CHAPTER - 3 : PARTITION VALUES

LET'S RECALL

- Are you familiar with the word 'averages'?
- Can you tell the meaning of individual series, discrete data and continuous data.
- Name the positional averages that you have previously studied.

Types of Average	Individual Data	Discrete Data	Continuous Data
1) Arithmetic Mean	$\bar{x} = \frac{\Sigma x}{n}$	$\bar{x} = \frac{\Sigma f_i x_i}{n}$	Direct method $\bar{x} = \frac{\Sigma f_i x_i}{n}$
2) Mode	Value repeated maximum number of times	The value which has maximum frequency	$\text{Mode} = l + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right] \times h$
3) Median	M = size of $\left(\frac{n+1}{2}\right)^{\text{th observation}}$	M = size of $\left(\frac{n+1}{2}\right)^{\text{th observation}}$	$M = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$

Introduction :

The procedure of dividing the data into equal parts is called 'partitioning'. Values dividing the data into a required number of equal parts are called 'Partition Values'.

In Class X, you have already studied about the measures of central tendency i.e. averages such as Arithmetic Mean, Median and Mode. Median is the value of the middlemost observation in the data when the observations are arranged in increasing or decreasing order of values. 'Median', is a special type of partition value because there are equal number of observations above as well as below it. Like Median, Quartiles, Deciles and Percentiles are also partition values, since they divide the given set of observations into equal number of parts. In general, they are referred to as 'fractiles'. Partition values form a part of descriptive statistics.

In the forthcoming chapters such as Population, Unemployment and Poverty, students will get acquainted with the use of partition values in economic data analysis.

Do you know?

Statistics Day : Prof. Prasanta Chandra Mahalanobis, an Indian Statistician was instrumental in formulating India's strategy for industrialization in the Second Five Year Plan (1956-61) which later came to be known as Mahalanobis Model.

Mahalanobis devised a measure of comparison between two data sets that is known as the Mahalanobis distance. He also devised a statistical method called 'fractile graphical analysis' which could be used to compare the socio-economic conditions of different groups of people. In recognition of the notable contributions made by P. C. Mahalanobis in the field of economic planning and statistical development, the Government of India has designated 29th of June every year, coinciding with his birth anniversary as 'Statistics Day', in the category of Special day to be celebrated at the national level.

Need for Partition Values :

The data consists of extreme values on the lower side and also on the higher side in magnitude. Such values are known as 'outliers'. The average used for such data often misinterprets its representative value. To overcome this misinterpretation, generally partition values like median, quartiles, deciles and percentiles are used.

Always remember :

$$\boxed{Q_2 = D_5 = P_{50} = \text{Median}}$$

You should know :

Application of Quartiles, Deciles and Percentiles in Economics :

- Quartiles are used in the study of all types of financial information concerning economic data, income data, stock data, sales and survey data etc.
- Income quartiles is the most objective method of comparing changes among individual income groups caused by economic changes such as wage fluctuations and inflation.
- Deciles too have wide application in finance and economics. Government uses deciles to study the level of economic inequality, measurement of poverty line, drought conditions etc.
- Deciles are used in investments, particularly to assess the performance of a portfolio investment such as a group of mutual funds.
- Percentiles are used in the measurement of test scores, health indicators, household income, household wealth, percentile wages.
- Percentiles can be used for benchmarking and baseline purposes.

LET'S LEARN :

Quartiles :

Meaning : 'Quartiles' are values of data which divide the whole set of observations into four equal parts. There are three Quartiles which divide the data into 4 equal parts. They are known as Q_1, Q_2 and Q_3 respectively.Second quartile is nothing but the median. To findout quartiles, generally the data is arranged in ascending order.

It is explained in the following example :

(1) Q_1 (2) Q_2 (3) Q_3 (4)

a) In general, for individual and ungrouped data we get the formula for Q_1, Q_2 and Q_3 as given below :

$$Q_i = \text{size of } i\left(\frac{n+1}{4}\right)^{\text{th Observation.}} \qquad i = 1, 2, 3$$

b) For grouped data or continuous data,

$$Q_i = l + \left(\frac{\frac{in}{4} - cf}{f}\right) \times h \qquad i = 1, 2, 3$$

Where

l = Lower limit of quartile class.

f = Frequency of the quartile class

cf = Cumulative frequency of the class preceding the quartile class.

n = Total of frequency.

h = Upper limit - lower limit of the quartile class.

Calculation of Quartiles

Solved Examples

A) Individual Data :

1) Calculate Q_1 and Q_3 of the first semester examination marks scored by the students as given : 40, 85, 84, 83, 82, 69, 68, 65, 64, 55, 45

Solution : Arrange the series in ascending order i.e. 40, 45, 55, 64, 65, 68, 69, 82, 83, 84, 85

n = Total number of observations

$n = 11$

$Q_1 = \text{size of } \left(\frac{n+1}{4}\right)^{\text{th Observation.}}$

$Q_1 = \text{size of } \left(\frac{11+1}{4}\right)^{\text{th Observation}}$

$Q_1 = \text{size of } \left(\frac{12}{4}\right)^{\text{th Observation}}$

$Q_1 = \text{size of } 3^{\text{rd}}$ Observation.

$Q_1 = \text{size of } 3^{\text{rd}}$ Observation. is 55

$\therefore$ $\mathbf{Q_1 = 55}$

Third Quartile

$Q_3 = \text{size of } 3\left(\frac{n+1}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } 3\left(\frac{11+1}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } 3\left(\frac{12}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } (3 \times 3)^{\text{ th Observation}}$

$Q_3 = \text{size of } 9^{\text{th Observation}}$ is 83

$\therefore$ **$Q_3 = 83$**

Ans : $Q_1 = 55$, $Q_3 = 83$

2) Calculate Q_3 for the given distribution.

20, 28, 31, 18, 19, 17, 32, 33, 22, 21

Solution : Arrange the data in ascending order.

17, 18, 19, 20, 21, 22, 28, 31, 32, 33

$n = 10$

$Q_3 = \text{size of } 3\left(\frac{n+1}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } 3\left(\frac{10+1}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } \left(3 \times \frac{11}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } \left(\frac{33}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } 8.25^{\text{th Observation}}$

$Q_3 = \text{size of } 8^{\text{th observation}} + 0.25(9^{\text{th observation}} - 8^{\text{th observation}})$

$Q_3 = 31 + 0.25\ (32 - 31)$

$Q_3 = 31 + 0.25 \times 1$

$\therefore$ **$Q_3 = 31.25$**

Ans : $Q_3 = 31.25$

B) Discrete Data : By arranging the observations in the data in ascending or descending order, we derive :

$Q_i = \text{size of } i\left(\frac{n+1}{4}\right)^{\text{th Observation}}$ where $i = 1, 2, 3$

1) Find out Q_1 and Q_3 from the following data.

Income (lakh ₹)	5	4	9	12	15	6	10
No. of Person	8	6	12	8	6	9	10

Solution : Arrange the data in ascending order and find out the cumulative frequency.

Income (lakh ₹) (*x*)	**No. of Person (*f*)**	**Cumulative frequency (*cf*)**
4	6	6
5	8	14
6	9	23
9	12	35
10	10	45
12	8	53
15	6	59
	$n = 59$	

$Q_1 = \text{size of } \left(\frac{n+1}{4}\right)^{\text{th Observation}}$

$Q_1 = \text{size of } \left(\frac{59+1}{4}\right)^{\text{th Observation}}$

$Q_1 = \text{size of } \left(\frac{60}{4}\right)^{\text{th Observation}}$

$Q_1 = \text{size of } 15^{\text{th Observation}}$

Size of 15th observation lies in *cf* 23, hence quartile value = ₹ 6 lakhs

$\therefore$ **Q_1 = ₹ 6 lakhs**

$Q_3 = \text{size of } 3\left(\frac{n+1}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } 3\left(\frac{59+1}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } 3\left(\frac{60}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } (3 \times 15)^{\text{th Observation}}$

$Q_3 = \text{size of } 45^{\text{th Observation}}$

Size of 45th observation lies in *cf* 45, hence quartile value = ₹ 10 lakhs

$\therefore$ **Q_3 = ₹ 10 lakhs**

Ans : Q_1 = ₹ 6 lakhs, Q_3 = ₹ 10 lakhs

C) Continuous data : Q_1 and Q_3 for continuous frequency distribution are calculated by applying the following steps.

1) Arrange the data in ascending or descending order.

2) Write respective frequencies of the class.
3) Find out cumulative frequency (*cf*)
4) Determine the quartile class.

Formula :

Step - I : First find the value of quartile

$Q_1 = \text{size of} \left(\frac{n}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of} \left(\frac{3n}{4}\right)^{\text{th Observation}}$

Step - II :

$$Q_i = l + \left(\frac{\frac{in}{4} - cf}{f}\right) \times h \qquad i = 1, 2, 3$$

Where

l = Lower limit of quartile class.

f = Frequency of the quartile class

cf = Cumulative frequency of the class preceding the quartile class.

n = Total of frequency.

h = Upper limit - lower limit of the quartile class.

1) Find out Q_1 and Q_3 quartile for the following data.

Rainfall (in cms)	20-30	30-40	40-50	50-60
No. of years	7	20	17	6

Rainfall (in cms)	**No. of years (*f*)**	**Cumulative frequency (*cf*)**
20-30	7	7
30-40	20	27
40-50	17	44
50-60	6	50
	$n = 50$	

Step I

$Q_1 = \text{size of} \left(\frac{n}{4}\right)^{\text{th Observation}}$

$Q_1 = \text{size of} \left(\frac{50}{4}\right)^{\text{th Observation}}$

$Q_1 = \text{size of } (12.5)^{\text{th Observation}}$

12.5 lies in *cf* 27, therefore first quartile class is 30 - 40

$\therefore\ l = 30 \quad f = 20 \quad cf = 7 \quad n = 50 \quad h = 10$

Step II

$$Q_1 = l + \left(\frac{\frac{n}{4} - cf}{f}\right) \times h$$

$$Q_1 = 30 + \left(\frac{\frac{50}{4} - 7}{20}\right) \times 10$$

$$Q_1 = 30 + \left(\frac{12.5 - 7}{20}\right) \times 10$$

$$Q_1 = 30 + \left(\frac{5.5}{20}\right) \times 10$$

$$Q_1 = 30 + \left(\frac{55}{20}\right)$$

$Q_1 = 30 + 2.75$

$Q_1 = 32.75$

$\therefore$ **Q_1 = 32.75**

Step I

$Q_3 = \text{size of} \left(\frac{3n}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of} \left(\frac{3 \times 50}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of} \left(\frac{150}{4}\right)^{\text{th Observation}}$

$Q_3 = \text{size of } 37.5^{\text{th Observation}}$

37.5 lies in *cf* 44 hence third quartile class is 40 - 50

$\therefore\ l = 40 \quad f = 17 \quad cf = 27 \quad n = 50 \quad h = 10$

Step II

$$Q_3 = l + \left(\frac{\frac{3n}{4} - cf}{f}\right) \times h$$

$$Q_3 = 40 + \left(\frac{\frac{3 \times 50}{4} - 27}{17}\right) \times 10$$

$$Q_3 = 40 + \left(\frac{37.5 - 27}{17}\right) \times 10$$

$$Q_3 = 40 + \left(\frac{10.5}{17}\right) \times 10$$

$$Q_3 = 40 + \left(\frac{105}{17}\right)$$

$Q_3 = 40 + 6.18$

$\therefore$ **Q_3 = 46.18**

Ans : Q_1 = 32.75, Q_3 = 46.18

Deciles :

Meaning : 'Deciles' are values of data which divide the whole set of observations into ten equal parts. There are nine points i.e. D_1, D_2 to D_9 which divide the data into 10 equal parts. To find out deciles, generally the data is arranged in ascending order.

a) For calculating D_1 to D_9 for individual and discrete data, use the following formula.

$$D_j = j\left(\frac{n+1}{10}\right)^{\text{th Observation}} \quad \text{where } j = 1, 2 \ldots 9$$

b) For grouped data or continuous data,

$$D_j = l + \left(\frac{\frac{jn}{10} - cf}{f}\right) \times h, \qquad j = 1, 2 \ldots 9$$

Where

D = Decile

l = Lower limit of decile class

f = Frequency of decile class

cf = Cumulative frequency of class preceding decile class

h = Upper limit of the class - lower limit of the decile class.

Calculation of Deciles

Solved Examples

A) Individual Data :

1) Calculate D_4 and D_8 for the following data.

10, 15, 7, 8, 12, 13, 14, 11, 9

Solution : Arrange the data in ascending order.

7, 8, 9, 10, 11, 12, 13, 14, 15

$$D_4 = \text{size of } 4\left(\frac{n+1}{10}\right)^{\text{th Observation}}$$

$$D_4 = \text{size of } 4\left(\frac{9+1}{10}\right)^{\text{th Observation}}$$

$$D_4 = \text{size of } 4\left(\frac{10}{10}\right)^{\text{th Observation}}$$

$$D_4 = \text{size of } (4 \times 1)^{\text{th Observation}}$$

$$D_4 = \text{size of } 4^{\text{th Observation}}$$

$\therefore$ $\mathbf{D_4 = 10}$

Calculation of D_8

$$D_8 = \text{size of } 8\left(\frac{n+1}{10}\right)^{\text{th Observation}}$$

$$D_8 = \text{size of } 8\left(\frac{9+1}{10}\right)^{\text{th Observation}}$$

$$D_8 = \text{size of } 8\left(\frac{10}{10}\right)^{\text{th Observation}}$$

$$D_8 = \text{size of } (8 \times 1)^{\text{th Observation}}$$

$$D_8 = \text{size of } 8^{\text{th Observation}}$$

$\therefore$ $\mathbf{D_8 = 14}$

Ans : $D_4 = 10$, $D_8 = 14$

2) Calculate D_8 from the given data

14, 13, 12, 11, 15, 16, 18, 17, 19, 20

Solution : First arrange the data in ascending order.

11, 12, 13, 14, 15, 16, 17, 18, 19, 20

$n = 10$

$$D_8 = \text{size of } 8\left(\frac{n+1}{10}\right)^{\text{th Observation}}$$

$$D_8 = \text{size of } 8\left(\frac{10+1}{10}\right)^{\text{th Observation}}$$

$$D_8 = \text{size of } 8\left(\frac{11}{10}\right)^{\text{th Observation}}$$

$$D_8 = \text{size of } (8 \times 1.1)^{\text{th Observation}}$$

$$D_8 = \text{size of } (8.8)^{\text{th Observation}}$$

$$D_8 = \text{size of } 8^{\text{th observation}} + 0.8\,(9^{\text{th observation}} - 8^{\text{th observation}})$$

$$D_8 = 18 + 0.8\,(19 - 18)$$

$$D_8 = 18 + (0.8 \times 1)$$

$$D_8 = 18 + 0.8$$

$\therefore$ $\mathbf{D_8 = 18.8}$

Ans : $D_8 = 18.8$

B) Discrete data :

1) Find out D_2 and D_4 for the following data.

Marks	10	20	30	40	50	60
No. of Students	5	6	4	5	10	9

Solution :

Marks	No. of students (*f*)	*cf*
10	5	5
20	6	11
30	4	15
40	5	20
50	10	30
60	9	39
	$n = 39$	

D_2 = size of $2\left(\frac{n+1}{10}\right)^{\text{th Observation}}$

D_2 = size of $2\left(\frac{39+1}{10}\right)^{\text{th Observation}}$

D_2 = size of $2\left(\frac{40}{10}\right)^{\text{th Observation}}$

D_2 = size of $(2 \times 4)^{\text{th Observation}}$

D_2 = size of $(8)^{\text{th Observation}}$

Size of $8^{\text{th Observation}}$ lies in *cf* 11

Hence D_2 = 20 marks

$\therefore$ **D_2 = 20**

Calculation of D_4

D_4 = size of $4\left(\frac{n+1}{10}\right)^{\text{th Observation}}$

D_4 = size of $4\left(\frac{39+1}{10}\right)^{\text{th Observation}}$

D_4 = size of $4\left(\frac{40}{10}\right)^{\text{th Observation}}$

D_4 = size of $(4 \times 4)^{\text{th Observation}}$

D_4 = size of $16^{\text{th Observation}}$

Size of $16^{\text{th Observation}}$ lies in *cf* 20

Hence D_4 = 40 marks

$\therefore$ **D_4 = 40**

Ans : D_2 = 20, D_4 = 40

C) Continuous Data :

Apply the steps as mentioned in Qualities of continuous data.

1) Find out D_5 and D_7 for the following data of marks of 100 students in a class test.

Marks	0-10	10-20	20-30	30-40	40-50
No. of Students	10	10	40	20	20

Marks	No. of students (*f*)	*cf*
0-10	10	10
10-20	10	20
20-30	40	60
30-40	20	80
40-50	20	100
	$n = 100$	

Calculation of D_5

Step I

D_5 = size of $\left(\frac{5n}{10}\right)^{\text{th Observation}}$

D_5 = size of $\left(\frac{5 \times 100}{10}\right)^{\text{th Observation}}$

D_5 = size of $\left(\frac{500}{10}\right)^{\text{th Observation}}$

D_5 = size of $50^{\text{th Observation}}$

Size of $50^{\text{th Observation}}$ lies in *cf* 60

Hence Decile class = 20-30

$\therefore\ l = 20 \quad f = 40 \quad cf = 20 \quad n = 100 \quad h = 10$

Step II

$$D_5 = l + \left(\frac{\frac{5n}{10} - cf}{f}\right) \times h$$

$$D_5 = 20 + \left(\frac{\frac{5 \times 100}{10} - 20}{40}\right) \times 10$$

$$D_5 = 20 + \left(\frac{\frac{500}{10} - 20}{40}\right) \times 10$$

$$D_5 = 20 + \left(\frac{50 - 20}{40}\right) \times 10$$

$$D_5 = 20 + \left(\frac{30}{40}\right) \times 10$$

$$D_5 = 20 + \frac{300}{40}$$

D_5 = 20 + 7.5

D_5 = 27.5 marks

$\therefore$ **D_5 = 27.5**

Calculation of D_7

Step I

D_7 = size of $\left(\frac{7n}{10}\right)^{\text{th Observation}}$

$$D_7 = \text{size of} \left(\frac{7 \times 100}{10}\right)^{\text{th Observation}}$$

$$D_7 = \text{size of} \left(\frac{700}{10}\right)^{\text{th Observation}}$$

D_7 = size of $70^{\text{th Observation}}$

D_7 = size of $70^{\text{th Observation}}$ lies in cf 80

Hence Decile class = 30-40

$\therefore l = 30 \quad f = 20 \quad cf = 60 \quad n = 100 \quad h = 10$

Step II

$$D_7 = l + \left(\frac{\frac{7n}{10} - cf}{f}\right) \times h$$

$$D_7 = 30 + \left(\frac{\frac{7 \times 100}{10} - 60}{20}\right) \times 10$$

$$D_7 = 30 + \left(\frac{\frac{700}{10} - 60}{20}\right) \times 10$$

$$D_7 = 30 + \left(\frac{70 - 60}{20}\right) \times 10$$

$$D_7 = 30 + \left(\frac{10}{20}\right) \times 10$$

$$D_7 = 30 + \left(\frac{100}{20}\right)$$

$D_7 = 30 + 5$

$D_7 = 35$ marks

$\therefore$ **$D_7 = 35$**

$\boxed{\textbf{Ans : } D_5 = 27.5,\ D_7 = 35}$

Percentiles :

Meaning : 'Percentiles' are values of data which divide the whole set of observations into 100 equal parts. There are 99 percentiles giving ninety nine dividing points. Symbolically, value of percentiles are denoted by P_1, P_2, ... P_{99}. To find out percentiles, generally the data is arranged in ascending order.

a) For calculating P_1 to P_{99} for individual and discrete data we use following formula.

$$P_k = \text{size of } k\left(\frac{n+1}{100}\right)^{\text{th Observation}} \qquad k = 1, 2, \ldots 99$$

b) For grouped data or continuous data,

$$P_k = l + \left(\frac{\frac{kn}{100} - cf}{f}\right) \times h \qquad k = 1, 2, \ldots 99$$

Where

P = Percentile

l = Lower limit of percentile class

f = Frequency of percentile class

cf = Cumulative frequency of class preceding percentile class

h = Upper limit of the class - lower limit of the percentile class.

Calculation of Percentiles

Solved Examples

A) Individual Data :

1) Find P_{40} for the following data.

10, 15, 8, 16, 19, 11, 12, 14, 9

Solution : Arrange the data in ascending order i.e. 8, 9, 10, 11, 12, 14, 15, 16, 19

$n = 9$

$$P_{40} = \text{size of } 40\left(\frac{n+1}{100}\right)^{\text{th Observation}}$$

$$P_{40} = \text{size of } 40\left(\frac{9+1}{100}\right)^{\text{th Observation}}$$

$$P_{40} = \text{size of } 40 \times \left(\frac{10}{100}\right)^{\text{th Observation}}$$

$$P_{40} = \text{size of} \left(\frac{40 \times 10}{100}\right)^{\text{th Observation}}$$

$$P_{40} = \text{size of} \left(\frac{400}{100}\right)^{\text{th Observation}}$$

P_{40} = size of $4^{\text{th Observation}}$

P_{40} = size of $4^{\text{th Observation}}$ is 11

$\therefore$ **$P_{40} = 11$**

$\boxed{\textbf{Ans : } P_{40} = 11}$

2) Calculate P_{85} from the following data.

79, 82, 36, 38, 51, 72, 68, 70, 64, 63

Solution : Arrange the data in ascending order i.e. 36, 38, 51, 63, 64, 68, 70 72, 79, 82

$n = 10$

$$P_{85} = \text{size of } 85\left(\frac{n+1}{100}\right)^{\text{th Observation}}$$

$$P_{85} = \text{size of } 85\left(\frac{10+1}{100}\right)^{\text{th Observation}}$$

P_{85} = size of $85\left(\frac{11}{100}\right)^{\text{th Observation}}$

P_{85} = size of $(85 \times 0.11)^{\text{th Observation}}$

P_{85} = size of $(9.35)^{\text{th Observation}}$

P_{85} = size of $9^{\text{th observation}} + 0.35(10^{\text{th observation}} - 9^{\text{th observation}})$

$P_{85} = 79 + 0.35\ (82 - 79)$

$P_{85} = 79 + 0.35 \times 3$

$P_{85} = 79 + 1.05$

$\therefore$ **$P_{85} = 80.05$**

Ans : $P_{85} = 80.05$

B) Discrete Data :

1) Find out P_{20} and P_{60} for the following data :

Height (in inches)	58	59	60	61	62	63	64
No. of persons	4	5	6	10	12	2	1

Solution : Arrange the data in ascending order.

Height (in inches)	No. of persons (*f*)	*cf*
58	4	4
59	5	9
60	6	15
61	10	25
62	12	37
63	2	39
64	1	40
	$n = 40$	

P_{20} = size of $20\left(\frac{n+1}{100}\right)^{\text{th Observation}}$

P_{20} = size of $20\left(\frac{40+1}{100}\right)^{\text{th Observation}}$

P_{20} = size of $20\left(\frac{41}{100}\right)^{\text{th Observation}}$

P_{20} = size of $\left(\frac{20 \times 41}{100}\right)^{\text{th Observation}}$

P_{20} = size of $\left(\frac{820}{100}\right)^{\text{th Observation}}$

P_{60} = size of $8.2^{\text{th Observation}}$

P_{60} = size of $8.2^{\text{th Observation}}$ lies in *cf* 9

Hence $P_{20} = 59$

$\therefore$ **$P_{20} = 59$**

Calculation of P_{60}

P_{60} = size of $60\left(\frac{n+1}{100}\right)^{\text{th Observation}}$

P_{60} = size of $60\left(\frac{40+1}{100}\right)^{\text{th Observation}}$

P_{60} = size of $60\left(\frac{41}{100}\right)^{\text{th Observation}}$

P_{60} = size of $\left(\frac{60 \times 41}{100}\right)^{\text{th Observation}}$

P_{60} = size of $\left(\frac{2460}{100}\right)^{\text{th Observation}}$

P_{60} = size of $(24.6)^{\text{th Observation}}$

P_{60} = size of $24.6^{\text{th Observation}}$ lies in *cf* 25

Hence $P_{60} = 61$

$\therefore$ **$P_{60} = 61$**

Ans : $P_{20} = 59$, $P_{60} = 61$

C) Continuous data :

Apply the steps as mentioned in Quartiles of continuous data.

1) Find P_{65} from the following data

Marks	0-5	5-10	10-15	15-20	20-25
No. of Students	3	7	20	12	8

Solution :

Marks	No. of students (*f*)	*cf*
0-5	3	3
5-10	7	10
10-15	20	30
15-20	12	42
20-25	8	50
	$n = 50$	

Step I

$$P_{65} = \text{size of}\left(\frac{65n}{100}\right)^{\text{th Observation}}$$

$$P_{65} = \text{size of}\left(\frac{65 \times 50}{100}\right)^{\text{th Observation}}$$

$$P_{65} = \text{size of}\left(\frac{3250}{100}\right)^{\text{th Observation}}$$

P_{65} = size of $32.5^{\text{th Observation}}$

P_{65} = size of $32.5^{\text{th Observation}}$ lies in cf 42

Hence percentile class = 15-20

$l = 15 \quad f = 12 \quad cf = 30 \quad n = 50 \quad h = 5$

Step II

$$P_{65} = l + \left(\frac{\frac{65n}{100} - cf}{f}\right) \times h$$

$$P_{65} = 15 + \left(\frac{\frac{65 \times 50}{100} - 30}{12}\right) \times 5$$

$$P_{65} = 15 + \left(\frac{\frac{3250}{100} - 30}{12}\right) \times 5$$

$$P_{65} = 15 + \left(\frac{32.5 - 30}{12}\right) \times 5$$

$$P_{65} = 15 + \left(\frac{2.5}{12}\right) \times 5$$

$$P_{65} = 15 + \left(\frac{2.5 \times 5}{12}\right)$$

$$P_{65} = 15 + \left(\frac{12.5}{12}\right)$$

$$P_{65} = 15 + 1.04$$

$\therefore$ **P_{65} = 16.04**

Ans : P_{65} = 16.04

EXERCISE

Q. 1. Choose the correct option :

1) Statments that do not apply to Quartiles.

a) First arrange the values in ascending or descending order.

b) Observation can be divided into 4 parts.

c) They are represented as Q_1, Q_2 and Q_3.

d) Q_2 is also known as median.

Options : 1) a 2) b and c 3) a, b and c 4) None of these

2) D_7 from the given data.

Data – 4, 5, 6, 7, 8, 9, 10, 11, 12

Options : 1) 7 2) 9 3) 10 4) 12

3) Statements related to partition values that are correct.

a) Exact divisions of percentiles into 100 parts gives 99 points

b) Deciles have total 9 parts

c) Quartiles are shown by Q_1, Q_2 and Q_3

d) Symbolically, Percentiles and Deciles are shown by P and D

Options : 1) a and c 2) a and b 3) a, b and c 4) a, c and d

Q. 2. Identify the correct pairs from the given options :

Group A	Group B
1) Quartiles	a) $D_j = \text{size of } j\left(\frac{n+1}{10}\right)^{\text{th Observation}}$
2) Deciles	b) $P_k = l + \left(\frac{\frac{kn}{100} - cf}{f}\right) \times h$
3) Percentiles	c) $Q_i = l + \left(\frac{\frac{in}{4} - cf}{f}\right) \times h$

Options : 1) 1-b, 2-c, 3-a 2) 1- c, 2-a, 3-b 3) 1- c, 2-b, 3-a 4) 1- a, 2-b, 3-c

Q. 3. Give economic terms :

1) Procedure for dividing the data into equal parts.

2) Value that divides the series into ten equal parts.

3) Value that divides the whole set of observations in to four equal parts.

Q. 4. Solve the following :

1) Calculate Q_1, D_4 and P_{26} for the following data.

18, 24, 45, 29, 4, 7, 28, 49, 16, 26, 25, 12, 10, 9, 8

2) Calculate of Q_3, D_5, and P_{35} for the given data.

Income (in lakhs ₹)	1	2	3	4	5	6
No. of family	2	5	20	25	15	12

3) Find out P_{50} for the following data.

Wages (in ₹) (x)	Number of workers
0-20	4
20-40	6
40-60	10
60-80	25
80-100	15

4) Calculate Q_3 for the following data.

Sales (in lakhs ₹)	10-20	20-30	30-40	40-50	50-60	60-70
No. of firms	20	30	70	48	32	50

5) Calculate D_7 for the following data.

Profit (in crores ₹)	10-20	20-30	30-40	40-50	50-60	60-70
No. of firms	20	30	70	48	32	50

6) Calculate P_{15} for the following data.

Investment (₹ in lakhs)	0-10	10-20	20-30	30-40	40-50	50-60
No. of firms	5	10	25	30	20	10

Q. 5. State with reasons whether you agree or disagree with the following statements :

1) Partition values have application only in theory but not in practice.
2) Average can misinterpret the representative value.
3) Median is also known as second quartile.

Q. 6. Answer the following questions on the basis of the given table :

Marks	30	10	20	40	50
No. of Students	13	4	7	8	6

1) Write the formula of Q_1 and Q_3.
2) Find out the cumulative frequency of the last value in the above data.
3) Find out the value of 'n' in the above data.