Mean Deviation :-

→ Individual Series

$$MD_{\bar{x}} = \frac{\Sigma |x - \bar{x}|}{N}$$ mean deviation from mean

$$MD_{median} = \frac{\Sigma |x - Med|}{N}$$ median $= \left(\frac{N+1}{2}\right)^{th}$ item size

$$MD_{mode} = \frac{\Sigma |x - mode|}{N}$$

Coefficients :-

$$M.D_{\bar{x}} = \frac{MD_{\bar{x}}}{\bar{x}} \qquad M.D_{median} = \frac{MD_{median}}{median}$$

$$M.D_{mod} = \frac{MD_{mode}}{mode}$$

Q] Calc mean deviation from mean as well as from median and coeff of mean deviation

ans 20, 22, 25, 38, 40, 50, 65, 70, 75

mean = 45 $MD_{\bar{x}} = \frac{160}{9} = 17.77$

x	(x-mean)	(x-median)
20	25	15
22	23	17
25	20	20
38	7	33
40	5	35
50	5	35
65	20	35
70	25	20
75	30	15
	Σ=160	200

$MD_{median} = 17.22$

Median = 40

coeff $MD_{\bar{x}} = \frac{17.78}{45} = 0.39$

coeff of $MD_{med} = \frac{17.22}{40} = 0.43$

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Discrete Series

$M.D_{\bar{x}} = \frac{\Sigma f|x-\bar{x}|}{N}$ $\quad \bar{x} = \frac{\Sigma fx}{N}$ or $\frac{\Sigma fx}{\Sigma f}$

coeff of $M.D_{\bar{x}} = \frac{MD_{\bar{x}}}{mean}$

$MD_{median} = \frac{\Sigma f|x-med|}{N}$ $\quad$ med = size of $\left(\frac{N+1}{2}\right)^{th}$ item

coeff of $M.D_{med} = \frac{MD_{med}}{median}$

$MD_{mode} = \frac{\Sigma f|x-mod)}{N}$ $\quad$ coeff = $\frac{MD_{mode}}{mode}$

Q]

x	f	$\lvert x-41\rvert$	$f\lvert x-41)$	cf	$\lvert x-med\rvert$	$f\lvert x-mod$
20	8	21	168	8	20	160
30	12	11	132	20	10	120
(40)	20	1	20	(40)	0	0
50	10	9	90	50	10	100
60	6	19	114	56	20	120
70	4	29	116	60	30	120
			640			620

$\bar{x} = \frac{\Sigma fx}{\Sigma f} = 41$ $\quad$ median = 40

$MD_{\bar{x}} = \frac{640}{60} = 10.66$ $\quad MD_{median} = \frac{620}{60} = 10.33$

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Continuous series

$MD_{\bar{x}} = \frac{\Sigma f|m-\bar{x}|}{\Sigma f}$ m = mid value of x

$\bar{x} = \frac{\Sigma fm}{\Sigma f}$ coeff of $MD_{\bar{x}} = \frac{MD_{\bar{x}}}{\bar{x}}$

x	f	cf	m	fm	$\lvert m-\bar{x}\rvert$	$f\lvert m-\bar{x}\rvert$
100-120	4	4	110	440	42.4	169.6
120-140	6	10	130	780	22.4	134.4
140-160	10	20	150	1500	2.4	24
160-180	8	28	170	1360	17.6	140.8
180-200	5	33	190	950	37.6	188
				5030		656.8

$\bar{x} = \frac{\Sigma fm}{\Sigma f} = \frac{5030}{33} = 152.4$

$MD_{\bar{x}} = \frac{656.8}{33} = 19.90$

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

$MD_{med} = \frac{\Sigma f|m-med|}{N}$

median class $= \frac{N+1}{2}$ th item

$= \frac{33+1}{2} = \frac{34}{2}^{th} = 17^{th}$

median class = 140-160

$med = l + \frac{\frac{N}{2} - cf}{f} \times i$

$= 140 + \frac{17-10}{10} \times 20$

$= 153$

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Standard deviation :-

- positive square root of arithmatic mean of squared deviation taken about mean of series

$$\sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N}}$$

S.D is always computed from mean because sum of deviations taken from mean is minimum.

discrete series

$$s.d = \sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{N}} = \sqrt{\frac{\Sigma f x^2}{N} - \left(\frac{\Sigma f x}{N}\right)^2}$$

$N = \Sigma f$

$\frac{\Sigma f x}{N}$ ↓ mean

Q] find std deviation

$$\sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{N}}$$

x	f	fx	x^2	fx^2
3	7	21	9	63
4	8	24	16	128
5	10	50	25	250
6	12	72	36	432
7	4	28	49	196
8	3	24	64	192
9	2	18	81	162
	46	237		1423

$$\sqrt{\frac{1423}{46} - \left(\frac{237}{46}\right)^2}$$

$$\sqrt{30.93 - 26.53}$$

$$\sigma = 2.09$$

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Continuous Series

$$\sigma = \sqrt{\frac{\Sigma fm^2}{N} - \left(\frac{\Sigma fm}{N}\right)^2}$$

x	f	m	fm	m^2	fm^2
0-10	5	5	25	25	125
10-20	10	15	150	225	2250
20-30	20	25	500	625	12500
30-40	40	35	1400	1225	49000
40-50	30	45	1350	2025	60750
50-60	20	55	1100	3025	60500
60-70	10	65	650	4225	42250
70-80	4	75	300	5625	22500
	139		5475		249875

$$= \sqrt{\frac{249875}{139} - \left(\frac{5475}{139}\right)^2}$$

$$= \sqrt{1797.66 - 1551.11}$$

$$\sigma = 15.69 \quad \text{ans}$$