

Dispersion :- Study of Variability or Scatterness of observations.

Classification :-

1) Absolute Measures

described in same unit

↳ Range

↳ Quartile deviation

↳ Mean Absolute deviation

↳ Standard Deviation

2) Relative measures

ratio or percentage of variability

↳ Coefficient of Variation

↳ Coefficient of Quartile deviation

↳ Coeff of mean deviation

Range :- difference between largest and Smallest value

$$\text{Range} = H - L$$

H = highest L = lowest

$$\text{Coefficient of Range} :- \frac{H - L}{H + L}$$

Individual Series :- 20, 35, 25, 30, 15

$$\text{Range} = 35 - 15 = 20 \quad \text{Coeff} = \frac{20}{50} = 0.4$$

Discrete Series :

x f

(10) 15

20 18

30 25

40 30

50 16

60 10

(70) 9

$$\text{Range} = 70 - 10 = 60$$

$$\text{coeff} = \frac{H - L}{H + L} = \frac{70 - 10}{70 + 10} = 0.75$$

Continuous Series :-

x	5-10	10-15	15-20	20-25	25-30
f	4	9	15	30	40

$$\text{range} = H - L = 30 - 5 = 25$$

$$\text{coeff} = \frac{30 - 5}{30 + 5} = \frac{5}{7} = 0.71$$

Quartiles :- divide data in 4 equal parts

25	25	25	25
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↑ ↑ ↑
Q₁ Q₂ Q₃

median

→ Inter Quartile Range :- $Q_3 - Q_1$

→ Quartile deviation = $\frac{Q_3 - Q_1}{2}$

→ Coefficient of Quartile Deviation = $\frac{Q_3 - Q_1}{Q_3 + Q_1}$

Individual Series :-

Q_i = Size of $i \left(\frac{N+1}{4} \right)^{\text{th}}$ item $i = 1, 2, 3$

$$Q_1 = 1 \times \left(\frac{N+1}{4} \right)^{\text{th}} \quad Q_2 = \left(\frac{N+1}{2} \right)^{\text{th}} \quad Q_3 = \frac{3}{4} (N+1)^{\text{th}}$$

< median

Q] Find Q_1 and Q_3 for odd no. of observations
21, 15, 40, 30, 26, 45, 50, 54, 60, 65, 70

in ascending order

15, 21, 26, 30, 40, 45, 50, 54, 60, 65, 70

$$Q_1 = \text{size of } \left(\frac{N+1}{4}\right)^{\text{th}} \text{ item} = \frac{11+1}{4} = 3^{\text{rd}} = 26$$

$$Q_3 = \text{size of } 3\left(\frac{N+1}{4}\right)^{\text{th}} : 9^{\text{th}} = 60$$

Q] Find Q_1 and Q_3 for even no. of observation

120, 150, 170, 180, 181, 187, 190, 192, 200, 210

$$Q_1 = \left(\frac{N+1}{4}\right)^{\text{th}} = \frac{10+1}{4} = 2.75^{\text{th}} \text{ item}$$

$$= \text{size of } 2^{\text{nd}} + 0.75 (\text{size of } 3^{\text{rd}} - \text{size of } 2^{\text{nd}})$$

$$= 150 + 0.75 (170 - 150)$$

$$= 165$$

$$Q_3 = 3 \times 2.75 = 8.25^{\text{th}} \text{ item}$$

$$= 192 + 0.25 (200 - 192)$$

$$= 194$$

$$Q_1 = \frac{127+1}{4} = 32^{\text{th}} \text{ item}$$

$$Q_1 = 40$$

$$Q_3 = 3 \times 32 = 96$$

$$Q_3 = 50$$

$$\text{Quartile deviation} = \frac{50 - 40}{2}$$

$$= 5$$

Discrete Series :-

wages	no. of worker	cf
10	2	2
20	8	10
30	20	30
40 ✓	25	<u>65</u>
50	42	<u>107</u>
60	20	127

Continuous Series:-

Step-I class = size of $\left(\frac{N}{4}\right)^{\text{th}}$ item

$$\text{Step-II } Q_1 = l + \frac{\left(\frac{N}{4}\right) - cf}{f} \times i$$

$$Q_2 = l + \frac{\frac{N}{2} - cf}{f} \times i = \text{median}$$

$$Q_3 = l + \frac{\frac{3N}{4} - cf}{f} \times i$$

Q] Find Q_1 and Q_3

x	f	cf
0-10	22	22
✓ 10-20	38	60
20-30	46	106
✓ 30-40	35	141
40-50	19	160

$$\text{class} = \left(\frac{N}{4}\right)^{\text{th}} \text{ item} = \frac{160}{4}$$

$$Q_1 = l + \frac{\frac{N}{4} - cf}{f} \times i$$

$$= 10 + \frac{40 - 22}{38} \times 10$$

$$Q_3 = 30 + \frac{120 - 106}{35} \times 10$$

$$= 14.74$$

$$= 34$$

Q] Find Q_1 , Q_3 , quartile deviation, coefficient of quartile deviation.

$$\text{Sol}^n \quad Q_1 = \left(\frac{N}{4}\right)^{\text{th}} \text{ item} = 15^{\text{th}}$$

Age	Person	cf
0-20	4	4
20-40	10	14
✓ 40-60	15	(29)
✓ 60-80	20	(49)
80-100	11	60

$$= 40 + \frac{15-14}{15} \times 20$$

$$= 41.33$$

$$Q_3 = \frac{3 \times N}{4} = 45^{\text{th}}$$

$$QD = \frac{Q_3 - Q_1}{2}$$

$$= \frac{76}{2} = 38$$

$$= 60 + \frac{45-29}{20} \times 20$$

$$= 76$$

$$\text{coeff of deviation} = \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{34.67}{117.33} = 0.295$$