Weighted Mean (الوسط الحسابي المرجح (الموزون))

Weighted Mean: In many cases, it may be necessary to weight the values of the phenomenon with different sizes or weights to indicate the relative importance of the phenomenon

If we have the values $x_1, x_2, \dots, x_n$ and the corresponding weights are $w_1, w_2, \dots, w_n$ then the weighted Mean is as follows

① $$\bar{X}_w = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} = \frac{w_1 x_1 + w_2 x_2 + \dots + w_n x_n}{w_1 + w_2 + \dots + w_n}$$

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② $$\bar{X}_w = \frac{\sum_{i=1}^{n} w_i f_i x_i}{\sum_{i=1}^{n} w_i f_i}$$

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Ex: The following data present Marks and number of study hours of a student for a set of study materials. Find the student's mean in these classes

Degrees X_i	Numbe of study hours		
75	3	94	3
87	2	61	4
63	3		

new values becomes

$x_i = 12, 7, 6, 16, 14$

$$\bar{X} = \frac{12+7+6+16+14}{5}$$

$= 11$

$\bar{X}_{new} = \bar{X}_{old} + 4 = 7 + 4 = 11$

4- If every value of observation is multiplied in constant number like (K) then

$\bar{X}_{new} = \bar{X}_{old} \cdot K$

Ex: Let $x_i = 4, 3, 5, 3, 5$

$$\bar{X} = \frac{4+3+5+3+5}{5}$$

$= 4$

If we multiplied every value of x_i in constant Value (4) then the new values becomes

16, 12, 20, 12, 20

$$\bar{X}_{new} = \frac{16+12+20+12+20}{5}$$

$= 16$

$\bar{X}_{new} = \bar{X}_{old} * 4 = 4(4) = 16$

Probabilites of Arthimatic Mean

1- The sum of the deviations of the values of the variable x̀ its arithmetic mean equal zero

$\sum (x_i - \bar{x}) = 0$ status of unclassified data

$\sum f_i (x_i - \bar{x}) = 0$ status of tabulated data

Example:- Let us have the following five singular values. $x_i = 7, 4, 3, 9, 2$
show that the deviation of the values from their arithmetic mean is zero.

Solution:- $\bar{x} = \frac{7+4+3+9+2}{5}$

$= 5$

From this we find that the deviation of the x_i values from their arithmetic mean are equal to Zero

x_i	7	4	3	9	2
$x_i - \bar{x}$	$7-5=2$	$4-5=-1$	$3-5=-2$	$9-5=4$	$2-5=-3$

we notice that the sum of the seond raw is equal to zero $(2-1-2+4-3)$

2- $\sum (x_i-\bar{X})^2$ = As little as possible
The sum of the squares of the deviations of X values from their arithmetic mean is the least possible, that it, less than the sum of the squares of any other value.

Ex. $x_i = 9, 8, 6, 5, 7$
$\bar{X} = 7$

$$\sum_{i=1}^{5} (x_i-\bar{X})^2 = (9-7)^2 + (8-7)^2 + (6-7)^2 + (5-7)^2 + (7-7)^2$$
$$= 10$$

If we subtract from these values any number other than the arithmetic mean, let it $A = 10$

$$\sum_{i=1}^{5} (x_i-\bar{X})^2 = (9-10)^2 + (8-10)^2 + (6-10)^2 + (5-10)^2 + (7-10)^2$$
$$= 55$$

That is mean $55 > 10$
$\therefore \sum (x_i-\bar{X})^2$ = As little as possible.

3- When we add any constant number (k) to all values of obsevation then the arithmetic mean for the new values $= \bar{X} + K$

Ex: Let $x_i = 8, 3, 2, 12, 10$
$\bar{X} = \frac{35}{5} = 7$
if we add the constant value (4) then the

new values be comes

$x_i = 12, 7, 6, 16, 14$

$$\bar{X} = \frac{12+7+6+16+14}{5}$$

$= 11$

$\bar{X}_{new} = \bar{X}_{old} + 4 = 7 + 4 = 11$

4- If every value of observation is multiplied in constant number like (k) then

$$\bar{X}_{new} = \bar{X}_{old} \cdot k$$

Ex: Let $x_i = 4, 3, 5, 3, 5$

$$\bar{X} = \frac{4+3+5+3+5}{5}$$

$= 4$

If we multiplied every value of x_i in constant Value (4) then the new Values becomes

16, 12, 20, 12, 20

$$\bar{X}_{new} = \frac{16+12+20+12+20}{5}$$

$= 16$

$\bar{X}_{new} = \bar{X}_{old} * 4 = 4(4) = 16$