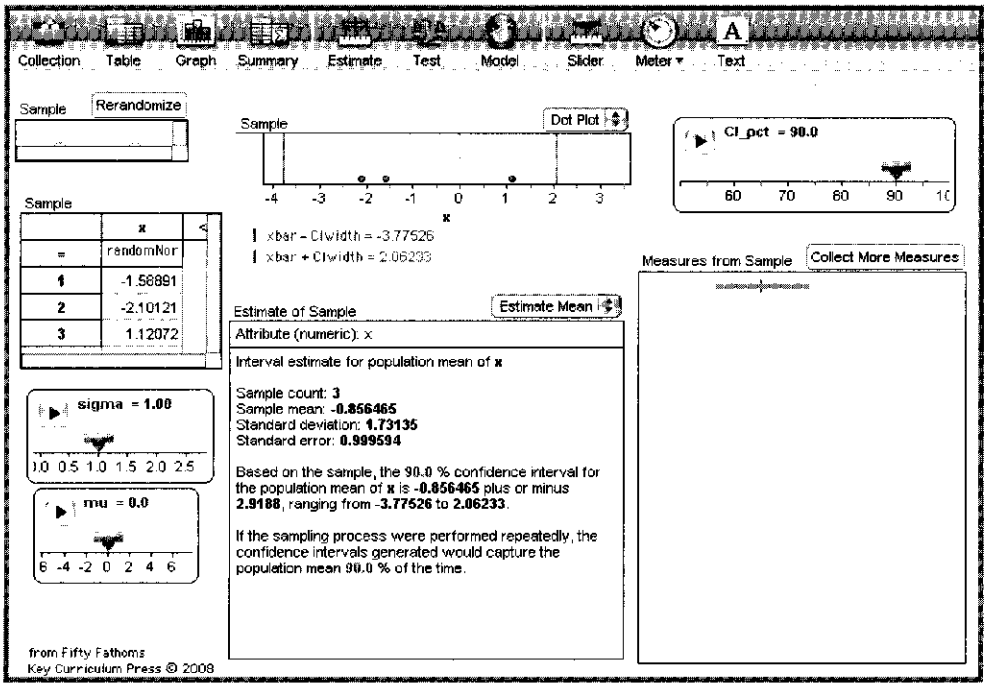
Demo 35: Capturing the Mean with Confidence Intervals

How confidence intervals of a mean do not always capture the population value •
What repeated CIs look like

In Demo 29, "Capturing with Confidence Intervals," we generated confidence intervals for a proportion. We saw that, for a 90% interval, roughly 90% of the intervals encompassed the true value. Here, we do the same, but with confidence intervals for the mean. Again, remember that in real life, we don't know the true mean—and we never will. In practice you get *one* sample and its interval, and you never see the others.



What To Do

▹ Open **Capturing the Mean with CIs.ftm.** It should look something like the illustration.

The **Sample** collection in the upper left has three cases; we're choosing a sample of three from a normal population with a mean of **mu** and a standard deviation of **sigma**, both controlled by the sliders below the table. The data appear in the graph top center, with the confidence interval limits in blue and red. The **CI_pct** slider controls the confidence level for the interval.

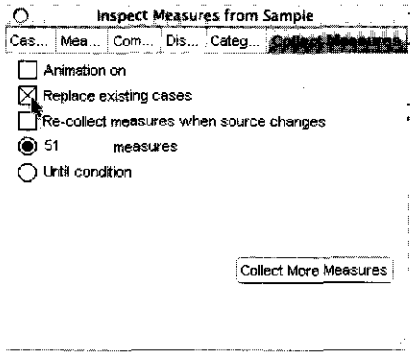
Meanwhile, below, you see a Fathom estimate (**Estimate of Sample**), where the program calculates the confidence interval (CI) and gives you additional statistics as well as the text "mantra" of what the CI means. In the lower right is another view (**Measures from Sample**), this time showing the CI from the estimate as a graphic box; the vertical line is the axis. As they appear, the boxes will be green if they enclose the true mean, black if they don't. We'll accumulate more objects throughout this demo.

Note: Unlike in Demo 34, "Exploring the Confidence Interval of the Mean," you can't drag the points in the graph, because they're calculated in a formula. In fact, that's one reason why we included both of these demos—it's great to drag the points, but it's also great to see what happens with repeated sampling.

▹ Click the **Rerandomize** button in the upper-left collection to see the sample points—and their CI—change. And each time you click, the new interval appears in the collection at the lower right. Explore this until you're comfortable with what's going on.

Note: The "bars" display is really the "gold balls" view of the measures collection; the balls have just mutated into the more useful bars. To see how this is done, check out the **Display** panel of that collection's inspector.

▷ Now we'll set up Fathom to collect these automatically. Double-click the lower-right display (the green and black bars) to open that collection's inspector. It should open to the **Collect Measures** panel. Edit the panel so that Fathom collects 51 measures (not 1), so that it replaces existing cases, and so that it does not collect measures when the source changes. The inspector should end up looking like the one in the illustration.



▷ Close the inspector and test it by pressing the **Collect More Measures** button. It should (eventually) fill with 50 bars (not 51—the first case is the "axis") as Fathom resamples, updating the graph and the estimate 50 times.

▷ Repeat that until you're convinced that about 90% of the bars encompass the mean.

▷ Play with the **CI_pct** slider to see what that does to the interval in the various graphs and to the number of intervals that catch the mean.

Questions

1 You would expect that 5 intervals out of every 50 would "miss" the mean when **CI_pct** is set at 90%. But that number should vary. Roughly, what's the range of numbers of "missing" intervals you found?

2 In general, what characterizes the intervals that miss (besides the fact that they miss)? That is, what do most of them have in common? **Sol**

3 When you change **CI_pct** and watch the display of the intervals in the lower right, what happens to the *positions* of the bars? What happens to their *widths*?

4 As you drag **CI_pct** to lower values, what happens to the number of intervals that miss? Explain why that is, based on watching the display of the 50 intervals. **Sol**

Extension

▷ Change **mu** and **sigma.** What effect does that have on how this works?

▷ Change the sample size by adding cases to the **Sample** collection. (Select the **Sample** collection and choose **New Cases** from the **Data** menu.) What effect does that have?

Challenges

5 When we looked at intervals of proportions in Demo 29, "Capturing with Confidence Intervals," the intervals were all roughly the same length. Here they differed. Why? Here, the short ones tended to miss. There, we got the same proportion of misses even though none were so short. How could that be? **Sol**

6 Consider Question 1—about the range of numbers of intervals that miss. Record those numbers as data in Fathom, and figure out a confidence interval for that number. See if it encloses the expected "true" value (5 for a 90% interval). Should you use a confidence interval of the mean, or of a proportion, or something else?