

11-7

Standard Deviation

Content Standards

S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages.

Also S.IC.6

Objectives To find the standard deviation and variance of a set of values
To apply standard deviation and variance

The last section described *several measures of center* (mean, median and mode). Several *measures of spread* (range and interquartile range) also were discussed. There are two other important measures of spread: *variance* and *standard deviation*. The steps for calculating the variance and standard deviation are slightly more complicated, but you will find using a table set-up helps keep you organized. The steps are as follows:

Essential Understanding Standard deviation is a measure of how far the numbers in a data set deviate from the mean.

In the previous lesson you studied range and interquartile range. Each of these is a **measure of variation**. A measure of variation describes how the data in a data set are spread out.

Variance and **standard deviation** are measures showing how much data values deviate from the mean. The Greek letter σ (sigma) represents standard deviation. σ^2 (sigma squared) is the variance.

Take note

Key Concepts Finding Variance and Standard Deviation

- Find the mean, \bar{x} , of the n values in a data set.
- Find the difference, $x - \bar{x}$, between each value x and the mean.
- Square each difference, $(x - \bar{x})^2$.
- Find the average (mean) of these squares. This is the variance.

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

- Take the square root of the variance. This is the standard deviation.

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

Example 1 – Find the mean, variance, and standard deviation for the data set of measurements (in feet) shown below:

HW #6-9, 14

$n = 9$

{6, 8, 7, 5, 10, 6, 9, 8, 4}

Data Values	$x - \bar{x}$	$(x - \bar{x})^2$
6	$6 - 7 = -1$	1
8	$8 - 7 = 1$	1
7	$7 - 7 = 0$	0
5	$5 - 7 = -2$	4
10	$10 - 7 = 3$	9
6	$6 - 7 = -1$	1
9	$9 - 7 = 2$	4
8	$8 - 7 = 1$	1
4	$4 - 7 = -3$	9
$\bar{x} = 63/9 = 7$	Add $(x - \bar{x})^2$ column:	30
To find VARIANCE:	Divide total by n -size:	$30/9 = 3.33$ variance σ^2
To find STANDARD DEVIATION:	Square root the variance:	$\sqrt{3.33} = 1.86$ - s.d.

On your quiz, I will give you this table, but no headers. You need to know what to fill in!

$\sum (x - \bar{x})^2$
 variance σ^2
 $\sqrt{3.33} = 1.86$ - s.d.

Problem 1 Finding Variance and Standard Deviation

What are the mean, variance, and standard deviation of these values?
 6.9 8.7 7.6 4.8 9.0

$\bar{x} = \frac{6.9 + 8.7 + 7.6 + 4.8 + 9.0}{5} = 7.4$ Find the mean.

Think
 How can you organize your work?
 Use a table to record the values.

x	\bar{x}	$x - \bar{x}$	$(x - \bar{x})^2$
6.9	7.4	-0.5	0.25
8.7	7.4	1.3	1.69
7.6	7.4	0.2	0.04
4.8	7.4	-2.6	6.76
9.0	7.4	1.6	2.56
Sum			11.30

Make a table.

Find difference between each value and the mean. Square the differences.

Add the squares of the differences.

$\sigma^2 = \frac{\sum (x - \bar{x})^2}{n} = \frac{11.3}{5} = 2.26$ Find the variance.

$\sigma = \sqrt{\sigma^2} = \sqrt{2.26} \approx 1.5$ Find the standard deviation.

The mean is 7.4. The variance is 2.26. The standard deviation is about 1.5.



Got It? 1. What are the mean, variance, and standard deviation of these values?

52 63 65 77 80 82

Data Values	$x - \bar{x}$	$(x - \bar{x})^2$
	Add $(x - \bar{x})^2$ column:	
To find VARIANCE:	Divide total by n -size:	
To find STANDARD DEVIATION:	Square root the variance:	

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Homework:

Find the mean, variance, and standard deviation for each data set.

6. 78 90 456 673 111 381 21

Data Values	$x - \bar{x}$	$(x - \bar{x})^2$
	Add $(x - \bar{x})^2$ column:	
To find VARIANCE:	Divide total by n -size:	
To find STANDARD DEVIATION:	Square root the variance:	

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what to fill in!**

7. 13 15 17 18 12 21 10

Data Values	$x - \bar{x}$	$(x - \bar{x})^2$
	Add $(x - \bar{x})^2$ column:	
To find VARIANCE:	Divide total by n -size:	
To find STANDARD DEVIATION:	Square root the variance:	

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what to fill in!

9. 60 40 35 45 39

Data Values	$x - \bar{x}$	$(x - \bar{x})^2$
	Add $(x - \bar{x})^2$ column:	
To find VARIANCE:	Divide total by n -size:	
To find STANDARD DEVIATION:	Square root the variance:	

On your quiz,
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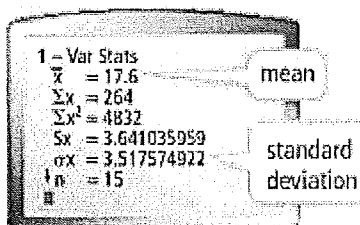
Problem 2 Using a Calculator to Find Standard Deviation **STEM**

Meteorology The table displays the number of U.S. hurricane strikes by decade from the years 1851 to 2000. What are the mean and standard deviation for this data set?

Decade	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Strikes	19	15	20	22	21	18	21	13	19	24	17	14	12	15	14

Source: National Hurricane Center

- Step 1** Use STAT EDIT to enter the data in list L1.
Step 2 In STAT CALC select the 1-Var Stats option.
 The mean is 17.6; the standard deviation is about 3.5.



In a data list, every value falls within some number of standard deviations of the mean. For example, if the mean is 50 and the standard deviation is 10, then a value x with $40 \leq x \leq 60$ is within one standard deviation of the mean.

Problem 3 Using Standard Deviation to Describe Data **STEM**

Meteorology Use the U.S. hurricane-strike data from Problem 2. Within how many standard deviations from the mean do all of the values fall?

Know

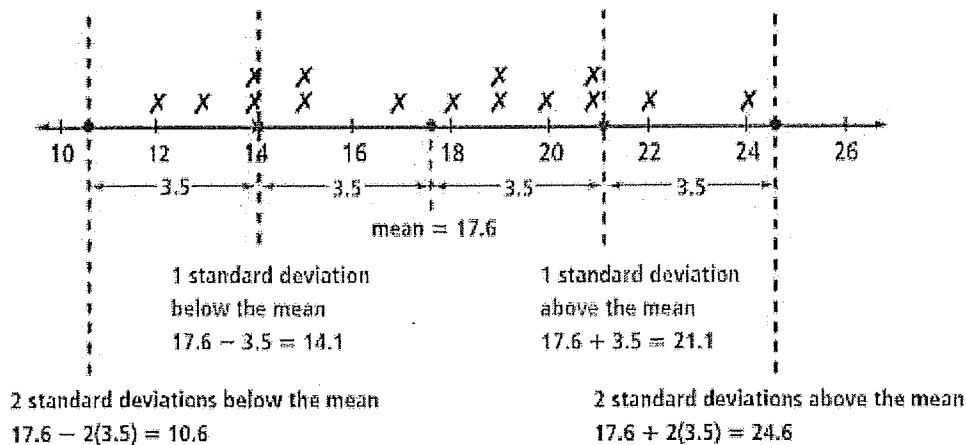
The data values, their mean, and their standard deviation

Need

The number of standard deviations from the mean that include all the data


Plan

- Draw a number line.
- Plot the data values and the mean.
- Mark off intervals of 3.5 on either side of the mean.



All of the values fall within two standard deviations of the mean. Hurricane watchers can expect that the number of U.S. hurricane strikes in a decade will probably fall within two standard deviations of the 15-decade mean.

- Got It? 3. Meteorology** Use the Atlantic Ocean hurricane data from Got It 2.
- a. Within how many standard deviations of the mean do all of the values fall?
 - b. **Reasoning** How might the U.S. Federal Emergency Management Agency (FEMA) use this information?

-  **Got It? 2. Meteorology** The table displays the number of hurricanes in the Atlantic Ocean from 1992 to 2006. What are the mean and standard deviation?

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number	4	4	3	11	10	3	10	8	8	9	4	7	9	14	5

Source: National Hurricane Center