Exploring the Meaning of Random Sample

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A random sample is a collection of outcomes from a repeated process. The outcomes vary from trial to trial. But students often believe that they have personal control over the outcomes, which contradicts the fundamental assumption that the process is random. This belief is often masked if we start out with TinkerPlots, because students do not think that computers have personal agency. It is also important that students come to see "number-of-repetitions" of a repeated chance process as what we mean by a random sample. To help the students come to a better understanding of "sample" and "sample size," we assembled paper spinners with the cutout in the Appendix, a pencil to act as the axis of the spinner, and a paper clip as the pointer on the spinner. We re-created the 50/50 spinner from the Melissa's spinner worksheet. We agreed on spinner rules: the spinner had to make at least one full turn and ties would be re-spun.

Samples and sample size. The students then worked in table groups to run a sample of size 10 and size 100. They first spun the spinner ten times and recorded their results of red and blue. Then they ran the spinner 100 times and recorded those results of red and blue. Each table had one sample of size 10 and one of size 100. We ended up with 7 samples of size 10 and 7 samples of size 100. We created a dot plot of the class results on the whiteboard. We looked at our results, and I asked students to consider why the results obtained from 100 spins tended to cluster more than the results from 10 spins. I recorded student responses, which ranged from "It's just chance" to "It's harder to get as lucky (e.g., 8 red 2 blue vs. 80 red, 20 blue) when there are 100 spins ("cause that like getting lucky 10 times in a row.") I emphasized that sample size and number of repetitions of a process mean the same thing. I also asked students to consider how number of spins was like our process of measuring—why didn't we just want to rely on one measurement of my arm-span?

Personal agency and chance. Then I asked students if they thought that they could influence the number of red and blue in 10 trials—a sample size of 10—if they did not steer the spinner or cheat somehow. About half the class was convinced that they could. They proposed that if the spinner started out in the middle of the red region, red outcomes would be more likely. Others said that if they started the spinner with just a "sliver" of red, that would lead to more blue outcomes. Others thought that counterclockwise motion would be different than clockwise motion. So, we designed investigations to find out, first eliciting predictions about outcomes and writing these in plain view. Then several table groups collected 5 samples of size 10 for each investigation, We collected many samples of size 10 and discovered that our predictions were about equally confirmed and disconfirmed. A few students gave voice to our general consensus: "We can't control it, unless we cheat."

Revisiting Sneaky Pete. When we moved to TinkerPlots simulations, I re-introduced the Sneaky Pete spinners that everyone had already agreed did not change the probability of red. That is, until they saw that they would actually run the spinner. Now, many believed that the Sneaky Pete partitions would be "closer" to 50-50 because the partitions were more "spread out." Other students argued against this notion, noting that what was important was that the arrangement of the equal partitions did not matter, just so long as there was an equal number of red and blue partitions. We again made predictions and ran Sneaky Pete 1000 times to compare to 1000 repetitions of the original spinner, finding that those who were arguing that re-arrangements of partitions would not matter had a stronger claim in light of our data.

Having the students physically spin the spinner and record their results and be able to see each group in their class doing the same thing gave them a concrete understanding of sample and sample size before going on create sampling distributions with TinkerPlots. It helped students see TinkerPlots as simulating a chance process like theirs, so that TinkerPlots chance stood in for chance more generally.

Dot Plot Record of Class Results (on whiteboard)

N repetitions (Sample Size) = ______ spins

_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
0r,10b	1r, 9b	2r,8b	3r,9b	4r,6b	5r,5b	6r,4b	7r,3b	8r,2b	9r,1b	10r,0b
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100% red