MarkBook®

Class Management Software

MARKBOOK MATH

AN AID TO UNDERSTANDING

Index

January 2021

Introduction

As teachers, one of the many difficult tasks we are faced with is coming up with a final grade for each student. A single number that best represents a students level of achievement. But that single number must be the distillation of many individual numbers representing achievement on a large number of individual assessments. What's the best way to do this?

Well, the bad news is that there is no perfect way to achieve this goal, but there will be a best way for you and for your students. MarkBook provides several options. Here is how each of them works.

1. Average

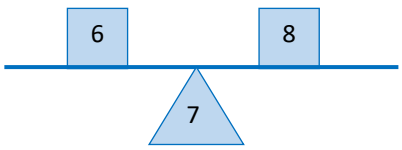
Historically, the most common method of determining this single representative number is by calculating the *Average*. In mathematics this is called the *Arithmetic Mean* but this document is meant to clarify, not confuse so we will call it the *Average*.

The Average (Mean) is found by adding up all of the numbers then dividing by the number of numbers. Confused? Consider this example.

We will start with a very simple case. Suppose you have 5 assignments, each is the equally important and you marked each of them out of 10. Suppose a student achieved these results:

Assignment #	Student's Mark	Out of
1	6	10
2	9	10
3	10	10
4	9	10
5	6	10

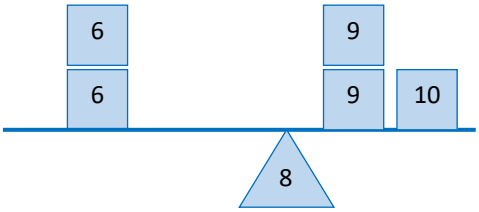
What we are trying to do is find a mark that would be the summary of all of these marks —a single value that represents the overall achievement. If it was just two marks, say 6 and 8 then the answer is easy — it is 7 as that lies between 6 and 8. Mathematically, you can calculate this by adding 6 and 8 then divide by 2: 6+8 = 14 14÷2=7.



With 5 numbers, its much harder to eyeball the value that provides the summary, and less precise. So we resort then to the calculation method. Add the numbers up, then divide by 5, the number of assignments.

Add up the numbers: 6+9+10+9+6=40
Divide by the number of assignments: 40÷5=8

So the average is 8. A single number that represents the combination of all 5 assignments.



OK, that was easy but mostly because each of the assignments was out of 10. Presumably the are equal in importance and therefore should contribute equally to the final grade. But that's not the real world. You have small assessments like quizzes and maybe reports, larger assessments like unit tests and essays and large assessments like exams and everything in between. How do we find the center of all of those?

2. The Weighted Average

Getting closer to the real world, lets change our sample marks.

Assessment	Student's Mark	Out Of
Vocabulary Quiz	3	5
Sentence Structure Assignment	16	20
Newspaper Article	7	10
Library Assignment	18	25
Unit Test	31	40

If you feel that the Out Of mark for each assessment accurately reflects the importance of each item, that is, that the Unit Test is 4 times more important than the Vocabulary Quiz and that the Library assignment is half as important as the Unit Test, etc. then there is a shortcut to determining the Weighted Average which takes into consideration the importance of each item.

We call this the Weighted Average as some items will contribute more heavily to the final result than others. In this case, in proportion to the Out Of score.

The shortcut works like this.

Add up all of the Marks that the student has earned and divide that by the total of the marks that could have been earned (the total of the Out Of) and finally, multiply by 100 to turn the result into a percent.

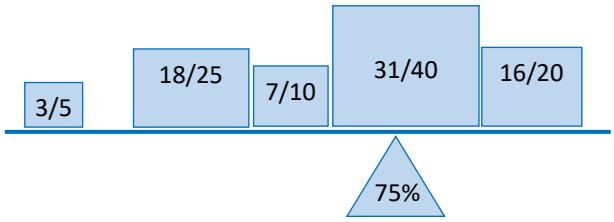
So total marks earned = 3+16+7+18+31= 75

The total possible marks = 100

The weighted average = 75/100 =75%

Looks like a lot of work to do for an entire class? Don't fret—that's why you are using MarkBook.

Here's what that looks like. The size of the box indicates the Out Of mark and therefore the weight or importance.



Weighted Average using the Out Of mark
to indicate importance (weight)

MarkBook Pro Tip : Calculating a Weighted Average using Out Of scores as weights

1. For each entry set the weight equal to the Out Of Mark
2. Set the Weight Method as Entry
3. Tell MarkBook to use Average as the Calculation Method

   From the main screen, select Mark Sets

   - On the Mark Sets screen, select Edit Mark Set Details
   - Set the Calculation Method to Average

Relax knowing that MarkBook has effortlessly and accurately done your calculations

3. Entry Importance

While using the Out Of mark is an indicator of the importance of a mark, that doesn't always fit the situation.

For example, you may be using a grading scheme that produces a mark out of 50 regardless of whether you are grading a small, less important assessment or a major assessment.

To manage this situation we will add a piece of information to our chart. The "Importance". The importance will influence how much weight an entry has in the final calculation. The greater the importance, the more that mark will contribute to the final grade. Consider the Importance as a Multiplier for each Entry—X3 has the same impact as if that entry was included three separate times compared to an entry with an importance of X1.

Assessment #	Student's Mark	Out of	Importance
1	30	50	10
2	45	50	15
3	50	50	10
4	45	50	20
5	30	50	40

Well, the arithmetic is starting to get more complicated now. So let's keep it simple. Let's assign each assessment some points. The points will be calculated by dividing the student's mark by the Out Of and then multiplying by the importance.

For Assessment #1:

30 ÷ 50 x 10 = 6 points

The points reflect the student's achievement and the importance. The higher the student's mark, the greater the points. The higher the importance, the greater the points.

Assessment #	Student's Mark	Out of	Importance	Points
1	30	50	10	6
2	45	50	15	13.5
3	50	50	10	10
4	35	50	20	14
5	30	50	40	24
		Total	95	67.5

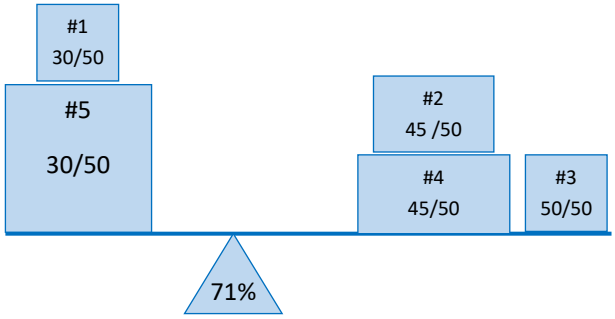
This shows some interesting things. For assignment #3, although the student scored a perfect 10/10 this only contributed 10 points. That's because the importance is low.

Assignment #5, where the student's achievement was just 60%, contributed more points. That's because the importance is high indicating a more important assessment.

The overall mark is found by dividing the Total Points by the of the importance values then multiply by 100 to get a percentage:

67.5 ÷ 95 x 100 = 71%

The picture looks pretty much the same but this time the size of the box indicates the Weight, not the Out Of.



Weighted Average using the Entry Importance

MarkBook Pro Tip : Calculating a Weighted Average using Entry Inportance

1. For each entry set the importance equal to the desired value
2. Tell MarkBook to use Average as the Calculation Method

   From the main screen, select Mark Sets

   - On the Mark Sets screen, select Edit Mark Set Details
   - Set the Calculation Method to Average

What are you going to do with the extra time MarkBook saved you with this calculation?

4. The Median—Finding the Middle Of the Road

The median is another way of finding that one number that summarizes a set of numbers. Just as a median divides a highway into two equal parts, the Median calculation finds the middle of a set of numbers. For example, the median height of Canadian men is 177 cm. That means that half of the men in Canada are taller than 177 cm and half are shorter.

Let's consider this set of results:

Assignment #	Student's Mark	Out of
1	6	10
2	9	10
3	10	10
4	8	10
5	6	10

To find the median we must first put the numbers in order from lowest to highest:

Rank	#1	#2	#3	#4	#5
Mark	6	6	8	9	10

Then you pick the value that is in the middle. That's #3, so the median is 8. There are the same number of marks higher than 8 as there are lower than 8.

But, what happens if there is an even number of marks? There is no middle number!

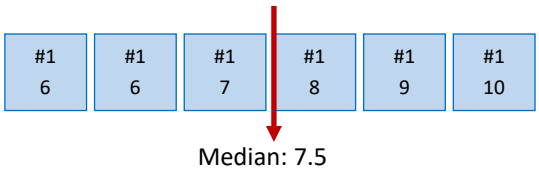
Rank	#1	#2	#3	#4	#5	#6
Mark	6	6	7	8	9	10

The middle of this group is between #3 and #4 so the Median is 7.5—halfway between.

5. A Weighted Median

Just as we did with the Average, we want to be able to reflect the relative importance of each assessment.

Here is another way of representing the Median calculation:

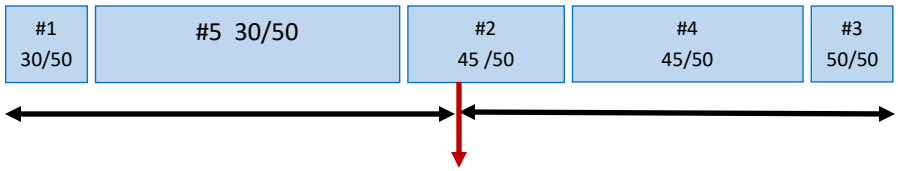


The size of each box represents the importance of each item. All of these boxes are the same size so all the items are of equal importance.

Let's add the importance value to our chart just like we did with the Average:

Assessment #	Student's Mark	Out of	Importance
1	30	50	10
2	45	50	30
3	50	50	10
4	45	50	30
5	30	50	40

Now let's see what that looks like if we draw the width of each box in proportion to its importance and put them in order.



The Median is 45/50 = 90%

Again, we are finding the median by finding the middle point. Half of the total importance is above the median, and half is below.

MarkBook Pro Tip : Calculating a Weighted Median Using Entry Importance

1. For each entry set the importance equal to the desired value
2. Tell MarkBook to use Median as the Calculation Method

   From the main screen, select Mark Sets

   - On the Mark Sets screen, select Edit Mark Set Details
   - Set the Calculation Method to Median

6. Mode—Using Bins for Collection Waypoints

A third way of finding the number to represent total achievement is to use the Mode. **The Mode is the most frequently occurring value.** Let's suppose you did a survey of the shoe sizes of the students in your classby having each student place one shoe in a bin corresponding to their shoe size and came up with the following result:

Shoe Size Bin	# of students
5	1
5 1/2	3
6	5
6 1/2	7
7	9
7 1/2	1
8	2

More students are wearing size 7 shoes than any other size, so the Mode is 7.

There are some caveats with using the Mode to represent data. For it to be a reliable indicator you need to have a large number of data items and few bins. In this example, there are 28 data items and 7 bins.

This means there may be limitations in using the Mode for student achievement. There needs to be a large number of assessments and there must be bin or Mode containers. That means that using the mode to determine an overall grade when you mark assessments out of 100 and there might be only 10 assessments is not going to give you a meaningful result.

A partial solution is to use letter grades or levels. This groups the data into a smaller number of categories so fewer assessments are needed. But this still means that the mode might not be a good indicator of student achievement during the early part of a term or semester but becomes more useful towards the end.

Here is an example of how the mode might be used with Levels as bins:

Level	# of assess-ments
4+	0
4	2
4-	7
3+	6
3	4
3-	2
2+	0
2	1
2-	0
1+	0
1	0
1-	0
R	0

The Mode is 4-. There were more assessments at that level than any other level.

However there are just 22 assessments spread over 13 levels so that can mean that this is not entirely reliable.

Reducing the number of levels to just 5, this becomes

Level	# of assess-ments
4	9
3	12
2	1
1	6
R	4

Now the mode is 3. So which is it, this student's overall achievement level is 4+ or 3?

That's where you come in. The best determiner of student achievement is the teacher. Your goal in using mode is likely to try and determine the student's most consistent level of performance. No matter what mathematical tool you use to produce a number to represent a student's overall achievement it is up to you to use your professional judgement to determine if that number is accurate or needs to be modified.

You may wish to calculate using the Average (Mean), Median and Mode, then compare the results to give you the complete picture.

MarkBook makes this easy, you just select the calculation method you wish to use and it will instantly recalculate and show you the results..

MarkBook Pro Tip : Calculating using Mode

1. Tell MarkBook to use Mode as the Calculation Method

   From the main screen, select Mark Sets

   - On the Mark Sets screen, select Edit Mark Set Details
   - Set the Calculation Method to Mode

Using Categories

Categories are a way of organizing assessments. You may wish to establish categories to group similar assessments like tests, quizzes, reports, assignments and exams. Or perhaps you would like to use categories based on what the assessments are evaluating such as Knowledge and Understanding, Inquiry, Communication and Application.

Categories can be more than just organizers, they can be used to reflect the relative importance of each of the areas. You may attach a value to each category to reflect its importance. In MarkBook these are called Category Weights.

Here are two examples of Using Category Weights.

Category	Weight
Quizzes	10
Tests	30
Reports	20
Assignments	30
Exam	30

Category	Weight
Knowledge & Understanding	30
Inquiry	20
Communication	20
Application	30

Notice that the Category Weights do not have to add up to 100 but that can be convenient as that will mean that the Category Weight is a percentage of the total.

If you do not use categories then the contribution of each assessment to the total grade is determined by the Importance that you have assigned to the assessment.

If you choose to use Category Weights the contribution of each assessment is determined by the Importance assigned to the assessment in combination with the Category Weight.

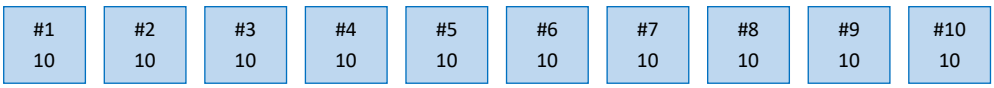
MarkBook Pro Tip : Comparing Calculation Methods

You can quickly compare the effect of the different calculation methods used in MarkBook.

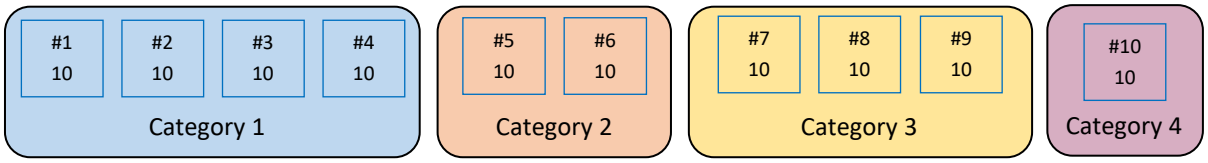
On the **Class Report** form, click the **Compare** Tab. The calculated result using each method is displayed for every student. This will help guide you in choosing the method you feel best represents student achievement and also will alert you to any unexpected results hat may occur.

Let's see how the use of category weights affects the calculations.

We will use a very simple example at first. Presume that you have 10 assessments each with and Importance Value of 10. Each assessment then contributes equally to the final grade.



Now let's organize these into some categories



That shouldn't change the final result calculation should it? Well it won't if you continue to use Entry Weight Calculation. However if you use Category Weight calculations things may change.

For Category Weight calculations, a Category Mark is calculated using either Average, Median or Mode for the items within the category, then the Average of the summary marks is calculated to give the final grade. Let's add some detail.

As there are so few values in the chart I will use Average as the way of calculating the Category Mark

Category	Assessment	Mark/10	Category Mark	Category Weight
1	1	7	(7+8+8+5)/4= 7	25
1	2	8		
1	3	8		
1	4	5		
2	5	7	(7+9)/2 = 8	25
2	6	9		
3	7	6	(6+8+8)/3 = 7	25
3	8	8		
4	9	7		
4	10	10	10	25

For this example we will assume that the Category Weights are all the same. Each Category contributes equally to the final Mark. To calculate the final mark then, the Category Marks are combined by averaging them.

Final Mark = (7 +8 + 7 + 10)/4 = 8 or 80%

Now you might be thinking, why is this important. Won't I get the same result by just calculating the average of all of the marks?

Well, the simple average of the marks, ignoring the categories is 7.5 or 75%. Why is this different?

The answer lies in considering how much each assessment is contributing to the total. The single assessment in Category 4 is contributing 1/4 of the final mark!

Assessment 1, only makes up 1/4 of Category 1, so it makes up just 1/16 of the final mark!

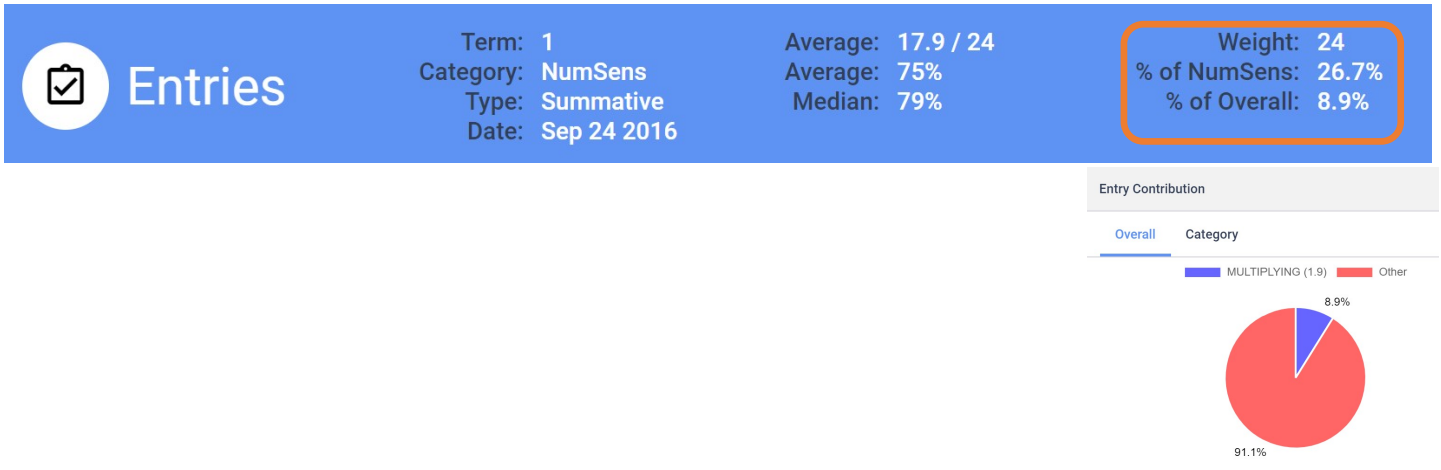
Here is the chart with that information added. The Contribution column indicates what percent each assessment contributes to the total.

Category	Assessment	Mark/10	Contribution	Category Mark	Category Weight
1	1	7	6 1/4 %	(7+8+8+5)/4= 7	25
1	2	8	6 1/4 %		
1	3	8	6 1/4 %		
1	4	5	6 1/4 %		
2	5	7	12 1/2%	(7+9)/2 = 8	25
2	6	9	12 1/2%		
3	7	6	8 1/3 %	(6+8+8)/3 = 7	25
3	8	8	8 1/3 %		
4	9	7	8 1/3 %		
4	10	10	25%	10	25

Notice that the actual grade on the assessment has no effect on the contribution. It is determined only by the Importance value assigned to the assessment and the Weight of the Category

The Contribution is an important measurement to consider to prevent an unexpected situation where a fairly insignificant assessment ends up contributing more than intended. This can easily happen if that insignificant assessment is the only one in a category. It will contribute the full category weight regardless of how small the importance value is.

Fortunately MarkBook makes it easy for you to monitor the Contribution as it is displayed in the Entries screen.



Category Weights

You may also choose to adjust category weights to reflect a situation where categories are not equal in their contribution to the overall grade. Changing the category weights may change the overall mark depending on the distribution of grades.

Category weights do not have to add up to 100 although that is a convenient total as each categories weight then is a percentage.

Here is an example where the category weights add up to 125.

Category	Assessment	Mark/10	Contribution	Category Mark	Category Weight	Contribution to Overall Grade
1	1	7	6 1/4 %	(7+8+8+5)/4= 7	50	50/125 X 100% = 40%
1	2	8	6 1/4 %			
1	3	8	6 1/4 %			
1	4	5	6 1/4 %			
2	5	7	12 1/2%	(7+9)/2 = 8	25	25/125 x 100%= 20%
2	6	9	12 1/2%			
3	7	6	8 1/3 %	(6+8+8)/3 = 7	35	35/125 x 100% = 28%
3	8	8	8 1/3 %			
4	9	7	8 1/3 %			
4	10	10	25%	10	15	12%

The overall grade is determined in the same way as we calculated the weighted average on page 3 in section 2. Points for each category are calculated based on the student's achievement in the category and the weight of the category

Category	Category Mark	Category Weight	Contribution to Overall Grade	Points
1	7	50	40%	7 x 40% = 2.8
2	8	25	20%	8 x 20% = 1.6
3	7	35	28%	7 x 28% = 1.96
4	10	15	12%	10 x 12% = 1.2

So, for this example, the overall mark is:

2.8 + 1.6 + 1.96 + 1.2 = 7.56 out of 10. or 75.6 %

Blended Calculations-

MarkBook also provides two Calculation Methods that combine the power of the methods above with a special technique called “Blended Calculations”

The two methods are Blended Median and Blended Mode. The sorting and grouping methods of Median and Mode which are then combined with category weights for the entries in the Mark Set to blend the categories together.

Blended Median

This calculation determines the middle mark for each category and the calculates a weighted average of these medians based on the category weights assigned. More heavily weighted categories make a larger contribute to the final mark.

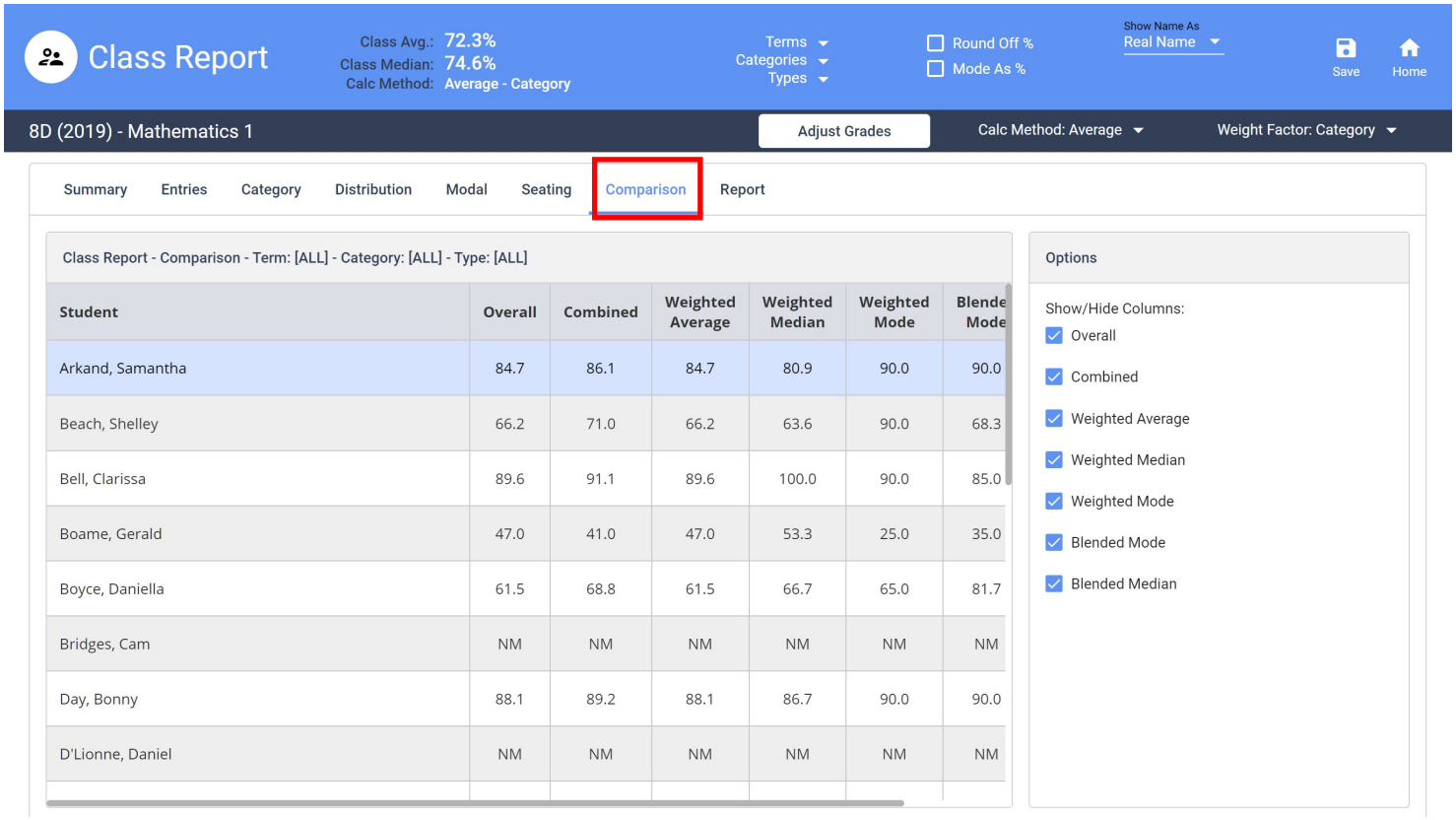
A variant of Blended median may be calculated by using the importance to provide more emphasis on the more recent results.

Blended Mode

This method also combines the results based on Category by determining the “most consistent” results for each category using the Bins (mode). Again the Bin that contains the largest number of results in each category is combined with the other categories in a weighted average.

Comparing Calculation Methods and Using Informed Professional Judgement (Adjust Grades)

Comparing Calculation Methods and Using Informed Professional Judgement



MarkBook provides you with a very powerful tool to compare the effect of the the various calculation methods described in this document.

Select Class Report from the Home screen and then click the Comparison tab. You will be shown the results for each student as they are calculated by the 6 different methods available. The Overall column displays the result using the currently chosen method.

You can change the calculation method at any time when in you feel that a different method is more appropriate.

You may also use your professional judgement to override the calculation and assign a grade that you feel more appropriately reflects that student's level of achievement.

Click **Adjust Grades** and enter the new mark that you wish to have associated with the students.

And Finally—

MarkBook provides you with a very powerful tool for recording, calculating, analyzing and displaying assessment results. The final choice of which methods to use relies on you to use your professional judgment to apply the tools to meet your assessment needs.

MarkBook is also extremely flexible. You can change marks, categories, weights and calculation methods at any time. There is no need to preset any of these values and if you later find that a decision you have made is not producing the most appropriate results for you, you can change any of them without having to re-enter any data.

MarkBook can help you and your students by simplifying and clarifying the mysteries of assessment and evaluation.