

30 PARTITION VALUES

Q:1 Define Partition Values.

Partition Values :- "The Procedure of dividing data into equal parts is called Partitioning."

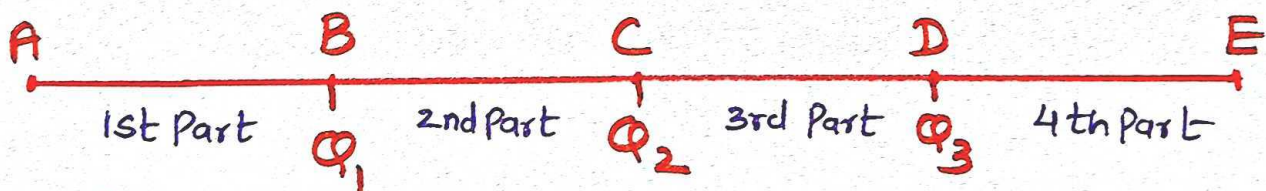
"Values which divide the data into required number of equal parts are called Partitioning Values."

Example :- Quartile, Deciles, Percentiles are examples of Partition Values.

Q:2 what are Quartiles? How would you calculate quartile for Individual Data?

(A) Quartiles :- "Quartiles are the values which divide the entire data into four equal parts"

There are Three Quartiles - Q_1 , Q_2 and Q_3 . It divide the data in 4 equal parts



$Q_2 = \text{Median}$

(B) Calculation of Quartile by Individual data :-

Step-1 :- Arrange the data in ascending order

Step-2 :- Apply the following formula →

$$Q_1 = 1 \left(\frac{N+1}{4} \right)^{\text{th}} \text{ observation}$$

$$Q_2 = 2 \left(\frac{N+1}{4} \right)^{\text{th}} \text{ observation}$$

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

Problem-1 :- Marks scored by students are —
65, 82, 68, 67, 84, 83, 66, 69, 81, 70, 85.

Find first quartile and Third Quartile.

Ans :- step-1 - Data in Ascending order —

65, 66, 67, 68, 69, 70, 81, 82, 83, 84, 85.

Step-2 - Formula

First Quartile = Q_1

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

$$Q_1 = \frac{n+1}{4} = \frac{11+1}{4} = \frac{12}{4}$$

Q_1 = Value of 3rd observation

$$Q_1 = \underline{\underline{67}}$$

Third Quartile = Q_3

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

$$Q_3 = 3 \left(\frac{11+1}{4} \right) = 3 \times \frac{12}{4}$$

$$Q_3 = 3 \times 3 = 9^{\text{th}} \text{ Observation}$$

$$Q_3 = \underline{\underline{83}}$$

Problem-2 :- Marks scored by students in first semester examination are given. Calculate Q_1 and Q_3 .

40, 85, 84, 83, 82, 69, 68, 65, 64, 55, 45.

Ans :- step-1 Data in ascending order —

40, 45, 55, 64, 65, 68, 69, 82, 83, 84, 85.

$$\underline{\underline{n = 11}}$$

Step-2 Formula.

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

$$Q_1 = \frac{11+1}{4} = \frac{12}{4}$$

$Q_1 =$ 3rd observation

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

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

$$Q_3 = 3\left(\frac{11+1}{4}\right) = 3 \times \frac{12}{4}$$

$Q_3 = 3 \times 3 = 9^{\text{th}}$ observation

$$\underline{\underline{Q_3 = 83}}$$

Problem-3

Q.3 Calculate Q_1 and Q_3 for the given data :-

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

Ans:- Step-1 Arrange data in ascending order.

= 17, 18, 19, 20, 21, 22, 28, 31, 32, 33 n=10

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

$Q_1 =$ Value of $1\left(\frac{10+1}{4}\right)$

$$Q_1 = \frac{11}{4} = 2.75^{\text{th}} \text{ observation}$$

$Q_1 =$ Value of 2nd observation +
0.75 (3rd - 2nd observation)

$$Q_1 = 28 + 0.75(19 - 18)$$

$$Q_1 = 28 + 0.75 \times 1$$

$$Q_1 = 28 + 0.75$$

$$\underline{\underline{Q_1 = 28.75}}$$

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

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

$$Q_3 = 3 \times \frac{11}{4} = \frac{33}{4} = 8.25^{\text{th}}$$

$Q_3 =$ 8th observation + 0.25
(9th - 8th)

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

$$Q_3 = 31 + 0.25 \times 1$$

$$\underline{\underline{Q_3 = 31.25}}$$

Problem-4 Calculate Q_1 and Q_3 from the following data :- 12, 9, 13, 16, 21, 22, 11, 14, 8, 17, 19, 26.

Ans:- Step-1 Arrange the data in ascending order :-

8, 9, 11, 12, 13, 14, 16, 17, 19, 21, 22, 26

$n = 12$

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

$Q_1 = \text{Size of } 1 \left(\frac{12+1}{4} \right) = \frac{13}{4} = 3.25^{\text{th}}$ Observation.

$Q_1 = \text{Value of 3rd observation} + \text{Value of } 0.25 \text{ (4}^{\text{th}} - 3^{\text{rd}} \text{ observation)}$

$Q_1 = 11 + 0.25(12-11)$

$Q_1 = 11 + 0.25 \times 1$

$Q_1 = \underline{11.25}$

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

$Q_3 = 3 \times \left(\frac{12+1}{4} \right) = 3 \times \frac{13}{4} = \frac{39}{4} = 9.75^{\text{th}}$ Observation

$Q_3 = 9^{\text{th}}$ observation + $0.75(10^{\text{th}} - 9^{\text{th}}$ observation)

$Q_3 = 19 + 0.75(21-19)$

$Q_3 = 19 + 0.75 \times 2$

$Q_3 = 19 + 1.50$

$Q_3 = \underline{20.50}$

Q:3 How would you calculate Quartile for Discrete data?

Calculation of Quartile by Discrete data :-

Step-1: Arrange the data in ascending order

Step-2: Calculate Cumulative Frequencies

Step-3: Formula -

$$Q_1 = \text{Value of } 1\left(\frac{n+1}{4}\right)^{\text{th}} \quad Q_3 = \text{Value of } 3\left(\frac{n+1}{4}\right)^{\text{th}} \text{ Observation}$$

Problem-1 Find the First quartile and third quartile from the following data

X	2	3	4	5	6	7	8	9	10
F	2	4	6	8	10	12	10	14	13

Ans:-

X	F	Cum. freq.
2	2	2
3	4	6
4	6	12
<u>$Q_1 = 5$</u>	8	<u>20</u>
6	10	30
7	12	42
8	10	52
<u>$Q_3 = 9$</u>	14	<u>66</u>
10	13	79 = c.f
	$n = 79$	

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

$$Q_1 = \text{Value of } \left(\frac{79+1}{4}\right)^{\text{th}}$$

$$Q_1 = \frac{80}{4} = 20^{\text{th}} \text{ Observation}$$

20th observation lies in group of 5

$$\therefore \underline{\underline{Q_1 = 5}}$$

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

$$Q_3 = \text{Value of } 3\left(\frac{79+1}{4}\right)^{\text{th}}$$

$$Q_3 = 3 \times \frac{80}{4} = 60^{\text{th}} \text{ Observation}$$

60th observation lies in the Group of 9.

$$\therefore \underline{\underline{Q_3 = 9}}$$

Problem - 2 :- 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 Step-1 - Arrange data in ascending order.

Income (lakh ₹) x	No. of Persons (f)	Cum. Frequency
4	6	6
5	8	14
$Q_1 = 6$	9	23
9	12	35
$Q_3 = 10$	10	45
12	8	53
15	6	59 = c.f
	$N = 59$	

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

$$Q_1 = \text{Value of } \left(\frac{59+1}{4}\right) = \frac{60}{4}$$

$Q_1 = 15^{\text{th observation}}$

15th observation lie in the group of Income 6 lakhs

$\therefore Q_1 = ₹ 6 \text{ lakhs}$

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

$$Q_3 = \text{Value of } 3 \times \left(\frac{59+1}{4}\right) = 3 \times 15$$

$Q_3 = 45^{\text{th observation}}$

45th observation lies in the group of income 10 lakhs

$\therefore Q_3 = ₹ 10 \text{ lakhs}$

Q:4 How would you calculate quartile for Continuous data?

Calculation of quartile for continuous data :-

1st step :- Arrange data in ascending order.

2nd step :- Find out Cumulative Frequency.

3rd step :- Formula

$$Q_1 = L_1 + \left(\frac{\frac{n}{4} - c.f}{f}\right) \times h$$

$$Q_3 = L_1 + \left(\frac{\frac{3n}{4} - c.f}{f}\right) \times h$$

Problem-1 Find out Q_1 and Q_3 for the following data

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

Solution:-

Rain Fall (in cms)	No. of years	Cum. Frequency
20-30	7	7
$Q_1 = 30-40$	20	27
$Q_3 = 40-50$	17	44
50-60	6	50 = cf
	$n = 50$	

1) $Q_1 =$ Value of $(\frac{n}{4})^{\text{th}}$ observation

$Q_1 =$ Value of $(\frac{50}{4}) = 12.5^{\text{th}}$ observation.

12.5th observation lies in the group of 30-40.

2) $\therefore L_1 = 30, \frac{n}{4} = 12.5, c.f = 7, f = 20, h = 10$

3) $Q_1 = L_1 + \left(\frac{\frac{n}{4} - c.f}{f} \right) \times h$

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

$$Q_1 = 30 + \frac{5.5}{20} \times 10$$

$$Q_1 = 30 + \frac{55}{20}$$

$$Q_1 = 30 + 2.75$$

$$Q_1 = 32.75 \text{ cms Rainfall}$$

th observation

4) Now $Q_3 =$ Value of $(\frac{3N}{4})^{\text{th}}$ observation
 $Q_3 =$ Value of $3 \times \frac{50}{4} = \underline{37.5^{\text{th}}}$ observation

5) 37.5th observation lies in the group - 40-50
 $\therefore L_1 = 40, f = 17, c.f = 27, \frac{3n}{4} = 37.5, h = 10$

$$6) Q_3 = L_1 + \left(\frac{\frac{3n}{4} - c.f}{f} \right) \times h$$

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

$$Q_3 = 40 + \frac{10.5}{17} \times 10$$

$$Q_3 = 40 + \frac{105}{17}$$

$$Q_3 = 40 + 6.18$$

$$Q_3 = 46.18 \text{ cms Rainfall}$$

Problem-2 → From the following frequency distribution annual examination marks of students in F.Y.J.C commerce, calculate first and Third quartile.

Marks	100-200	200-300	300-400	400-500	500-600
No. of students	15	20	25	30	10

Solution:

Marks (x)	No. of students (F)	Cum. Frequency
100-200	15	15
200-300	20	35
300-400	25	60
400-500	30	90
500-600	10	100 = c.f
	N = 100	

1) $Q_1 =$ Value of $\left(\frac{n}{4}\right)^{\text{th}}$ observation

$$Q_1 = \text{Value of } \left(\frac{100}{4}\right)^{\text{th}} = 25^{\text{th}}$$

25th observation lies in the group of 200-300

2) $L_1 = 200, f = 20, c.f = 15,$

$$h = 100, \frac{n}{4} = 25$$

3) $Q_1 = L_1 + \left(\frac{N/4 - c.f}{f} \right) \times h$
 $Q_1 = 200 + \left(\frac{25 - 15}{20} \right) \times h$
 $Q_1 = 200 + \frac{10}{20} \times 100$
 $Q_1 = 200 + 50 = 250$
 $Q_1 = 250$ Marks

4) $Q_3 =$ Value of $\left(\frac{3n}{4} \right)^{th}$ observation
 $Q_3 =$ Value of $\frac{3 \times 100}{4} = 75^{th}$.
 75th observation Lies in the group of - 400-500
 5) $L_1 = 400, F = 30, c.f = 60$
 $h = 100, \frac{3N}{4} = 75$

6) $Q_3 = L_1 + \left(\frac{3n - c.f}{f} \right) \times h$
 $Q_3 = 400 + \left(\frac{75 - 60}{30} \right) \times 100$
 $Q_3 = 400 + \frac{15}{30} \times 100$
 $Q_3 = 400 + 50$
 $Q_3 = 450$ marks

Problem-3 - Calculate Q_1 and Q_3 from 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

Solution :-

Sales in lakhs (x)	No. of Firms (f)	Cum. freq.
10-20	20	20
20-30	30	50
30-40	70	120
40-50	48	168
50-60	32	200
60-70	50	250 = c.f
	<u>50</u>	
	$n = 250$	

1) $Q_1 =$ Value of $\left(\frac{n}{4} \right)^{th}$ observation
 $Q_1 = \left(\frac{250}{4} \right) = 62.50^{th}$
 62.50th observation lies in the group - 30-40
 2) $L_1 = 30, f = 70, c.f = 50$
 $h = 10, \frac{n}{4} = 62.50$

$$3) Q_1 = L_1 + \left(\frac{\frac{n}{4} - c.f}{f} \right) \times h$$

$$Q_1 = 30 + \frac{62.50 - 50}{70} \times 10$$

$$Q_1 = 30 + \frac{12.50}{70} \times 10$$

$$Q_1 = 30 + 1.785$$

$$Q_1 = 31.79 \text{ lakhs of sales.}$$

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

$$Q_3 = \frac{3 \times 250}{4} = \frac{750}{4}$$

$$Q_3 = \text{Value of } 187.5^{\text{th}} \text{ Observation}$$

5) 187.5th Observation lies in the group - 50-60
 $\therefore L_1 = 50, f = 32, c.f = 168$
 $h = 10 \quad \frac{3n}{4} = 187.5$

$$6) Q_3 = L_1 + \left(\frac{\frac{3n}{4} - c.f}{f} \right) \times h$$

$$Q_3 = 50 + \frac{187.5 - 168}{32} \times 10$$

$$Q_3 = 50 + \frac{19.5 \times 10}{32}$$

$$Q_3 = 50 + \frac{195}{32}$$

$$Q_3 = 50 + 6.1$$

$$Q_3 = 56.1 \text{ lakhs sales}$$

Q:5 what are deciles? How would you calculate decile for individual data?

(A) Deciles:- "Deciles are the values which divide the entire data into Ten equal parts".

There are Nine deciles $D_1, D_2, D_3, D_4, D_5, D_6, D_7, D_8, D_9$.
 Deciles can be calculated for individual data, discrete data and for continuous data.

(B) Calculation of Deciles for Individual Data:-

Step-1 - Arrange the data in ascending order.

Step-2 - Formulae :-

$$D_1 = \text{Value of } \frac{(n+1)}{10}^{\text{th}}$$

$$D_2 = \text{Value of } \frac{2(n+1)}{10}^{\text{th}}$$

$$D_3 = \text{Value of } \frac{3(n+1)}{10}^{\text{th}}$$

$$D_4 = \text{Value of } \frac{4(n+1)}{10}^{\text{th}}$$

$$D_5 = \text{Value of } \frac{5(n+1)}{10}^{\text{th}}$$

$$D_6 = \text{Value of } \frac{6(n+1)}{10}^{\text{th}}$$

$$D_7 = \text{Value of } \frac{7(n+1)}{10}^{\text{th}}$$

$$D_8 = \frac{8(n+1)}{10}^{\text{th}}$$

$$D_9 = \frac{9(n+1)}{10}^{\text{th}}$$

1) Find the D_1 and D_6 from the following data :-
5, 12, 3, 8, 22, 6, 7, 2, 15

Solution :- step-1 Data in ascending order -

2, 3, 5, 6, 7, 8, 12, 15, 22 $n=9$

Step-2 - Formula

$$1) D_1 = \text{Value of } \frac{(n+1)}{10} \text{th observation}$$

$$D_1 = \text{Value of } \left(\frac{9+1}{10}\right)$$

$$D_1 = \frac{10}{10} = 1\text{st observation}$$

$$\therefore \underline{D_1 = 2}$$

$$2) D_6 = \text{Value of } 6 \left(\frac{n+1}{10}\right) \text{th observation}$$

$$D_6 = 6 \left(\frac{9+1}{10}\right) \text{th observation}$$

$$D_6 = 6 \times \frac{10}{10} = 6\text{th observation}$$

$$\therefore \underline{D_6 = 8}$$

Problem-2 Calculate D_4 and D_8 for the following data -
10, 15, 7, 8, 12, 13, 14, 11, 9.

Solution :- step-1 - Arrange the data in ascending order -

7, 8, 9, 10, 11, 12, 13, 14, 15 $n=9$

Step-2 - Formula -

$$1) D_4 = \text{Value of } \frac{4(n+1)}{10} \text{th observation.}$$

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

$$D_4 = 4 \times \frac{10}{10} = 4\text{th observation}$$

$$\underline{D_4 = 10}$$

$$2) D_8 = \text{Value of } 8 \left(\frac{n+1}{10}\right) \text{th observation.} \quad \left. \begin{array}{l} D_8 = 8\text{th observation} \\ \underline{D_8 = 14} \end{array} \right\}$$

$$D_8 = 8 \left(\frac{9+1}{10}\right) = 8 \times \frac{10}{10}$$

Problem-3 Calculate D_8 from the given data:-
14, 13, 12, 11, 15, 16, 18, 17, 19, 20.

Solution :- Step-1 Arrange the data in ascending order
11, 12, 13, 14, 15, 16, 17, 18, 19, 20 $n=10$

Step-2 - Formula - $D_8 = \text{value of } 8\left(\frac{n+1}{10}\right)^{\text{th}} \text{ observation}$

$$D_8 = \text{Value of } 8\left(\frac{10+1}{10}\right)^{\text{th}} = 8 \times \frac{11}{10}$$

$$D_8 = \text{Value of } \frac{88}{10} = 8.8 \text{ th observation}$$

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

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

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

$$D_8 = 18.8$$

Problem-4 - Calculate D_4 from the following data -
21, 24, 27, 30, 3, 6, 9, 12, 15, 18.

Solution :- Step-1 Arrange data in ascending order -
3, 6, 9, 12, 15, 18, 21, 24, 27, 30. $n=10$

Step-2 - Formula - $D_4 = \text{value of } 4\left(\frac{n+1}{10}\right)^{\text{th}} \text{ observation}$

$$D_4 = \text{value of } 4\left(\frac{10+1}{10}\right) = 4 \times \frac{11}{10} = \frac{44}{10} = 4.4$$

$$D_4 = 4.4 \text{ th observation.}$$

$$D_4 = 4 \text{th observation} + 0.4 (5 \text{th} - 4 \text{th observation})$$

$$D_4 = 12 + 0.4(15-12)$$

$$D_4 = 12 + 0.4 \times 3$$

$$D_4 = 12 + 1.2$$

$$D_4 = 13.2$$

Q:6 How would you calculate Deciles for Discrete data?

Calculation of Deciles for Discrete Data :-

Step-1 - Arrange the data in ascending order.

Step-2 - Formula

Problem-1 - An average of Virat Kohli's hour per day were tracked for the period of 30 days and the following data was given :-

No. of hours	3	4	5	6	7	8
No. of days	1	4	3	4	8	10

Calculate - D_8 .

Solution :-

No. of Hours x	No. of days (CF)	Cum. Frequency C.F
3	1	1
4	4	5
5	3	8
6	4	12
7	8	20
8	10	30 = cf
	$n = 30$	

1) $D_8 = \text{Value of } 8 \left(\frac{n+1}{4} \right)^{\text{th}}$

$D_8 = \text{Value of } 8 \times \frac{30+1}{4}$

$D_8 = 8 \times \frac{31}{4}$

$D_8 = 24.8^{\text{th}}$ Observation

2) 24.8th observation lies in the group of 8 hours

$\therefore D_8 = 8 \text{ Hours}$

Problem-2 :- 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 (x)	No. of Students (F)	Cum. Frequency (cf)
10	5	5
$D_2 \rightarrow 20$	6	11
30	4	15
$D_4 \rightarrow 40$	5	20
50	10	30
60	9	39 = cf
	$n = 39$	

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

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

$$D_2 = \text{Value of } 2 \times \frac{40}{10} = 8^{\text{th}}$$

$D_2 = 8^{\text{th}}$ observation.
8th observation lies in the group of 20 marks.

$\therefore \underline{D_2 = 20 \text{ marks}}$

$$2) D_4 = \text{Value of } 4\left(\frac{n+1}{10}\right)^{\text{th}}$$

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

$$D_4 = \text{Value of } 4 \times \frac{40}{10} = 16^{\text{th}}$$

$$D_4 = 16^{\text{th}} \text{ observation}$$

16th observation lies in the group of - 40 marks

$\therefore \underline{D_4 = 40 \text{ marks}}$

Q - Problem - 3 :- Find D_3 and D_5 for the following data :-

Marks	1	2	3	4	5	6
No. of students	5	6	4	5	10	15

Solution :-

Marks (x)	No. of Students (F)	Cum. Freq. (cf)
1	5	5
2	6	11
$D_3 \rightarrow 3$	4	15
4	5	20
$D_5 \rightarrow 5$	10	30
6	15	45 = cf
	$n = 45$	

$$1) D_3 = \text{Value of } 3\left(\frac{n+1}{10}\right)^{\text{th}}$$

$$D_3 = 3\left(\frac{45+1}{10}\right)^{\text{th}}$$

$$D_3 = 3 \times \frac{46}{10}$$

$$D_3 = 13.8$$

$D_3 = 13.8^{\text{th}}$ observation lies in the group of 3

$\therefore \underline{D_3 = 3}$

2) $D_5 =$ Value of $5\left(\frac{n+1}{10}\right)^{\text{th}}$ observation

$$D_5 = \text{Value of } 5\left(\frac{45+1}{10}\right) = 5 \times \frac{46}{10} = 5 \times 4.6 = 23^{\text{rd}}$$

$D_5 =$ 23rd observation which lies in the group - 5 marks

$D_5 = 5$ marks

Q:7 How would you calculate Deciles for Continuous data?

Problem-1 Find out D_5 and D_7 for the following data :-

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

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

1) $D_5 =$ Value of $5\left(\frac{n}{10}\right)^{\text{th}}$
 $=$ Value of $5 \times \frac{100}{10}$

$D_5 =$ Value of 50th observation

2) 50th observation lies in the group of - 20-30 marks.

$\therefore L_1 = 20, F = 40, c.f = 20, h = 10.$

3) $D_5 = L_1 + \left(\frac{\frac{5n}{10} - c.f}{f}\right) \times h$

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

$$D_5 = 20 + \frac{30}{40} \times 10$$

$$D_5 = 20 + 7.5$$

$D_5 = 27.5$ Marks

4) $D_7 =$ Value of $\left(\frac{7n}{10}\right)^{\text{th}}$ observation

$$D_7 = \text{value of } \frac{7 \times 100}{10} = 70^{\text{th}}$$

5) 70th observation lies in the group - 30-40

$\therefore L_1 = 30, F = 20, c.f = 60$

$h = 10$

$$6) D_7 = L_1 + \left(\frac{\frac{7n}{10} - c.f}{f} \right) \times h$$

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

$$D_7 = 30 + \frac{10}{20} \times 10$$

$$D_7 = 30 + 5$$

$$D_7 = 35 \text{ marks}$$

Problem - 2 The mother of 100 babies were surveyed to understand the sleeping pattern of their kids. The following data is given. Find D_6 using data.

Hours of sleep	0-8	8-10	10-12	12-14	14-16
No. of babies	20	35	30	10	5

Solution :-

Hours of sleep	No. of babies (F)	Cum. Frequency (C.F)
0-8	20	20
8-10	35	55
10-12	30	85
12-14	10	95
14-16	5	100 = c.f
	n = 100	

1) $D_6 =$ Value of $\left(\frac{6n}{10}\right)^{\text{th}}$ observation

$$D_6 = \text{Value of } \frac{6 \times 100}{10}$$

$$D_6 = \underline{\underline{60^{\text{th}} \text{ observation.}}}$$

2) 60th observation lies in the group, 10-12

$$L_1 = 10, F = 30, c.f = 55, h = 10$$

$$3) D_6 = L_1 + \left(\frac{\frac{6n}{10} - c.f}{F} \right) \times h$$

$$D_6 = 10 + \frac{60 - 55}{30} \times 10$$

$$D_6 = 10 + \frac{5}{30} \times 10$$

$$D_6 = 10 + \frac{10}{30}$$

$$D_6 = 10 + 0.33$$

$$D_6 = \underline{\underline{10.33}}$$

Q:8 - Explain Percentiles? How would you calculate Percentile for Individual data?

Percentiles - "Percentiles are the values which divide the entire data into 100 equal parts."

There are 99 Percentiles which divide the data into 100 parts

Percentiles can be calculated for Individual data, discrete data and for Continuous data.

Percentiles for Individual data :-

Step-1 - Arrange the data in ascending order.

Step-2 Formula.

Problem-1 :- Find the P_{30} and P_{50} from the following data:-
5, 12, 3, 8, 22, 6, 7, 2, 15

Solution :- Step-1 Arrange the data in ascending order -
2, 3, 5, 6, 7, 8, 12, 15, 22 $n=9$

1) P_{30} = Value of $30 \left(\frac{n+1}{100} \right)^{th}$ observation.
 P_{30} = Value of $30 \left(\frac{9+1}{100} \right) = 30 \times \frac{10}{100}$
 P_{30} = Value of 3rd observation

$P_{30} = 5$

2) P_{50} = Value of $50 \left(\frac{n+1}{100} \right)^{th}$ observation.
 P_{50} = Value of $50 \left(\frac{9+1}{100} \right)$
 P_{50} = Value of $50 \times \frac{10}{100}$
 P_{50} = 5th observation

\therefore $P_{50} = 7$

Problem-2 Calculate P_{85} from the following data -

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

Solution :- step-1 :- Arrange data in ascending order -

36, 38, 51, 63, 64, 68, 70, 72, 79, 82. $n=10$

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

$$P_{85} = \text{Value of } 85 \left(\frac{10+1}{100} \right) = 85 \times \frac{11}{100} \\ = 85 \times 0.11 = 9.35$$

$P_{85} = 9.35^{\text{th}}$ observation.

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

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

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

$$P_{85} = 79 + 1.05$$

$$P_{85} = \underline{\underline{80.05}}$$

Problem-3 Find P_{60} for the following data.

4, 8, 36, 32, 24, 12, 16, 28, 20.

Solution - step-1 Arrange data in ascending order.

4, 8, 12, 16, 20, 24, 28, 32, 36 $n=9$

Step-2 → Formula

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

$$P_{60} = \text{Value of } 60 \left(\frac{9+1}{100} \right)$$

$$P_{60} = 60 \times \frac{10}{100} = 6^{\text{th}} \text{ observation}$$

$$\underline{\underline{P_{60} = 24}}$$

Problem-4 - find P_{25} for the following data:-
5, 50, 45, 10, 15, 35, 40, 25, 20, 30.

Solution :- step-1 - Arrange data in ascending order.

5, 10, 15, 20, 25, 30, 35, 40, 45, 50 $n=10$

Step-2 → Formula

$P_{25} = \text{Value of } 25 \frac{(n+1)}{100} \text{th observation}$

$$P_{25} = \text{Value of } 25 \left(\frac{10+1}{100} \right) = 25 \times \frac{11}{100} = \frac{11}{4} = 2.75$$

$P_{25} = \text{Value of } 2.75 \text{th observation}$

$P_{25} = \text{Value of 2nd observation} + 0.75 (\text{3rd} - \text{2nd observation})$

$$P_{25} = 10 + 0.75(15 - 10)$$

$$P_{25} = 10 + 0.75 \times 5$$

$$P_{25} = 10 + 3.75$$

$$P_{25} = \underline{\underline{13.75}}$$

Q:9 How would you calculate Percentile for Discrete Data ?

Discrete Data - step-1 - Arrange data in ascending order.

step-2 - find Cumulative frequency

step-3 - Formula

Problem-1 :- Calculate P_{80} from the following data :-

Marks	10	20	30	40	50
No. of students	5	4	6	3	1

Solution:-

Marks (x)	No. of Students (F)	Cum. Freq. C.F
10	5	5
20	4	9
30	6	15
40	3	18
50	1	19 c.f
Total	n = 19	

① $P_{80} = \text{Value of } 80 \left(\frac{n+1}{100} \right)^{\text{th}}$

$P_{80} = \text{Value of } 80 \left(\frac{19+1}{100} \right)^{\text{th}}$

$P_{80} = 89 \times \frac{20}{100} = 16^{\text{th}}$ Observation

② 16th observation lies in the group of 40 marks.

$\therefore P_{80} = \underline{40 \text{ marks}}$

Problem-2 :- Calculate P_{75} for the following :-

Marks	10	20	30	40	50
No. of students	1	6	3	4	5

Solution

Marks x	(F) No. of Students	Cum. Freq. cf
10	1	1
20	6	7
30	3	10
40	4	14
50	5	19=c.f
<u>N = 19</u>		

① $P_{75} = \text{Value of } 75 \left(\frac{n+1}{100} \right)^{\text{th}}$ observation

$P_{75} = \text{Value of } 75 \left(\frac{19+1}{100} \right)$

$P_{75} = \text{Value of } 75 \times \frac{3}{100} = 15$

$P_{75} = 15^{\text{th}}$ observation

$P_{75} = 15^{\text{th}}$ observation

② 15th observation lies in the group of 50 marks

$\therefore P_{75} = \underline{50 \text{ marks}}$

Problem-3 - The General Managers of Western Railways calculate the average delay in Trains over the period of 30 days. Find out P_{25} from the given data -

Delay (in minutes)	5	7	10	12	15	20
No. of days	3	10	7	4	5	1

Solution

Delay (in minutes)	No. of days (f)	Cum. Freq. CF
5	3	3
7	10	13
10	7	20
12	4	24
15	5	29
20	1	30 = cf
	n = 30	

① P_{25} = Value of $25 \left(\frac{n+1}{100} \right)^{\text{th}}$ observation

P_{25} = Value of $25 \left(\frac{30+1}{100} \right)^{\text{th}}$

P_{25} = Value of $25 \times \frac{31}{100} = 7.75$

P_{25} = 7.75th observation.

② 7.75th observation lies in the group of 7 minutes

$\therefore P_{25} = \underline{7 \text{ minutes delay}}$

Problem-4 :- Find out P_{20} and P_{60} for the following data :-

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

Solution

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

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

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

P_{20} = Value of $20 \times \frac{41}{100} = \frac{820}{100}$

$P_{20} = \underline{8.2 \text{ th observation.}}$

② 8.2th observation lies in the group of 59 inch height

$\therefore P_{20} = \underline{59 \text{ inch height}}$

③ P_{60} = Value of $60 \left(\frac{n+1}{100} \right)^{\text{th}}$

P_{60} = Value of $60 \times \frac{41}{100} = \frac{2460}{100}$

$$P_{60} = \frac{2469}{100} = 24.6 \text{th observation}$$

④ 24.6th observation lies in the group of 61 inch height

$$\therefore P_{60} = \underline{61 \text{ inch height}}$$

Q:10 How would you calculate Percentile for Continuous data?

Continuous data :-

Problem-1 :- Calculate 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)	Cum. Freq. ^{CF}
0-5	3	3
5-10	7	10
10-15	20	30
15-20	12	42
20-25	8	50 = CF
	$n = 50$	

① $P_{65} = \text{Value of } \left(\frac{65n}{100} \right)^{\text{th}}$

$$P_{65} = \text{Value of } \frac{65 \times 50}{100} = 32.5$$

$$P_{65} = 32.5 \text{th observation}$$

② 32.5th observation lies in the group - 15-20

$$\therefore L_1 = 15, f = 12, C.F = 30, h = 5$$

$$3) P_{65} = L_1 + \left(\frac{\frac{65n}{100} - CF}{f} \right) \times h$$

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

$$P_{65} = 15 + \frac{2.5 \times 5}{12}$$

$$P_{65} = 15 + \frac{12.5}{12}$$

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

$$\underline{\underline{P_{65} = 16.04}}$$

Problem-2 :- Calculate P_{40} and P_{60} from the following data:-

Marks	10-20	20-30	30-40	40-50	50-60
No. of students	5	4	8	4	4

Solution

Marks	No. of students	Cum. Frequency
10-20	5	5
20-30	4	9
30-40	8	17
40-50	4	21
50-60	4	25 c.f
Total	n = 25	

① P_{40} = Value of $\left(\frac{40n}{100}\right)^{th}$

P_{40} = Value of $\frac{40 \times 25}{100}$

P_{40} = 10th observation

② 10th observation lies in the group - 30-40 marks.
 $L_1 = 30, f = 8, c.f = 9, h = 10.$

③ $P_{40} = L_1 + \left(\frac{\frac{40n}{100} - c.f}{f}\right) \times h$

$P_{40} = 30 + \frac{10 - 9}{8} \times 10$

$P_{40} = 30 + \frac{1}{8} \times 10$

$P_{40} = 30 + \frac{10}{8}$

$P_{40} = 30 + 1.25$

$P_{40} = 31.25$ marks

④ P_{60} = Value of $\left(\frac{60n}{100}\right)^{th}$ observation

P_{60} = Value of $\frac{60 \times 25}{100}$

$P_{60} = 15$ th observation

⑤ 15th observation lies in the group of 30-40 marks

$L_1 = 30, f = 8, c.f = 9, h = 10$

⑥ $P_{60} = L_1 + \left(\frac{\frac{60n}{100} - c.f}{f}\right) \times h$

$P_{60} = 30 + \left(\frac{15 - 9}{8}\right) \times 10$

$P_{60} = 30 + \frac{6}{8} \times 10$

$P_{60} = 30 + \frac{60}{8}$

$P_{60} = 30 + 7.5$

$P_{60} = 37.5$

Q:11 Give the correct option :-

d

1) Statement 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 d) None of these.

② D_7 From the given data - 10

Data - 4, 5, 6, ~~7~~, 8, 9, 10, 11, 12

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

$$D_7 = 7 \left(\frac{n+1}{10} \right)$$

$$= 7 \times \frac{9+1}{10}$$

$$= 7 \times \frac{10}{10}$$

$$= 7^{\text{th}} \text{ observation}$$

$D_7 = 10$

③ Statement related to Partition values that are correct

a, c and d

- 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 as P and D.

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

Q:12 Choose the correct pair.

1) Quartiles

2) Deciles

3) Percentiles

a) $D_j = \text{size of } j \left(\frac{n+1}{10} \right)^{\text{th}} \text{ observation}$

b) $P_k = L + \left(\frac{\frac{kn}{100} - cf}{f} \right) \times h$

c) $Q_i = L + \left(\frac{\frac{in}{4} - cf}{f} \right) \times h$

options a) 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:13 Give economic terms :-

1. Procedure for dividing the data into equal parts.

Ans: Partitioning

2. Values that divides the series into 10 equal parts.

Ans: Deciles

3. Values that divides the whole set of observations in four equal parts.

Ans: Quartiles

Q:14 Answer the following questions on the basis of given data :-

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

Solution - Data arranged in ascending order.

Marks	No. of students	Cum. Freq.
10	4	4
20	7	11
30	13	24
40	8	32
50	6	38 = c.f
Total	n = 38	

Q:3 Find out the cumulative frequency of the last value of above data?

Ans: 38

Q:4 Find out value of n in the above data?

Ans: 38

Q:1 - write the formula of Q_1 and Q_3 .

$Q_1 =$ Value of $\left(\frac{n+1}{4}\right)^{th}$ observation

$Q_3 =$ Value of $3\left(\frac{n+1}{4}\right)^{th}$ observation

Q:2 Find out the median of above data.

$$Q_2 = \text{Value } 2\left(\frac{n+1}{4}\right)^{th} \text{ observation}$$

$$= 2 \times \frac{38+1}{4} = \frac{1}{2} \times \frac{39}{2} = 19.5$$

19.5th observation lies in the group of 30 marks

\therefore Median = $Q_2 = 30$ marks

Q: 15 State with reason whether you agree or disagree with the following statements?

1) Partition Values have application only in Theory but not in Practice.

Ans: - No. I do not agree with this statements.

Reasons: - 1. Partition Values are Very useful in Theory as well as in Practice

2) Quartiles are Very useful to provide financial information regarding income, sales, purchase etc.

3) Income Quartiles are also useful to compare individual income due to change in wages or inflation.

4) Deciles are also useful to provide data on investment (e.g) Portfolio investment, mutual fund investment.

5) Government also uses deciles to study the level of economic inequalities, measurement of Poverty line etc.

6) Percentiles are Very useful for benchmarking and for base line purposes.

7) Percentiles are also used in measurement of Test scores, household income, household wealth, health measures etc.

② Average can misinterpret the representative values.

Ans: - Yes. I agree with this statement.

Reasons 1) Averages are not based on all observation like median and mode.

2) The data generally shows Positional Average which is not affected by extreme values

3) So the Averages used for such data often misinterprets its representative values

4. To reduce this misinterpretation, generally Partition Values are Used.

5) example - Median, Quartile, Deciles and Percentiles are Used to increase accuracy of Averages.

3) Median is also known as Second Quartile.

Ans. Yes. I agree with this statement.

Reasons 1) Median is the middle most values in the arranged data

2) Median is the value which divides the entire data into two equal parts.

3) It is also not affected by its extreme value i.e. very low and very high values.

4) Median = $\frac{n}{2}$ and $Q_2 = 2\left(\frac{n}{4}\right) = \frac{n}{2}$

5) Thus median is also called second quartile.

Q:16 Complete correlations —

1) Percentile : 100 Parts :: Deciles : 10 Parts

2) Deciles : 10 Parts :: Quartile : Four parts

3) Q_2 : P_{50} :: D_5 : Median

