Mean formula's

Arithmetic mean :-

(a) Direct Method

$$\bar{X} = \frac{\Sigma X}{N}$$

$\bar{X}$ = Mean
N = No. of items
Σ = Total

Dis/cont.

$$\bar{X} = \frac{\Sigma fx}{\Sigma f}$$

(b) Shortcut method :-

$$\bar{X} = A + \frac{\Sigma d}{N} \quad , \quad \bar{X} = \frac{A + \Sigma Fd}{\Sigma f}$$

A = Assume
N = No. of items
D = Divation (changes).

- $N = \Sigma F$
- X is always fixed
- F is counting

Mid Point :-

$$x = \frac{l_1 + l_2}{2}$$

Questions related to computation of Arithmetic Mean

(i) $N = 5$

$$\bar{X} = \frac{\Sigma X}{N}$$

$$\bar{X} = \frac{132 + 140 + 144 + 136 + 148}{5}$$

$$\bar{X} = \frac{700}{5} \Rightarrow \bar{X} = 140 \text{ Ans}$$

(ii) $N = 10$

$$\bar{X} = \frac{\Sigma X}{N}$$

$$\Sigma X = 30 + 28 + 32 + 12 + 18 + 20 + 25 + 15 + 26 + 14$$

$$\bar{X} = \frac{220}{10} \Rightarrow \bar{X} = 22 \text{ Ans}$$

(iii) $N = 12$

$$\bar{X} = \frac{\Sigma X}{N}$$

$$\frac{96 + 100 + 98 + 75 + 270 + 80 + 102 + 100 + 94 + 75 \quad 200 + 610}{12}$$

$$\bar{X} = \frac{1980}{12} \qquad \bar{X} = 165 \text{ Ans}$$

(IV) Direct method :-

$N = 10$

$$\bar{X} = \frac{\Sigma X}{N}$$

$$\frac{154+168+155+155+167+181+161+160+164+165}{10}$$

$$\bar{X} = \frac{1630}{10} \Rightarrow \bar{X} = 163 \text{ Ans}$$

Shortcut method.

X	$d = X - A$
154	$154 - 160 = -6$
168	$168 - 160 = +8$
155	$155 - 160 = -5$
155	$155 - 160 = -5$
167	$167 - 160 = +7$
181	$181 - 160 = +21$
161	$161 - 160 = +1$
160	$160 - 160 = 0$
164	$164 - 160 = +4$
165	$165 - 160 = +5$
	$\Sigma d = 30$

$$\bar{X} = A + \frac{\Sigma d}{N}$$

$$\bar{X} = 160 + \frac{30}{10}$$

$160 + 3$

$= 163$ Ans

(V) $-4, +2, -3, +1, 0, +10$

$$\bar{X} = A + \frac{\Sigma d}{N}$$

X	X = d + A
6	10 - 4
12	10 + 2
7	10 - 3
11	10 + 1
10	10 + 0
20	10 + 10
	$\Sigma d = 6$

$\bar{X} = 10 + \frac{6}{6}$

$= 10 + 1$

$\bar{X} = 11$ Ans

2.

(i)

X	F	Fu
4	20	80
5	40	200
6	30	180
7	10	70
	$\Sigma F = 100$	$\Sigma Fu = 530$

$\bar{X} = \frac{\Sigma Fu}{\Sigma F}$

$\bar{X} = \frac{530}{100}$

$\bar{X} = 5.3$ Ans

(ii)

X	F	Fu
10	5	50
12	8	96
14	10	140
16	12	192
18	7	126
20	6	120
22	2	44
	$\Sigma F = 50$	$\Sigma Fu = 768$

$\bar{X} = \frac{\Sigma Fu}{\Sigma F}$

$\bar{X} = \frac{768}{50}$

$\bar{X} = 15.36$

(iii)

X	F	FX
0	2	0
1	5	5
2	7	14
3	11	33
4	12	48
5	24	120
6	12	72
7	18	126
8	16	128
9	10	90
10	3	30
	$\Sigma F = 120$	$\Sigma FX = 666$

$$\bar{X} = \frac{\Sigma FX}{\Sigma F}$$

$$\bar{X} = \frac{666}{120}$$

$$\bar{X} = 5.55$$

(i) 666 Ans (ii) 5.55 Ans

3.

X	F	FX
0	2	0
1	4	4
2	6	12
4	8	32
7	10	70
10	12	120
15	14	210
20	16	320
	$\Sigma F = 72$	$\Sigma FX = 768$

$$\bar{X} = \frac{\Sigma FX}{\Sigma F}$$

$$\bar{X} = \frac{768}{72}$$

$$\bar{X} = 10.67$$

(i) 768

(ii) 10.67

4.

F	X	F_n
10	50	500
15	40	600
25	30	750
30	20	600
20	10	200
$\Sigma F = 100$		$\Sigma F_n = 2650$

$$\bar{X} = \frac{\Sigma F_n}{\Sigma F}$$

$$\bar{X} = \frac{2650}{100}$$

$$\bar{X} = 26.5 \text{ Ans}$$

5

(i)

C-I	X	F	F_n
0 - 10	5	5	25
10 - 20	15	7	105
20 - 30	25	8	200
30 - 40	35	6	210
40 - 50	45	7	180
		$\Sigma F = 30$	$\Sigma F_n = 720$

$$\bar{X} = \frac{\Sigma F_n}{\Sigma F}$$

$$\bar{X} = \frac{720}{30} = \bar{X} = 24 \text{ Ans}$$

(ii)

C - D	X	F	Fu
0-10	5	12	60
10-20	15	18	270
20-30	25	27	675
30-40	35	20	700
40-50	45	17	765
50-60	55	6	330
		$\Sigma F = 100$	$\Sigma Fu = 2800$

$$\bar{X} = \frac{\Sigma Fu}{\Sigma F} = \bar{x} = \frac{2800}{100}$$

$$= 28 \text{ Ans}$$

(iii)

C - D	X	F	Fu
0-5	2.5	5	12.5
5-10	7.5	10	75.0
10-15	12.5	14	175.0
15-20	17.5	20	350.0
20-25	22.5	35	787.5
25-30	27.5	15	412.5
30-35	32.5	1	32.5
		$\Sigma F = 100$	$\Sigma Fx = 1845$

$$\bar{X} = \frac{\Sigma Fu}{\Sigma F}$$

$$\bar{X} = \frac{1845}{100} \quad \bar{X} = 18.45 \text{ Ans}$$

7

(i)

C-I	F	X	Fx
10-20	4	15	60
20-30	12	25	300
30-40	40	35	1400
40-50	45	45	1845
50-60	42	55	2310
60-70	11	65	715
	$\Sigma F = 150$		$\Sigma Fx = 6630$

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{6630}{150} = 44.2 \text{ Ans}$$

9

(i)

C-I	F	X	Fx
-40 to -30	10	-35	-350
-30 to -20	20	-25	-700
-20 to -10	30	-15	-450
-10 to 0	42	-5	-210
0-10	65	5	325
10-20	180	15	2700
20-30	10	25	2500
	$\Sigma F = 365$		ΣFx 1565

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{1565}{365}$$

$$\bar{x} = 4.28$$

ii

C-I	F	X	Fx
0-5	6	2.5	15
5-15	8	10	80
15-25	15	20	300
25-45	25	35	875
45-65	18	55	450
65-85	10	75	750
85-150	7	117.5	822.5
150-300	11	225	2475
	ΣF 100		Σ 5767.5

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{5767}{100} = 63.075$$

$$\bar{x} = 63.075.$$

10.

C-I	Tallymark(F)	X	Fx
11-13	𝍸 = 3	12	36
13-15	1111 = 4	14	56
15-17	𝍸 = 5	16	80
17-19	𝍸 1 = 6	18	108
19-21	𝍸 = 5	20	100
21-23	1111 = 4	22	88
23-25	111 = 3	24	72
	$\Sigma F = 30$		ΣFx 540

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{540}{30} = 18$$

$$\bar{x} = 18.$$

(ii) $$X_c = \frac{x_1 n_1 + x_2 n_2 \cdots x_n n_n}{n_1 + n_2}$$

$$55 = \frac{61 \times 40 + x2 \times 60}{60 + 40}$$

$$55 = \frac{61 \times 40 + x2 \times 60}{100}$$

$$2440 + 60 \times 2 = 5500$$

$$60 \times 2 = 5500 - 2440$$

$$60 \times 2 = 3060$$

$$x2 = \frac{3060}{60} = 51$$

$$\boxed{x2 = 51}$$

(iii) $15 \times 110\ lb = 1650\ lb$

$5 \times 100\ lb = 500\ lb$

$5 \times 125\ lb = 625\ lb$

$500 + 625 = 1125\ lb$

$1650 - 1125$

$= 525$

$$\frac{525}{5} = 105$$

26. $5'8''$

$5 \times 12 + 8$

$60 + 8$

$= 68$

$68 \times 50 = 3400$

$5 \times 12 + 4 = 64$
$5 \times 12 + 6 = 66$
$5 \times 12 + 8 = 68$
$5 \times 12 + 10 = 70$
$6 \times 12 + 0 = 72$

F	X	F_x
4	64	256
12	66	792
4	68	272
8	70	560
2	72	144
		$\Sigma f_x = 2022$

$3400 - 2022$
$= 1378$
$\frac{1378}{20} = 68.8$
5 feet 8'8" inch

27
(i) Avg. rainfall for the year, excluding July
$11 \times 4cm$
$= 44$
The avg. of the year
$12 \times 5cm$
$= 60$
$60 - 44$
16 Ans

ii Mon - Sat
4.2 x 6 Days
= 25.2 cm
7 x 7 days = 49 cm
49 - 25.2
= 23.8 cm

iii Avg. monthly sales 11 months = Rs 12,000
Total sales for 11 months = 11 x Rs 12000
= 132000
Avg. monthly sales 12 months = 11375
12 x 11375
= 136500
Total sales for 12 months − Total sales for 11 mon
136500 - 132000
Rs. 4500 Ans

Median

Individual series :-

Assending order

$X = x_1, x_2, x_3 \ldots x_n$

$\text{Median}(M) = \left(\frac{N+1}{2}\right)^{th}$ item

Discreate series :-

X	F	CF
same	same	same

$M = \left(\frac{N+1}{2}\right)^{th}$ item

Continous series :-

C.I	F	CF

$\Sigma F = N$

$M = l_1 + \frac{l_2 - l_1}{f}(m - c)$

$l_1 + \frac{l_2 - l_1}{F}\left(\frac{N}{2} - c\right.$

$l_1 + \frac{i}{F}\left(\frac{N}{2} - C\right)$

$m = \left(\frac{n}{2}\right)^{th}$ item

$i = l_2 - l_1$

28

(i) 34, 29, 26, 37, 31

Asending order → 26, 29, 31, 34, 37

$$M = \left(\frac{N+1}{2}\right)^{th} \text{ item}$$

$$\left(\frac{5+1}{2}\right)^{th} \text{ item}$$

$$\frac{6}{2} \text{ item}$$

3rd

$$M = 31$$

When the point

$$M = \left(\frac{6+1}{2}\right)^{th} \text{ item}$$

$$M = 3.5^{th} \text{ item}$$

$$M = \frac{3rd + 4th \text{ item}}{2}$$

$$M = \frac{31+34}{2} = \frac{65}{2} = 32.5$$

ii

15, 20, 23, 23, 25, 25, 25, 27, 40

$$M = \left(\frac{9+1}{2}\right)$$

$$\frac{10}{2} = 5 \text{ value} = 25.$$

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2, 3, 4, 5, 5, 5, 6, 6, 7, 7, 7, 7, 8, 8, 9, 10, 11

$\left(\frac{n}{2}\right)$th & $\left(\frac{n}{2}+1\right)$

average of 9th & 10 value

9th value = 7, 10th value = 7 $\rightarrow \frac{(7+7)}{2} = 7$

102, 104, 107, 110, 111, 113, 115, 116, 117, 170

N = 10

average of 5th and 6th value

5th = 114, 6th = 113

$\frac{111+113}{2} = \frac{224}{2} = 112$

11, 11, 12, 15, 15, 15, 18, 19, 20, 21, 22, 27, 28, 30, 32, 33, 40

N = 17

$\left(\frac{n+1}{2}\right) = \frac{17+1}{2}$ = 9th value

= 20.

X	Y
28	26
30	33
32	35
35	42
46	44
47	66
60	68

X	Y
62	72
63	80
64	85

n = 10

For x

5th = 46, 6th = 47

$\frac{46+47}{2} = 46.5$

For y

5th = 44, 6th = 66

$\frac{44+66}{2} = 55$

x = 46.5

y = 55

55 > 46.5

(iv) 2, 3, 3, 5, 5, 5, 6, 7

n = 8

$\frac{n}{2}$ th value + $\left(\frac{n}{2}+1\right)$ th value

$\frac{n}{2} = 4 \rightarrow$ 4th value = 5

$\left(\frac{n}{2}+1\right) = 5 \rightarrow$ 5th value = 5

$\frac{5+5}{2} = \frac{10}{2} = 5$

5 days

30 (i) n = 15

Total students = 15

Fail = 5 students

Pass = 10 students

The mean of 10 students who passed = 9, 6, 7, 8, 8, 9

5, 4, 7

having only the sum of 10 students masses is not enough to determine the middle value.

6 Ans

(ii) 4, 5, 5, 6, 6, 7, 8, 8, 9, 9

$$n = 15$$

$$\left(\frac{n+1}{2}\right) = \frac{16}{2} = 8\text{th}$$

(iii) Total = 20
Failed = 8 → marks = 0
Successful - 12 → marks given
Failed Students
A, B, C, D, E, F, G, H
Successful students
5, 8, 4, 8, 7, 5, 6, 9, 5, 8, 7, 5

A, B, C, D, E, F, G, H, 4, 5, 5, 5, 5, 6, 7, 7, 8, 8, 8, 9.

$$n = 20$$

Median = average of 10th & 11 terms

10th term = 5
11th term = 5

$$\text{Median} = \frac{5+5}{2} = 5.$$

34. (i)

C.I	F	CF
5-15	4	4
15-25	6	10
25-35	10	20
35-45	5	25
45-55	3	28
	28	

$N = 28$

$\frac{N}{2} = \frac{28}{2} = 14^{th}$ item

Up to 15-25 → CF = 10

Up to 25-35 → CF = 20

$$L + \left(\frac{\frac{N}{2} - CF}{f}\right) \times h$$

$L = 25$, $N = 28$, $CF = 10$, $f = 10$, $h = 10$

$$25 + \left(\frac{14-10}{10}\right) \times 10$$

$$25 + \left(\frac{4}{10}\right) \times 10$$

$25 + 4 = 29$

Median wages = 29

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(ii) $L = 20, i = 10, f = 8, m = 12, C = 8$

$$L + \left(\frac{\frac{N}{2} - C}{f}\right) \times i$$

$$\frac{N}{2} = m = 12$$

$$20 + \frac{12 - 8}{8} \times 10 = 20 + \frac{4}{8} \times 10$$

$$20 + 0.5 \times 10$$
$$= 20 + 5$$
$$= 25$$

(iii)

C-D	F	CF
0-10	25	25
10-20	40-25 = 15	40
20-30	20	60
30-40	15	75
40-50	20	95
50-60	30	125
60-70	65	190
70-80	50	240
	=240	

$N = 240$

$\frac{N}{2} = 120$

median class = 50-60

$$L + \left(\frac{\frac{N}{2} - C}{f}\right) \times i$$

$L = 50, N = 120, C = 95, f = 30, i = 10$

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Mode

Individual series

Assending order

Maximum frequency of Mode (Z)

Ex :- 20, 25, 35, 35, 35, 35, 40, 42

Max frequency of 35 = 4

Mode = 35

Discreate series

X	f	sum of two-two	sum of three-three	Maximum frequency
1	3	—	—	
		8		
2	5		18	
		15		
3	10		21	
		16		I = 1
4	6			+
		15	25	III = 3
5	9			
		19	25	IIII = 4
6	10			
		18	27	IIII = 5
7	8			
		13	23	II = 2
8	5			
		9	17	
9	4	—	—	
			—	

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Maximum of freq of - 6 = 5

Mode (Z) = 6 Ans.

Continous series

$\Sigma F = N$

$$\text{Mode}(Z) = l_1 + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} [l_2 - l_1]$$

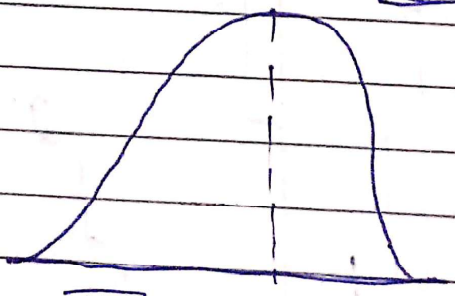
यदि दोनो से बड़ा हो $f_1 > f_0$ & f_2

$$(Z) = l_1 + \frac{f_2}{f_0 - f_2} (l_2 - l_1$$

यदि बड़ा या एक छोटा या दोनो ही छोटे हो तो $\therefore f_1 < f_0$ or f_2

C-I	F	sum of 2, 2	sum of 3, 3	Max. frequency
	f_0			
30-40	f_1			
	f_2			

$Z = 3M - 2\bar{x}$ Emp.



$\bar{x} = M = Z$

41. 33, 20, 35, 50, 37, 33, 35, 25, 35, 34, 35

(i) 20, 25, 33, 33, 34, 35, 35, 35, 35, 37, 50

Max. frequency of 35 = 4

$\boxed{Z = 35}$

(v) 2, 3, 8, 18, 18, 18, 24, 32, 32, 32

Max. frequency of 18 = 3

" " " 32 = 3

$\boxed{Z = 18, 32}$

(ii) 60, 61, 61, 62, 62, 63, 63, 63, 64, 64, 64, 64, 65, 65, 66, 64

Max. frequency of 64 = 4

$\boxed{Z = 64}$ 64 inches

(iii) 4s = S, S, S, S

5s = S, S, S, S, S

6s = S, S, S, S, S, S

7s = S, S, S, S, S, S, S

8s = S, S, S, S, S, S, S, S

Max. frequency of 8s = 8

$\boxed{Z = 8}$

X	F	sum of 2, 2	sum of 3 3	Max Freq.
0	1	6	—	—
1	5		9	—
2	4	11	10	16
3	7		17	21
4	10	26	33	1 = 1
5	16		31	41 1111 = 4
6	15	29	35	45 11111 = 5
7	14		20	111 = 3
8	6	13	27	1 = 1
9	7		15	21
10	8	—	—	—

Max freq. = 6 = 5

Z = 6

Harmonic Mean

Individual series

$x = x_1, x_2, x_3 \cdots x_n$

x	Reciprocal 1/x

$$H.M = \frac{N}{\Sigma\left(\frac{1}{x}\right)}$$

Discreate series

X	F	f/x

$$H.M = \frac{N}{\Sigma\left(\frac{f}{x}\right)}$$

Continuous series

C.I	f	x	f/x

$$H.M = \frac{N}{\Sigma\left(\frac{f}{x}\right)}$$

Avg. speed = $\frac{\text{Distance}}{\text{Time}}$

$$\text{Time} = \frac{D}{SP}$$

$$D = SP \times \text{Time}$$

SP	D	T = D/S

Questions relating to computation of H.M

93

(i)

x	Rec = 1/x	
85	1/85	0.0118
70	1/70	0.0143
15	1/15	0.0667
500	1/500	0.002
36	1/36	0.0278
20	1/20	0.05
45	1/45	0.0222
250	1/250	0.004
40	1/40	0.025
		0.2238

$$H.M = \frac{N}{\Sigma\left(\frac{1}{x}\right)} \qquad \frac{9}{0.2238} = 40.21$$

(ii)

x	Rec 1/x	
5	1/5	0.2
10	1/10	0.1
192	1/192	0.0052
14,374	1/14374	0.00006
20,498	1/20,498	0.00004
1,20,674	1/120674	0.0000
1,245	1/1245	0.0008
1,491	1/1491	0.00067
		0.3069

5 10 192 14,374 20,498 1,20,674 1,245 1,491

5 10 192 14374 20498 120674 1245 1491

2 0 6 7 4 1 2

$$\frac{8}{0.3069} = 26.07$$

iii

X	1/x	
5·0	1/5	0·2
0·08	1/0·08	12·5
0·8974	1/0·8974	1·114
0·0001	1/0·0001	10000
0·0284	1/0·0284	35·21
0·005	1/0·005	200
0·721	1/0·721	1·387
		10450·411

$$\frac{7}{10450.411} = 0.00067$$

(iv)

X	1/x	
1·0	1/1	1
1·5	1/1·5	0·667
0·5	1/0·5	2
0·05	1/0·05	20
0·095	1/0·095	10·53
1·245	1/1·245	0·803
0·009	1/0·009	111·11
		146·11

$$\frac{7}{146.11} = 0.0479$$

94

X	F	Fx
10	2	0·2
20	4	0·2
30	3	0·1
40	0	0
50	1	0·02
		0·52

$$\frac{10}{0.52} = 19.23$$

96.

$$H.M = \frac{N}{\sum \frac{1}{x}}$$

$$WHM = \frac{\sum w}{\sum \frac{w}{x}}$$

Size (x_i)	weight (w_i)	$1/x_i$	w_i/x_i
60	5	0.01667	0.05001
80	10	0.01250	0.12500
150	2	0.00667	0.01334
160	4	0.00625	0.02500
200	1	0.00500	0.00500
		0.0470	0.21835

$$HM = \frac{5}{0.04709} = 106.18$$

$$WHM = \frac{20}{0.21835} = 91.60$$

15.

i	x	f	$\frac{1}{x}$	$f \times \frac{1}{x}$
	5	4	0.2000	0.8000
	~~6~~	~~8~~	~~0.0667~~	
	15	~~25~~	0.0667	0.335
	25	11	0.0400	0.4400
	35	6	0.0286	0.7116
	45	4	0.0222	0.088
				1.8396

$\frac{46}{1.9667} = 23.4 \text{ km/h}$

iii

SP	D	T = D/S
40	20	0.5
60	10	0.1667
	30	0.6667

$\frac{30}{0.6667} = 45 \text{ km/h}$

Computation of H.M.

Q7

(i)

x	log x
3	0.4771
8	0.9031
9	0.9542
	2.3344

Al. $\frac{\text{log } x}{N}$

$\frac{2.3344}{3} = \text{Al. } 0.7781$

$= 5.9999$

$H.M = 5.999$

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(iii)

x	log x
375	2.5740
15.3	1.1847
28.5	1.4548
12.01	1.3224
4.5	0.6532
3.7	0.5682
12.79	1.1069
	8.0542

$$\frac{8.5642}{7} = 1.223457$$

$$10^{1.223457} = 17.04$$

(iv)

x	log x
5.6	0.7482
56	1.7482
560	2.7482
0.56	$\bar{1}$.7482
0.056	2.7482
	2.7410

$$\frac{2.7410}{5} = 0.5482$$

$$\text{Anti log } 10^{0.5482} = 5.6$$

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(v)

x	$\log x$
70	1.8457
105	1.0212
500	2.6990
75	1.8757
8	0.9031
250	2.3979
8	0.9031
82	1.9138
	13.5583

$$\frac{13.5583}{8} = 1.6948$$

$$\text{GM} = 10^{1.6948} = 49.5$$

(iii)

x	$\log x$
20	1.3010
108	2.0334
1080	3.0334
500	2.6990
4	0.6021
	9.6689

$$\frac{9.6689}{5} = 1.9338$$

$$\text{GM} = 10^{1.9338} = 85.8$$

$1+r = e^{0.02231} \approx 1.0226$

$r = 0.0226 = 2.26\%$ per annum

$P_{15} = 20 \times (1+0.0226)^{15}$

$P_{15} = 20 \times (1.0226)^{15}$

$(1.0226)^{15}$

$e^{15 \cdot 0.02231} = e^{0.3345} = 1.397$

$P_{15} = 20 \times 1.397$

$= 27.94$ lakh

(ii) $P = 10,000$

$A = 12,294$

$t = 5$ years

$A = P \times (1+r)^t$

$12,294 = 10,000 \times (1+r)^5$

$(1+r)^5 = \frac{12,294}{10,000} = 1.2294$

$1+r = (1.2294)^{1/5}$

$\ln(1+r) = \frac{1}{5} \ln(1.2294)$

$\ln(1.2294) = 0.2066$

$1+r = \frac{0.2066}{5} = 0.04132$

$1+r = e^{0.04132} \approx 1.0422$

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Partition values

→

Quantiles	Q_1, Q_3
Quantiles	Q_{n_1} to Q_{n_4}
Octile	O_1 to O_7
Deciles	D_1 to D_9
Percentiles	P_1 to P_{99}

$Q = 4$, $Q_n = 5$, $D = 10$, $O = 8$, $P = 100$

Ascending order

Individual series

$$Q_1 = \frac{1(N+1)}{4}\text{th item}$$

$$Q_3 = \frac{3(N+1)}{4}\text{th item}$$

$$D_2 = \frac{2(N+1)}{10}\text{th item}$$

$$P_5 = \frac{5(N+1)}{100}\text{th item}$$

$$Q_{n_2} = \frac{2(N+1)}{5}\text{th item}$$

$$O_7 = \frac{7(N+1)}{8}\text{th item}$$

$$P_{85} = \frac{85(N+1)}{100}\text{th item}$$

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$r = 0.0422 = 4.22\%$ per annum

GM

Individual series

$$GM = AL\left[\frac{\Sigma \log x}{N}\right]$$

Discrete series

x	F	log x	f log x

$$GM = AL\left[\frac{\Sigma f \log x}{\Sigma F}\right]$$

Continuous series

$$GM = AL\left[\frac{\Sigma f \log x}{\Sigma F}\right]$$

C.I	F	x	log x	f log x

Discreate series

x	F	CF

$N = \Sigma F$

$\Sigma F = N$

Continuous series

C-B	F	CF

$\Sigma F = N$

$Q_1 = l_1 + \frac{l_2 - l_1}{F}(q_1 - c)$, $q_1 = 1\left(\frac{N}{4}\right)^{th}$ of

$Q_3 = l_1 + \frac{l_2 - l_1}{F}(q_3 - c)$, $q_3 = 3\left(\frac{N}{4}\right)^{th}$ of

$D_3 = l_1 + \frac{l_2 - l_1}{F}(d_3 - c)$, $d_3 = 3\left(\frac{N}{10}\right)^{th}$ of

$P_{80} = l_1 + \frac{l_2 - l_1}{F}(P_{80} - c)$, $P_{80} = 80\left(\frac{N}{100}\right)$

$O_3 = l_1 + \frac{l_2 - l_1}{F}(O_3 - c)$, $O_3 = 3\left(\frac{N}{8}\right)^{th}$ of

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) 6, 8, 8, 9, 10, 11, 12, 13, 14

$N = 9$

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

$\left(\frac{9+1}{4}\right)^{th}$ item

2.5 item

2nd + 0.5(3rd - 2nd)

8 + 0.5(8 - 8)

8 + 0.5 × 0

8 + 0

= 8

$Q_3 = 3\left(\frac{N+1}{4}\right)^{th}$ item

$3\left(\frac{9+1}{4}\right)^{th}$ item

3×2.5^{th} item

$= 7.5^{th}$ item

7th + 0.5(8th - 7th)

12.05(13 - 12)

12 + 0.5

= 12.5

(iii) 2, 3, 4, 7, 12, 13, 15, 17, 21, 65, 90

$\left(\frac{11+1}{2}\right)^{th} = \frac{12}{2} = 6$

6th value = 13

M = 13

$Q_3 = \frac{3(N+1)}{4}$

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

$= 9$

9th value = 21

(iv) 0, 6, 12, 15, 17, 18, 18, 19, 20, 21

N = 10

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

$1\left(\frac{10+1}{4}\right) = \frac{11}{4} = 2.75$

2nd + 0.7(3rd - 2nd)

6 + 0.7 (12 - 6)

6.7 × 6

40.2

V

$Q_3 = 3\left(\frac{N+1}{4}\right)$

$3\left(\frac{10+1}{4}\right) = 3\frac{11}{4} = 3 \times 2.75$

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= 8.25

8th + 0.2(9th - 8th)

19 + 0.2(20 - 19)

19.2 x 1

= 19.2

17, 18, 20, 20, 21, 23, 24, 25, 25, 27, 29
30, 30, 32, 32, 33, 38, 45, 46, 47, 52

$Q_1 = \frac{1(N+1)}{4} = \frac{21+1}{4} = \frac{22}{4} = 5.5$

$\frac{5\text{th} + 6\text{th value}}{2} = \frac{21+23}{2}$

$= 22.5$

$Q_3 = \frac{3(N+1)}{4} = \frac{3(21+1)}{4} = \frac{3 \times 22}{4}$

$\frac{66}{4} = 16.5$

$\frac{16\text{th} + 17\text{th value}}{2} = \frac{33+38}{2} = 35.5$

$P_{60} = \frac{60(n+1)}{100} = \frac{60(21+1)}{100} = \frac{60 \times 22}{100}$

$= \frac{1320}{100} = 13.2$

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Range = L - S Minimum value - minimum value.

Quartile Deviation = $\frac{L-S}{L+S}$

Mean Deviation

Standard Deviation

IQR - Inter-Quartile Range = $Q_3 - 1$ - 50% Area

$P_{90} - P_{10}$ - 80% Area

PR = Percentile Range

(i) $\frac{x}{0} = \infty$

(ii) $\frac{0}{x} = 0$

(iii) $\frac{\infty}{x} = 0$

(iv) $\frac{x}{0} = \infty$

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

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

$$P.R = P_{90}, P_{10}$$

$$P_{90} = l_1 + \frac{l_2 - l_1}{F}(P_{90} - c)$$

$$P_{90} = 90\left(\frac{N}{100}\right)$$

$$P_{10} = 10\left(\frac{N}{100}\right)$$

x | F | CF

)

$L = 2488, \quad S = 384$

$R = L - S$

$R = 2488 - 384$

$= 2104$

C of R

$$\frac{L - S}{L + S}$$

$$\frac{2488 - 384}{2488 + 384} = \frac{2104}{2872}$$

$$= 0.733$$

$L = 20, \quad S = -20$

$R = L - S$

$R = 20 - (-20)$

$= 40$

$$C \text{ of } R = \frac{L - S}{L + S} = \frac{(20) - (-20)}{(20) + (-20)} = \frac{40}{0} = \infty$$

$R = L - S$

$L = (-10)$

$S = (10)$

$10 - 1 = 9$

$$C \text{ of } R = \frac{L - S}{L + S} = \frac{10 - 1}{10 + 1} = \frac{9}{11} = 0.81$$

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2 (ii)

X	F
4	10
5	13
7	12
10	17
12	13
14	12

$R = L - S$

$L = 14, \quad S = 4$

$R = 14 - 4 = 10$

$C \text{ of } R = \frac{L-S}{L+S} = \frac{14-4}{14+4} = \frac{10}{18} = 0.555$

(i)

X	F
1	2
2	7
3	17
4	29
5	38
6	41
7	40
8	30
9	17
10	6

$L = 10$

$S = 1$

$R = L - S$

$10 - 1$

$= 9$

$R = L - S$

$= 51 - 1$

$= 50$

$\frac{L-S}{L+S} = \frac{50-1}{50+1} = \frac{50}{51}$

(iii)

x	F
5	4
10	6
15	12
20	8
25	2

$L = 25, S = 5$

$R = L - S$

$25 - 5$

$= 20$

$\frac{L-S}{L+S} = \frac{20-5}{20+5} = \frac{15}{25} = 0.833$

4

(i) C of $R = 0.5$

$L = 15$

$S = ?$

C of $R = \frac{L-S}{L+S}$

$0.5 = \frac{15-S}{(15+S)}$

$0.5 \times (15+S) = 15 - S$

$7.5 + 0.5S = 15 - S$

$0.5S + S = 15 - 7.5$

$1.5s = 7.5$

$s = \frac{7.5}{1.5}$

$s = 5$

5 (i) $Q_3 - Q_1 = 8$

$Q_3 + Q_1 = 22$

I.Q.D $= Q_3 - Q_1$

$= 22 - 8$

$= 14$

$\frac{L-S}{L+S} = \frac{22-8}{22+8} = \frac{14}{30} = 0.364$

(ii) $Q_1 = 12, Q_3 = 20$

$Q.D = \frac{Q_3 - Q_1}{2} = \frac{20-12}{2} = \frac{8}{2} = 4$

$C.Coff. = \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{20-12}{20+12} = \frac{8}{32}$

$= 0.25$

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Correlation

Types Degree of correlation - At a glance

Degree of Correlation	Positive coefficient of correlation	Negative coefficient of correlation
1. Perfect	+1	-1
2. High Degree	+0.75 to +0.99	-0.75 to -0.99
3. Moderate Degree	+0.25 to +0.75	-0.25 to -0.75
4. Low Degree	0 to +0.25	0 to -0.25
5. No correlation	0	0

Karl Pearson's Arithmatic mean
Assumed mean

$$r = \frac{\Sigma dx dy}{N \cdot \sigma x \cdot \sigma y}$$

$$\frac{\Sigma dx \cdot dy}{N \cdot \sqrt{\frac{\Sigma d^2 x}{N}} \times \sqrt{\frac{\Sigma d^2 y}{N}}}$$

$$r = \frac{\Sigma dx dy}{\sqrt{\Sigma d^2 x \Sigma d^2 y}}$$

x	$dx = x - \bar{x}$	d^2x	y	$dy = y - \bar{y}$	d^2y	$dxdy$

Sl.	X	$dx = x - \bar{x}$	d^2x	y	$dy = y - \bar{y}$	d^2y	$dx \cdot dy$
	12	$12 - 10 = +2$	4	14	$14 - 9 = +5$	25	10
	9	$9 - 10 = -1$	1	8	$8 - 9 = -1$	1	1
	8	$8 - 10 = -2$	4	6	$6 - 9 = -3$	9	6
	10	$10 - 10 = 0$	0	9	$9 - 9 = 0$	0	0
	11	$11 - 10 = +1$	1	11	$11 - 9 = 2$	4	2
	13	$13 - 10 = +3$	9	12	$12 - 9 = 3$	9	9
	7	$7 - 10 = -3$	9	3	$3 - 9 = -6$	36	18
	70		28	63		84	46

$$r = \frac{\Sigma dx\,dy}{\sqrt{\Sigma d^2x\ \Sigma d^2y}} = \frac{46}{\sqrt{28 \times 84}}$$

$$= \frac{46}{48.49} = \frac{28 \times 84}{}$$

$$= r = \pm 0.94$$

Positive high degree correlation.

3

x	$dx = x - \bar{x}$	d^2x	y	$dy = y - \bar{y}$	d^2y	dxdy
11	11 − 14 = −3	9	50	50−58 = −8	64	24
13	13 − 14 = −1	1	50	50−58 = −8	64	8
14	14 − 14 = 0	0	55	55−58 = −3	9	0
16	16 − 14 = 2	4	60	60−58 = 2	64	16
16	16 − 14 = 2	4	65	65−58 = 7	49	14
15	15 − 14 = 1	1	65	65−58 = 7	49	7
15	15 − 14 = 1	1	65	65−58 = 7	49	7
14	14 − 14 = 0	0	60	60−58 = 2	4	0
13	13 − 14 = 1	1	60	60−58 = 2	4	2
13	13 − 14 = 1	1	50	50−58 = −8	64	8
140		22	580		420	86

$\frac{140}{10} = 14$ $\qquad$ $\frac{580}{10} = 58$

$$r = \frac{\Sigma dx\,dy}{\sqrt{\Sigma d^2x \Sigma d^2y}}$$

$$\frac{86}{\sqrt{22 \times 420}} = \frac{86}{96.12}$$

$$= 0.8947$$