# Section 5.3 Standard Deviation

**Learning targets**:

- Demonstrate understanding of new terminology.
- Calculate the standard deviation for a set of data.
- Interpret standard deviation values as they relate to the context of the data.

# Key Terms:

- **Deviation:** the difference between a data value and the mean of the set of data it came from.
  - Ex. If the number 12 came from a set of data whose mean is 10, then its **deviation** is $12 - 10 = 2$.
  - Ex. If the number 5 came from a set of data whose mean is 10, then its **deviation** is $5 - 10 = -5$.
- **Standard Deviation:** a measure of dispersion or scatter for a set of data with relation to its mean.
  - A **low** standard deviation indicates that most data values are **close to the mean value** (the numbers are less scattered, they are mostly pretty much close to the mean).
  - A **high** standard deviation indicates that much of the data is **scattered far from the mean** of the data (there are lots of values far below and/or above the mean).

# Example #1:

Which of these two data sets would you expect to have a **higher** standard deviation?

| | | | | | | |
|---|---|---|---|---|---|---|
| **Set 1:** | 2 | 7 | 10 | 11 | 15 | 21 |
| **Set 2:** | 5 | 7 | 8 | 8 | 10 | 10 |

*Answer*: **Set 1** – because the values are more scattered (less close to the mean) than in **Set 2**.

## **Mean:**

The symbol that represents the **mean** of a set of data is $\bar{x}$ (which we read as "**x bar**")

$\mu$

**Formula for the mean:** $\bar{x} = \frac{\sum x}{n}$

summation notation

$\sum$ **is the symbol that represents the process of adding up (summing) a list of values**

**"$x$" represents individual data values**

**"$n$" represents the number of values in the data set**

# Steps for calculating $\sigma$

Standard dev.

- Calculate the **mean** of the data: $\overline{x}$
- Calculate the **deviation** for each value in the data set by subtracting the mean from each number: $(x - \overline{x})$
- **Square** the deviations found in step 2:
  $(x - \overline{x})^2$

# Steps for calculating $\sigma$ (cont'd)

- **Add up** the squared deviations: $\sum(x-\bar{x})^2$
- **Divide** this sum by how many values are in the data set: $\frac{\sum(x-\bar{x})^2}{n}$
- Take the **square root** of the value found in the last step to find $\boldsymbol{\sigma}$.
- This value is the standard deviation: $\boldsymbol{\sigma} = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$

## Standard Deviation:

The symbol that represents the **standard deviation** of a set of data is $\sigma$ (which we read as "**sigma**")

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

$(x - \bar{x})$ **represents the deviation value for each number in the data set**

# Example #2:

A teacher has two chemistry classes. She gives the same tests to both classes. Calculate the standard deviation for each class and use their values to compare the results for the two classes.

| Test | Class A (%) | Class B (%) |
|---|---|---|
| 1 | 94 | 84 |
| 2 | 56 | 77 |
| 3 | 89 | 81 |
| 4 | 67 | 81 |
| 5 | 84 | 74 |

## Class A:

Calculate $\bar{x}$: $\frac{390}{5} = 78$

| Data Values $x$ | Deviations $x - \bar{x}$ | Squared deviations $(x - \bar{x})^2$ |
|---|---|---|
| 94 | 94−78 = 16 | 256 |
| 56 | −22 | 484 |
| 89 | 11 | 121 |
| 67 | −11 | 121 |
| 84 | 6 | 36 |
| | | 1018 |

Calculate $\sigma$: $= \sqrt{\frac{\Sigma(x-\bar{x})^2}{n}} = \sqrt{\frac{1018}{5}} = 14.3$

## Class B:

Calculate $\bar{x}$: 79.4

| Data Values $x$ | Deviations $x - \bar{x}$ | Squared deviations $(x - \bar{x})^2$ |
|---|---|---|
| 84 | 4.6 | 21.16 |
| 77 | -2.4 | 5.76 |
| 81 | 1.6 | 2.56 |
| 81 | 1.6 | 2.56 |
| 74 | -5.4 | 29.16 |
| | | 61.2 |

Calculate $\sigma$: 3.50

Interpretation of these standard deviation values:

# You Try:

Take the two sets of data from Example #1 and calculate their standard deviations.

### Example: Parking Spaces per House in Hampton Street

Isabella went up and down the street to find out how many parking spaces each house has. Here are her results:

$$\bar{x} = \frac{113}{55}$$

$$\bar{x} = 2.05$$

| Parking Spaces | Frequency | $(x-\bar{x})^2$ | $\cdot f$ |
|---|---|---|---|
| 1 | 15 | 1.1025 | 16.5375 |
| 2 | 27 | 0.0025 | 0.0675 |
| 3 | 8 | .9025 | 7.22 |
| 4 | 5 | 3.8025 | 19.0125 |
| | | | 42.8375 |

What is the mean number of Parking Spaces?

What is the standard deviation?

$$\sigma = \sqrt{\frac{42.8375}{55}} = 0.88$$

# ASSIGNMENT:

**Page 233 – 234: #2, 5, 6, 7, 8**