2. Find the range and standard deviation of the data set in Guided Practice Exercise 1 on page 745.

OUTLIERS Measures of central tendency and dispersion can give misleading impressions of a data set if the set contains one or more *outliers*. An <mark>outlier</mark> is a value that is much greater than or much less than most of the other values in a data set.

EXAMPLE 4   **Examine the effect of an outlier**

AIR HOCKEY You are competing in an air hockey tournament. The winning scores for the first 10 games are given below.

14, 15, 15, 17, 11, 15, 13, 12, 15, 13

a. Find the mean, median, mode, range, and standard deviation of the data set.

b. The winning score in the next game is an outlier, 3. Find the new mean, median, mode, range, and standard deviation.

c. Which measure of central tendency does the outlier affect the most? the least?

d. What effect does the outlier have on the range and standard deviation?

Solution

a. **Mean:** $\overline{x} = \dfrac{14 + 15 + \cdots + 13}{10} = 14$ **Median:** 14.5   **Mode:** 15

   Range: $17 - 11 = 6$

   Std. Dev.: $\sigma = \sqrt{\dfrac{(14 - 14)^2 + (15 - 14)^2 + \cdots + (13 - 14)^2}{10}} \approx 1.7$

b. **Mean:** $\overline{x} = \dfrac{14 + 15 + \cdots + 3}{11} = 13$ **Median:** 14   **Mode:** 15

   Range: $17 - 3 = 14$

   Std. Dev.: $\sigma = \sqrt{\dfrac{(14 - 13)^2 + (15 - 13)^2 + \cdots + (3 - 13)^2}{11}} \approx 3.5$

c. The mean is most affected by the outlier. The mode is least affected by the outlier.

d. The outlier causes both the range and standard deviation to increase.

✓ **GUIDED PRACTICE**   for Example 4

3. **WHAT IF?** In part (b) of Example 4, suppose the winning score in the next game is 25 instead of 3. Find the new mean, median, mode, range, and standard deviation of the data set.