I. Summation

$\sum$ the summation sign indicates that entities should be summed.

So, consider the following example of a set of numbers: 2, 3, 6, 9, -4

What is the sum?

We can think of the numbers in terms of a variable, X.

$X_1 = 2$
$X_2 = 3$
$X_3 = 6$
$X_4 = 7$
$X_5 = -4$

$$\boxed{\sum_{i=1}^{N} X}$$

can be described as "sum all the cases in X from case 1 to case N (N represents the number of cases in the population—in this case, N=5).

Note, if one is dealing with a sample rather than a population, lower case "n" is used instead of "N".

$\overline{X}$ refers to the mean of variable x in a sample

μ refers to the mean of x in a population

So,

$$\mu = \frac{\sum_{i=1}^{N} X}{N}$$

And

$$\overline{X} = \frac{\sum_{i=1}^{n} X}{n}$$

II. **Variance and standard deviation**

σ^2 stands for the population variance

while

s stands for the sample variance

So,

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

and

$$s^2 = \frac{\sum (\bar{X} - X_i)^2}{n-1}$$

Why n-1 instead of n when we are calculating out a sample variance? Remember that the sample variance is really an "estimate" of the population variance. Whenever we are estimating something we think in terms of "degrees of freedom"—which can be thought of as the amount of information we have to calculate an estimate of the sample variance. When calculating the sample variance, we've used up one piece of information because we needed to first estimate the sample mean. Therefore, we only have n-1 degrees of freedom remaining. Simulations have demonstrated that calculating the sample variance in this manner makes it a more unbiased (that is, a more accurate) estimate of the population variance.

How does one calculate the standard deviation of a variable, either in a sample or in the population? Just take the square root of the variance.