

Standard Deviation

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The **standard deviation** of a numerical data set is a measure of how much a typical value in the data set differs from the mean. The symbol σ represents the standard deviation. It is read as “sigma.” It is given by

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

where n is the number of values in the data set. The deviation of a data value x is the difference of the data value and the mean of the data set, $x - \bar{x}$.

Step 1 Find the mean, \bar{x} .

Step 2 Find the deviation of each data value, $x - \bar{x}$.

Step 3 Square each deviation, $(x - \bar{x})^2$.

Step 4 Find the mean of the squared deviations. This is called the *variance*.

Step 5 Take the square root of the variance.

Example 1 The data set shows the hourly pay rates for several employees at a restaurant. Find and interpret the standard deviation of the data set.

\$9.30, \$8.00, \$7.50, \$8.50, \$10.40, \$9.30, \$9.70, \$9.30

Step 1 Find the mean, \bar{x} . $\bar{x} = \frac{9.3 + 8 + \cdots + 9.7 + 9.3}{8} = \frac{72}{8} = 9$

Step 2 Find the deviation of each data value, $x - \bar{x}$, as shown.

Step 3 Square each deviation, $(x - \bar{x})^2$, as shown.

Step 4 Find the mean of the squared deviations, or variance.

$$\frac{0.09 + 1 + \cdots + 0.49 + 0.09}{8} = \frac{6.22}{8} \approx 0.8$$

Step 5 Use a calculator to take the square root of the variance.

$$\sqrt{\frac{6.22}{8}} \approx 0.9$$

x	\bar{x}	$x - \bar{x}$	$(x - \bar{x})^2$
9.3	9	0.3	0.09
8	9	-1	1
7.5	9	-1.5	2.25
8.5	9	-0.5	0.25
10.4	9	1.4	1.96
9.3	9	0.3	0.09
9.7	9	0.7	0.49
9.3	9	0.3	0.09

► The standard deviation is about 0.9. This means that the typical hourly pay rate of an employee differs from the mean by about \$0.90.

Practice

Check your answers at BigIdeasMath.com.

Find and interpret the standard deviation of the data set.

- Exam scores: 98, 95, 82, 85, 77, 85, 91, 93, 75, 80, 81, 90
about 7.0; The typical exam score differs from the mean by about 7 points.
- Stock prices per share: \$9.70, \$13.50, \$9.50, \$7, \$7.80, \$16.40, \$10.20, \$9, \$14.90, \$12
about 2.9; The typical stock price per share differs from the mean by about \$2.90.