

11-7 Reteaching

Standard Deviation

The mean tells you what the center of a set of data values looks like. But two very different data sets can have the same mean. For example, each of these data sets has a mean of 25.

Set A: {23 24 25 26 27}



Set B: {1 5 25 45 49}



Notice that the data values on the number line for set B are much more spread out from the mean than the data values for set A. *Variance* and *standard deviation* are measures of how widely data values differ from the mean.

The lowercase Greek letter sigma, σ , is the symbol for standard deviation. Variance is the square of the standard deviation, and is written as σ^2 . For a set of n data values:

$$\sigma^2 = \frac{\sum(x - \bar{x})^2}{n}$$

$$\sigma = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$$

Problem

What are the variance and standard deviation for the data set {100 158 170 192}?

Step 1 Find the mean of the values.

$$\bar{x} = \frac{100 + 158 + 170 + 192}{4} = 155.$$

Step 2 Subtract the mean from each value in the data set. Then square each difference.

$$(100 - 155)^2 = 3025 \quad (158 - 155)^2 = 9$$

$$(170 - 155)^2 = 225 \quad (192 - 155)^2 = 1369$$

Step 3 Find the mean of the squared differences. This is the variance.

$$\sigma^2 = \frac{3025 + 9 + 225 + 1369}{4} = 1157$$

Step 4 Find the square root of the variance. This is the standard deviation.

$$\sigma = \sqrt{1157} \approx 34$$

The variance for the data set is 1157 and the standard deviation is about 34.

Exercises

Find the variance and standard deviation for each data set.

1. 6.5 7.0 9.0 8.0 7.5 **0.74; about 0.86**

2. 5.6 5.8 5.9 6.1 **0.0325; about 0.18**

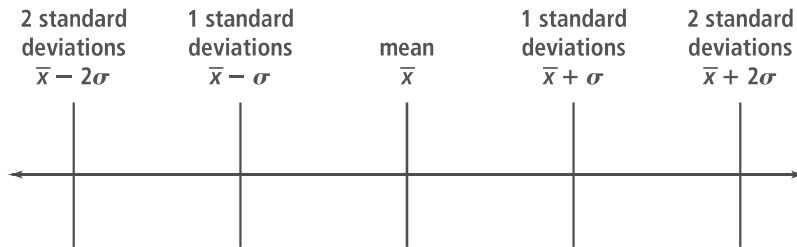
3. 201 203 208 210 211 **15.44; about 3.93**

4. 12 14 15 17 19 **5.84; about 2.42**

11-7 Reteaching (continued)

Standard Deviation

You can describe the spread of a set of data values by counting the number of standard deviations from the mean that it takes to include some or all of the values.



Problem

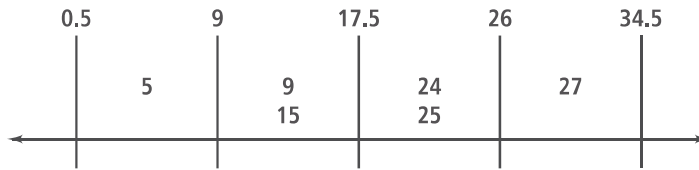
The data set {5 9 15 24 25 27} has a mean of 17.5 and a standard deviation of about 8.5. Within how many standard deviations of the mean do all the values fall?

Step 1 Draw five lines to represent the mean and two standard deviations on either side of the mean.

Step 2 Substitute the values for \bar{x} and σ . Simplify each expression.

$\bar{x} - 2\sigma$	$\bar{x} - \sigma$	$\bar{x} = 17.5$	$\bar{x} + \sigma$	$\bar{x} + 2\sigma$
$= 17.5 - 2(8.5)$	$= 17.5 - 8.5$		$= 17.5 + 8.5$	$= 17.5 + 2(8.5)$
$= 0.5$	$= 9$		$= 26$	$= 34.5$

Step 3 Label each line with the appropriate value. Write each data value in the appropriate section. If a value falls on a line between two sections, write it in the section closest to the mean.



The drawing shows that all the values fall within two standard deviations of the mean.

Exercises

A family buys groceries weekly. Over four weeks their grocery costs are \$72.42, \$91.50, \$58.99, and \$69.02.

5. Within how many standard deviations of the mean do all the costs fall? **2**
6. How many costs fall within one standard deviation of the mean? **2**
7. Within how many standard deviations of the mean would a cost of \$102.00 fall? **3**