OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

Introduction to Mean and Standard Deviation

Student Worksheet

By now you know that scientists need to use data to support their explanations about the natural world. But how can you interpret your data or know if you have enough data to have confidence in your conclusions? This activity will help you learn how to make two calculations that are commonly used in statistical analysis.

Mean-the value obtained by dividing the sum of several quantities by their number; an average.

Standard deviation- a quantity calculated to indicate the extent of deviation for a group as a whole.

Introduction to Mean

Most people have some familiarity with the concept of average. Let's look at a couple examples to get a better idea of how it works. Make a quick guess about the average of this set of numbers

Practice Data set

2	7	5	7	9	11	5	8

Estimate of mean:_____

Now calculate it by finding the sum of the numbers. Sum:_____

Now divide the sum by the quantity of numbers you added up (there were 8 numbers). Mean:_____

How do you think the mean would change if the lowest and highest numbers were removed?

_____

Now calculate the new mean with the lowest and highest number removed. New mean: _____

If all you did was remove the highest and lowest, why did the mean change?

_____

_____

Now let's look at standard deviation. Most people are not nearly as familiar with standard deviation, but it is not that complicated. In the data set above the lowest value was 4.75 below the mean of 6.75. This is called the variance. Two data sets can have the same average with very different variance. For example consider the following rosters of these two basketball teams. Calculate the average.

Pirates Tigers

Player	Height (ft)	Player	Height (ft)
1	5.8	1	5
2	6	2	6
3	6	3	4.8
4	6.2	4	7
5	6	5	7.2
Mean height		Mean height	

The mean height is the same but the teams are very different. One way to describe this would be with standard deviation. Calculating standard deviation takes more steps but is not difficult. Use the data tables below to calculate SD. The first row is done for you. The last step is finding the square root of the total of the last column after dividing the total by the number of data points.

Pirates	Data points	Difference from the mean	(Difference from the mean)^2
	5.8	0.2	0.04
Total			
Mean >>>>>		Average of last column >>>>	

Take the sum of the squared values, divide by the number of observations (data points), then take the square root of that sum. Standard deviation: _____

Tigers	Data points	Difference from the mean	(Difference from the mean)^2
Total			
Mean >>>>>		Average of last column >>>>	

Take the sum of the squared values, divide by the number of observations (number of data points), then take the square root of that sum. Standard deviation: _____

So now you have calculated standard deviation twice. Not that difficult right? Here is the equation for standard deviation:

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

σ = population standard deviation

N = the size of the population

x_i = each value from the population

μ = the population mean

Yes you did that math. You must be a math genius.

Practice with data you collect

Now we will practice this still with data we collect and see how this data can be useful.

Data collection:

Field scientists will often use the length of their pace as a way to make measures of distance in the field. In order to do this you must know how long your pace is and how much your pace varies.

Procedure:

Count the number of paces it takes to walk the distance your instructor lays out. You will just walk back and forth counting your steps.

1. Start with your toe on one line and count the number of steps it takes to get your toe to the other line.
2. It is appropriate to estimate a partial, final step following your instructor's guidelines.
3. Turn around and repeat your count for a total of ten trials.
4. Record your data below.

Trial	**Number of steps**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Mean	

Look at some of your classmates' data. Notice how much your pace differs and how much the number of steps differs in each trial. If you have large differences in your number of steps each time your measurements will be unreliable. But how much difference is too much?

We can use a standard deviation calculation to compare you to your classmates.

Trial	Data points	Difference from the mean	(Difference from the mean)^2
Total			
Mean >>>>>		Average of last column >>>>	

Standard deviation (square root of average squared difference (total from last column divided by number of data points)): _____

Look at three of your classmates' standard deviations:

Classmate 1: _____ Classmate 2: _____ Classmate 3: _____