Topic 6: Evolution – 6c. Standard Deviation

Resources:

Miller, K, Levine, J. (2004). *Biology.* Boston, MA: Pearson Prentice Hall.

Sholty, M. Fantasy Football: Using Standard Deviation to Your Advantage [Internet]. Bleacher Report. 2009 July 28. Available from: http://bleacherreport.com/articles/225828-fantasy-football-using-standard-deviation-to-your-advantage

Triola, M. (1992). *Elementary Statistics,* 5th edition. New York, NY: Addison-Wesley Publishing Company.

Building on:

Evolution is change. *Microevolution* is the change in the frequency of an allele in a population. *Macroevolution* is a change in a *population* over time that can lead to a new species. If a particular characteristic is measure for a population, say the neck length on giraffes, and a *histogram* showing the number of giraffes with necks within a set range is constructed, the histogram will probably be in the shape of a *bell curve.* This is typical of a *stable population.* When graph peaks at one extreme, this is considered *directional selection,* and if the graph peaks has two peaks, one at each extreme, this is *disruptive selection. Standard deviation* can be used to see how many are clustered around the *mean* (a small standard deviation) or spread out from the mean (a large standard deviation). The standard deviation combined with the histogram can be used to predict changes taking place in a species that may lead to new species.

Links to Chemistry and Physics:

Statistical analysis

Stories:

Fantasy football may not have very much to do with evolution, but it can be used as an example of using standard deviation to look at statistics. Michael Shorty, writing for the website, *Bleacher Report*, shows how he used standard deviation to decide which was more important to draft in the early rounds of his fantasy football league, a quarterback or a running back. Using the fantasy league points earned last year by quarterbacks he uses standard deviation to compare them with the points earned by running backs. If the standard deviation is small for the quarterbacks that indicates there is very little deviation in the points that they earned. That also means that which quarterback you draft is not that critical. If the standard deviation in the points earned by the quarterbacks is large, then some quarterbacks must be a lot better or worse than others. That would make the quarterback selection important. The same can be done for the running backs and all of the other positions.

Sholty found that it was more important to draft good running backs early because he found that the standard deviation in their points earned the previous year was considerably larger than the standard deviation for the quarterbacks.

To read the details of Shorty's article, go to:
http://bleacherreport.com/articles/225828-fantasy-football-using-standard-deviation-to-your-advantage

Materials for this Lab:

- Meter sticks
- Calculators
- Graph paper if you want a histogram constructed
- Board for recording the class data

Are You Average??

Standard Deviation

The **standard deviation** is a statistic that tells you how tightly all the various examples are clustered around the mean in a set of data. It is kind of like finding the average of the average. Let me put it this way, if the class average for shoe size is an 11, you might think this class has really big feet. However, there may be a cluster of big-footed guys with size 14 or even 15 feet while the rest of the class has average to low average foot sizes. This is where standard deviation can help you. If everyone in the class has big feet and their shoe sizes are all close to size 11, then the standard deviation will be small. If the first scenario is true, a cluster of big-footed guys and the rest of the class average of low average for foot size, then the standard deviation will be large.

Standard deviation can be used for comparing any group of related data such as:

1. Height
2. Arm span
3. Or lots of other things

Calculating Standard Deviation

1. Measure each member of your data set (the length of your right foot) and record them on the data chart.
2. Calculate the mean for your group of data. (average foot length)
3. For each member of your data set (each foot), subtract the average length from the length of that particular foot, and record it on the data chart in the column called "Deviation." Note that some values may be positive and some may be negative.
4. Next, square the deviation value for each member of your data set (for each foot) and record that in the column labeled "D^2." Note that by squaring the deviation values, you have gotten rid of all of your negative values (a negative X a negative = a positive).
5. Add all the values in the D^2 column and record them at the bottom as the "Sum of Squares."
6. Now get the average of the Sum of Squares (divide the sum of squares by the number of feet measured in your data set). The answer is called the variance. Record this number in the box labeled, "Variance."
7. Finally, take the square root of the variance and you will have the standard deviation. Record this in the box that is labeled, "Standard Deviation."

The standard deviation tells you that about 68% of the right feet in your class should have a length that is the mean length + or - the standard deviation. So, if the mean length was 27.9 cm and the standard deviation was 1.4 cm, that would mean that about 68% of the feet in class should be between 27.9+ or -.1.4 cm (between 26.5 cm and 29.3 cm).

Foot Length (cm)	Deviation	D^2
	Sum of Squares	=
Average Mass (g)	=	
	Variance	=
	Standard Deviation	=

1. How many feet were within one standard deviation?
2. How many feet were above one standard deviation?
3. How many feet were below one standard deviation?
4. If you made a bar graph with number of feet versus standard deviations, what shape do you think it would be?