LECTURE 20

WEIGHTED ARITHMETIC AVERAGE

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Need for weighting an average : In the calculation of simple average, each item of the series is considered equally important but there may be cases where all items may not have equal importance, and some of them may be comparatively more important than the others. The fundamental purpose of finding out an average is that it shall "fairly" represent, so far as a single figure can, the central tendency of the many varying figures from which it has been calculated. This being so, it is necessary that if some items of a series are more important than others, this fact should not be overlooked altogether in the calculation of an average. If we have to find out the average income of the employees of a certain mill and if we simply add the figures of the income of the manager, an accountant, a clerk, a labourer and a watchman and divide the total by five, the average so obtained cannot be a fair representative of the income of these people. The reason is that in a mill, there may be one manager, two accountants, six clerks, one thousand labourers and one dozen watchmen, and if it is so, the relative importance of the figures of their income is not the same. Similarly, if we are finding out the change in the cost of living of a certain group of people and if we merely find the simple arithmetic average of the prices of the commodities consumed by them, the average would be unrepresentative. All the items of consumption are not equally important. The price of salt may increase by 500 per cent but this will not affect the cost of living to the extent to which it would be affected, if the price of wheat goes up only by 50%. In such cases, if an average has to maintain its representative character, it should take into account the relative importance of the different items from which it is being calculated. The simple average gives equal importance to all the items of a series.

Direct Method : In calculating the weighted arithmetic average, each value of the variable is multiplied by its weights and the products so obtained are aggregated. This total is divided by the total of weights and the resulting figure is the weighted arithmetic average.

Symbolically,

$$\overline{X}_w = \frac{X_1 w_1 + X_2 w_2 + X_3 w_3 + ... + X_n w_n}{w_1 + w_2 + w_3 + ... + w_n}$$

where $\overline{X}_w$ stands for the weighted arithmetic average, X_1, X_2, etc., for the values of the variable and w_1, w_2 etc., for their respective weights :

The formula can be written in short as :

$$\overline{X}_w = \frac{\sum Xw}{\sum w}$$

where, ΣXw stands for the sum of the products of the values and their respective weights, and Σw for the sum of the weights.

Indirect method : Weighted arithmetic mean can be calculated by an indirect method also where we assume an average and take the deviation from the assumed mean. These deviations are multiplied by respective weights of items. The sum of these products is then divided by the total of weights and added to the assumed average. This figure would be the value of the weighted arithmetic average.

Symbolically,

$$\overline{X}_w = A_w + \frac{\sum (dx) w}{\sum w}$$

where, $\overline{X}_w$ = weighted arithmetic mean; A_w = assumed mean weighted; dx = deviations of items from assumed mean; w = Weights of various items.

Example 2. Calculate simple and weighted arithmetic averages from the following data and comment

Designation	Monthly salary (in Rs.)	Strength of the cadre
Class I Officers	1,500	10
Class II Officers	800	20
Subordinate Staff	500	70
Clerical Staff	250	100
Lower Staff	100	150

Solution :

Computation of Simple and Weighted A.M.

Designation	Monthly salary in Rs. (X)	Strength of the cadre (w)	(Xw)
Class I Officers	1,500	10	15,000
Class II Officers	800	20	16,000
Subordinate Staff	500	70	35,000
Clerical Staff	250	100	25,000
Lower staff	100	150	15,000
N = 5	**ΣX = 3,150**	**Σ(w) = 350**	**Σ(Xw) = 1,06,000**

Simple arithmetic average = $\frac{\sum X}{N} = \frac{3150}{5}$ = Rs. 630

Weighted arithmetic average = $\frac{\sum (Xw)}{\sum w} = \frac{1{,}06{,}000}{350}$ = Rs. 302.857