

Extension

Calculate Variance and Standard Deviation

GOAL Find the variance and standard deviation of a data set.

Key Vocabulary

- variance
- standard deviation

COMMON CORE

CC.9-12.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*

In addition to range and mean absolute deviation, *variance* and *standard deviation* are also measures of dispersion that can be used to describe the spread of a set of data.

KEY CONCEPT

For Your Notebook

Variance and Standard Deviation

The **variance** of a numerical data set is denoted by σ^2 , which is read as “sigma squared.” For the data set x_1, x_2, \dots, x_n , the variance is given by:

$$\sigma^2 = \frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{n}$$

The **standard deviation** of a numerical data set is denoted by σ , which is read as “sigma.” For the data set x_1, x_2, \dots, x_n , the standard deviation is the square root of the variance and is given by:

$$\sigma = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{n}}$$

EXAMPLE 1 Find variance and standard deviation

E-MAIL SIZES The sizes of e-mails (in kilobytes) in your inbox are 1, 2, 2, 7, 4, 1, 10, 3, and 6. Find the variance and standard deviation of the data.

Solution

STEP 1 Find the mean.

$$\bar{x} = \frac{1 + 2 + 2 + 7 + 4 + 1 + 10 + 3 + 6}{9} = \frac{36}{9} = 4$$

STEP 2 Find the variance.

$$\sigma^2 = \frac{(1 - 4)^2 + (2 - 4)^2 + \dots + (6 - 4)^2}{9} = \frac{76}{9} = 8.444 \dots$$

STEP 3 Find the standard deviation.

$$\sigma = \sqrt{\sigma^2} = \sqrt{8.444 \dots} \approx 2.9$$

► The variance is about 8.4, and the standard deviation is about 2.9.

IMPROVE ACCURACY

The more accurate the value of σ^2 you use to calculate σ , the more accurate the value of σ you obtain. In the final answer, both results are rounded.

USING A CALCULATOR You can use a graphing calculator to find the standard deviation of a data set.

EXAMPLE 2 Find standard deviation

HOUSEHOLDS In 2000 the numbers (in thousands) of households in the 13 states with Atlantic Ocean coastline are given. Find the standard deviation of the data.

299 6338 3006 518 1981 2444 475 3065
7057 3132 408 1534 2699

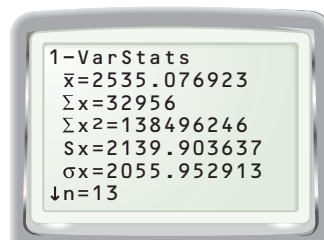
Solution

STEP 1 Enter the data into a graphing calculator. Press **STAT** and select Edit. Enter the data into List 1 (L_1).

STEP 2 Calculate the standard deviation. Press **STAT**. From the CALC menu select 1-Var Stats.

On this screen, σ_x stands for standard deviation.

► The standard deviation of the data is about 2056.



PRACTICE

EXAMPLE 1
for Exs. 1–3

Use the formulas for variance and standard deviation to find the variance and standard deviation of the data. Round to the nearest tenth, if necessary.

- 4, 5, 3, 2, 4, 7, 8, 9, 4, 6, 7, 8, 9, 1
- 14, 16, 19, 20, 28, 7, 24, 15, 16, 30, 33, 24
- 110, 205, 322, 608, 1100, 240, 185, 552, 418, 300

EXAMPLE 2
for Exs. 4–7

In Exercises 4–6, use a graphing calculator to find the standard deviation of the data. Round to the nearest tenth, if necessary.

- 3.5, 3.8, 4.1, 3.0, 3.8, 3.6, 3.3, 4.0, 3.8, 3.9, 3.2, 3.0, 3.3, 4.2, 3.0
- 66, 43, 9, 28, 7, 5, 90, 9, 78, 6, 69, 55, 28, 43, 10, 54, 13, 88, 21, 4
- 1002, 1540, 480, 290, 2663, 3800, 690, 1301, 1750, 2222, 4040, 800
- REASONING** The heights (in feet) of 9 pecan trees are 72, 84, 81, 78, 80, 86, 70, 80, and 88. For parts (a)–(c) below, round your answers to the nearest tenth.
 - Find the standard deviation of the data.
 - Suppose you include a pecan tree with a height of 136 feet. *Predict* the effect of the additional data on the standard deviation of the data set.
 - Find the standard deviation of the new data set in part (b). *Compare* the results to your prediction in part (b).