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Statistics

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13.2

1.

Soln:

A distribution which is not symmetrical is known as skewed distribution. So in a skewed distribution mean, median and mode are not equal.

There are two types of skewness, they are:

(i) Positive skewness: When Mean > Median > Mode.

(ii) Negaive skewness: When Mean < Median < Mode.

Difference between skewness and dispersion.

Skewness	Dispersion

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It denotes the absence of symmetry of data. It gives the idea about direction of variation from mean, direction of mode. It helps us to determine the extent to which a central value is a representative of the whole distribution.	It Denotes the scatterness of data. It gives the idea about homogeneity and heterogeneity of distribution. It helps to determine the nature of variations of data on a either side of the central value like mean, median or mode.

The various measures of skewness are:

Absolute measure of skewnwss

(i) Karl Pearson’s measure of skewness = mean – mode or mean – median.

(ii) Bowley’s measure of skewness = $Q_3 + Q_1 - 2M_d$.

Relative Measure of skewness

(i) Karl Pearson’s coefficient of skewness.

$S_k(P)$ = (Mean – Mode)/S.D.

If mode is ill – defined than,

$S_k(P)$ =

(ii) Bowley’s coefficient of skewness,

$S_k(B)$ = .

2.

Soln:

Absolute measure of skewness are given by:

(i) Karl Pearson’s measure of skewness = Mean – Mode.

Or, Mean – Median.

(ii) Bowley’s measure of skewness = $Q_3 + Q_1 - 2M_d$

Relative measure of skewness is given by:

(i) Karl pearson’s coefficient of skewnwss,

$S_k(P)$ =

If Mode is ill – defined than.

S_k (P) = .

(ii) Bowley’s coefficient of skewness,

$S_k(B)$ = .

Skewness is positive if mean, median and mode of the frequency distribution satisfy the following condition: Mean > Median > Mode.

Skewness is negative is mean, median and mode of the frequency distribution satisfy the condition Mean < Median < Mode.

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3.

Soln:

(i) Here, Mean > Mode

So, it is positively skewed.

(ii) Here, Mean = Median = Mode,

So, it is symmetrical distribution.

(iii) Here, Median > Mean,

So, it is negatively skewed.

4.

Soln:

n = 50, $\sum^{x}$ = 150, $\sum^{x^2}$ = 600, M_o = 1.75

So, $\overline{x}$ = $\frac{\sum^{x}}{n}$ = $\frac{150}{50}$ = 3.

σ = $\sqrt{\frac{\sum^{x^2}}{n} - \left(\frac{\sum^{x}}{n}\right)^2}$ = $\sqrt{\frac{600}{50} - \left(\frac{150}{50}\right)^2}$ = $\sqrt{12-9}$ = $\sqrt{3}$ = 1.73.

Now, S_k (P) = $\frac{\bar{x}-M_o}{\sigma}$ = $\frac{11-12.45}{6.63}$ = -0.22

5.

a.

Soln:

We know,

C.V. = $\frac{\sigma}{\overline{x}}$ * 100%

Or, 5 = $\frac{2}{\overline{x}}$ * 100

So, Mean = 40.

Again, S_k(P) = $\frac{\bar{x}-M_o}{\sigma}$

Or, 0.5 = $\frac{40-M_o}{2}$

Or, M_o = 39.

So, M_o = 39.

b.

Soln:

We have,

S_k(P) = $\frac{3(\bar{x}-M_d)}{\sigma}$= $\frac{\bar{x}-M_o}{\sigma}$ …(i)

Form 2nd and 3rd ratio,

3$(\bar{x}-M_d)$ = $\bar{x}-M_o$

Or, 3$\bar{x}$ - $\bar{x}$ = 3M_d - M_o

Or, 2$\bar{x}$ = 3 * 17.4 – 15.3

Or, $\bar{x}$ = $\frac{36.9}{2}$

So, Mean($\bar{x}$) = 18.45

From 1st and last ratio,

Or, 0.35 = $\frac{18.45-15.3}{\sigma}$

Or, σ = $\frac{3.15}{0.35}$ = 9.

So, coefficient of variation = $\frac{\sigma}{\bar{x}}$ * 100% = $\frac{9}{18.45}$ * 100% = 48.78%.

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6.

a.

Soln:

Here, mean of A is greater then mean of B so distribution A is better, Also the median of A is greater than B, so A is more intelligent.

b.

Soln:

For distribution A,

Coefficient of variation (C.V.) = $\frac{\sigma}{\bar{x}}$ * 100% = $\frac{10}{100}$ * 100% = 10%.

$S_k(P)$ $\frac{3(\bar{x}-M_d)}{\sigma}$ = $\frac{3(100-90)}{10}$ = 3.

For distribution of B,

Coefficient of variation (C.V.) = $\frac{\sigma}{\bar{x}}$ * 100% = $\frac{10}{90}$ * 100% = 11.11 %.

$S_k(P)$ = $\frac{3(\bar{x}-M_o)}{\sigma}$ = $\frac{3(90-80)}{10}$ = 3.

So, C.V. (A) ≠ C.V. (B) but $S_k(P)$ for A = $S_k(P)$ for B.

7.

Soln:

Calculation of Coefficient of skewness,

Wages(x)	Frequency(f)	fx	x^2	fx^2
100	2	200	10,000	20,000
110	6	660	12,100	72,600
120	10	1,200	14,400	144,000
130	8	1,040	16,900	135,200
140	4	560	19,600	78,400
	N = 30	$\sum^{fx}$ = 3,660		$\sum^{f} x^2$ = 450,200

Now, $\bar{x}$ = $\frac{\sum^{fx}}{N}$ = $\frac{3660}{30}$ = 122.

Or, σ = $\sqrt{\frac{\sum^{f} x^2}{N} - \left(\frac{\sum^{fx}}{N}\right)^2}$ = $\sqrt{\frac{450200}{30} - (122)^2}$ = $\sqrt{15006.67 - 14884}$ = $\sqrt{122 - 67}$ = 11.07.

Since, the maximum frequency of given data is 10. So, M_o = 120.

So, $S_k(P)$ = $\frac{\bar{x}-M_O}{\sigma}$ = $\frac{122-120}{11.07}$ = 0.18.

8.

Soln:

Calculation of karl Pearson’s Coefficient of Skewness

Daily sales	Frequency	Mid – value (x)	fx	x^2	fx^2	C.F.

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0 – 10	2	5	10	25	50	2
10 – 20	9	15	135	225	2025	11
20 – 30	10	25	250	625	6250	21
30 – 40	7	35	245	1225	8575	28
40 – 50	2	45	90	2025	4059	30
	N = 30		$\sum^{fx}$ = 730		$\sum^{f} x^2$ = 20950.	

Here, $\bar{x} = \frac{\sum^{fx}}{N} = \frac{730}{30}$ = 24.33

Here, 10 is the maximum frequency, so(20 – 30) is the modal class,

Here, L = 20, f_1 = 10,f_0 = 9,f_2 = 7,h = 10,

So, $M_o = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} * h = 20 + \frac{(10-9)}{20-16} * 10 = 20 + \frac{10}{4}$ = 22.5

So, S.D.(σ) = $\sqrt{\frac{\sum^f x^2}{N} - \left(\frac{\sum^{fx}}{N}\right)^2} = \sqrt{\frac{20950}{30} - (24.33)^2} = \sqrt{698.33 - 591.95}$ = 10.31

Thus, $S_k(P) = \frac{\bar{x} - M_o}{\sigma} = \frac{24.33 - 22.5}{10.31}$ = 0.18.

9.

Soln:

Calculation of karl Pearson's Coefficient of Skewness

Weight	Frequency	Mid – value (x)	d = x – 65	fd	d^2	fd^2	c.f
40 – 50	5	45	-20	-100	400	2000	5
50 – 60	10	55	-10	-100	100	1000	15
60 – 70	15	65	0	0	0	0	30
70 – 80	8	75	10	80	100	800	38
80 – 90	2	85	20	40	400	800	40
	N = 30		$\sum^{fx}$ = -80				$\sum^{f} x^2$ = 4660

Here, $\bar{x} = a + \frac{\sum^{fd}}{N} = 65 + -\frac{80}{40}$ = 63.

Here, 15 is the maximum frequency, so(60 – 70) is the modal class,

Here, L = 60, f_1 = 15,f_0 = 10,f_2 = 8,h = 10,

So, $M_o = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} * h = 60 + \left(\frac{15-10}{2*15-10-8}\right) * 10$ = 60 + 417 = 64.17.

So, S.D.(σ) = $\sqrt{\frac{\sum^f d^2}{N} - \left(\frac{\sum^{fd}}{N}\right)^2} = \sqrt{\frac{4600}{40} - \left(-\frac{80}{40}\right)^2} = \sqrt{115 - 4}$ = 10.53.

Thus, $S_k(P) = \frac{\bar{x} - M_o}{\sigma} = \frac{63 - 64.17}{10.53}$ = - 0.11

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10.

Soln:

Calculation of karl Pearson's Coefficient of Skewness

Height	c.f.	f	Mid – value (x)	fx	x^2	fx^2
0 – 7 7 – 14 14 – 21 21 – 28	4 12 24 30	4 8 12 6	3.5 10.5 17.5 24.5	14 84 210 147	12.25 110.25 306.25 600.25	49 882 3675 3601.6
	N = 50		$\sum^{fx}$ = 445			$\sum^{f} x^2$= 8207.5

Here, $\bar{x} = \frac{\sum^{fd}}{N} = \frac{445}{30} = 14.84$

Here, 12 is the maximum frequency, so(14 – 21) is the modal class,

Here, L = 14, $f_1 = 12, f_0 = 8, f_2 = 6, h = 7$,

So, $M_o = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} * h = 14 + \left(\frac{12-8}{2*12-8-6}\right) * 7 = 14 + 2.8 = 16.8$

So, S.D.(σ) = $\sqrt{\frac{\sum^{f} d^2}{N} - \left(\frac{\sum^{fd}}{N}\right)^2} = \sqrt{\frac{8207.5}{30} - (14.84)^2} = 7.318$

Thus, $S_k(P) = \frac{\bar{x} - M_o}{\sigma} = \frac{14.84 - 16.8}{7.318} = -0.26$.

11.

Soln:

Calculation Of bowley's coefficient of skewness,

Variable	f	c.f
10 – 15	8	8
15 – 20	12	20
20 – 25	20	40
25 – 30	18	58
30 – 35	2	60
	N = 60	

Here, $\frac{N}{2} = \frac{60}{2} = 30$.

So, Median lies in the class (20 – 25).

Here, L = 20, $\frac{N}{2} = 30$.

c.f. = 20, f = 20, h = 5,

$M_d = L + \left(\frac{\frac{N}{2} - c.f,}{f}\right) * h = 20 + \frac{(30-20)}{20} * 5$.

= 20 + 2.5 = 22.5

Again, $\frac{N}{4} = \frac{60}{4} = 15$.

Q_1lies in the class (15 – 20).

Here, L = 15, $\frac{N}{4} = 15$,

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c.f. = 8, f = 12, h = 5,

$M_d = L + \left(\frac{\frac{N}{4} - c.f,}{f}\right) * h = 15 + \frac{(15-8)}{12} * 5.$

= 15 + 2.92 = 17.92

Again, $\frac{3N}{4} = \frac{3*60}{4} = 45.$

Q_3lies in the class (25 – 30).

Here, L = 25, $\frac{3N}{4} = 45,$

c.f. = 40, f = 18, h = 5,

$M_d = L + \left(\frac{\frac{3N}{4} - c.f,}{f}\right) * h = 25 + \frac{(45-40)}{18} * 5.$

$= 25 + \frac{25}{18} = 26.39.$

So, $S_k(B) = \frac{Q_3 + Q_1 - 2M_d}{Q_3 - Q_1} = \frac{26.39 + 17.92 - 2*22.5}{26.39 - 17.92} = -0.08$

12

Soln:

Since the given frequency distribution has opened ended class. So, the appropriate coefficient of skewenss is the skewness based on quartiles, i.e. Bowley's coefficient of skewness.

Calculation of Bowley's coefficient,

Income Group	Frequency	c.f.
Below 100	5	5
100 – 140	12	17
140 – 180	25	42
180 – 220	14	56
220 – 260	8	64
	N = 64	

Here, $\frac{N}{2} = \frac{64}{2} = 32.$

So, Median lies in the class (140 – 180).

$M_d = L + \left(\frac{\frac{N}{2} - c.f,}{f}\right) * h = 140 + \frac{(32-17)}{25} * 40$

= 164.

Again, $\frac{N}{4} = \frac{64}{4} = 4.$

Q_1lies in the class (100 – 140).

Here, L = 100, $\frac{N}{4} = 16,$

c.f. = 5, f = 12, h = 40,

$M_d = L + \left(\frac{\frac{N}{4} - c.f,}{f}\right) * h = 100 + \frac{(16-5)}{12} * 40$

= 136.67.

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Again, $\frac{3N}{4} = 3 * 16 = 48.$

Q_3lies in the class (180 – 220).

Here, L = 180, $\frac{3N}{4} = 48,$

c.f. = 42, f = 14, h = 40,

$M_d = L + \left(\frac{\frac{3N}{4} - c.f,}{f}\right) * h = 180 + \frac{(48-42)}{14} * 40 = 197.14.$

So, $S_k(B) = \frac{Q_3+Q_1-2M_d}{Q_3-Q_1} = \frac{197.14+136.67-2*164}{197.14-136.67} = \frac{5.81}{60.47} = 0.096.$

13.

Soln:

Re – arranging the given data for calculation of Karl Pearson's Coefficient,

Marks	f	Mid-value(x)	fx	c.f.	X^2	fx^2
20 – 30	4	25	100	4	625	2,500
30 – 40	16	35	560	20	1,225	19,600
40 – 50	6	45	270	26	2,025	12,150
50 – 60	16	55	880	42	3,025	48,400
60 – 70	8	65	520	50	4,225	33,800
	N = 50		$\sum^{fx}$ = 2,330			$\sum^{f} x^2$= 116,450

Here, $\bar{x} = \frac{\sum^{fx}}{N} = \frac{2330}{50} = 46.6$

Or,$(\sigma) = \sqrt{\frac{\sum^{f} d^2}{N} - \left(\frac{\sum^{fd}}{N}\right)^2} = \sqrt{\frac{116450}{50} - (46.6)^2} = \sqrt{2329 - 2171.56} = 12.55.$

Since, N = 50, $\frac{N}{2} = \frac{50}{2} = 25$

So, M_d lies in the class (40 – 50).

So, l = 40, $\frac{N}{2}$ = 25, c.f. = 20, f = 6, h = 10.

So, $M_d = l + \left(\frac{\frac{N}{2} - c.f}{f}\right) * h = 40 + \frac{25-20}{6} * 10$

= 40 + 8.33 = 48.33

So, $S_k(P) = \frac{3(\bar{x}-M_d)}{\sigma} = \frac{3(46.6-48.33)}{12.55} = -\frac{5.19}{12.55} = -0.41.$

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