Making Friends with Standard Deviation

Intent

Students will continue to build their understanding of mean and standard deviation.

Mathematics

When a nonzero constant is added to each value in a data set, the **mean**, a measure of the center of the distribution, will change by that amount. However, the **standard deviation**, a measure of the spread of the data, will not change. When each value in a data set is transformed by multiplication by a particular constant, both the mean and the standard deviation will change. In this activity, students explore these transformations and draw conclusions about their effects on these two descriptive statistics. They will also continue to create data sets that have given values for these statistics.

Progression

Students work on the activity in groups and discuss their results as a class.

Approximate Time

35 minutes

Classroom Organization

Groups, followed by whole-class discussion

Doing the Activity

This activity requires little or no introduction.

Question 3 is intended primarily as further work for groups that finish early. You might warn students that they will be able to create data sets with those exact means but will only be able to approximate the standard deviations.

Discussing and Debriefing the Activity

Focus the discussion on parts c and d of Questions 1 and 2.

Students' explanations of the patterns they observe in Question 1d may take several forms. For example, they may picture the data points on the number line, so that adding the same thing to each data point just moves the points along and hence also moves the mean. Or they may see the change in the mean algebraically (although it's unlikely they will have a full algebraic explanation involving the distributive law).

Students may attribute the lack of change in the standard deviation to the fact that the spread doesn't change when the set of data points is moved along. Or they may recognize that when all the data are changed the same way, the mean also changes, so the spread from the mean remains the same.

The explanations for Question 2d will be similar.

Fathom Dynamic Data™ software can be used to provide a visual demonstration of the effects on a simple data set of adding or multiplying by a constant.

Key Question

What conclusions did you reach about how standard deviation is affected by changes in the data?

Supplemental Activity

Making Better Friends (extension) provides additional opportunities for students to explore standard deviation, continuing the challenges posed in this activity.

Deviations

Intent

In this activity, students continue to develop their understanding of standard deviation.

Mathematics

Students will apply their understanding of **standard deviation** as a measure of spread and the ideas developed in *Making Friends with Standard Deviation* related to the effects of linear transformations of data (adding a constant or multiplying by a constant) on the mean and standard deviation of a data set. In the activity, they will create new data sets with specific statistics as compared to a given data set.

Progression

Students will work on the activity individually and share their results in a class discussion.

Approximate Time

25 minutes for activity (at home or in class)

15 minutes for discussion

Classroom Organization

Individuals, followed by whole-class discussion

Doing the Activity

Point out that the instructions for Questions 2, 3, and 4 suggest that students need not actually calculate the mean and standard deviation for their new data sets. Instead, they can explain why they believe they have maintained the mean while changing the standard deviation or kept the standard deviation the same while changing the mean.

Discussing and Debriefing the Activity

You might first have students share their data sets in their groups and then ask for volunteers to describe their methods for creating the required data sets without calculating the means or standard deviations.

The mean of the data in Question 1 is exactly 20; the standard deviation is about 3.9. There are various ways to do Questions 2 through 4 without calculations. One approach to Questions 2 and 3 is to move the highest and lowest values either both away from the mean or both toward the mean by the same amount. For Question 4, one method is to add a specific amount to every data item.

Key Question

How does this activity relate to yesterday's activity, *Making Friends with Standard Deviation?*

Supplemental Activity

Mean Standard Dice (reinforcement or extension) offers practice with standard deviation. It also demonstrates that doing the same experiment more times doesn't change either the mean or the standard deviation. Students may be surprised about the result for standard deviation in Question 3.