Population and Sample Standard Deviations

If x_1, x_2, ..., x_n are the data values for an entire population, the **population standard deviation** is

$$\text{SD} = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \text{mean}_x)^2}$$

If the data values are only a sample from the population, then the **sample standard deviation** is

$$\text{sd} = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (x_i - \text{mean}_x)^2}$$

1. Explain in words what the difference is in the two formulas. What happens if the sample size n is large?

2. Each of the following lists has an average of 50. For which one is the standard deviation of the numbers biggest? smallest?

(i) 0, 20, 40, 50, 60, 80, 100

(ii) 0, 48, 49, 50, 51, 52, 100

(iii) 0, 1, 2, 50, 98, 99, 100

2. Guess which of the following two lists has the larger standard deviation. Check your guess by computing the sd for both lists.

(i) 9, 9, 10, 10, 12

(ii) 7, 8, 10, 11, 13

3. True or false: the mean is always greater than the standard deviation? Find an example to justify your answer.

4. True or false and explain: SD and sd can't be negative.

5. What are the SD and sd of the list 5, 5, 5, 5, 5?

6. Find the sd for each list. Explain how lists b)–d) are related to list a) and what impact that has on the sd.

   a) 1, 3, 4, 4, 5, 7

   b) 11, 13, 14, 14, 15, 17

   c) 2, 6, 8, 8, 10, 14

   d) −3, −9, −12, −12, −15, −7