11 Statistics

Let's recall.

Ex. The numbers of pages of a book Ninad read for five cosecutive days were 60, 50, 54, 46, 50. Find the average number of pages he read everyday.

Solution : Average $= \dfrac{\text{Sum of all scores}}{\text{Total number of scores}}$

$= \dfrac{60 + \square + \square + \square + 50}{\square} = \dfrac{\square}{\square} = \square$

$\therefore$ Average of number of pages read daily is $\square$

The average is also known as 'Arithmetic mean' or 'Mean'.

Let's learn.

The number of pages read everyday in the above example is numerical data. The conclusion that Ninad read about 50 pages everyday is drawn from the numerical data.

In this way, collecting information regarding certain problem or situation, analysing this information and after interpretation drawing conclusion about it, is a seperate branch of knowledge. This branch is known as 'Statistics'.

Arithmetic Mean

We have seen that the average of 60, 50, 54, 46 and 50 is 52. The average is called as **'arithmetic mean'** or simply **'mean'** in statistical language. To find the mean of numerical data, we add all the scores in the data and divide the sum by total number of scores. Let's study some aspects of the method. See the following example.

Ex. The marks obtained by 37 students of std 8 in a test of 10 marks are given below. Find the mean of the data.

2, 4, 4, 8, 6, 7, 3, 8, 9, 10, 10, 8, 9, 7, 6, 5, 4, 6, 7, 8, 4, 8, 9, 7, 6, 5, 10, 9, 7, 9, 10, 9, 6, 9, 9, 4, 7.

Solution: If we go on adding the scores one after the other, it will take lot of time. We know that 7 + 7 + 7 + 7 + 7 = 7 × 5 = 35. This simplifies the operation of addition, when a number is to be added to itself. So let us use the method and add the numbers by classifying them.

Marks, x_i Scores	Tally Marks	No. of students frequency f_i	$f_i \times x_i$
2	|	1	1 × 2 =2
3	|	1	1 × 3 =3
4	𝍸	5	5 × 4 =20
5	||	2	2 × 5 =10
6	𝍸	5	5 × 6 = 30
7	𝍸 |	6	6 × 7 = 42
8	𝍸	5	5 × 8 = 40
9	𝍸 |||	8	8 × 9 = 72
10	||||	4	4 × 10 = 40
		N = 37	$\Sigma f_i x_i$ = 259

$$\text{Mean} = \frac{\Sigma f_i \times x_i}{N}$$
$$= \frac{259}{37}$$
$$= 7$$

Prepare a table as above and follow the steps to calculate the mean of a data.

- Write the scores in the 1st column, in asending order as $x_1 < x_2 < x_3 \ldots$.
- Write the tally marks in next column.
- Count the tally marks of scores and write the frequency of the score, denoted as f_i. Write the sum of all frequencies below the frequency column. The total frequencies is denoted by 'N'.
- In last column write the products $f_i \times x_i$. The sum of $f_i \times x_i$ is denoted as $\Sigma f_i \times x_i$. 'Σ' (sigma) indicates the 'sum'. Arithmetic mean is denoted by $\bar{x}$

$$\therefore \text{ Mean } \bar{x} = \frac{\Sigma f_i \times x_i}{N}$$

Ex. The production of soyabean per acre, in quintal obtained by 30 farmers in Rajapur, is given below.

9, 7.5, 8, 6, 5.5, 7.5, 5, 8, 5, 6.5, 5, 5.5, 4, 4, 8,
6, 8, 7.5, 6, 9, 5.5, 7.5, 8, 5, 6.5, 5, 9, 5.5, 4, 8.

From the given data, prepare a frequency table and find the average production per acre of soyabean.

Solution :

Production per Acre frequentcy x_i	Tally marks	No of farmers f_i	$f_i \times x_i$
4	|||	3	12
5	𝍸	5	25
5.5	||||	4	22
6	|||	3	18
6.5	||	2	13
7.5	||||	4	30
8	𝍸	6	48
9	|||	3	27
		N = 30	$\Sigma f_i x_i = 195.$

Mean $\bar{x} = \frac{\Sigma f_i \times x_i}{N} = \frac{195}{30} = 6.5$

Hence average production of soyabean per acre is 6.5 quintal.

Practice Set 11.1

1. The following table shows the number of saplings planted by 30 students. Fill in the boxes and find the average number of saplings planted by each student.

No. of saplings (Scores) x_i	No. of students (frequency) f_i	$f_i \times x_i$
1	4	4
2	6	☐
3	12	☐
4	8	☐
	N = ☐	$\Sigma f_i x_i$ = ☐

Mean $\bar{x} = \frac{\square}{N}$

$= \frac{\square}{\square}$

$= \square$

∴ The average number of trees planted ☐.

2. The following table shows the electricity (in units) used by 25 families of Eklara village in a month of May. Complete the table and answer the following questions.

Electricity used (Units) x_i	No.of families (frequency) f_i	$f_i \times x_i$
30	7	.....
45	2	.....
60	8	.....
75	5	.....
90	3	.....
	N = ...	$\Sigma f_i x_i$ =.....

(1) How many families use 45 units electricity ?

(2) State the score, the frequency of which is 5.

(3) Find N, and $\Sigma f_i x_i$

(4) Find the mean of electricity used by each family in the month of May.

3. The number of members in the 40 families in Bhilar are as follows:
1, 6, 5, 4, 3, 2, 7, 2, 3, 4, 5, 6, 4, 6, 2, 3, 2, 1, 4, 5, 6, 7, 3, 4, 5, 2, 4, 3, 2, 3, 5, 5, 4, 6, 2, 3, 5, 6, 4, 2. Prepare a frequency table and find the mean of members of 40 families.

4. The number of Science and Mathematics projects submitted by Model high school, Nandpur in last 20 years at the state level science exibition is :
2, 3, 4, 1, 2, 3, 1, 5, 4, 2, 3, 1, 3, 5, 4, 3, 2, 2, 3, 2. Prepare a frequency table and find the mean of the data.

Let's learn.

Last year we have studied simple bar graph and joint bar graph. Now we will study some more bar graphs.

Subdivided bar graph/diagram

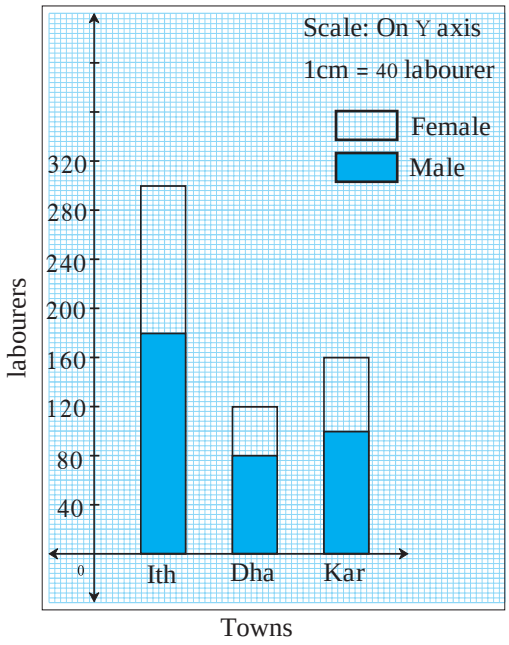
As in a joint bar graph, we can compare the information in a data by a subdivided bar diagram also. Here information of two or more constituents is shown by parts of a single bar.

We will see the steps for drawing a subdivided bar graph.

Town	Ithalapur	Dhanodi	Karmabad
Male labourers	180	80	100
Female labourers	120	40	60
Total labourers	300	☐	☐

- First pepare a table of the given data as shown above.

- Draw the X- axis and Y- axis on a graph paper.
- Write the names of towns on X-axis, keeping equal distances between two consecutive bars.
- Show number of labourers on Y - axis with the scale 1cm = 40 labourers.
- Total number of labourers in the town Ithlapur is 300. Show it by a single bar.

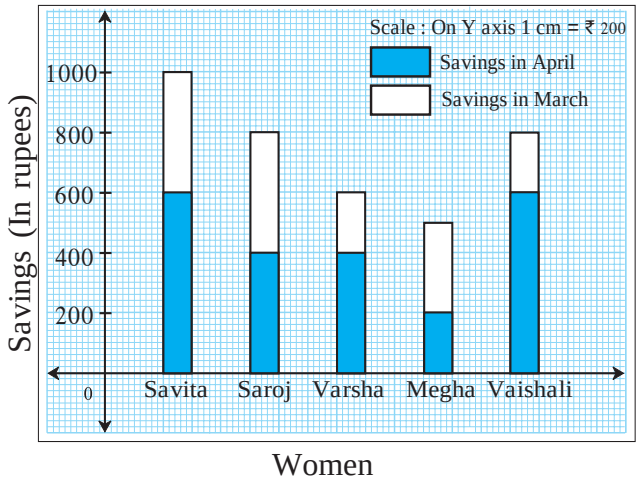


- Show the number of male labourers by a part of the bar by some mark.
- Obviously the remaining part of the bar will represent the female labourers. Show this part by another mark.
- Simililarly draw the sub divided bars for the towns Dhanodi and Karmabad.

Following the above steps, the given information is shown by subdivided bar diagram, in the adjacent figure. observe it.

Practice Set 11.2

1. Observe the following graph and answer the questions.



(1) State the type of the graph.

(2) How much is the savings of Vaishali in the month of April?

(3) How much is the total of savings of Saroj in the months March and April?

(4) How much more is the total savings of Savita than the total savings of Megha?

(5) Whose savings in the month of April is the least?

2. The number of boys and girls, in std 5 to std 8 in a Z.P. school is given in the table. Draw a subdivided bar graph to show the data.
(Scale : On Y axis, 1cm= 10 students)

Standard	5^{th}	6^{th}	7^{th}	8^{th}
Boys	34	26	21	25
Girls	17	14	14	20

3. In the following table number of trees planted in the year 2016 and 2017 in four towns is given. Show the data with the help of subdivided bar graph.

year \ town	Karjat	Wadgoan	Shivapur	Khandala
2016	150	250	200	100
2017	200	300	250	150

4. In the following table, data of the transport means used by students in 8^{th} standard for commutation between home and school is given. Draw a subdivided bar diagram to show the data.
(Scale : On Y axis : 1 cm = 500 students)

Town → / Mean of commutation ↘	Paithan	Yeola	Shahapur
cycle	3250	1500	1250
Bus and Auto	750	500	500
On foot	1000	1000	500


Let's learn.

Percentage bar graph/diagram

In the town Arvi, 42 trees out of 60 trees planted are survived and in the town Morshi 45 trees out of 75 are servived. In the town Barshi 45 trees out of 90 are servived.

To know in which town the plantation is more successful, only numbers of trees planted are not sufficient. For that we have to find percentage of survived plants.

In Arvi, the percentage of trees survived = $\frac{42}{60} \times 100 = 70$.

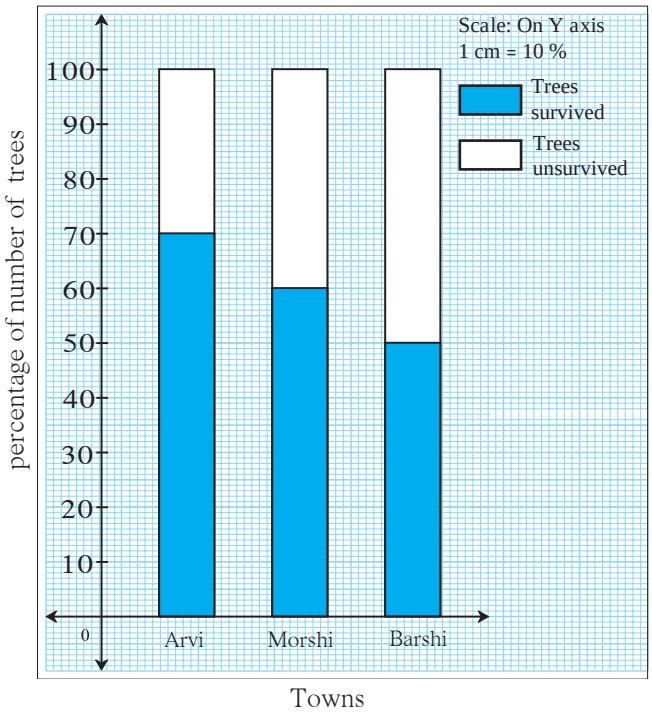
In Morshi, the percentage of trees survived = $\frac{45}{75} \times 100 = 60$.

From these percentages notice that the percentage of survival of trees in Arvi is more. It means the percentages give somewhat different information. A subdivided bar graph which is drawn by converting the data into percentages is called a percentage bar graph.

That means percentage bar graph is a specific type of subdivided bar graph. We draw the percentage bar graph of the above data using following steps.

- First of all we prepare a table as follows.

Town	Arvi	Morshi	Barshi
Total number of trees	60	75	90
Trees survived	42	45	45
Percentage of survived trees	$\frac{42}{60} \times 100 = \boxed{70}$	$\frac{45}{75} \times 100 = \boxed{60}$	$\frac{45}{90} \times 100 = \boxed{50}$



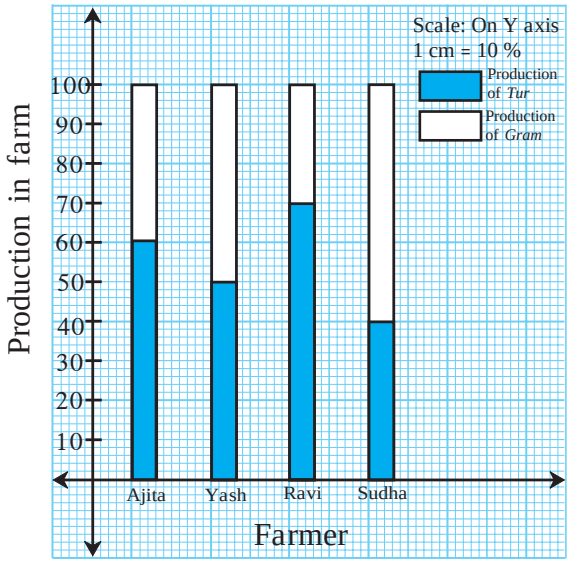
- In a percentage bar graph, all bars are of height 100 units.
- In each bar we show percentage of survived trees. Remaining part shows the percentage of trees which did not survive.
- A percentage bar graph is a specific type of subdivided bar graph, so the remaining procedure of drawing a percentage bar graph is the same as that of a subdivided bar graph.

Practice Set 11.3

1. Show the following information by a percentage bar graph.

Division of standard 8	A	B	C	D
Number of students securring grade A	45	33	10	15
Total number of students	60	55	40	75

2. Observe the following graph and answer the questions.



(1) State the type of the bar graph.
(2) How much percent is the Tur production to total production in Ajita's farm ?
(3) Compare the production of Gram in the farms of Yash and Ravi and state whose percentage of production is more and by how much ?
(4) Whose percentage production of Tur is the least?
(5) State production percentages of Tur and gram in Sudha's farm.

3. The following data is collected in a survey of some students of 10^{th} standard from some schools. Draw the percentage bar graph of the data.

School	1^{st}	2^{nd}	3^{rd}	4^{th}
Inclination towards science stream	90	60	25	16
Inclination towards commerce stream	60	20	25	24

Activity : Compare and discuss a percentage bar diagram and a subdivided bar diagram. Use it to learn the graphs in the subjects like Science, Geography.

Answers

Practice Set 11.1 **2.** (1) 2 (2) 75 (3) N = 25, $\Sigma f_i \times x_i = 1425$ (4) 57
3. 3.9 **4.** 2.75

Practice Set 11.2 **1.** (1) Sub-divided bar graph. (2) ₹ 600 (3) ₹ 800
(4) ₹ 500 (5) Megha's

Practice Set 11.3 **2.** (1) Percentage bar graph (2) 60%
(3) Yash's, more by 20% (4) Sudha's
(5) 40% and 60%