Class Mark

* Central tendency:

Measures of central tendency are numerical indices that attempts to answer the question: What is the typical value of the observations in the distribution?

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* Popular measures of central Tendency

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1. Mean ——— Arithmatic mean
2. Median (মধ্যমা)   Geometric "
3. Mode   Harmonic "

Arithmatic mean:- Let us cosider n observations $x_1, x_2, \dots, x_n$

Arithmatic mean, $\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n}$

$= \frac{\sum_{i=1}^{n} x_i}{n}$

* $\bar{x} = \frac{16+18+19+20+22}{5} = \frac{95}{5} = 19$

... Bureau of statistics (BBS)

Age at first marriage x_i	Number of women f_i	$f_i x_i$
11	17	187
12	28	336
13	37	481
14	52	728
15	70	1050
16	48	768
17	36	612
18	23	414
19	11	209
20	8	160
	$\Sigma f_i = n = 330$	$\Sigma f_i x_i = 4945$

$$\text{Arithmatic mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$= \frac{4945}{330}$$

$$= 14.98$$

Let us have a grouped data as follows:-

Class limits	Frequency f_i	x_i	$f_i x_i$
14.5 – 19.5	1	17	17
19.5 – 24.5	6	22	132
24.5 – 29.5	9	27	243
29.5 – 34.5	2	32	64
34.5 – 39.5	2	37	74

~~এরকম~~ data থাকলে x_i

হবে $\dfrac{\text{upper limit} + \text{lower limit}}{2}$

যেমন প্রথমটির ক্ষেত্রে $x = \dfrac{14.5 + 19.5}{2} = 17$

So, Arithmatic mean $\bar{x} = \dfrac{\Sigma f_i x_i}{\Sigma f_i}$

$$= \frac{530}{20}$$

$$= 26.5$$

~~H.W [illegible] data [illegible] BPL worker [illegible]~~

Some Properties of Arithmetic mean:-

(1) Arithmetic mean is dependent on both origin and scale of measurement.

Proof:- Let x be a quantitative variable taking on values $x_1, x_2, \dots, x_n$. Let d be a new variable taking on values $d_1, d_2, \dots, d_n$ such that

$d_i = \frac{x_i - a}{h}$ where a and h are the change of origin and scale respectively.

$$\Rightarrow x_i = a + h d_i$$

$$\Rightarrow \Sigma x_i = \Sigma a + h \Sigma d_i.$$

$$\Rightarrow \frac{\Sigma x_i}{n} = \frac{\Sigma a}{n} + h \frac{\Sigma d_i}{n}.$$

$$\Rightarrow \bar{x} = \frac{na}{n} + h \cdot \bar{d}$$

$$\Rightarrow \bar{x} = a + h\bar{d}$$

So, arithmetic mean is dependent on both origin and scale.

$\Sigma \rightarrow$ এটার মানে হচ্ছে Summetion. এটার সাথে $i = 1$ to n মানে $\sum_{i=1}^{n}$ লিখতে হয়, শুধু Σ লিখলেও হয়, না লিখলে বুঝে নেওয়া যায় 1 to n আছে।

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(2) The algebric sum of the deviations of the values $x_1, x_2, \ldots, x_n$ from their arithmetic mean is zero. that is $\sum_{i=1}^{n}(x_i - \bar{x}) = 0$

Proof :- L.H.S : $\sum_{i=1}^{n}(x_i - \bar{x})$

$$= (x_1 - \bar{x}) + (x_2 - \bar{x}) + \cdots + (x_n - \bar{x})$$

$$= (x_1 + x_2 + \cdots + x_n) - (\bar{x} + \bar{x} + \cdots + \bar{x})$$

$$= \sum_{i=1}^{n} x_i - n\bar{x}$$

$$= \sum_{i=1}^{n} x_i - n \cdot \frac{\sum_{i=1}^{n} x_i}{n}$$

$$= \sum_{i=1}^{n} x_i - \sum_{i=1}^{n} x_i$$

$$= 0$$

$$= R.H.S$$

(proved)

Median

Median is that value in a data set which divides the set into two equal parts where the data set is arranged in ascending or descending order.

Formula of median:-

When n is not divisible by 2

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

Example:-

Let us have the values

13, 17, 12, 16, 19

At first we have to arrange the values either in ascending order or descending order.

12, 13, 16, 17, 19

Here, $n = 5$ which is not divisible by 2

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

$= \left(\frac{6}{2}\right)$ th value

$=$ 3rd value

our 3rd value is 16.

So Median $= 16$.

Let us add another value with the data set which is 10. So the new data set is

10, 12, 13, 16, 17, 19

Here, $n = 6$ which is divisible by 2.

$$\text{So median} = \frac{\left(\frac{n}{2}\right)\text{th value} + \left(\frac{n}{2}+1\right)\text{th value}}{2}$$

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

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

$$= \frac{13+16}{2}$$

$= \frac{29}{2} = 14.5$ is the median.