

# Section 3.2

## Weighted and Trimmed Means and Outliers

# **Lesson 5:**

## **Weighted Means - Percentage of a Total**

In a **weighted mean**, the data points are not all of equal value. For example, a teacher might assign different weights to different parts of a student's grade: assignments might be worth 45% of the final grade, a quiz worth 15%, and an exam worth the remaining 40%. In this case, each data point is worth a percentage of the total.

**weighted mean:** the mean  
calculated when certain data  
entries are worth more than  
others

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**Example 2**

Frieda earned grades of 85%, 72%, 65%, and 90% on four tests in one term in her math class.

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- a) If each test were worth the same percentage of her final grade, what would be her final grade?

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### SOLUTION

- a) If all the tests were worth the same percentage of her final grade, her final grade could be calculated using the arithmetic mean.

$$x = \frac{85 + 72 + 65 + 90}{4}$$

$$\bar{x} = \frac{312}{4}$$

$$\bar{x} = 78\%$$

Frieda's final grade would be 78%.

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**Example 2**

Frieda earned grades of 85%, 72%, 65%, and 90% on four tests in one term in her math class.

- b) What was her term mark if the first test was worth 10% of her final grade, the second and third were each worth 20%, and the fourth test was worth 50%?

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**Example 2**

Frieda earned grades of 85%, 72%, 65%, and 90% on four tests in one term in her math class.

- b) What was her term mark if the first test was worth 10% of her final grade, the second and third were each worth 20%, and the fourth test was worth 50%?

**SOLUTION**

- b) In this case, each test is worth a percentage of the final grade. This is a weighted mean. To find her final grade, you need to find 10% of her first grade, 20% of each of the next two, and 50% of the last and add the percentage values together.



## Example 2

Frieda earned grades of 85%, 72%, 65%, and 90% on four tests in one term in her math class.

- b) What was her term mark if the first test was worth 10% of her final grade, the second and third were each worth 20%, and the fourth test was worth 50%?

### SOLUTION

$$\bar{x} = (85 \times 0.10) + (72 \times 0.20) + (65 \times 0.20) + (90 \times 0.50)$$

$$\bar{x} = 8.5 + 14.4 + 13 + 45$$

$$\bar{x} \approx 81\%$$

The weighted mean is 81%.

**You Try:**

**#4 on page 126**

**(solution on next slide)**

Assignment 3<sup>4</sup>.

$$8/10 = 80\% \quad 6.5/10 = 65\% \quad 16/20 = 80\%$$

$$\text{Ave} = \frac{80 + 65 + 80}{3} = \frac{225}{3} = 75$$

$$\text{Weighted Ave} = 75 \times 0.15 + 85 \times 0.25$$

$$+ 100 \times 0.05 + 70 \times 0.05 + 70 \times 0.05$$

$$+ 86 \times 0.45$$

$$= 11.25 + 21.25 + 5 + 3.5 + 3.5 + 38.7$$

$$= 83.2\%$$

## Example:

In Workplace & Apprenticeship 30, a student's mark is a weighted mean as follows:

- assignments and quizzes are worth 35%
- unit exams are worth 50%
- the final exam is worth 15%

If a student in this class averaged 75% on their assignments and quizzes, 70% on their unit exams, **what grade would they need to get on their final exam in order to have an overall mark of 75%?**

## Solution:

$$\begin{array}{l} \text{weighting} \times \text{grade} \\ \text{(assignment/quiz)} \end{array} + \begin{array}{l} \text{weighting} \times \text{grade} \\ \text{(unit exams)} \end{array} + \begin{array}{l} \text{weighting} \times \text{grade} \\ \text{(final exam)} \end{array} = \text{final overall grade}$$

## Solution:

$$\begin{array}{l} \text{weighting} \times \text{grade} + \text{weighting} \times \text{grade} + \text{weighting} \times \text{grade} = \text{final overall grade} \\ \text{(assignment/quiz)} \quad \quad \quad \text{(unit exams)} \quad \quad \quad \text{(final exam)} \\ (0.35) \times 75\% \end{array}$$

## Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\%$$

## Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL}$$



## Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL} = 75\%$$

## Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL} = 75\%$$

$$26.25 + 35 + (0.15) \times \text{FINAL} = 75$$

## Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL} = 75\%$$

$$26.25 + 35 + (0.15) \times \text{FINAL} = 75$$

$$(0.15) \times \text{FINAL} = 75 - 26.25 - 35$$

## Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL} = 75\%$$

$$26.25 + 35 + (0.15) \times \text{FINAL} = 75$$

$$(0.15) \times \text{FINAL} = 75 - 26.25 - 35$$

$$(0.15) \times \text{FINAL} = 13.75$$

### Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL} = 75\%$$

$$26.25 + 35 + (0.15) \times \text{FINAL} = 75$$

$$(0.15) \times \text{FINAL} = 75 - 26.25 - 35$$

$$(0.15) \times \text{FINAL} = 13.75$$

$$\frac{(0.15) \times \text{FINAL}}{(0.15)} = \frac{13.75}{(0.15)}$$

### Solution:

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL} = 75\%$$

$$26.25 + 35 + (0.15) \times \text{FINAL} = 75$$

$$(0.15) \times \text{FINAL} = 75 - 26.25 - 35$$

$$(0.15) \times \text{FINAL} = 13.75$$

$$\frac{(0.15) \times \text{FINAL}}{(0.15)} = \frac{13.75}{(0.15)}$$

$$\text{FINAL} = 91.666666$$

### **Solution:**

weighting x grade + weighting x grade + weighting x grade = final overall grade  
(assignment/quiz) (unit exams) (final exam)

$$(0.35) \times 75\% + (0.50) \times 70\% + (0.15) \times \text{FINAL} = 75\%$$

$$26.25 + 35 + (0.15) \times \text{FINAL} = 75$$

$$(0.15) \times \text{FINAL} = 75 - 26.25 - 35$$

$$(0.15) \times \text{FINAL} = 13.75$$

$$\frac{(0.15) \times \text{FINAL}}{(0.15)} = \frac{13.75}{(0.15)}$$

$$\text{FINAL} = 91.666666$$

**The student would need to get approximately 92% on the final exam to have an overall mark of 75%.**

**You Try:**

**#5 on page 127**

**(solution on next slide)**



$$75\% \times 0.2 + 80\% \times 0.2 + 86\% \times 0.2 + \text{Final} \times 0.4 = 86\%$$

$$15 + 16 + 17.2 + \text{Final} \times 0.4 = 86$$

$$\text{Final} \times 0.4 = 86 - 15 - 16 - 17.2$$

$$\text{Final} \times 0.4 = 37.8$$

$$\text{Final} = 37.8 / 0.4 = 94.5$$

He would need to get **94.5% on his final exam** to achieve a final grade of 86%.

# **Lesson 6:**

## **Weighted Means - Repeating Items**

The weighted mean calculation can be used in another situation, when there is repetition of entries in the data set. The end result is the same as the arithmetic mean, but the calculation may be easier.

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**Example 3**

In her job as a server at a restaurant, Glenna earned 2 tips of \$6.00, 3 tips of \$8.00, 3 tips of \$10.00, and 6 tips of \$12.00.

Calculate the mean tip using two different methods.

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### Example 3

In her job as a server at a restaurant, Glenna earned 2 tips of \$6.00, 3 tips of \$8.00, 3 tips of \$10.00, and 6 tips of \$12.00.

Calculate the mean tip using two different methods.

#### SOLUTION

Method 1: The mean tip can be calculated using the arithmetic mean calculation.

$$\text{sum of tips} = \$6.00 + \$6.00 + \$8.00 + \$8.00 + \$8.00 + \$10.00 + \$10.00 + \$10.00 + \\ \$12.00 + \$12.00 + \$12.00 + \$12.00 + \$12.00 + \$12.00$$

$$\text{sum of tips} = \$138.00$$

$$\bar{x} = \frac{\$138.00}{14}$$

$$\bar{x} \approx \$9.86$$

Glenna's mean tip was \$9.86.

### Example 3

In her job as a server at a restaurant, Glenna earned 2 tips of \$6.00, 3 tips of \$8.00, 3 tips of \$10.00, and 6 tips of \$12.00.

Calculate the mean tip using two different methods.

Method 2: Calculate the tip as a weighted mean. Group the tips by value

$$\bar{x} = \frac{(2 \times \$6.00) + (3 \times \$8.00) + (3 \times \$10.00) + (6 \times \$12.00)}{2 + 3 + 3 + 6}$$

$$x = \frac{\$12.00 + \$24.00 + \$30.00 + \$72.00}{14}$$

$$\bar{x} = \frac{\$138.00}{14}$$

$$\bar{x} = \$9.86$$

Glenna's mean tip was \$9.86.

# Homework:

## Build Your Skills

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#4, 5, 6

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#7, 8, 9

## Practise Your New Skills

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#2, 4, 5