5. Measures of Central Tendency

Exercises

Q1. Which average would be suitable in following cases?

(i) Average size of readymade garments.

(ii) Average intelligence of students in a class.

(iii) Average production in a factory per shift.

(iv) Average wage in an industrial concern.

(v) When the sum of absolute deviations from average is least.

(vi) When quantities of the variable are in ratios.

(vii) In case of open-ended frequency distribution.

Answer.

(i) Average size of readymade garments. Mode

Explanation: Mode is suitable average for average size of readymade garments because it gives the most frequent occurring value.

(ii) Average intelligence of students in a class. Median

Explanation: Median is a suitable average in case of a qualitative nature of the data.

(iii) Average production in a factory per shift. Mean

Explanation: Production can be measured on a quantitative scale so Arithmetic mean is suitable in this case.

(iv) Average wage in an industrial concern. Mean

Explanation: Wage can be measured on a quantitative scale so arithmetic mean is suitable in this case.

(v) When the sum of absolute deviations from average is least. Mean

Explanation: Mean shall be used because sum of deviations from mean is always zero or least than the other averages.

(vi) When quantities of the variable are in ratios. Mean

Explanation: Ratios are quantitative, so it is suitable to use arithmetic mean.

(vii) In case of open-ended frequency distribution. Median

Explanation: Median is used because there is no need to adjust class size or magnitude for using median.

Q2. Indicate the most appropriate alternative from the multiple choices provided against each question.

(i) The most suitable average for qualitative measurement is

(a) Arithmetic mean

(b) Median

(c) Mode

(d) Geometric mean

(e) None of the above

(ii) Which average is affected most by the presence of extreme items?

(a) Median

(b) Mode

(c) Arithmetic mean

(d) None of the above

(iii) The algebraic sum of deviation of a set of n values from A.M is

(a) N

(b) 0

(c) 1

(d) none of the above

Answer.

(i) The most suitable average for qualitative measurement is Median.

(ii) Arithmetic mean is the average affected by the presence of the extreme values.

(iii) 0 is the sum of deviations of a set of n values from AM.

Q3. Comment whether the following statements are true or false.

(i) The sum of deviation of items from median is zero.

(ii) An average alone is not enough to compare series. (iii) Arithmetic mean is a positional value.

(iv) Upper quartile is the lowest value of top 25% of items.

(v) Median is unduly affected by extreme observations.

Answer.

(i) The sum of deviation of items from median is zero. False

Explanation: Generally, sum of deviations from mean is zero; but only in the case of symmetric distribution (mean=median=mode) above statement is true.

(ii) An average alone is not enough to compare series. True

Explanation: Averages are very rigid values, they don't say anything about the variability of the series, and thus they are not enough to compare series.

(iii) Arithmetic mean is a positional value. False

Explanation: Arithmetic mean is not a positional value because it is calculated on the basis of all the observations.

(iv) Upper quartile is the lowest value of top 25% of items. True

Explanation: Quartile refers to a quarter, so when the frequency is arranged in a ascending order the upper quartile refers to the first 25% of the items.

(v) Median is unduly affected by extreme observations. False

Explanation: Median doesn't get affected by extreme observations because it only takes the median class to calculate it. It is mean which gets affected by extreme observations.

Q4. If the arithmetic mean of the data given below is 28, find
(a) the missing frequency, and
(b) the median of the series:

Profit per retail shop (in Rs)	0-10	10 -20	20-30	30-40	40-50	50-60
Number of retail shops	12	18	27	-	17	6

Answer.

(a) Let us take the missing frequency as x

Profit per retail shop (in Rs .) (X)	Number of retail shops (f)	Mid values (m)	fm
0-10	12	5	60
10-20	18	15	270
20-30	27	25	675
30-40	x	35	35x
40-50	17	45	765
50-60	6	55	330
	∑f = 80 + x		∑Fm = 2100 + 35x

Mean = ∑fm/∑f Mean = 28

Substituting the values in the formula we get,

$$28 = \frac{2100 + 35x}{80 + x}$$

28 x (80 + x) = 2100 + 35x

2240 + 28x = 2100 + 35x

7x = 140 x = 20

Thus, the missing value frequency is 20.

(b)

Profit per retail shop(in Rs) (X)	Number of retail shops (f)	Cumulative frequency (cf)
0-10	12	12
10-20	18	30
20-30	27	57
30-40	20	77
40-50	17	94
50-60	6	100
	∑f = 100	

Formula of median is as follow: Median
$= L + \frac{(N/2 - c.f)}{f} \times h$

By substituting the value in the formula we get,

$\text{Median} = 20 + \frac{(50 - 30)}{27} \times (30\text{-}20)$

$\text{Median} = 20 + \frac{(20)}{27} \times (10) = 20 + \frac{200}{27} = 20 + 7.41 = 27.41$

Thus the median value of the series is 27.41.

Q5. The following table gives the daily income of ten workers in a factory. Find the arithmetic mean.

Workers	A	B	C	D	E	F	G	H	I	J
Daily Income (in Rs .)	120	150	180	200	250	300	220	350	370	260

Answer.

Formula of mean is as follow:

Mean = $\frac{\text{Sum of all the observations}}{\text{No. of observations}}$

$= \frac{120+150+180+200+250+300+220+350+370+260}{10}$

$= \frac{2400}{10} = 240$

Thus, average income of the workers is Rs 240.

Q6. Following information pertains to the daily income of 150 families

Calculate the arithmetic mean.

Income (in Rs)	Number of families
More than 75	150
More than 85	140
More than 95	115
More than 105	95
More than 115	70
More than 125	60

More than 135	40
More than 145	25

Answer

Income (in Rs.)	Number of families f)	Mid values (x)	fx
75-85	10	80	800
85-95	25	90	2250
95-105	20	100	2000
105-115	25	110	2750
115-125	10	120	1200
125-135	20	130	2600
135-145	15	140	2100
145-155	25	150	3750
	∑f = 150		∑fx = 17450

Formula of mean is as follow:		
Mean = Sum of all the observations / No. of observations	=	∑fx / ∑f

= 17450/150 = 116.33

Thus, the average mean income for 150 families is Rs . 116.33.

Size of Land Holdings (in acres)	Less than 100	100-200	200-300	300-400	400 and above
Number of families	40	89	148	64	39

Q7. The size of land holdings of 380 families in a village is given below. Find the median size of land holdings.

Answer.

To calculate the mean size of holding, first calculate the cumulative frequency.

Size of land holdings (in acres) (X)	Number of families (f)	Cumulative frequency (cf)
0-100	40	40
100-200	89	129
200-300	148	277
300-400	64	341
400-500	39	380
	∑f =380	

Then, find the median frequency

Median frequency = N/2 = 380/2 = 190

Formula of median is as follow: Median = $L + \frac{(N/2 - c.f)}{f} \times h$

By substituting the value in the formula we get,

$= 200 + \frac{(190 - 129)}{148} \times 100 = 241.21$

Thus, the median size of land holding is 241.21 acres.

Q8. The following series relates to the daily income of workers employed in affirm. Compute (a) highest income of lowest 50% workers (b) minimum income earned by the top 25% workers and (c) maximum income earned by 25% workers.

Daily Income (in Rs)	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35-39**
Numbers of workers	**5**	**10**	**15**	**20**	**10**	**5**

Answer.

Daily income(in Rs)	Class interval (X)	Number of workers (f)	Cumulative frequency (cf)
10-14	9.5-14.5	5	5
15-19	14.5-19.5	10	15
20-24	19.5-24.5	15	30
25-29	24.5-29.5	20	50
30-34	29.5-34.5	10	60
35-39	34.5-39.5	5	65
		$\sum f = 65$	

a) To compute highest income of lowest 50% we need to calculate median

Median frequency = N/2 = 65/2 = 32.5

Formula for median is s follows

$$\text{Median} = L + \frac{(N/2 - c.f)}{f} \times h$$

By substituting the values in the formula, we get

$$\text{Median} = 24.5 + \frac{(32.5 - 30)}{20} \times 5$$

$$= 24.5 + 0.625 = 25.125$$

Highest income of lowest 50% workers is Rs 25.125.

b) For minimum income of 25% of workers we need to calculate Q_1.

First Quartile frequency = D/4 = 65/4 = 16.25

$$Q_1 = L + \frac{(N/4 - c.f)}{f} \times h$$

By substituting the values in the formula, we get

$$Q_1 = 19.5 + \frac{(16.25 - 15)}{15} \times 5 = 19.9166$$

Minimum income earned by the top 25% workers is Rs 19.92.

c) For maximum income of 25% of workers we need to calculate Q_3.

Third quartile frequency = 3(D/4) = 3 (65/4)= 48.75

$$Q_3 = L + \frac{(3(N/4) - c.f)}{f} \times h$$

By substituting the values in the formula, we get

$$Q_3 = 24.5 + \frac{(48.75 - 30)}{20} \times 5$$

$$= 24.5 + 4.6875 = 29.1875$$

Maximum income earned by 25% workers is Rs 29.19.

Q9. The following table gives production yield in kg. per hectare of wheat of 150 farms in a village. Calculate the mean, median and mode values.

Production yield (kg. per hectare)	50-53	53-56	56-59	59-62	62-65	65-68	68-71	71-74	74-77
Number of farms	3	8	14	30	36	28	16	10	5

Answer.

To calculate mean, median and mode values

Production yield (kg per hectare) (X)	Number of farms (f)	Mid values (m)	Cumulative Frequency (cf)	fm
50-53	3	51.5	3	154.5
53-56	8	54.5	11	436
56-59	14	57.5	25	805
59-62	30	60.5	55	1815
62-65	36	63.5	91	2286
65-68	28	66.5	119	1862
68-71	16	69.5	135	1112
71-74	10	72.5	145	725
74-77	5	75.5	150	377.5
	∑f =150			∑fm= 9573

Formula of mean is as follows:

$$\text{Mean} = \frac{\sum fm}{\sum f} = 9573/150 = 63.82 \text{ kg/hectare}$$

Formula of median is as follows: $\text{Median} = L + \frac{(N/2 - cf)}{f} \times h$

By substituting the value in the formula we get,

$$= 62 + \frac{(75 - 55)}{36} \times 3$$

$$= 62 + 1.67 = 63.67 \text{ kg/hectare}$$

Formula of mode is as follows: $\text{Mode} = L + \frac{d1}{d1 + d2} \times h$

By substituting the value in the formula we get,

$$= 62 + 6/6+8 \times 3 = 62 + 18/14 = 62 + 1.28$$

$$= 63.28 \text{ kg/hectare}$$

Mean, median and mode values are 63.82 kg/hectare, 63.67 kg/hectare and 63.28 kg/hectare.