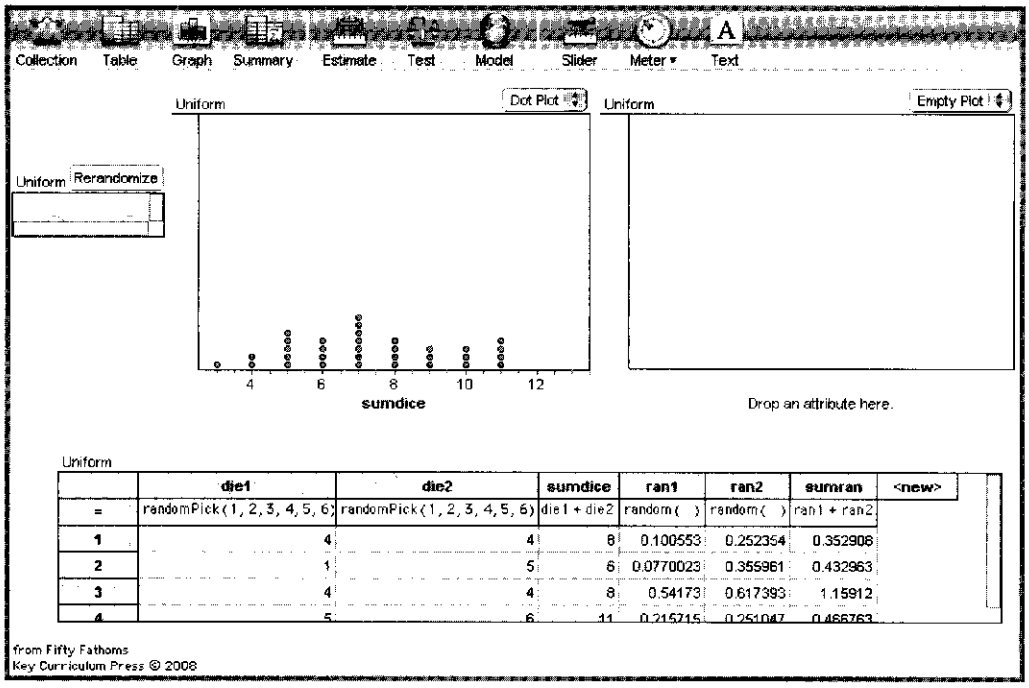
Demo 21: Adding Uniform Random Variables

What happens when you add two uniform random variables • How that corresponds to adding two dice

This demo gives a brief look into distributions of uniform random variables—what they look like, how they vary, and what happens when we add them. We'll start by looking at a familiar, though discrete, uniform distribution: that of a fair die. We know what happens when we add two dice; does the same thing happen when we add uniformly distributed random numbers?



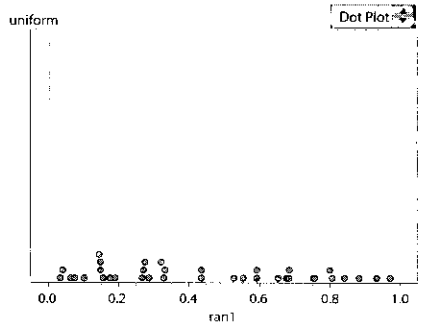
What To Do

▷ Open **Adding Uniform.ftm**. It will look something like the illustration.

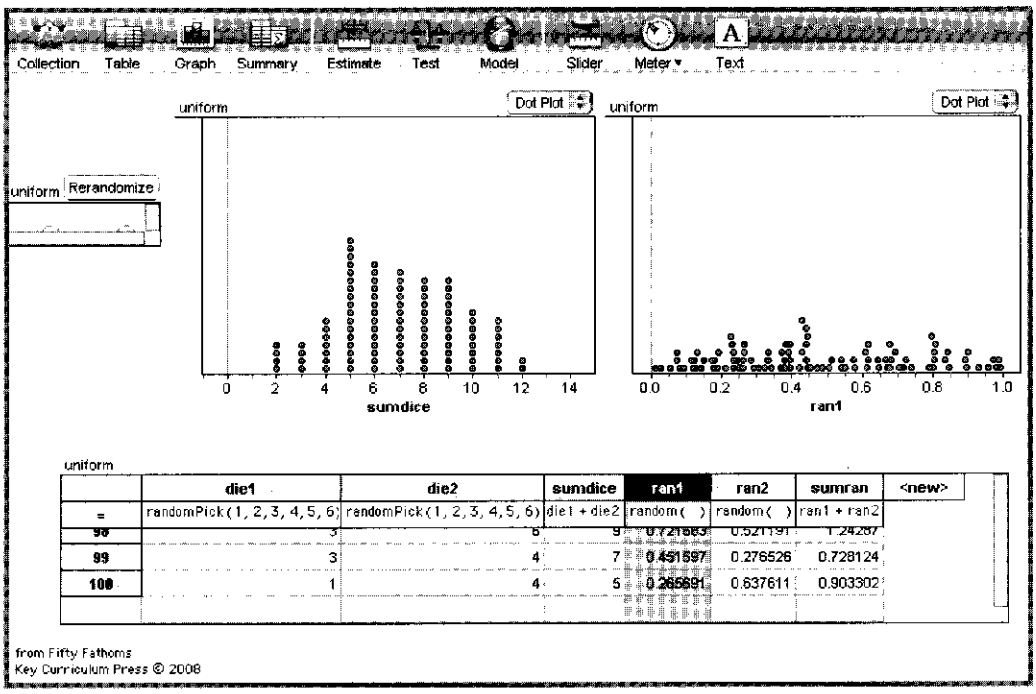
The case table at the bottom shows the data and, in its top row, the formula for each of the attributes (columns). You can see that **die1** and **die2** are fair dice (read their formula) and that **sumdice** is their sum. The left graph shows the distribution of 36 sums of dice. The attributes **ran1** and **ran2** are uniform random numbers in the range 0 to 1; **sumran** is their sum.

▷ Press the **Rerandomize** button in the collection near the upper left. The random numbers and the graph change. Repeat to get a sense of how varied the distributions can be.

▷ Drag the column head—the attribute name—**ran1** to the horizontal axis of the right-hand graph. Fathom makes a dot plot of the random numbers. You'll see a graph like this:



▷ Press **Rerandomize** a few more times; see how these "uniform" random numbers often bunch up or leave gaps.



- Drag the attribute **sumran** to that same horizontal axis, replacing **ran1.** Except for a change of scale and a slight bunching toward the center, the graph probably looks about the same.

The dice bunch up, why don't the uniform numbers? Let's add cases.

- Choose **New Cases** from the **Collection** menu. Add 64 cases, for a total of 100. At this point your window will look something like the illustration.

You may need to alter the vertical scales for comparison.

- Change both graphs to histograms (using the pop-up menus in the graphs themselves). Now the graphs probably look a lot more similar.
- Put **die1** and **ran1** on the horizontal axes, replacing the **sum**s. See how flat the histograms look (not very). Press **Rerandomize** to see how varied they can be.
- Add cases! With anything selected, choose **New Cases** again from the **Collection** menu. This time, add 900 cases, for a total of 1000. See how the graphs change? They look flatter. **Rerandomize** to check.
- Now replace **die1** and **ran1** with **sumdice** and **sumran,** respectively. You should see the characteristic triangular shape that you get when you analyze the dice theoretically.

Isn't it interesting how the way we plot a distribution affects the conclusions we might draw? In a dot plot, the uniform random numbers and the dice numbers look rather different, but in a histogram, they look the same.

The point is that you get the same sort of result with uniform continuous random variables that you do with their discrete cousins, die rolls. Since it may be easier to analyze die rolls at first, you can use that analogy to help you understand uniform distributions.

Extension

Extend the demo to add three or four or more random numbers. What happens to the shape of the distribution?