Standard Deviation

In statistics, we often have a list of data values that we want to be able to concisely describe. For example, how could we describe the list of numbers (1, 2, 8, 9) ? Besides reporting the size of the list, we are mainly interested in two things: some measure of "central tendency", such as a mean (i.e. average), and some measure of how dispersed the values are. The most common way to measure the dispersion of values is the standard deviation.

Consider these two lists: (1, 2, 8, 9) and (5, 5, 5, 5). Both lists have the same mean. But we want to be able to say that the first list has its values more spread out than the second list. This is what the standard deviation measures.

Calculating the mean is easy: add up all the values in the list and then divide by how many there are. But the formula for standard deviation goes like this:

$$standard\ deviation = \sqrt{\frac{\sum_{i=1}^{n}(x_i - mean)^2}{n}}$$

Here is the step-by-step procedure for calculating the standard deviation, along with a worked example for the list (1, 2, 8, 9). Remember to use real-numbers (not integers) throughout your calcualtions.

1. First, calculate the mean. In our example, it is (1 + 2 + 8 + 9) / 4 = 5.0
2. For each value in the list, calculate its deviation from the mean. In other words, subtract the mean from each value. In our example, we would obtain these deviations: –4, –3, 3, 4.
3. Square each of the deviations. In our example, we have 16, 9, 9, 16.
4. Add up all the squared deviations. In our example, this is 16 + 9 + 9 + 16 = 50.0
5. Divide by the size of the list. In our example, this is 50 / 4 = 12.5
6. Take the square root to get the final answer. $\sqrt{12.5}$ is approximately 3.54, and this is the standard deviation of our example.

Now you are ready! Write a program that will calculate the mean as well as the standard deviation of a list of values entered by the user. Ask the user interactively for the values, and assume that they will all be entered on a single line, so that you can input them with a single input statement that grabs a string containing the list. Then, you can tokenize on a space to get the values themselves. Print out the mean and standard deviation to 2 decimal places.

For example, an I/O session would go like this. In this program, I recommend putting a \n at the end of the prompt, because the user may have a lot of data.

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Please enter a list of numbers, separated by spaces:
1 2 8 9

The mean is 5.00 and the standard deviation is 3.54.
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