

## THE STANDARD DEVIATION ALGEBRA 2 WITH TRIGONOMETRY

Measurements of central tendency, such as the mean and median, are important numbers that summarize average behavior of a data set. But, it is also important to know how much the data varies in a data set. The **interquartile range** from the last lesson was a rough measurement of **dispersion**. A more important measurement of dispersion is known as the **standard deviation** and can be thought of as the average distance the points of data in a set fall away from the set's mean.

### STANDARD DEVIATION FORMULA

For the data set  $\{x_1, x_2, \dots, x_n\}$  the standard deviation is given by  $\sigma_x = \sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2}$

**Exercise #1:** Both of the following data sets have means of 5. Calculate the standard deviation of both data sets using the formula above and round your answers to the nearest *tenth*.

Data Set #1:  $\{2, 4, 5, 9\}$

Data Set #2:  $\{4, 5, 5, 6\}$

In all practical applications, we will assume the use of the graphing calculator to find the standard deviation of a data set. In *Exercise #2* we return to a data set from the last lesson.

**Exercise #2:** Biologists are studying the weight of brown trout in upstate New York streams. They capture and weigh 15 brown trout from the Saw Kill Creek in Red Hook, New York. Their weights, accurate to the nearest hundredth of a pound, are given below:

2.45, 1.60, 1.53, 2.89, 2.85, 1.09, 1.23, 2.39, 2.97, 2.28, 1.79, 1.48, 1.62, 1.17, 1.41

(a) Determine the mean and standard deviation of the weights of the brown trout. Round both answers to the nearest *hundredth* of a pound.

(b) Use your calculator to sort the data above in ascending order. Then, using your answers from part (a), determine the percent of brown trout weights that fall within one standard deviation of the mean.



**Exercise #3:** Which of the following data sets would have the smallest standard deviation? Do this without the use of your calculator.

- (1) {3, 5, 9, 13, 18}      (3) {1, 3, 5, 10, 15}  
(2) {-4, 0, 1, 2, 5}      (4) {4, 4, 4, 5, 5}
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Samples Versus Populations – Many times when statistical studies are done, it is not possible to get a data value for each member of the **population**. In this case a **sample** must be taken. There is a slight difference between how the population standard deviation,  $\sigma_x$ , is calculated and how the **sample standard deviation**,  $s_x$ , is calculated. It is important in any problem to pay close attention to whether a sample or the entire population is being discussed.

**Exercise #4:** A car company is trying to determine the fuel efficiency, in miles per gallon, of their latest hybrid vehicle. They drive a sample of 50 of these vehicles and determine the fuel efficiency. The data set is given in the table below.

- (a) Using your calculator, determine the mean and standard deviation of the fuel efficiency. Round your standard deviation to the nearest *hundredth*.

Fuel Efficiency ( $x_i$ )	Number of Cars ( $f_i$ )
37	2
38	6
39	18
40	15
41	8
42	1

- (b) Based on (a), how many cars in this sample had a fuel efficiency more than one standard deviation **below** the mean?

- (c) The government will only allow the company to advertise a fuel efficiency for a vehicle that is at most two standard deviation above the mean. Can the company claim this car gets 42 miles per gallon? Explain.

**Exercise #5:** In which of the following would it be appropriate to use the entire population instead of a sample?

- (1) determining the average weight of New Yorkers  
(2) determining the average time spent on cell phones by American teenagers  
(3) determining the average quiz grade for a given Algebra 2 class  
(4) determining the average weight of Atlantic salmon
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Name: \_\_\_\_\_

Date: \_\_\_\_\_

**THE STANDARD DEVIATION**  
**ALGEBRA 2 WITH TRIGONOMETRY - HOMEWORK**

**SKILLS**

1. Which of the following data sets has the smallest standard deviation?

(1)  $\{3, 4, 4, 5\}$                       (3)  $\{-1, 1, 3, 5\}$

(2)  $\{4, 7, 10, 20\}$                       (4)  $\{2, 5, 9, 11\}$

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2. Which of the following data sets has a standard deviation of zero?

(1)  $\{-2, -1, 0, 1, 2\}$                       (3)  $\{7, 7, 7, 7, 7\}$

(2)  $\{3, 3, 4, 5, 5\}$                       (4)  $\{0, 0, 1, 1, 2\}$

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3. For the data set  $\{3, 5, 9, 12, 15, 18, 21\}$ , which of the following is true?

(1) interquartile range =  $2 \cdot$  standard deviation

(2) interquartile range  $> 2 \cdot$  standard deviation

(3) interquartile range  $< 2 \cdot$  standard deviation

(4) interquartile range =  $\frac{1}{2} \cdot$  standard deviation

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**APPLICATIONS**

4. For each of the following statistical studies, determine whether it would be more appropriate to use a sample or the entire population.

(a) Determining the average cholesterol level of 40 year old Americans

(b) Determining the average age of math teachers at Arlington High School

(c) Determining the average weight of newborn bald-headed eagles.

5. Mr. Weiler's Advanced Calculus class took a quiz with the results shown below. Determine the mean and standard deviation of the quiz grades. Round both answers to the nearest *tenth*.

56, 68, 75, 77, 78, 82, 85, 86, 88, 90, 93, 98, 100



