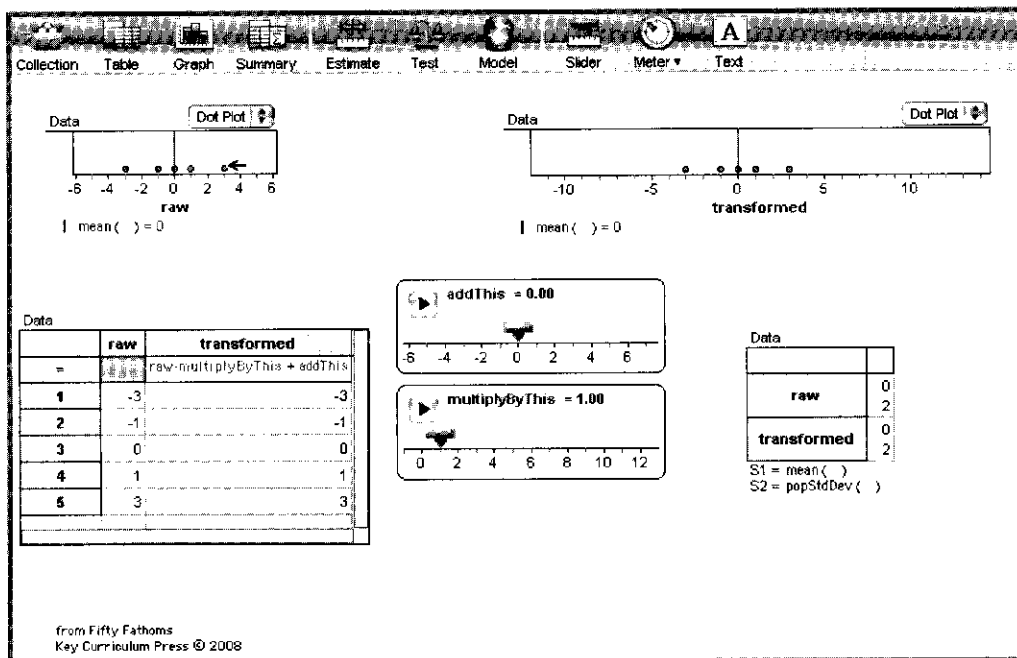


## Demo 4: Transforming the Mean and Standard Deviation

*What happens to the mean and standard deviation when you add a constant to every value or multiply every value by a constant*

One issue that deserves a dynamic demo is what happens to the mean and standard deviation of a set of data when you add a constant to every data value or multiply the data values by a constant.



### What To Do

- ▶ Open **Transform Mean and SD.ftm**. It should look like the illustration.

The main thing to note is that there are two graphs—one of the **raw** data and one of the **transformed** data. Also note that the original data,  $\{-3, -1, 0, 1, 3\}$ , have a standard deviation of 2, as you can see in the *summary table* bottom right. If you've never seen a summary table, take a moment to figure it out.

- ▶ Drag the highest point in the **raw** graph (with **raw = 3**—where the arrow is in the illustration) and see how it changes the mean and standard deviation in the summary table. You can also see the mean change on the graph itself. Note that the transformed data mirror the raw data exactly.

**Note:** The **raw** and **transformed** axes are not linked; if you rescale one, the other will not change.

- ▶ In the case table, retype **3** as the highest data value and press **Enter**. The display should now be as it was when you began—with a mean of 0 and a standard deviation of 2 for both the raw and transformed data. (If necessary, simply close and reopen the file.)
  - ⇒ **Undo** is in the **Edit** menu. Its shortcut is **⌘+Z** (Mac) or **Control+Z** (Windows).
- ▶ Play with the slider called **addThis**. Note what happens to the transformed data.
- ▶ Also note what happens to the mean and standard deviation of the transformed data.
- ▶ Return **addThis** to 0. (Use **Undo**, or just edit the number in the slider.)
- ▶ Play with the slider called **multiplyByThis**. Watch what happens. When you're done, return its value to 1.

Note that you can observe these phenomena quantitatively by comparing the values on the sliders to the values in the summary table. That is, when you change **multiplyByThis** from 1 to 2, how does the standard deviation change?

### Questions

- 1 What happens to the mean if you add  $x$  to every value in a data set?
- 2 What happens to the standard deviation?
- 3 What happens to the mean if you multiply every number in a data set by  $x$ ?
- 4 What happens to the standard deviation?

### Challenges

The two questions that follow are not really about transformations of the entire data set but, rather, about the effect of dragging a single point on the standard deviation. You could think of these as an extension of Demo 1, “The Meaning of Mean,” and Demo 2, “Mean and Median.”

- 5 In Demo 2, “Mean and Median,” you dragged the point on the far right to see how far you had to drag it in order to increase the mean by one. (You had to drag it five units.) Check that, and see how far you have to drag that point to increase the *standard deviation* by one.
- 6 Do the same for the *middle* point in the distribution. How far do you have to move it to increase the mean by one? How far to increase the standard deviation by one? Compare that to moving the extreme point, and explain why it’s the same or different. **Sol**