**Solution.**

NUMBER OF LETTERS IN EACH WORD

| No. of Letters | Tally Bars | Frequency |
|---|---|---|
| 1 | \|\|\| | 3 |
| 2 | 𝍸 \|\|\|\| | 9 |
| 3 | 𝍸 \| | 6 |
| 4 | \|\|\|\| | 4 |
| 5 | 𝍸 \|\| | 7 |
| 6 | 𝍸 | 5 |
| 7 | \|\|\|\| | 4 |
| 8 | \|\|\|\| | 4 |
| 9 | \| | 1 |
| 10 | — | — |
| 11 | \| | 1 |
| | **Total** | 44 |

This method of classifying helps in condensing the data, only where values are largely repeated, otherwise hardly any condensation will be done.

## FORMATION OF CONTINUOUS FREQUENCY DISTRIBUTION

This type of classification is most popular in practice. The following technical terms are important when a continuous frequency distribution is formed or data are classified according to class-intervals :

**1. Class Limits** The class limits are the lowest and the highest values that can be included in the class. For example, take the class 20–40. The lowest value of the class is 20 and the highest 40. The two boundaries of class are known as the lower limit and the upper limit of the class. The lower limit of a class is the value below which there can be no item in the class. The upper limit of a class is the value above which no item can belong to that class. Of the class 70–89, 70 is the lower limit and 89 upper limit, *i.e.*, in this class there can be no value which is less than 70 or more than 89. Similarly, if we take the class 90–109, there can be no value in that class which is less than 90 or more than 109. The way in which class limits are stated depends upon the nature of the data.

**2. Class Intervals** The difference between the Upper and Lower Limit of a class is known as class interval of that class. For example, in the class 100–200, the class interval is 100 (*i.e.*, 200 minus 100). An important decision while constructing a frequency distribution is about the width of the class interval, *i.e.*, whether it should be 10, 20, 50, 100, 500, etc. The decision would depend upon a number of factors such as the range in the data, *i.e.*, the difference between the smallest and largest item, the details required and number of classes to be

formed, etc. A simple formula to obtain the estimate of appropriate class interval, *i.e.*, $i$ is :

where, $$i = \frac{L - S}{k}$$

$L$ = largest item

$S$ = smallest item

$k$ = the number of classes.

For example, if the salary of 100 employees in a commercial undertaking varied between Rs. 10,000 and Rs. 30,000 and we want to form 10 classes, then the class interval would be

$$i = \frac{L - S}{k}$$

$L$ = 30,000, $S$ = 10,000, $k$ = 10

$$\therefore \quad i = \frac{30,000 - 10,000}{10} = 2,000$$

The starting class would be 10,000—12,000, the next 12,000—14,000, and so on.

The question now is how to fix the number of classes, *i.e.*, $k$. The number can be either fixed arbitrarily keeping in view the nature of problem under study or it can be decided with the help of Sturges' Rule. According to him, number of classes can be determined by the formula:

$$k = 1+3.322 \log N$$

where $N$ = total number of observations

and log = logarithms of the number

Thus, if 10 observations are being studied, the number of classes shall be :

$k = 1 + (3.322 \times 1) = 4.322$ or 4. and if 100 observations are being studied, the number of classes shall be:

$k = 1 + (3.322 \times 2) = 1 + 6.644 = 7.644$ or 8.

It should be noted that since log is used in the formula, the number of classes shall generally be between 4 and 20; it cannot be less than 4 even if $N$ is less than 10 and if $n$ is 10 $k$ will be $1 + (3.323 \times 6) = 1 + 19.938 = 20.938$ or 21.

Sturges suggested the following formula for determining the magnitude of class interval:

$$i = \frac{\text{Range}}{1 + 3.322 \log N}$$

where Range is the difference between the largest and smallest items.

For example, if in the above illustration we apply this formula the magnitude of class interval shall be:

$$i = \frac{30,000 - 10,000}{1 + (3.322 \times 2)} = \frac{20,000}{7.644} = 2616.43 \text{ or } 2600.$$

**Illustration 3.** Prepare a frequency distribution of the marks obtained by 50 students in an examination with width of each class interval as 10. Use exclusive method of classification:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 57 | 44 | 80 | 75 | 00 | 18 | 45 | 14 | 04 | 64 |
| 72 | 51 | 69 | 34 | 22 | 83 | 70 | 20 | 57 | 28 |
| 96 | 56 | 50 | 47 | 10 | 34 | 61 | 66 | 80 | 46 |
| 22 | 10 | 84 | 50 | 47 | 73 | 42 | 33 | 48 | 65 |
| 10 | 34 | 66 | 53 | 75 | 90 | 58 | 46 | 39 | 69 |

**Solution.**
Preparation of Frequency Distribution

FREQUENCY DISTRIBUTION OF THE MARKS

| *Marks* | *Tally Bars* | *Frequency* |
|---|---|---|
| 0–10 | \|\| | 2 |
| 10–20 | \|\|\|\| | 5 |
| 20–30 | \|\|\|\| | 4 |
| 30–40 | \|\|\|\| | 5 |
| 40–50 | \|\|\|\| \|\|\| | 8 |
| 50–60 | \|\|\|\| \|\|\| | 8 |
| 60–70 | \|\|\|\| \|\| | 7 |
| 70–80 | \|\|\|\| | 5 |
| 80–90 | \|\|\|\| | 4 |
| 90–100 | \|\| | 2 |
| | | **Total** 50 |

**Illustration 4.** Prepare a frequency distribution of the marks obtained out of 100 for the following observations:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 45 | 40 | 42 | 50 | 60 | 62 | 68 | 70 | 42 |
| 75 | 75 | 80 | 81 | 25 | 26 | 31 | 32 | 78 | 45 |
| 31 | 45 | 42 | 43 | 55 | 56 | 78 | 80 | 81 | 62 |
| 60 | 62 | 58 | 69 | 70 | 45 | 50 | 56 | 72 | 58 |
| 75 | 62 | 62 | 65 | 60 | 70 | 35 | 37 | 40 | 55 |

*(B.Com., Bharthidasan Univ., 2009)*

**Solution.** Since the lowest value is 15 and the largest 81, we take class interval of 10.

FREQUENCY DISTRIBUTION OF THE MARKS

| *Marks* | *Tally Bars* | *Frequency* |
|---|---|---|
| 15–25 | \| | 1 |
| 25–35 | \|\|\|\| | 5 |
| 35–45 | \|\|\|\| \|\|\| | 8 |
| 45–55 | \|\|\|\| \| | 6 |
| 55–65 | \|\|\|\| \|\|\|\| \|\|\|\| | 14 |
| 65–75 | \|\|\|\| \|\| | 7 |
| 75–85 | \|\|\|\| \|\|\|\| | 9 |
| | | **Total** 50 |

**Illustration 5.** Classify the following data by taking class interval such that their mid-values are 17, 22, 27, 32, and so on.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 42 | 30 | 54 | 40 | 48 | 15 | 17 | 51 | 42 | 25 | 41 |
| 30 | 27 | 42 | 36 | 28 | 26 | 37 | 54 | 44 | 31 | 36 | 40 |
| 36 | 22 | 30 | 31 | 19 | 48 | 16 | 42 | 32 | 21 | 22 | 46 |
| 33 | 41 | 21 | | | | | | | | | |

*(B.Com., Madurai Kamaraj Univ., 2011)*

**Solution.** Since we have to classify the data in such a manner that the mid-values are 17, 22, 27, etc. the first class should be 15–19 [mid-value = (15 + 19)/2 = 17], second class 20–24 etc.

FREQUENCY DISTRIBUTION OF MARKS

| *Marks* | *Tally Bars* | *Frequency* |
|---|---|---|
| 15–19 | \|\|\|\| | 4 |
| 20–24 | \|\|\|\| | 4 |
| 25–29 | \|\|\|\| | 4 |
| 30–34 | 𝍸 \|\|\| | 8 |
| 35–39 | \|\|\|\| | 4 |
| 40–44 | 𝍸 \|\|\|\| | 9 |
| 45–49 | \|\|\| | 3 |
| 50–54 | \|\|\| | 3 |
| | **Total** | 39 |

**Illustration 6.** The marks obtained by 50 students are given below:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 31 | 13 | 46 | 31 | 30 | 45 | 38 | 42 | 30 | 9 |
| 30 | 30 | 46 | 36 | 2 | 41 | 44 | 18 | 29 | 63 |
| 44 | 30 | 19 | 5 | 44 | 15 | 7 | 25 | 12 | 30 |
| 6 | 22 | 24 | 37 | 15 | 6 | 39 | 32 | 21 | 20 |
| 42 | 31 | 19 | 14 | 23 | 28 | 17 | 53 | 22 | 21 |

Construct a group frequency distribution.

*(M.Com., Calicut Univ., 2009)*

**Solution.** The lowest value is 2 and largest 63. The appropriate class intervals shall be 10 because 7 classes would be formed by taking 10 as class interval.

FREQUENCY DISTRIBUTION OF MARKS

| *Marks* | *Tally Bars* | *No. of Students* |
|---|---|---|
| 0–10 | 𝍸 \| | 6 |
| 10–20 | 𝍸 \|\|\|\| | 9 |
| 20–30 | 𝍸 𝍸 | 10 |
| 30–40 | 𝍸 𝍸 \|\|\|\| | 14 |
| 40–50 | 𝍸 \|\|\|\| | 9 |
| 50–60 | \| | 1 |
| 60–70 | \| | 1 |
| | **Total** | 50 |