

Weighted Mean Scores

Report Calculations: Weighted Mean

The weighted mean is a mean where there is some variation in the relative contribution of individual data values to the mean. Each data value (X_i) has a weight assigned to it (W_i). Data values with larger weights contribute more to the weighted mean and data values with smaller weights contribute less to the weighted mean. The formula is:

$$\bar{X}_w = \frac{\sum W_i X_i}{\sum W_i}$$

There are several reasons why you might want to use a weighted mean

1. Each individual data value might actually represent a value that is used by multiple people in your sample. The weight, then, is the number of people associated with that particular value.
2. Your sample might deliberately over represent or under represent certain segments of the population. To restore balance, you would place less weight on the over represented segments of the population and greater weight on the underrepresented segments of the population.
3. Some values in your data sample might be known to be more variable (less precise) than other values. You would place greater weight on those data values known to have greater precision.

Further reading

http://www.xycoon.com/weighted_mean.htm

http://en.wikipedia.org/wiki/Weighted_mean

Example Weighted Mean Scores

Example:

Let us take the example of a category “History” within a Case, which has 5 questions. The Category is scored on a scale of 1 to 5. Where 1 is poor and 5 is excellent and the scores for each grade is not linear but defined based on some standards (as depicted in the table under column Score) within the institute. The minimum pass for the “History” category is 40%.

Student A

| Question Number | SP Response | Score | Maximum Score | Percentage Score | Weight | Weighted Score |
|-----------------|-------------|-------|---------------|------------------|--------|----------------|
| 1 | 5 | 3.5 | 3.5 | 100.00 % | 0.5 | 50.00 |
| 2 | 4 | 2.75 | 3.5 | 78.57 % | 0.5 | 39.29 |
| 3 | 3 | 2.0 | 3.5 | 57.14 % | 1 | 57.14 |
| 4 | 1 | 0.5 | 3.5 | 14.29 % | 2 | 28.58 |
| 5 | 2 | 1.0 | 3.5 | 28.57 % | 3 | 85.71 |

$$\begin{aligned}
 \text{The Score for the History Category} &= \frac{\text{Sum of Weighted Score}}{\text{Sum of the Weights}} \\
 &= \frac{50.00 + 39.29 + 57.14 + 28.58 + 85.71}{(0.5 + 0.5 + 1 + 2 + 3)} \\
 &= \frac{260.72}{7} = 37.25 \%
 \end{aligned}$$

Example:

Let us take the example of a case “Chest Pain” within a Form, which has 4 categories. The Category scores are calculated as described in the previous section. The category scores are calculated as a percentage and then the weights are applied to each category to get the weighted score for each category. The weighted average score is then calculated for the case based on individual category scores and the weightage of each category within the case. The minimum score required for passing this case is 60%.

Student A

| Category Name | % Score | Minimum Pass % | Must Pass | Weight | Weighted Score |
|---------------|---------|----------------|-----------|--------|----------------|
| History | 65 | 60 | No | 1.5 | 97.50 |
| Physical | 80 | 65 | No | 0.5 | 40.00 |
| Communication | 55 | 50 | Yes | 1 | 55.00 |
| ACIR | 45 | 40 | Yes | 2 | 90.00 |
| Patient Note | 54 | 50 | No | 1.5 | 81.00 |

$$\begin{aligned}
 \text{The score for the “Chest Pain” Case} &= \frac{\text{Sum of Weighted Score}}{\text{Sum of the Weights}} \\
 &= \frac{97.50 + 40.00 + 55.00 + 90.00 + 81.00}{(1.5 + 0.5 + 1 + 2 + 1.5)} \\
 &= \frac{363.50}{6.5} = 55.92 \%
 \end{aligned}$$

Student A will be marked as “Fail” for this case because the minimum pass required for case is 60% and the student weighted average score was only 55.92 %.

Student B

| Category Name | % Score | Minimum Pass % | Must Pass | Weight | Weighted Score |
|---------------|---------|----------------|-----------|--------|----------------|
| History | 70 | 60 | No | 1.5 | 105.00 |
| Physical | 80 | 65 | No | 0.5 | 40.00 |
| Communication | 45 | 50 | Yes | 1 | 45.00 |
| ACIR | 60 | 40 | Yes | 2 | 120.00 |
| Patient Note | 70 | 50 | No | 1.5 | 105.00 |

$$\begin{aligned}
 \text{The score for the "Chest Pain" Case} &= \frac{\text{Sum of Weighted Score}}{\text{Sum of the Weights}} \\
 &= \frac{105.00 + 40.00 + 45.00 + 120.00 + 105.00}{(1.5 + 0.5 + 1 + 2 + 1.5)} \\
 &= \frac{415.00}{6.5} = 69.17\%
 \end{aligned}$$

Student B will be marked as "Fail" for this case, even though student B scored 69.17% which is more than the minimum required for this case. The student did not pass the communication category and got only 45%, overall based on the "Must Pass" requirement for Communication Category, hence Student B will be marked as failed.

Example:

Let us take the example of a Form "Neurological" with three cases in the system and the "Brain Tumor" marked as a must pass for the student in order to pass the test session for the Neurological Form specification. The Case scores are calculated as described in the previous section and each student is marked as pass or fail for each case. The case scores are calculated as a percentage and then the weights are applied to each case to get the weighted score for each case. Weighted average score is calculated for the form based on individual case scores and the weight of each case within the form. In order to pass this Test Session, a student must have a score of 60% for the form and must pass the Brain Tumor Case.

Student A

| Case Name | % Score | Minimum Pass % | Must Pass | Weight | Weighted Score |
|--------------|---------|----------------|-----------|--------|----------------|
| Brain Tumor | 65 | 60 | Yes | 2.0 | 130.00 |
| Chest Pain | 55 | 60 | No | 1.5 | 82.50 |
| Cough & Cold | 75 | 65 | No | 0.5 | 37.50 |

$$\begin{aligned}
 \text{The score for the "Neurological" Form} &= \frac{\text{Sum of Weighted Score}}{\text{Sum of the Weights}} \\
 &= \frac{(130.00 + 82.50 + 37.50)}{(2.0 + 1.5 + 0.5)} \\
 &= \frac{250.00}{4.0} = 62.5\%
 \end{aligned}$$

The Student A will be marked as Pass for the test session as the calculated score is 62.5% and the student has also passed the "Brain Tumor" case with 65% score.

Student B

| Case Name | % Score | Minimum Pass % | Must Pass | Weight | Weighted Score |
|--------------|---------|----------------|-----------|--------|----------------|
| Brain Tumor | 60 | 60 | Yes | 2.0 | 120.00 |
| Chest Pain | 50 | 60 | No | 1.5 | 75.00 |
| Cough & Cold | 70 | 65 | No | 0.5 | 35.00 |

The score for the “Neurological” Form = $\frac{\text{Sum of Weighted Score}}{\text{Sum of the Weights}}$
 = $\frac{(120.00 + 75.00 + 35.00)}{(2.0 + 1.5 + 0.5)}$
 = $\frac{230.00}{4.0} = 57.5\%$

The Student B will be marked as “Fail” for the test session as their score is 57.5% which is less than the minimum pass score required for the “Neurological” Form. The student passed the “Brain Tumor” case with 60% score, but since the weighted average score for the form is less than the minimum pass score required for the form, the student will be marked as failed.

Student C

| Case Name | % Score | Minimum Pass % | Must Pass | Weight | Weighted Score |
|--------------|---------|----------------|-----------|--------|----------------|
| Brain Tumor | 57 | 60 | Yes | 2.0 | 114.00 |
| Chest Pain | 75 | 60 | No | 1.5 | 112.50 |
| Cough & Cold | 90 | 65 | No | 0.5 | 45.00 |

The score for the “Neurological” Form = $\frac{\text{Sum of Weighted Score}}{\text{Sum of the Weights}}$
 = $\frac{(114.00 + 112.50 + 45.00)}{(2.0 + 1.5 + 0.5)}$
 = $\frac{271.50}{4.0} = 67.875\%$

The Student C will be marked as Failed for the test session even though the weighted mean average score is 67.875 %, which is higher than the minimum pass score. The student failed in the case marked as a “Must Pass” for them. The student C got 57 % score for the “Brain Tumor” which was a must pass requirement for the student. (Dhingra,Sukhtej,2006)

WORKSHEET

| Question Number | Evaluator Response | Score | Maximum Score | Percentage Score | Weight | Weighted Score |
|-----------------|--------------------|-------|---------------|------------------|--------|----------------|
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The Score for the Category = $\frac{\text{Sum of Weighted Score}}{\text{Sum of the Weights}}$