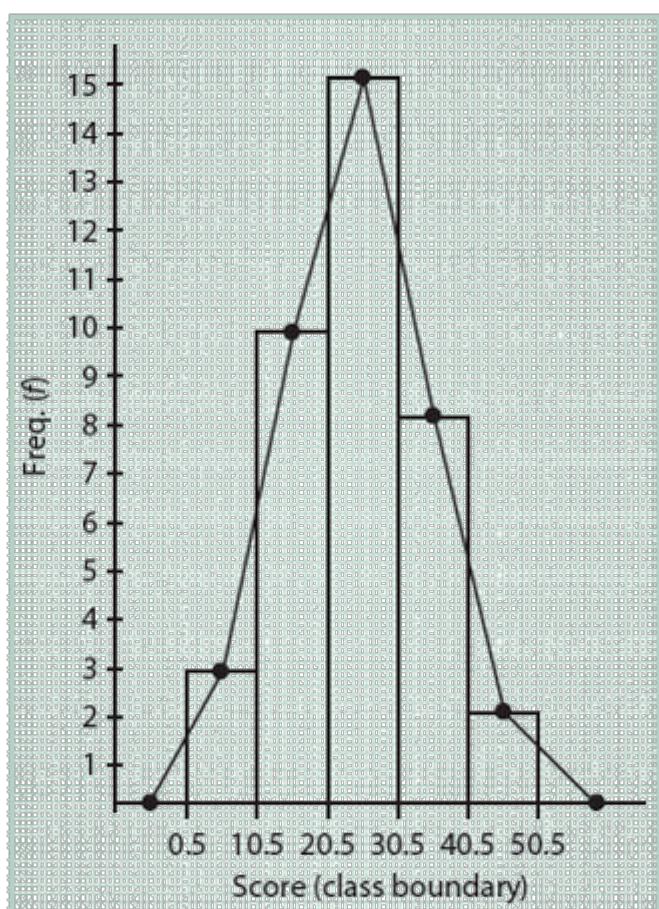
Use a frequency polygon to illustrate this information.



### Solution

**Table 14.34b**

| Class interval | Freq. ( $f$ ) | Mid point/<br>class mark | Class boundary<br>LCB – UCB |
|----------------|---------------|--------------------------|-----------------------------|
| 1–10           | 3             | 5.5                      | 0.5–10.5                    |
| 11–20          | 10            | 15.5                     | 10.5–20.5                   |
| 21–30          | 15            | 25.5                     | 20.5–30.5                   |
| 31–40          | 8             | 35.5                     | 30.5–40.5                   |
| 41–50          | 2             | 45.5                     | 40.5–50.5                   |

**Fig. 14.14**

## Exercise 8

Draw a frequency polygon for each question 1–5.

1. The table shows the frequency of scores obtained by 30 students in a test.

**Table 14.35**

| Class interval | Freq. ( $f$ ) |
|----------------|---------------|
| 1–5            | 2             |
| 6–10           | 5             |
| 11–15          | 8             |
| 16–20          | 10            |
| 21–25          | 3             |
| 26–30          | 2             |

2. The distribution below shows the number of hours each student spends playing games in a week.

**Table 14.36**

| Class interval | No. of students |
|----------------|-----------------|
| 1–10           | 2               |
| 11–20          | 5               |
| 21–30          | 8               |
| 31–40          | 3               |
| 41–50          | 1               |

3. The distribution below shows the number of hours each student spends studying a day during examination period.

**Table 14.37**

| Class interval | Frequency |
|----------------|-----------|
| 1–5            | 3         |
| 6–10           | 10        |
| 11–15          | 12        |
| 16–20          | 8         |
| 21–25          | 2         |

4. In an examination, the marks scored by 50 candidates were as follows:

|    |    |    |    |    |
|----|----|----|----|----|
| 23 | 58 | 57 | 77 | 83 |
| 47 | 59 | 58 | 77 | 84 |
| 32 | 54 | 56 | 66 | 76 |
| 41 | 62 | 53 | 73 | 67 |
| 29 | 55 | 71 | 72 | 69 |
| 61 | 52 | 59 | 75 | 70 |
| 35 | 47 | 60 | 63 | 64 |
| 45 | 49 | 53 | 78 | 84 |
| 30 | 48 | 95 | 83 | 91 |
| 38 | 37 | 82 | 79 | 92 |

Use a width of 10.

5. The distribution below shows the shoe sizes of a group of 50 adults. Prepare an ungrouped frequency table.

|    |    |    |    |    |    |    |   |    |
|----|----|----|----|----|----|----|---|----|
| 8  | 11 | 10 | 10 | 9  | 6  | 9  | 8 | 11 |
| 7  | 10 | 10 | 7  | 10 | 10 | 6  | 8 | 10 |
| 9  | 9  | 8  | 9  | 6  | 8  | 8  | 6 | 11 |
| 8  | 10 | 9  | 11 | 11 | 8  | 11 | 9 | 8  |
| 11 | 10 | 10 | 10 | 10 | 8  | 7  | 8 | 6  |

## SUMMARY

In this chapter, we have learnt the following:

- ◆ Data representation is the preparation of the given data so that analysis of the data and conclusion may be easily drawn.
- ◆ Data can be represented in the following forms:
  - (a) Data array
  - (b) Frequency distribution
  - (c) Pictogram
  - (d) Pie chart
  - (e) Bar chart
  - (f) Line graph
  - (g) Histogram
  - (h) Frequency polygon
- ◆ Data array is the arrangement of data either in ascending order or in

descending order of magnitude.

- ◆ Frequency distribution is the tabular arrangement of data that tells us how many times a given data appears. When it is a grouped frequency table, it requires a class interval.
- ◆ Pictogram is the representation of data in picture form.
- ◆ Pie chart is a circle divided into sectors such that the angles at the centre are proportional to the magnitude of the frequencies representing the items.
- ◆ Bar chart is a rectangular bar erected to show the proportion of the frequencies of items or scores being represented.
- ◆ Line graph is a graph that depends on connecting the Cartesian coordinates of points by straight lines.
- ◆ Histogram is like the bar chart but the bars are joined together such that they have common boundaries and the bars may or may not have equal width.
- ◆ Frequency polygon is the connection of the mid-points of the top of the histogram by a line graph.

### GRADUATED EXERCISES

1. In an SSCE agriculture examination, the scores of the best six candidates are as shown in the table below.

**Table 14.38**

| Student   | Akin | Musa | Chidera | Bayo | Emeka | Ali |
|-----------|------|------|---------|------|-------|-----|
| Objective | 30   | 40   | 35      | 40   | 40    | 30  |
| Theory    | 60   | 40   | 40      | 40   | 50    | 10  |
| Practical | 10   | 30   | 35      | 40   | 30    | 50  |

Represent the data on a

- (a) Component bar chart
- (b) Multiple bar chart

2. In a certain school, the lessons for each week are itemised below:  
English 10, Mathematics 7, Biology 3, Statistics 4, Igbo 3, Others 9.  
Draw a pie chart to illustrate this information. (WAEC)

3. In an examination, the percentage marks scored by 50 students were as follows:

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 77 | 62 | 77 | 94 | 92 | 66 | 53 | 70 | 80 | 34 |
| 56 | 52 | 67 | 51 | 43 | 89 | 85 | 81 | 63 | 85 |
| 39 | 60 | 62 | 72 | 62 | 34 | 74 | 51 | 71 | 43 |
| 57 | 47 | 51 | 70 | 40 | 35 | 42 | 66 | 27 | 24 |
| 97 | 42 | 53 | 55 | 72 | 71 | 59 | 51 | 87 | 45 |

Prepare a frequency distribution table using class intervals of 21 - 30, 31 - 40,

4. In a class of 45 students, their teacher instructed them to list one colour they liked best from the following: Red, Blue, Yellow, and White

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| R | B | Y | B | B | W | Y | B | W |
| Y | R | Y | B | W | R | W | W | B |
| B | Y | R | W | R | B | W | B | B |
| W | R | Y | B | W | Y | W | R | W |
| B | B | B | Y | R | B | W | Y | Y |

- (a) Prepare a frequency table for the above data.
- (b) Use the frequency table to provide a pictogram.

5. The table below is the population of an extended family in a village.

**Table 14.39**

| Age (yr) | Freq. ( <i>f</i> ) |
|----------|--------------------|
| 1–10     | 8                  |
| 11–20    | 10                 |
| 21–30    | 18                 |
| 31–40    | 20                 |
| 41–50    | 15                 |
| 51–60    | 10                 |
| 61–70    | 5                  |
| 71–80    | 2                  |

- (a) Use the frequency table to provide a histogram.
- (b) Use the histogram to draw a frequency polygon.
- (c) If a person is selected at random, find the probability that he/she is above 50 years.

6. Table 14.40 shows the frequency distribution of the heights of 40 students in a school.

**Table 14.40**

| Height (cm) | No. of students |
|-------------|-----------------|
| 150–154     | 5               |
| 155–159     | 9               |
| 160–164     | 8               |
| 165–169     | 7               |
| 170–174     | 6               |
| 175–179     | 5               |

(a) Use the frequency table to draw a histogram.

(b) Construct a frequency polygon.

(c) What fraction of the students is below 165 cm.

7. The marks scored by 50 students in a Geography examination were as follows:

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 60 | 54 | 40 | 67 | 53 | 73 | 37 | 55 | 62 | 43 |
| 44 | 69 | 39 | 32 | 45 | 58 | 48 | 67 | 39 | 51 |
| 46 | 59 | 40 | 52 | 61 | 48 | 23 | 60 | 59 | 47 |
| 65 | 58 | 74 | 47 | 40 | 59 | 68 | 51 | 50 | 50 |
| 71 | 51 | 26 | 36 | 38 | 70 | 46 | 40 | 51 | 42 |

(a) Using a class interval of 21 – 30, 31 – 40, etc., prepare a frequency distribution table.

(b) Draw a histogram to represent the distribution.

(c) Construct a frequency polygon.

(d) If a student is selected at random, find the probability that he/she obtains a mark greater than 63. (WAEC)

8. The table below shows the sizes of shoes of 25 students.

**Table 14.41**

| Size ( $x$ )    | 5 | 6 | 7 | 8 | 9 |
|-----------------|---|---|---|---|---|
| No. of students | 2 | 6 | 9 | 5 | 3 |

(a) Represent the table on a line graph.

(b) What is the ratio in the lowest term of the number of students wearing size 8 to all the students.

9. Four angles of the 5 sectors of a pie chart are  $84^\circ$ ,  $72^\circ$ ,  $56^\circ$  and  $78^\circ$ . If the fifth sector represents a population of 1.6 million, what population will the sector with  $56^\circ$  sector represent? (WASSCE)

10. The following are the ages of 50 people in a hamlet, whose blood groups are "O".

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 45 | 20 | 31 | 47 | 22 | 49 | 60 | 55 | 38 | 22 |
| 18 | 79 | 35 | 36 | 33 | 22 | 56 | 65 | 48 | 41 |
| 69 | 51 | 63 | 78 | 73 | 50 | 52 | 44 | 46 | 43 |
| 15 | 18 | 25 | 74 | 33 | 34 | 51 | 60 | 40 | 19 |
| 53 | 19 | 31 | 32 | 52 | 24 | 74 | 39 | 41 | 25 |

Using class intervals of 11 - 20, 21 - 30, etc.,

- (a) Construct a frequency table for the distribution.
- (b) Draw a histogram for the age distribution.
- (c) What percentage of the age was within the age range of 61 - 80 years?