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Graphical Representation

(Histograms, Frequency Polygon and Ogives)

23.1 Graphical Representation :

The statistical data can be represented by diagram, chart, *etc.*, so that the significance attached to these data may immediately be grasped. Of course, the diagrams should be neatly and accurately drawn.

Out of several types of diagrams, charts, *etc.*, we shall be studying only the following three types of diagrams :

1. Histogram,   2. Frequency polygon,

3. Ogive (cumulative frequency curve).

23.2 Histogram :

A *histogram* is a two-dimensional graphical representation of continuous frequency distribution.

In this case, rectangles are drawn with bases proportional to class intervals and heights proportional to the frequencies of respective classes.

23.3 Histogram for Continuous Grouped Data :

Steps :

1. Convert the data in the exclusive form, if it is in inclusive form.

2. Taking suitable scales, mark class intervals on x-axis and frequencies on y-axis.

   The scales chosen for both the axes need not be the same.

3. Construct rectangles with class intervals as bases and corresponding frequencies as heights.

1 Draw a histogram to represent the following :

Class interval	0 – 8	8 – 16	16 – 24	24 – 32	32 – 40
Frequency	6	9	12	10	5

Solution :

Starting from 0, mark 8, 16, 24, 32 and 40 on x-axis at equal distances and 2, 4, 6, 8, 10 and 12 on y-axis at equal distances.

Now draw the rectangles to get the required histogram.
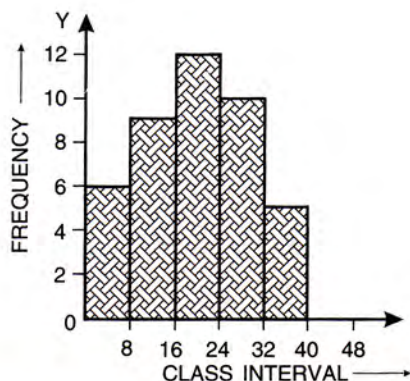
2 Draw a histogram to represent the following :

Pocket money in ₹	150–200	200–250	250–300	300–350	350–400	
Frequency	10	5	7	4	3	[2005]

Solution :

Note : In the given frequency distribution, the first class interval is 150 – 200; therefore, the scale on *x*-axis starts at 150. For this, in general, a kink (break) or a zig-zag curve is drawn near the origin to tell that the graph is drawn to scale beginning at 150 and not at the origin itself.
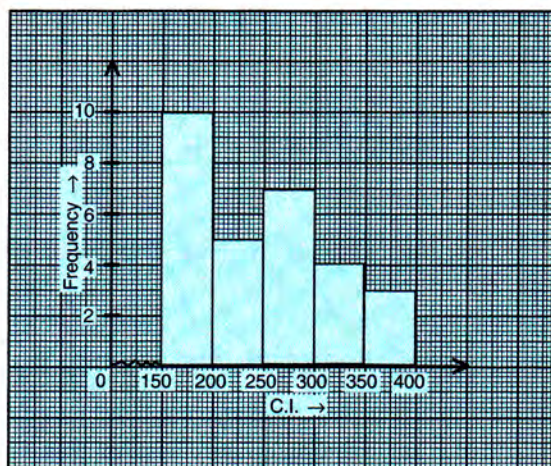
23.4 **For Discontinuous Grouped Data :**

3 Draw a histogram for the following :

Class interval	11–20	21–30	31–40	41–50	51–60
Frequency	5	8	13	10	6

Solution :

In this case, the class intervals given are in inclusive form. So, first of all we have to convert them into exclusive form.

Since the adjustment factor

$$= \frac{1}{2} \text{ (difference between the upper limit of a class and the lower limit of next class)}$$

$$= \frac{1}{2} (21 - 20) = 0{\cdot}5.$$

∴ To convert given class intervals in exclusive form, subtract the adjustment factor from all the lower limits and add it to all upper limits.

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The adjusted class intervals would then be as follows :

Class Interval (Inclusive form)	Class Interval (Exclusive form)	Frequency
11 – 20	10·5 – 20·5	5
21 – 30	20·5 – 30·5	8
31 – 40	30·5 – 40·5	13
41 – 50	40·5 – 50·5	10
51 – 60	50·5 – 60·5	6
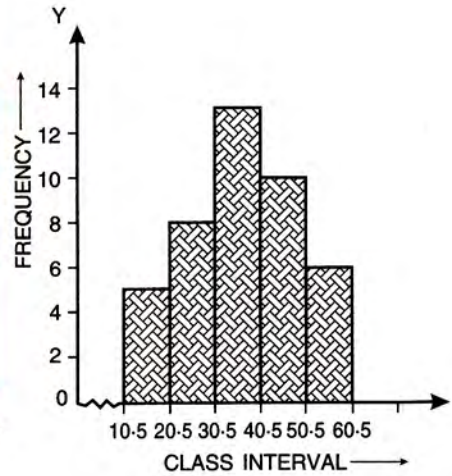
And the required histogram will be as shown alongside.

23.5 When Class Marks are Given :

First of all, find the class intervals and then draw the histogram.

4 Draw the histogram for the following :

| Class mark	25	35	45	55	65
Frequency	7	15	18	12	8

Solution :

Since the difference between the values of any two consecutive class marks is 10, therefore, subtract $\dfrac{10}{2}$ = 5 from each class mark to get the lower limit of the corresponding class interval and add 5 to each class mark to get the upper limit.

Thus, the given frequency distribution will be of the form :

C.I.	Frequency
20 – 30	7
30 – 40	15
40 – 50	18
50 – 60	12
60 – 70	8

and the required histogram will be as shown alongside.
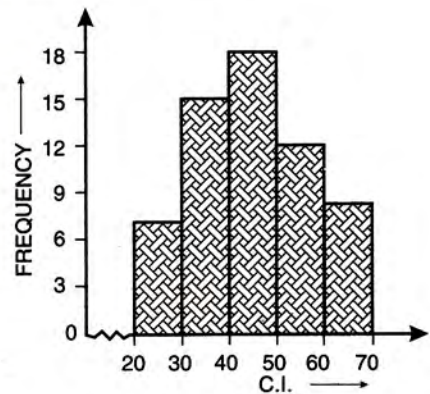
23.6 Cumulative Frequency and Cumulative Frequency Table :

The *cumulative frequency of a class interval is the sum of frequencies of all the classes up to this class interval.*

C.I.	f
20 – 25	3
25 – 30	6
30 – 35	10
35 – 40	8
40 – 45	4

$\Rightarrow$

C.I.	Cumulative frequency
20 – 25	3
25 – 30	$3 + 6 = 9$
30 – 35	$3 + 6 + 10 = 19$
35 – 40	$3 + 6 + 10 + 8 = 27$
40 – 45	$3 + 6 + 10 + 8 + 4 = 31$

$\Rightarrow$

	c.f.
less than 20	0
less than 25	3
” ” 30	9
” ” 35	19
” ” 40	27
” ” 45	31

23.7 Cumulative Frequency Curve or an Ogive :

If we plot the points taking the upper limits of the class intervals as x-co-ordinates and their corresponding cumulative frequencies as y-co-ordinates and then join these points by a free hand curve, the curve so obtained is called *cumulative frequency curve*.

Steps :

1. Construct a cumulative frequency table.
2. Mark the actual class limits along x-axis.
3. Mark the cumulative frequencies of respective classes along y-axis.
4. Plot the points corresponding to cumulative frequency at each upper limit point.
5. Join the points plotted by a free hand curve.

5 Draw a cumulative frequency curve (ogive) for the following distribution :

Marks	5–10	10–15	15–20	20–25	25–30
No. of students	7	9	12	8	6

Solution :

The cumulative frequency table for the given distribution is :

Marks (Class interval)	No. of students (Frequency)	Cumulative frequency
5 – 10	7	7
10 – 15	9	16
15 – 20	12	28
20 – 25	8	36
25 – 30	6	42

Taking upper class limits along x-axis and corresponding cumulative frequencies along y-axis, mark the points (10, 7), (15, 16), (20, 28), (25, 36) and (30, 42).

Join the points marked by a free hand curve (as shown below). **Ans.**
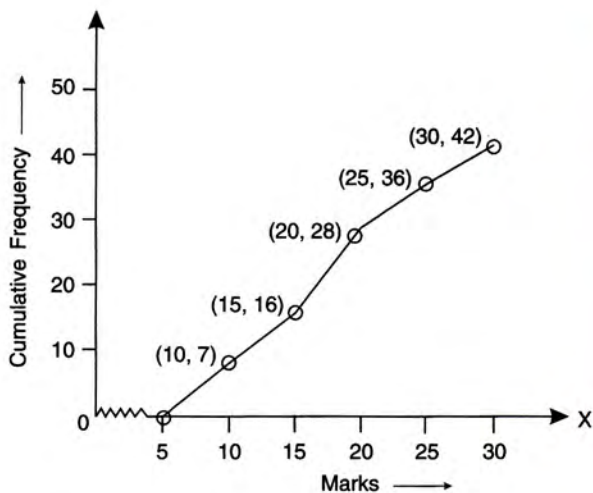
1. An ogive is always started from a point on x-axis representing the lower limit of the first class and is terminated at the upper limit of the last class.
2. The ogive, that we are studying in this chapter, is also called a **less than ogive**. Such an ogive is always a rising curve
3. The ogive of the type drawn alongside is a *less than ogive*.

EXERCISE 23

1. Draw histograms for the following frequency distributions :

(i)

Class interval	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Frequency	12	20	26	18	10	6

(ii)

Class interval	10 – 16	16 – 22	22 – 28	28 – 34	34 – 40
Frequency	15	23	30	20	16

(iii)

Class interval	30 – 39	40 – 49	50 – 59	60 – 69	70 – 79
Frequency	24	16	09	15	20

(iv)

Class mark	16	24	32	40	48	56	64
Frequency	8	12	15	18	25	19	10

2. Draw a cumulative frequency curve (ogive) for each of the following distributions :

(i)

Class interval	10 – 15	15 – 20	20 – 25	25 – 30	30 – 35	35 – 40
Frequency	10	15	17	12	10	8

(ii)

Class interval	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59
Frequency	23	16	15	20	12

3. Draw an ogive for each of the following distributions :

(i)

Marks obtained	less than 10	less than 20	less than 30	less than 40	less than 50
No. of students	8	25	38	50	67

(ii)

Age in years (less than)	10	20	30	40	50	60	70
Cumulative frequency	0	17	32	37	53	58	65

4. Construct a frequency distribution table for the numbers given below, using the class intervals 21-30, 31-40, ..., *etc.*

75, 67, 57, 50, 26, 33, 44, 58, 67, 75, 78, 43, 41, 31, 21, 32, 40, 62, 54, 69, 48, 47, 51, 38, 39, 43, 61, 63, 68, 53, 56, 49, 59, 37, 40, 68, 23, 28, 36 and 47.

Use the table obtained to draw : (i) a histrogram   (ii) an ogive.

5. (a) Use the information given in the adjoining histogram to construct a frequency table.
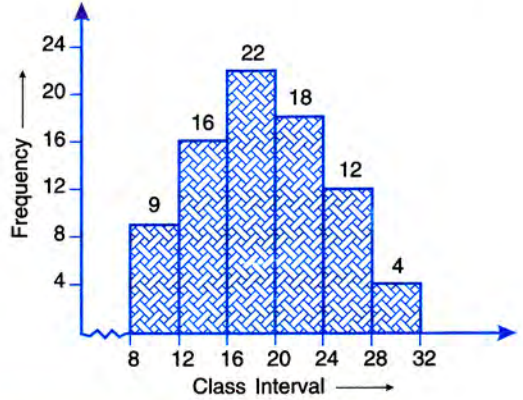
   (b) Use this table to construct an ogive.

6.

Class mark	12·5	17·5	22·5	27·5	32·5	37·5	42·5
Frequency	12	17	22	27	30	21	16

   (a) From the distribution, given above, construct a frequency table.

   (b) Use the table obtained in part (a) to draw : (i) a histogram, (ii) an ogive.

7. Use graph paper for this question.

   The table given below shows the monthly wages of some factory workers.

   (i) Using the table, calculate the cumulative frequencies of workers.

   (ii) Draw a cumulative frequency curve.

   Use 2 cm = ₹ 500, starting the origin at ₹ 6500 on *x*-axis, and 2 cm = 10 workers on the *y*-axis.

Wages (in ₹.)	6500 – 7000	7000 – 7500	7500 – 8000	8000 – 8500	8500 – 9000	9000 – 9500	9500 – 10000
No. of workers	10	18	22	25	17	10	8

8. The following table shows the distribution of the heights of a group of factory workers :

Ht. (cm) :	150 – 155	155 – 160	160 – 165	165 – 170	170 – 175	175 – 180	180 – 185
No. of workers :	6	12	18	20	13	8	6

   (i) Determine the cumulative frequencies.

   (ii) Draw the '*less than*' cumulative frequency curve on graph paper. Use 2 cm = 5 cm height on one axis and 2 cm = 10 workers on the other.

9. Construct a frequency distribution table for each of the following distributions :

(i)

Marks (less than)	0	10	20	30	40	50	60	70	80	90	100
Cumulative Frequency	0	7	28	54	71	84	105	147	180	196	200

(ii)

Marks (more than)	0	10	20	30	40	50	60	70	80	90	100
Cumulative Frequency	100	87	65	55	42	36	31	21	18	7	0