Calculating the Mean and Standard Deviation

Many of the questions from the patient satisfaction surveys include rating scales. This will require calculating means and standard deviations for data analysis. This can be done using popular spreadsheet software, such as Microsoft Excel®, or even online calculators. If neither of these is readily available, both the mean and standard deviation of a data set can be calculated using arithmetic formulas. Following are brief descriptions of the mean and standard deviation with examples of how to calculate each.

The Mean

For a data set, the mean is the sum of the observations divided by the number of observations. It identifies the central location of the data, sometimes referred to in English as the average. The mean is calculated using the following formula.

$$M = \frac{\Sigma(X)}{N}$$

Where Σ = Sum of
X = Individual data points
N = Sample size (number of data points)

Example: To find the mean of the following data set: 3,2,4,1,4,4.

$$M = \frac{3+2+4+1+4+4}{6} = \frac{18}{6} = 3$$

The Standard Deviation

The standard deviation is the most common measure of variability, measuring the spread of the data set and the relationship of the mean to the rest of the data. If the data points are close to the mean, indicating that the responses are fairly uniform, then the standard deviation will be small. Conversely, if many data points are far from the mean, indicating that there is a wide variance in the responses, then the standard deviation will be large. If all the data values are equal, then the standard deviation will be zero. The standard deviation is calculated using the following formula.

$$S^2 = \frac{\Sigma(X-M)^2}{n - 1}$$

Where Σ = Sum of
X = Individual score
M = Mean of all scores
N = Sample size (number of scores)

Example: To find the Standard deviation of the data set: 3,2,4,1,4,4.

Step 1: Calculate the mean and deviation.

X	M	(X-M)	$(X\text{-}M)^2$
3	3	0	0
2	3	-1	1
4	3	1	1
1	3	-2	4
4	3	1	1
4	3	1	1

Step 2: Using the deviation, calculate the standard deviation

$$S^2 = \frac{(0+1+1+4+1+1)}{(6-1)} = \frac{8}{5} = 1.6$$

$$S = 1.265$$

What to Infer from the Mean and Standard Deviation

As explained previously, if the data points are close to the mean, indicating that the responses are fairly uniform, then the standard deviation will be small. Conversely, if many data points are far from the mean, indicating that there is a wide variance in the responses, then the standard deviation will be large. However, the standard deviation alone is not particularly useful without a context within which one can determine meaning.

A standard deviation of 1.265 with a mean of 3, as calculated in our example, is much different than a standard deviation of 1.265 with a mean of 12. By calculating how the standard deviation relates to the mean, otherwise known as the coefficient of variation (CV), you will have a more uniform method of determining the relevance of the standard deviation and what it indicates about the responses of your sample. The closer the CV is to 0, the greater the uniformity of data. The closer the CV is to 1, the greater the variability of the data.

$$CV = \frac{S}{M}$$

Using our example of a standard deviation of 1.265 and a mean of 3, you will see that the coefficient of variation is rather large, indicating that the data has a great deal of variability with respect to the mean and there is not general consensus among the sample.

$$CV = \frac{S}{M} = \frac{1.265}{3} = .42$$

Using the example of a standard deviation of 1.265 and a mean of 12, you will see that the coefficient of variation is rather small, indicating that the data has a greater deal of uniformity with respect to the mean and there is a general consensus among the sample.

$$CV = \frac{S}{M} = \frac{1.265}{12} = .11$$