

## Weighted Average<sup>1</sup> Quick Sheet<sup>2</sup>

A weighted Average is simply an average (arithmetic mean) of a set of values in which each value is interacted with a complementing value of some sort.

For example, you might want to know the weighted average price of apples purchased at different stores. To do this we'll think of each purchase apple purchase to include a quantity and a price. We'll call the quantity  $X_i$  and price  $E_i$ , with the subscript "i" simply representing the different quantities. Suppose we purchase 50 apples at store 1 ( $X_1$ ) with a price of \$.69 each ( $E_1$ ), 35 apples at store 2 ( $X_2$ ) with a price of \$0.75 each ( $E_2$ ) and 60 apples at store 3 ( $X_3$ ) with a price of \$0.65 each ( $E_3$ ). We could simply add up the amount we paid at each store ( $X_i \times E_i$ ) and divide this by the total number of apples ( $X_1+X_2+X_3$ ).

Store (i)	Quantity (X)	Price (E)	Quantity x Price		Total Paid	Total Paid / Total Quantity
1	50	0.69	50 x 0.69	$X_1 \times E_1$	34.50	
2	35	0.75	35 x 0.75	$X_2 \times E_2$	26.25	
3	60	0.65	60 x 0.6	$X_3 \times E_3$	39.00	
Total	145				99.75	

The Total Paid/Total Quantity =  $99.75/145 = 0.69$ , which is the weighted average price per apple.

We can generalize this with the equation  $\frac{\sum X_i \times E_i}{\sum X_i}$  and then make it more specific with the equation  $\frac{X_1 E_1 + X_2 E_2 + X_3 E_3}{X_1 + X_2 + X_3}$ .

Let's say that Y is the sum of all  $X_i$ s ( $\sum X_i = Y$ ) such that we have the percentage of Y represented by each  $X_i$  ( $\frac{X_i}{Y} = Y_i$ ) multiplied by each  $E_i$  resulting in  $\frac{X_i}{Y} E_i$ . The sum of these is equal to  $\frac{X_1 E_1 + X_2 E_2 + X_3 E_3}{X_1 + X_2 + X_3}$ , which we can simplify as  $\frac{X_1}{Y} E_1 + \frac{X_2}{Y} E_2 + \frac{X_3}{Y} E_3$  which is the weighted average equation.

$\sum Y_i E_i = \text{Weighted Average}$				
Individual Inputs	Sum of Inputs	Individual Weights	Sum of Weights	Effects
$X_i$	$\sum X_i = Y$	$\frac{X_i}{Y} = Y_i$	$\sum Y_i = 1$	$E_i$

<sup>1</sup> This is intended to present an abbreviated presentation of the included concepts in corporate finance and is not intended to be a full or complete representation of the concepts, models, metrics or the underlying foundations from which they are built.

<sup>2</sup> This material set was provided by Richard Haskell, PhD, Associate Professor of Finance, Bill and Vieve Gore School of Business, Westminster College, Salt Lake City, Utah (2017), [rhaskell@westminstercollege.edu](mailto:rhaskell@westminstercollege.edu).