Exercise - 11.1

1. Calculate the quartile deviation and its coefficient from the following data.

a.

Marks	20-30	30-40	40-50	50-60	60-70	70-80
No. of students	4	12	16	10	8	6

Solution:

Marks (x)	frequency (f)	c.f
20-30	4	4
30-40	12	16
40-50	16	32
50-60	10	42
60-70	8	50
70-80	6	56
	N = 56	

Now,

$$Q_1 = \frac{N}{4} = \frac{56}{4} = 14$$

c.f greater than 14 is 16. So, Q_1 lies in the class (30-40)

Using formula

$$Q_1 = L + \frac{\frac{N}{4} - c.f}{f} \times i$$

$$= 30 + \frac{\frac{56}{4} - 4}{12} \times 10$$

$$= 30 + \frac{10}{12} \times 10$$

$$= 38.3333$$

Again,

For $Q_3 = \frac{3N}{4}$

$= \frac{3 \times 56}{4} = 42$

$\therefore$ C.f = 42, so it lies in (50-60) class

We know,

$$Q_3 = L + \frac{\frac{3N}{4} - Cf}{f} \times i$$

$= 50 + \frac{42 - 32}{10} \times 10$

$= 60$

Now,

Quartile deviation (Q.D) $= \frac{Q_3 - Q_1}{2}$

$= \frac{60 - 38.3333}{2}$

$= 10.833$

Also,

Coefficient of $QD = \frac{Q_3 - Q_1}{Q_3 + Q_1}$

$= \frac{60 - 38.3333}{60 + 38.3333}$

$= 0.2203$

b.

Marks	20-30	30-40	40-50	50-60	60-70	70-80
No. of students	3	5	6	8	4	4

Solution:

marks(x)	No. of stds (f)	c.f
20-30	3	3
30-40	5	8
40-50	6	14
50-60	8	22
60-70	4	26
70-80	4	30
	N = 30	

Now,

For, $Q_1 = \frac{N}{4} = \frac{30}{4} = 7.5$

c.f greater than 7.5 is 8. So, Q_1 lies in (30-40) class.

$$\therefore Q_1 = L + \frac{\frac{N}{4} - c.f}{f} \times i$$

$$= 30 + \frac{7.5 - 3}{5} \times 10$$

$$= 39$$

Again,

$$Q_3 = \frac{3N}{4} = \frac{3 \times 36}{4} = 22.5$$

c.f just greater than 22.5 is 26. So, Q_3 lies in class (60-70).

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

$$= 60 + \frac{22.5 - 22}{4} \times 10$$

$$= 61.25$$

we know,

$$Q.D = \frac{Q_3 - Q_1}{2}$$

$$= \frac{61.25 - 39}{2}$$

$$= 11.125$$

Also,

$$\text{Coefficient of Q.D} = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

$$= \frac{61.25 - 39}{61.25 + 39}$$

$$= 0.2219$$

c.

Volume of water	5-10	10-15	15-20	20-25	25-30
No. of families	4	12	16	6	2

Solution:

Volume of water (x)	No. of families (f)	C.f
5-10	4	4
10-15	12	16
15-20	16	32
20-25	6	38
25-30	2	40
	N = 40	

For $Q_1 = \frac{N}{4} = \frac{40}{4} = 10$

C.f just greater than 10 is 16. So, Q_1 lies in class (10-15)

$$\therefore Q_1 = L + \frac{\frac{N}{4} - c.f}{f} \times i$$

$$= 10 + \frac{10 - 4}{12} \times 5$$

$$= 12.5$$

Also,

$$Q_3 = \frac{3N}{4}$$

$= \frac{3 \times 40}{4}$

$= 30$

C.f greater than 30 is 32.50, Q_3 lies in class (15-20)

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

$= 15 + \frac{30 - 16}{16} \times 5$

$= 19.375$

Here,

$Q.D = \frac{Q_3 - Q_1}{2}$

$= \frac{19.375 - 12.5}{2}$

$= 3.4380$

Again,

Coefficient of $QD = \frac{Q_3 - Q_1}{Q_3 + Q_1}$

$= \frac{19.375 - 12.5}{19.375 + 12.5}$

$= 0.2150$ ~~0.216~~

d.

Age (years)	0-5	5-10	10-15	15-20	20-25
No. of person	5	20	15	20	10

Solution:

Age (x)	No. of Person (f)	C.f
0-5	5	5
5-10	20	25
10-15	15	40
15-20	20	60

20-25	10	70	
	N=70		

for, $Q_1 = \frac{N}{4} = \frac{70}{4} = 17.5$

C.f greater than 17.5 is 25. So, Q_1 lies in class (5-10)

$$\therefore Q_1 = L + \frac{\frac{N}{4} - Cf}{f} \times i$$

$$= 5 + \frac{17.5 - 5}{20} \times 5$$

$$= 8.125$$

Also,

$$Q_3 = \frac{3N}{4} = \frac{3 \times 70}{4} = 52.5$$

C.f greater than 52.5 is 60, So, Q_3 lies in class (15-20)

$$\therefore Q_3 = L + \frac{\frac{3N}{4} - C.f}{f} \times i$$

$$= 15 + \frac{52.5 - 40}{20} \times 5$$

$$= 18.125$$

Here,

$$Q.D = \frac{Q_3 - Q_1}{2} = \frac{18.125 - 8.125}{2} = 5$$

Also,

$$\text{Coefficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{18.125 - 8.125}{18.125 + 8.125}$$

$$= 0.381$$

c.

Age (yrs)	60-65	65-70	70-75	75-80	80-85	85-90
No. of stds	7	5	8	4	3	3

Solution:

Age (x)	No. of stds (f)	C.f
60-65	7	7
65-70	5	12
70-75	8	20
75-80	4	24
80-85	3	27
85-90	3	30
	N = 30	

for $Q_1 = \frac{N}{4} = \frac{30}{4} = 7.5$

C.f greater than 7.5 is 12. So, Q_1 lies in class (65-70)

$\therefore Q_1 = L + \frac{\frac{N}{4} - Cf}{f} \times i$

$= 65 + \frac{7.5 - 7}{5} \times 5$

$= 65.5$

Also,

for $Q_3 = \frac{3N}{4} = \frac{3 \times 30}{4} = 22.5$

$\therefore Q_3$ = L + C.f greater than 22.5 is 24. So, Q_3 lies in class (75-80).

$\therefore Q_3 = L + \frac{\frac{3N}{4} - C.f}{f} \times i$

$= 75 + \frac{22.5 - 20}{4} \times 5$

$= 78.125$

Here,

$$Q.D = \frac{Q_3 - Q_1}{2}$$

$$= \frac{78.125 - 65.5}{2}$$

$$= 6.31$$

Also,

coefficient of $Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$

$$= \frac{78.125 - 65.5}{78.125 + 65.5}$$

$$= 0.09$$

f.

x	4-8	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40
f	6	10	18	30	15	12	16	6	5

Solution:

x	f	c.f
4-8	6	6
8-12	10	16
12-16	18	34
16-20	30	64
20-24	15	79
24-28	12	91
28-32	10	101
32-36	6	107
36-40	5	112
	N=112	

For $Q_1 = \frac{N}{4} = \frac{112}{4}$

$$= 28$$

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Cf greater than 28 is 34. So, Q_1 lies in class (12-16)

$$\text{So } Q_1 = L + \frac{\frac{N}{4} - Cf}{f} \times i$$

$$= 12 + \frac{28 - 16}{18} \times 4$$

$$= 14.667$$

Also,

$$Q_3 = \frac{3N}{4} = \frac{3 \times 112}{4} = 84$$

C.f greater than 84 is 91. So, Q_3 lies in class (24-28)

$$\therefore Q_3 = L + \frac{\frac{3N}{4} - Cf}{f} \times i$$

$$= 24 + \frac{84 - 79}{12} \times 4$$

$$= 25.667$$

Now,

$$Q.D = \frac{Q_3 - Q_1}{2} = \frac{25.667 - 14.667}{2}$$

$$= 5.499$$

Also,

$$\text{Coefficient of } Q.D = \frac{25.667 - 14.667}{25.667 + 14.667}$$

$$= 0.272$$

2. Calculate quartile deviation and its coefficient from the following data.

a.

Marks	less than 30	30-40	40-50	50-60	60-70	70 above
No. of students	3	6	9	5	3	2

Solution.

Marks (x)	No. of student (f)	c.f
less than 30	3	3
30-40	6	9
40-50	9	18
50-60	5	23
60-70	3	26
70 above	2	28
	N = 28	

Here,

$$Q_1 = \frac{N}{4} = \frac{28}{4} = 7$$

c.f just greater than 7 is 9. So, Q_1 lies in class (30-40)

$$\therefore Q_1 = L + \frac{\frac{N}{4} - Cf}{f} \times i$$

$$= 30 + \frac{7 - 3}{6} \times 10$$

$$= 36.667$$

Again,

$$Q_3 = \frac{3N}{4} = \frac{3 \times 28}{4} = 21$$

c.f greater than 21 is 23. So, Q_3 lies in class (50-60)

$$\therefore Q_3 = L + \frac{\frac{3N}{4} - Cf}{f} \times i$$

$$= 50 + \frac{21-18}{5} \times 10$$

$$= 56$$

Again,

$$Q.D = \frac{Q_3 - Q_1}{2}$$

$$= \frac{56 - 36.667}{2}$$

$$= 9.665$$

Also,

$$\text{Coefficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

$$= \frac{56 - 36.667}{56 + 36.667}$$

$$= 0.21$$

b.

x	less than 30	30-40	40-50	50-60	60-70	70 above
f	2	4	6	8	4	3

solution:

x	f	c.f
less than 30	2	2
30-40	4	6
40-50	6	12
50-60	8	20
60-70	4	24
70 above	3	27
	N=27	

For, $q_1 = \frac{N}{4} = \frac{27}{4} = 6.75$

c.f greater than 6.675 is 12. so, q_1 lies in class (40-50)

$$\therefore q_1 = L + \frac{\frac{N}{4} - c.f}{F} \times i$$

$= 40 + \frac{6.75 - 6}{6} \times 10$

$= 41.25$

for $Q_3 = \frac{3N}{4} = \frac{3 \times 27}{4} = 20.25$

c.f greater than 20.25 is 24. so, Q_3 lies in class 60-70

Now,

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

$= 60 + \frac{220.25 - 20}{4} \times 10$

$= 60.625$

Here,

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

$= \frac{60.625 - 41.25}{2}$

$= 9.6875$

Also,

Coefficient of $Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$

$= \frac{60.625 - 41.25}{60.625 + 41.25}$

$= 0.1901$

c.

x	Below 25	25-30	30-35	35-40	40-45	45 above
f	5	12	22	25	17	9

Solution:

x	f	c.f
below 25	5	5
25-30	12	17
30-35	22	39
35-40	25	64
40-45	17	81
45 above	9	90
	N = 90	

for $Q_1 = \frac{N}{4} = \frac{90}{4} = 22.5$

C.f greater than 22.5 is 39. So, Q_1 lies in class (30-35)

$\therefore Q_1 = L + \frac{\frac{N}{4} - c.f}{f} \times i$

$= 30 + \frac{22.5 - 17}{22} \times 5$

$= 31.25$

Again,

$Q_3 = \frac{3N}{4} = \frac{3 \times 90}{4} = 67.5$

C.f greater than 67.5 is 81. So, ~~c.f~~ Q_1 lies in (40-45) class.

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

$= 40 + \frac{67.5 - 64}{17} \times 5$

$= 41.029$

Here,

$Q.D = \frac{Q_3 - Q_1}{2} = \frac{41.029 - 31.25}{2} = 4.89$

Again,

$$\text{Coefficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

$$= \frac{41.029 - 31.25}{41.029 + 31.25}$$

$$= 0.135$$

d.

Income (Rs)	below 25	25-30	30-35	35-40	40-45	45-above
frequency	5	12	22	25	17	9

Solution:

Income (x)	frequency	c.f
below 25	5	5
25-30	12	17
30-35	22	39
35-40	25	64
40-45	17	81
45 above	9	90
	N = 90	

Here, $Q_1 = \frac{N}{4} = \frac{90}{4} = 22.5$

d.

Income (Rs)	below 50	50-70	70-90	90-110	110-130	130-150	150 abo
frequency	5	12	22	25	17	10	9

Solution:

Income (x)	frequency (f)	c.f
below 50	5	5
50-70	12	17
70-90	22	39
90-110	25	64
110-130	17	81
130-150	10	91

150 above	9	100	
	N = 100		

Here,

$$Q_1 = \frac{N}{4} = \frac{100}{4} = 25$$

C.f greater than 25 is 39. So, Q_1 lies in class (70-90)

$$\therefore Q_1 = L + \frac{\frac{N}{4} - c.f}{f} \times i$$

$$= 70 + \frac{25 - 17}{22} \times 20$$

$$= 77.27$$

Also

$$Q_3 = \frac{3N}{4} = \frac{3 \times 100}{4} = 75$$. C.f greater than 75 is 81.

So, Q_3 lies in class (110-130).

$$\therefore Q_3 = L + \frac{\frac{3N}{4} - Cf}{f} \times i$$

$$= 110 + \frac{75 - 64}{17} \times 20$$

$$= 122.94$$

Again,

$$Q.D = \frac{Q_3 - Q_1}{2}$$

$$= \frac{122.94 - 77.27}{2}$$

$$= 22.835$$

Again,

$$\text{Coefficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

$$= \frac{122.94 - 77.27}{122.94 + 77.27}$$

$$= 0.228$$

3. Calculate the quartile deviation and its coefficient from the given data.

a.

Class interval	20-29	30-39	40-49	50-59	60-69	70-79
Frequency	100	90	85	80	60	50

Solution:

Here, Cf = lower limit of 2^{nd} class - upper limit of 1^{st} class / 2

$$= \frac{30 - 29}{2}$$

$$= 0.5$$

Class Interval	frequency	C.f
19.5 - 29.5	100	100
29.5 - 39.5	90	190
39.5 - 49.5	85	275
49.5 - 59.5	80	355
59.5 - 69.5	60	415
69.5 - 79.5	50	465
	N = 465	

For $Q_1 = \frac{N}{4} = \frac{465}{4} = 116.25$

Cf greater than 116.25 is 190. So, Q_1 lies in class (29.5-39.5)

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

$$= 29.5 + \frac{116.25 - 100}{90} \times 10$$

c. 31.30

Again,

$$Q_3 = \frac{3N}{4} = \frac{3 \times 465}{4}$$

$$= 348.75$$

C.f greater than 348.75 is 355. So, Q_3 lies in class (49.5 - 59.5)

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

$$= 49.5 + \frac{348.75 - 275}{80} \times 10$$

$$= 58.71$$

Here,

$$Q.D = \frac{Q_3 - Q_1}{2}$$

$$= \frac{58.71 - 31.30}{2}$$

$$= 13.71$$

Also,

$$\text{Coefficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

$$= \frac{58.71 - 31.30}{58.71 + 31.30}$$

$$= 0.3$$

b.

Class Interval	10-19	20-29	30-39	40-49	50-69
Frequency	4	7	8	5	9

Solution:

Here, cf = lower limit of 2nd class - upper limit of first class

$$= \frac{20-19}{2}$$

$$= \frac{0.5}{2}$$

class Interval	frequency	cf
9.5 - 19.5	4	4
19.5 - 29.5	7	11
29.5 - 39.5	8	19
39.5 - 49.5	5	24
49.5 - 69.5	9	33
	N = 33	

Here,

$$Q_1 = \frac{N}{4} = \frac{33}{4} = 8.25$$

C.f greater than 8.25 is 11. So, Q_1 lies in class (19.5 - 29.5)

$$\therefore Q_1 = L + \frac{\frac{N}{4} - C.f}{f} \times i$$

$$= 19.5 + \frac{8.25 - 4}{7} \times 10$$

$$= 25.57$$

Again,

$Q_3 = \frac{3N}{4} = \frac{3 \times 33}{4} = 24.75$. C.f greater 24.75 is 33. So, Q_3 lies in class (49.5 - 69.5)

$$\therefore Q_3 = L + \frac{\frac{3N}{4} - C.f}{f} \times i$$

$$= 49.5 + \frac{24.75 - 24}{9} \times 10$$

$$= 50.33$$

Here,

$$Q.D = \frac{Q_3 - Q_1}{2}$$

$$= \frac{50.33 - 25.57}{2}$$

$$= 12.38$$

Again,

Coefficient of $QD = \frac{50.33 - 25.57}{50.33 + 25.57}$

$$= 0.3262$$

c.

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
No. of students	1	4	8	10	5	6	8	10	7	5

Solution:

Here, $CF = \frac{10-9}{2} = 0.5$

Marks	No. of students	C.f
-0.5 - 9.5	1	1
9.5 - 19.5	4	5
19.5 - 29.5	8	13
29.5 - 39.5	10	23
39.5 - 49.5	5	28
49.5 - 59.5	6	34
59.5 - 69.5	8	42
69.5 - 79.5	16	58
79.5 - 89.5	7	59
89.5 - 99.5	5	64
	N = 64	

Here, $Q_1 = \frac{N}{4} = \frac{64}{4} = 16$

Cf greater than 16 is 23. So, Q_1 lies in class (29.5 - 39.5)

$\therefore Q_1 = L + \frac{\frac{N}{4} - C.f}{f} \times i$

$= 29.5 + \frac{16 - 13}{10} \times 10$

$= 32.5$

Also,

$Q_3 = \frac{3N}{4} = \frac{3 \times 64}{4} = 48$. C.f greater than 48 is 52. So, Q_3 lies in class (69.5 - 79.5)

$\therefore Q_3 = L + \frac{\frac{3N}{4} - C.f}{f} \times i$

$= 69.5 + \frac{48 - 42}{10} \times 10$

$= 75.5$

Here, $Q.D = \frac{Q_3 - Q_1}{2}$

$= \frac{75.5 - 32.5}{2}$

$= 21.5$

Also,

Coefficient of $Q.D = \frac{75.5 - 32.5}{75.5 + 32.5}$

$= 0.398$

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d.

x	5-7	8-10	11-13	14-16	17-19	20-22
f	14	24	38	20	4	8

Solution:

Here, Cf = lower limit of 2nd class - upper limit of 1st class / 2

$$= \frac{8-7}{2}$$

$$= 0.5$$

x	f	C.f
4.5 - 7.5	14	14
7.5 - 10.5	24	38
10.5 - 13.5	38	76
13.5 - 16.5	20	96
16.5 - 19.5	4	100
19.5 - ~~22.7~~ 22.5	8	108
	N = 108	

for $Q_1 = \frac{N}{4} = \frac{108}{4} = 27$

C.f greater than 27 is 38. So, Q_1 lies in class (7.5 - 10.5).

$\therefore Q_1 = L + \frac{\frac{N}{4} - C.f}{f} \times i$

$= 7.5 + \frac{27-14}{24} \times 3$

$= 9.125$

Again,

$Q_3 = \frac{3N}{4}$

$= \frac{3 \times 108}{4}$

$= 81$

c.f greater than Q1 is 96. So, Q_3 lies in (lass (13.5 - 16.5).

$\therefore Q_3 = L + \frac{\frac{3N}{4} - c.f}{f} \times i$

$= 13.5 + \frac{81 - 76}{20} \times 3$

$= 14.25$

Here,

$Q.D = \frac{Q_3 - Q_1}{2}$

$= \frac{14.25 - 9.125}{2}$

$= 2.5625$

Again,

Coefficient of $QD = \frac{Q_3 - Q_1}{Q_3 + Q_1}$

$= \frac{14.25 - 9.125}{14.25 + 9.125}$

$= 0.21925$