4 Diagrams and Graphs

Introduction

In the previous chapter we have discussed the classification and tabulation that help in summarising the collected data and presenting them in a systematic manner. Although tabulation is a good technique to present the data, diagrams are advanced technique to represent the data. Diagrams and Graphs are the methods for simplifying the complexity of quantitative data.

4.1 Significance of Diagrams and Graphs

- It gives a clear picture of the data
- We can make comparison between different samples easily
- The technique can be used universally at any place at any time. This technique is used almost in all subjects and other various fields
- It is more attractive and impressive

Graphs originated when ancient astronomers drew the position of the stars in the heavens. Roman surveyors also used coordinates to locate landmarks on their maps. William Henry Playfair, Scottish engineer and Political economist, is known as the founder of Graphical methods of Statistics. He invented four types of diagrams the line graph, bar chart, pie chart and circle graph. He used graphs to present economic data pictorially.

4.2 Diagrams

Commonly used diagrams are

1. Bar diagrams
2. Pie diagram

Bar diagram

A Bar Diagram consists of a set of separated rectangles. Each rectangle is known as bar. There are four types of bar diagrams.

(a) Simple Bar Diagram

(b) Multiple Bar Diagram

(c) Sub Divided Bar Diagram (Component Bar Diagram)

(d) Percentage Bar Diagram

Simple Bar Diagram

A simple bar diagram is used to represent only one variable. It is constructed by horizontal or vertical bars with same width. It is used in qualitative and quantitative cases.

Illustration 4.1

The following table gives the number of students in Science, Humanities and Commerce streams of a school. Represent the data by simple bar diagram

	Stream	No. of Students
	Science	240
	Humanities	120
	Commerce	100

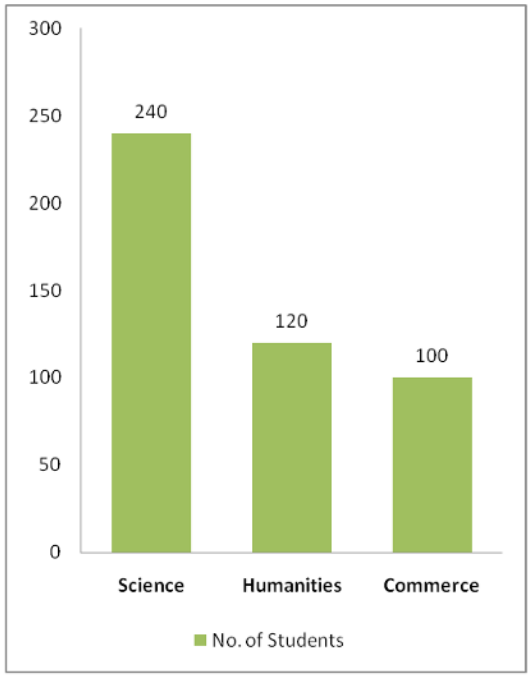
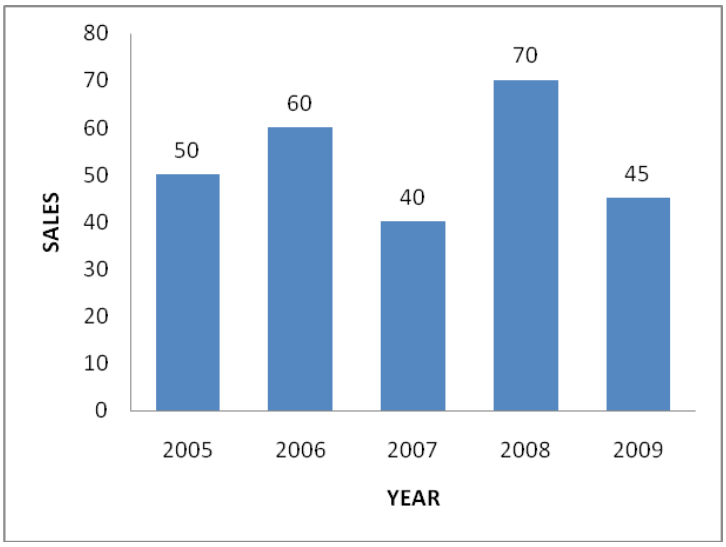


Illustration 4.2

Following table gives sales of a company for the last 5 years. Represent the data by simple bar diagram

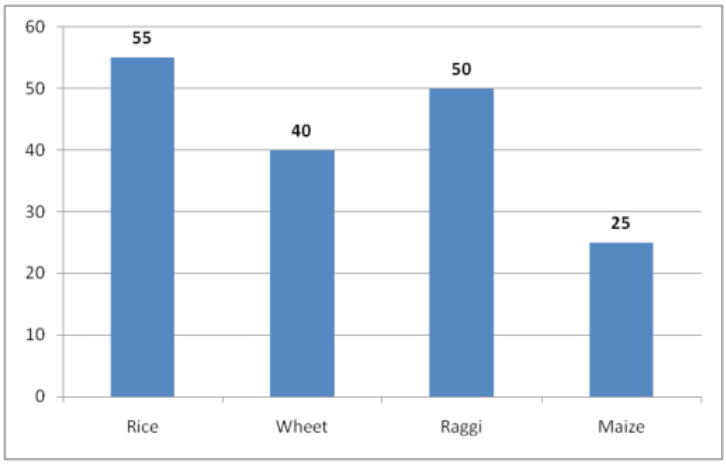
Year	*2005*	*2006*	*2007*	*2008*	*2009*
Sales in lakhs	*50*	*60*	*40*	*70*	*45*

Solution:



Know your progress

You are given a simple bar diagram representing data related to the production (in lakh tones) of different crops in India



Based on the above diagram, answer the following.

1. Which crop has recorded the highest production?
2. Represent the above diagram in tabular form
3. State the difference in production of the highest and the least production of crops

Activity

Collect the data of percentage results of HSE in last four years from your school and represent it by a simple bar diagram

Multiple Bar Diagram

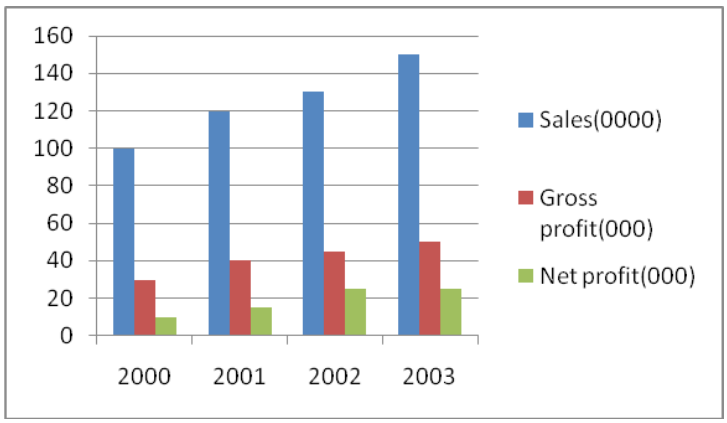
Multiple bar diagrams are those diagrams which show two or more sets of data simultaneously. Each set of variables is represented by a set of bars placed close to each other.

Illustration 4.3

Draw a multiple bar diagram for the following data.

Year	Sales (000)	Gross Profit (000)	Net Profit (000)
2000	100	30	10
2001	120	40	15
2002	130	45	25
2003	150	50	25

Solution:



Know your progress

Draw a suitable bar diagram from the following data

Items	Year	
	2000	2004
Industries	250	350
Agriculture	670	300
Internal trade	500	800

Activity

Collect the data of number of boys and girls in the last five years from your school and represent it in bar diagram

Sub Divided Bar Diagram

The subdivided or component bar diagrams are used to represent data in which the total magnitude (bar) is divided into different parts or components. In these

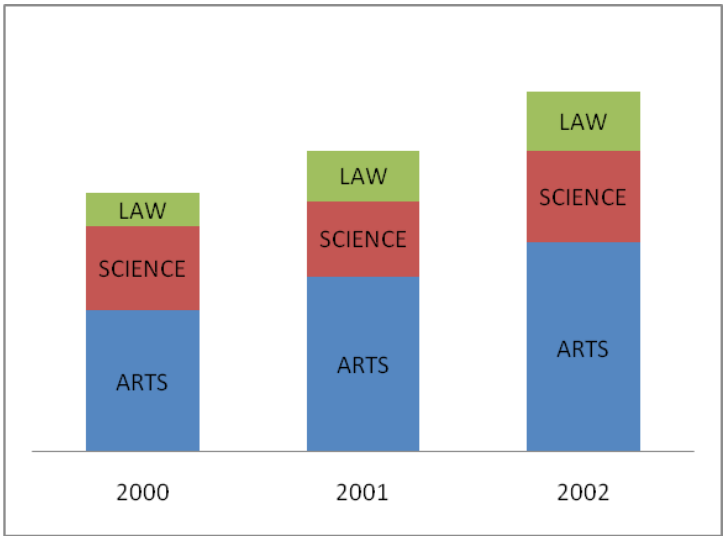
types of diagrams, first make simple bars for each class taking total magnitude in that class and then divided theses simple bars into parts in the ratio of various components.

Illustration 4.4

During 2000-02 the number of students in a university is as follows. Represent the data by using sub divided bar diagram

Year	*Arts*	*Science*	*Law*	*Total*
2000	*17000*	*10000*	*4000*	*31000*
2001	*21000*	*9000*	*6000*	*36000*
2002	*25000*	*11000*	*7000*	*43000*

Solution:



Percentage Bar Diagram

Percentage bar diagram is a modified form of the component bar diagram. It is used when the comparison of components is important. To construct a percentage bar diagram, the component bars correspond to the percentages of the total of each category.

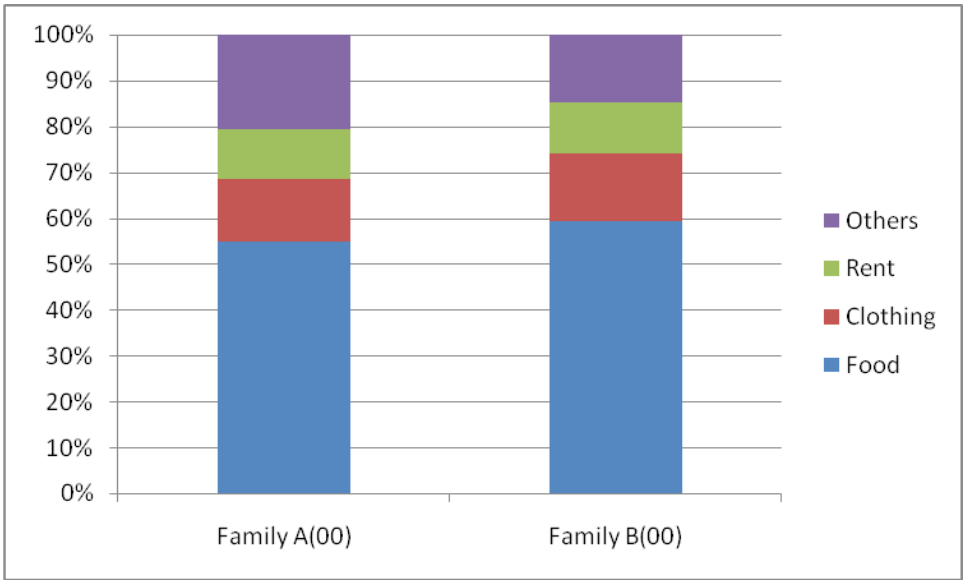
Illustration 4.5

The following are the expenditure of two families for various items. Represent it by using percentage bar diagram.

Types of items	Family A(00)	Family B(00)
Food	40	80
Clothing	10	20
Rent	8	15
Others	15	20
Total	73	135

Solution:

Types of items	Family A(00)	Percentage of family A	Family B(00)	Percentage of family B
Food	40	54.8	80	59.3
Clothing	10	13.7	20	14.8
Rent	8	11	15	11.1
Others	15	20.5	20	14.8
Total	73	100	135	100



Know your progress

During 2005-08 the number of students in a school are as follows

Year	humanities	science	commerce
2005-06	110	150	60
2006-07	118	180	55
2007-08	120	240	120

Represent the above data by percentage bar diagram

Activity

Collect the data of number of students studying in science, humanities and commerce from neighborhood of three schools and represent it in a bar diagram.

Pie diagram

Pie diagram is a circular diagram, with sectors representing the values of the data given. The areas of each sector will be proportional to the values of items and the area of the whole circle will be proportional to the totality.

In constructing a pie chart, the first step is to prepare the data so that the various component values can be transposed into corresponding degrees on the circle by using the formulae

$$Angle = \frac{Item frequency}{Total frequency} \times 360 \tag{4.1}$$

Illustration 4.6

The sales of an appliance in 5 cities in October,2013 is given in lakhs(Rs) is given below. Draw a pie diagram to represent the population in a town

City	*Sales in lakhs*
Kannur	*79*
Kozhikode	*99*
Cochin	*134*
Kollam	*70*
Trivandrum	*83*

Solution:

Cities	*Sales in lakhs*	*Angle*
Kannur	*79*	$\frac{79}{465} \times 360 = 61.2$
Kozhikode	*99*	$\frac{99}{465} \times 360 = 76.6$
Cochin	*134*	$\frac{134}{465} \times 360 = 103.7$
Kollam	*70*	$\frac{70}{465} \times 360 = 54.2$
Trivandrum	*83*	$\frac{83}{465} \times 360 = 64.3$

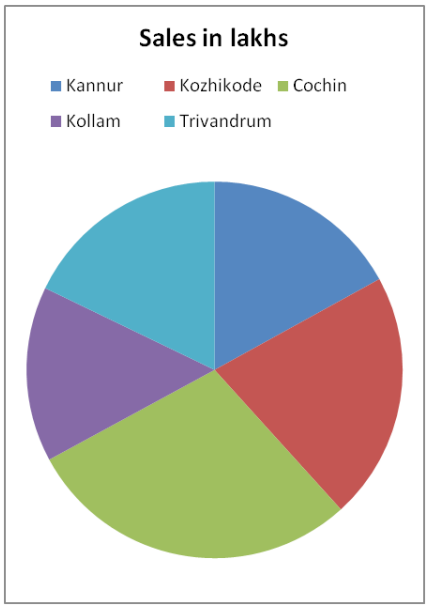


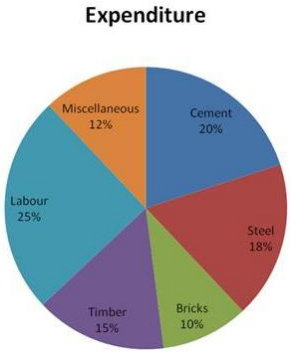
Illustration 4.7

The following figures relate to the cost of constructions of house in Delhi Draw a pie diagram to represent it.

Items	*Expenditure*
Cement	*20%*
Steel	*18%*
Bricks	*10%*
Timber	*15%*
Labour	*25%*
Miscellaneous	*12%*

Solution:

Items	*Corresponding angles*
Cement	$\frac{20}{100} \times 360 = 72$
Steel	$\frac{18}{100} \times 360 = 64.8$
Bricks	$\frac{10}{100} \times 360 = 36$
Timber	$\frac{15}{100} \times 360 = 54$
Labour	$\frac{25}{100} \times 360 = 90$
Miscellaneous	$\frac{12}{100} \times 360 = 43.2$



Know your progress

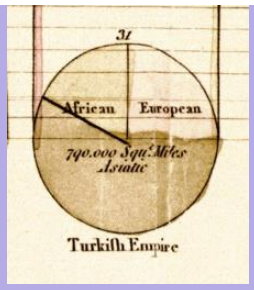
Draw a pie diagram to represent the following data of investment patterns in the 5 year plan

Agriculture	:	20%
Irrigation	:	18%
Small industries	:	22%
Transport	:	14%
Social service	:	15%
Others	:	11%

Activity

Collect the expenditure of various food items (rice, wheat, oil, et(c) from your home in a month and represent by means of pie diagram.

Pie Chart from William Henry Playfairs Statisical Breviory (1801), showing the proportions of the Turkish Empire located in Asia, Europe and Africa before 1789.



4.3 Graphs

The graphs are designed to make known clearly the characteristic features of a data .In the previous chapter we have seen that the frequency distribution can be represented in a table. But the graphs are more attractive to the eye than the tabulated data. The most commonly used graphs for representing a frequency distribution are

(a) Histogram

(b) Frequency Polygon

(c) Frequency Curve

(d) Ogives(cumulative frequency curve)

(e) Scatter Plot

Histogram

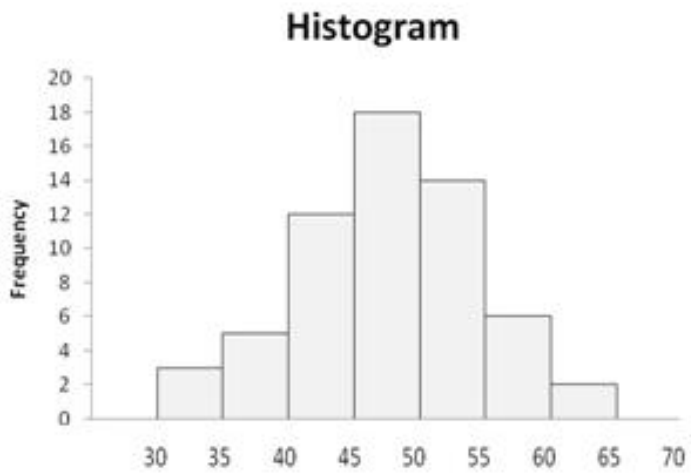
Histogram is an important method for displaying the frequency distribution .It is a set of vertical bars whose heights are proportional to the frequencies represented. In constructing histogram ,the variable is always taken on the X-axis and frequencies on the Y - axis. The width of the bars in the histogram will be proportional to the class interval. A histogram generally represents a continuous curve.

Illustration 4.8

The frequency distribution of weights of 60 students of a class in a school is given below. Draw histogram

Weight in kg	*30-35*	*35-40*	*40-45*	*45-50*	*50-55*	*55-60*	*60-65*
No. students	*3*	*5*	*12*	*18*	*14*	*6*	*2*

Solution:



Frequency Polygon

Mid points of the top of bars in a histogram are joined together by straight lines and then join to the X-axis at both extreme points. It gives a frequency polygon Another method of constructing frequency polygon is to take the midpoints of the various class intervals and then plot the frequency corresponding to each point and to join all these points with straight lines

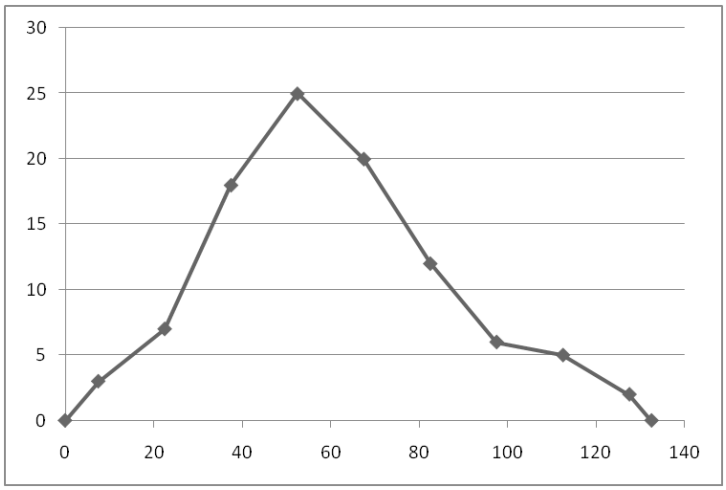
Illustration 4.9

Draw a frequency polygon for the following data

Profit (000)	*0-15*	*15-30*	*30-45*	*45-60*	*60-75*	*75-90*	*90-105*	*105-120*	*120-135*
No. Companies	*3*	*7*	*18*	*25*	*20*	*12*	*6*	*5*	*2*

Solution:

Mid Points	*7.5*	*22.5*	*37.5*	*52.5*	*67.5*	*82.5*	*97.5*	*112.5*	*127.5*
Frequency	*3*	*7*	*18*	*25*	*20*	*12*	*6*	*5*	*2*



Frequency Curve

A frequency curve is obtained by joining the points of a frequency polygon with a freehand smooth curve.

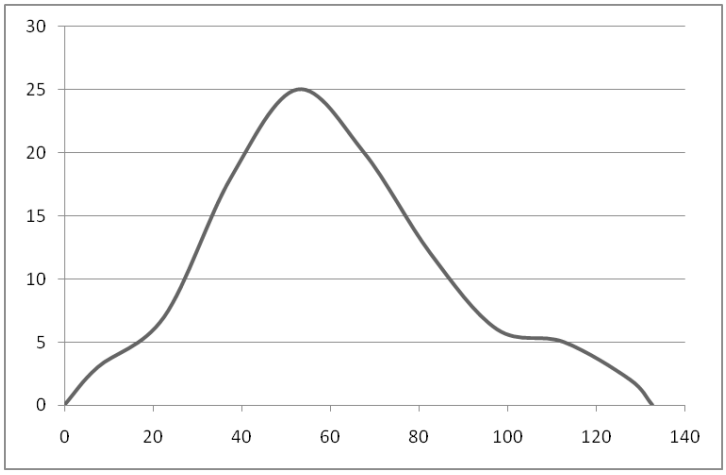
Illustration 4.10

Draw frequency curve for the following data

Profit (000)	*0-15*	*15-30*	*30-45*	*45-60*	*60-75*	*75-90*	*90-105*	*105-120*	*120-135*
No. Companies	*3*	*7*	*18*	*25*	*20*	*12*	*6*	*5*	*2*

Solution:

Mid Points	*7.5*	*22.5*	*37.5*	*52.5*	*67.5*	*82.5*	*97.5*	*112.5*	*127.5*
Frequency	*3*	*7*	*18*	*25*	*20*	*12*	*6*	*5*	*2*



Know your progress

1. Draw a histogram on the basis of following data

Mid values	18	25	32	39	46	53	60
Frequency	10	15	32	42	26	12	9

(hint:actual class=25-18=7, 18 ± 7/2, 14.5-21.5)

2. The following table gives the marks of 60 students in a class. Draw a histogram

marks	20-24	25-29	30-34	35-39	40-44	45-49
No.of students	10	16	7	11	9	7

(hint: change inclusive classes into exclusive classes)

3. Prepare histogram, frequency polygon and frequency curve from the following data

Marks:	0-5	5-10	10-15	15-20	20-25	25-30
No. of students:	8	6	26	40	30	8

Activity

Collect the marks of students from your class in a particular subject and draw histogram, frequency polygon and frequency curve

Ogives (Cumulative Frequency Curve)

Suppose a teacher is interested to knowing how many students have scored less than 30 marks in a class test or how many students have scored more than 50 marks in a test. To answer these questions, it is necessary to add the frequencies. When frequencies are added, they are called cumulative frequencies. These frequencies are then listed in a table called a cumulative frequency table. The curve obtained by plotting cumulative frequencies is called a cumulative frequency curve or ogive. There are two types of ogives

1. Less than Ogive
2. Greater than Ogive (More than Ogive)

Less than Ogive

It is drawn by plotting points with the upper bound of the classes along X-axis and the corresponding less than cumulative frequencies along Y-axis and joining these points with a smooth curve is called a less than ogive.

Illustration 4.11

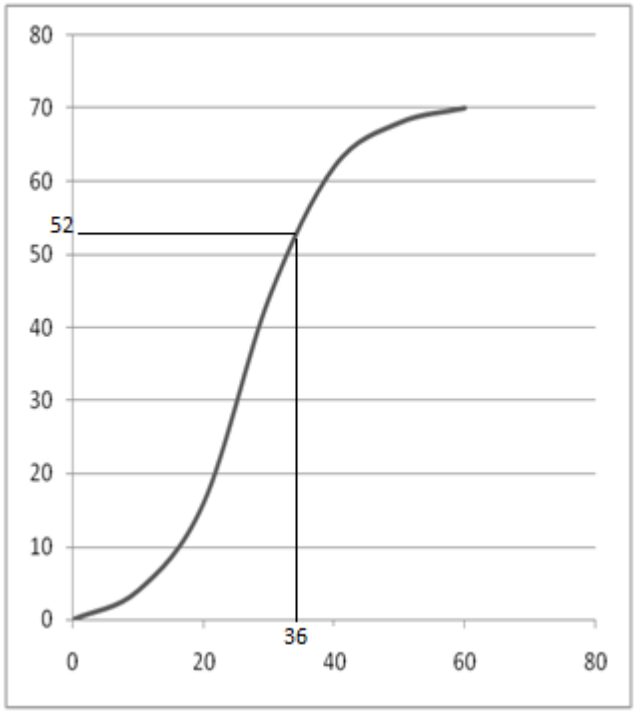
Below is given the frequency distribution of ages of 100 persons in a colony. Draw a less than ogive

Age	*0-10*	*10-20*	*20-30*	*30-40*	*40-50*	*50-60*
No. persons	*4*	*12*	*28*	*18*	*6*	*2*

Using this ogive, find how many persons have age less than 36

Solution:

Age	Frequency	Upper bound	Less than cumulative frequency
0-10	4	10	4
10-20	12	20	16
20-30	28	30	44
30-40	18	40	62
40-50	6	50	68
50-60	2	60	70



Number of persons having age less than 36 is equal to 52

Greater than Ogive (more than Ogive)

In order to get greater than ogive, we plot the lower limits along X - axis and corresponding greater than cumulative frequencies along Y - axis and joined these points with a smooth curve.

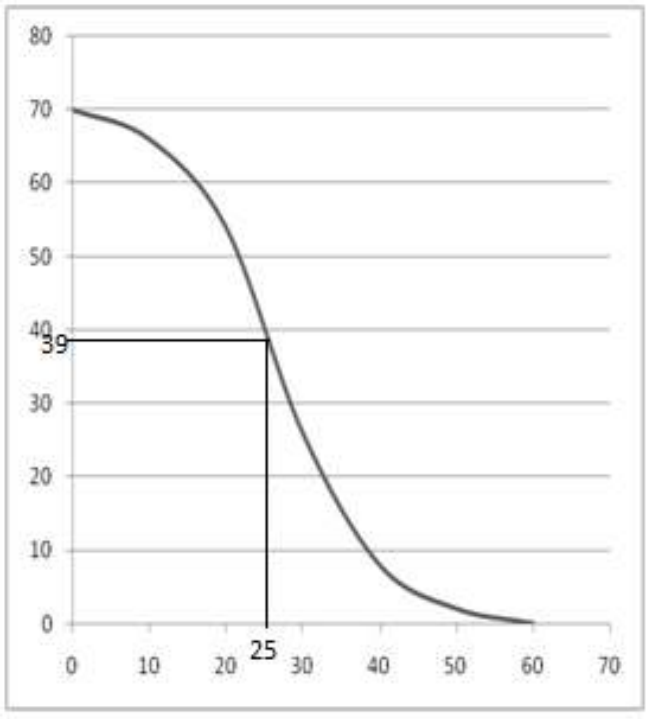
Illustration 4.12

Given below is the frequency distribution of ages of 100 persons in a colony.Draw a greater than ogive and also find how many persons have age greater than 25

Age	0-10	10-20	20-30	30-40	40-50	50-60
No.persons	4	12	28	18	6	2

Solution:

Age	Frequency	Lower bound	Greater than cumulative frequency
0-10	4	0	70
10-20	12	10	66
20-30	28	20	54
30-40	18	30	26
40-50	6	40	8
50-60	2	50	2



The number of persons greater than age 25 is equal to 39

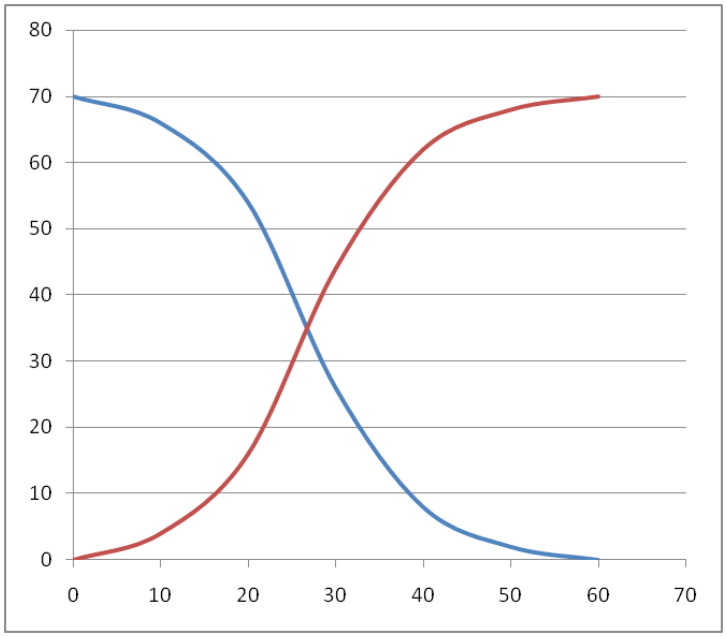
Illustration 4.13

Draw a less than ogive and greater ogive (Ogives) in the same graph.

Age	*0-10*	*10-20*	*20-30*	*30-40*	*40-50*	*50-60*
Number of persons	*4*	*12*	*28*	*18*	*6*	*2*

Solution:

Age	*Frequency*	*Upper bound*	*Less than cumulative frequency*	*Lower bound*	*Greater than cumulative frequency*
0-10	*4*	*10*	*4*	*0*	*70*
10-20	*12*	*20*	*16*	*10*	*66*
20-30	*28*	*30*	*44*	*20*	*54*
30-40	*18*	*40*	*62*	*30*	*26*
40-50	*6*	*50*	*68*	*40*	*8*
50 - 60	*2*	*60*	*70*	*50*	*2*



Know your progress

The following are the frequency distribution of daily wages of 60 persons in a company. Draw a greater than ogive and less than ogive (ogives) in a same graph

Wage (in tens)	30-40	40-50	50-60	60-70	70-80	80-90
Number of persons	5	10	20	15	7	3

Activity

Collect the data of height of students from your class and draw ogives

Scatter plot

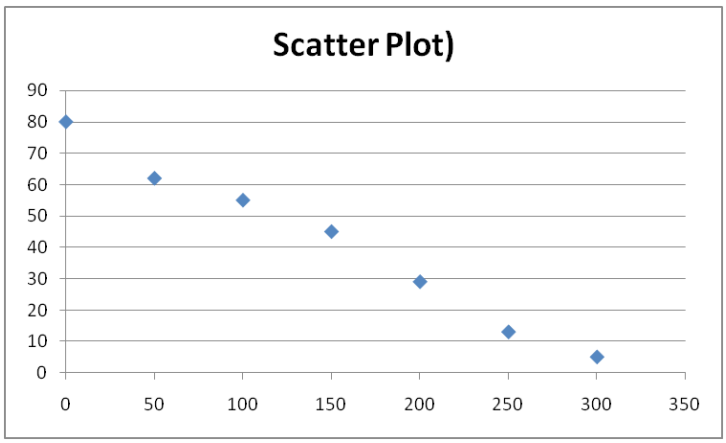
Scatter plot is a diagram to represent a bivariate data. It is used to analyse the relationship between two variables. In a scatter plot, one variable is represented along the X- axis and the other variable along the Y- axis. Each pair is represented by a single point.

Illustration 4.14

A driver keeps a record of the distance travelled and amount of fuel in his tank on a long journey. Draw a scatter plot.

Distance Travelled (in KM)	*0*	*50*	*100*	*150*	*200*	*250*	*300*
Fuel in Tank (in Ltr)	*80*	*73*	*67*	*61*	*52*	*46*	*37*

Solution:



Know your progress

An insurance company interested in studying the basic pay and LIC premium remittance of employees in a locality. They took a sample of 7 employees

Basic pay (00)	:	42	45	50	29	60	65
LIC remittance (in tens)	:	18	30	40	35	70	60

Represent the data on a graph

Activity

Collect the heights and weights of students from your class and represent it on a graph together.

Difference between Diagrams and Graphs

DIAGRAMS	GRAPHS
It is more attractive to eye	Less attractive
It is not based on the co-ordinate system	It is based on the co-ordinate system
Does not represent any mathematical relationship between variables	It represents mathematical relationship between variables
It is not so helpful in statistical analysis	Very much used in statistical analysis
It is used for a specific purpose	It is capable for further mathematical treatments

Let us sum up

In this chapter we have discussed different types of diagrams and graphs. It helps us to make comparison among various type of data very easily.Diagrams and graphs give a birds eye view of the entire data. The types of diagrams and graphs discussed in this chapter are very common and useful in day to day life

Learning outcomes

After transaction of this unit, the learner:-

- identifies importance of diagrammatic representation of data.
- explains different types of diagrams and graphs.
- creates different types of diagrams and graphs.
- interprets data using diagrams and graphs.

Evaluation Items

1. Which of the following is a one dimensional diagram?
   (a) bar diagram (b) frequency polygon
   (c)frequency curve (d) ogives

2. In an ogive ,the points are plotted for
   (a) the values and frequencies (b)the values and cumulative frequencies
   (c)frequencies and cumulative frequencies (d)none of the above

3. Pie chart represents the components of a factor by
   (a) percentage (b) angles
   (c) sectors (d)circles

4. Histogram is suitable for the data presented as
   (a) continous grouped frequency distribution (b) individual series
   (c)discrete grouped frequency distribution (d) all the above

5. With the help of histogram we can prepare
   (a) frequency polygon (b) frequency curve
   (c) both (d) none

6. Discuss the importance of diagrams and graphs

7. Prepare a table consisting of the merits and demerits of diagrams and graphs?

8. Illustrate four different types of bar diagrams

9. Write the importance of ogives?

10. Following table gives the birth rate per thousand of different countries over a period, represent by a suitable bar diagram

Country	Birth rate
India	32
Germany	18
UK	20
China	40

11. The data below show the yearly profits (in thousands of rupees) of the two companies A and B

Year	Company A	Company B
2000	120	90
2001	135	95
2002	140	108
2003	160	120

Represent the data by means of a suitable diagram (hint: multiple bar diagram)

12. The following table gives the height of trees

Height	**No. of trees**
Below 7 feet	26
Below 14 feet	57
Below 21 feet	92
Below 28feet	134
Below 35 feet	216
Below 42 feet	287
Below 49 feet	341
Below 56 feet	360

Represent the data in the form of histogram

13. Height distribution of a group of students are given below

Height (cm)	150-153	153-156	156-159	159-162	162-165	165-168	168-171	171-173
No. students	4	8	15	20	28	16	10	4

(a) Draw ogives

(b) How many students have heights less than 160 cm

(c) How many students have height greater than 166 cm

Answers

1. a , 2. b , 3. c , 4. a , 5. c