OVERVIEW

In this activity, students take samples from a mixer whose contents are unknown and use this data to determine the location of the center of the hidden distribution.

Activity Time: One class period

Objectives

- Use data from random samples to draw inferences about a collection.
- Develop an understanding that, in some situations, even a relatively small random sample can provide enough information to to make accurate inferences about features of a population.

Common Core Standards Addressed

Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

Grade 7, Statistics and Probability Standard 1

Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.

Grade 7, Statistics and Probability Standard 2

Prerequisites

None

Materials

- Mystery Mixers worksheet (one copy per student)
- **Mystery Mixer 1.tp**
- **Mystery Mixer 2.tp**
- **Mystery Mixer 3.tp**
- **Mystery Mixer 4.tp**

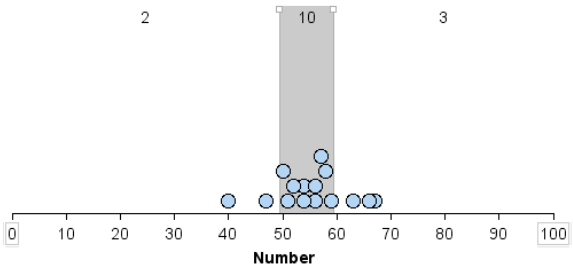
LESSON PLAN

Introduction (10 minutes)

Open the TinkerPlots document **Mystery Mixer 1.tp** and project it for students to see**.** Explain the task described in the student worksheet. Make sure students understand that there are 500 positive integers between 0 and 100 in the mixer. The integers vary, but they also tend to clump in a particular area, for example, around 45.

The goal of the activity is to draw samples until you think you have a good sense of where the integers are clumped, but keeping the sample size as small as possible.

Click the **RUN** button to add five integers to the plot. Repeat this, perhaps two more times, adding a total of 15 numbers to the plot. Ask students where the data are centered. As they describe the center, use dividers to indicate where the center of the data is (click the **Divider** button in the upper plot toolbar and adjust the borders). Many students will refer to this as the *center clump*, which can be used as an informal way of indicating the center of a distribution.



Make it clear that getting more data costs money, and that students want to make a good guess about where the center of the 500 integers is, but pay as little as possible to make it.

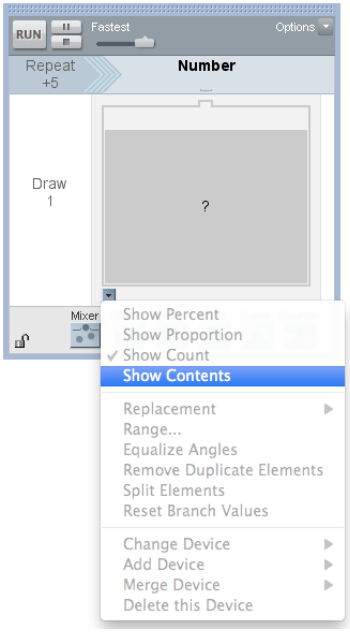
Student Work at Computers (20 minutes)

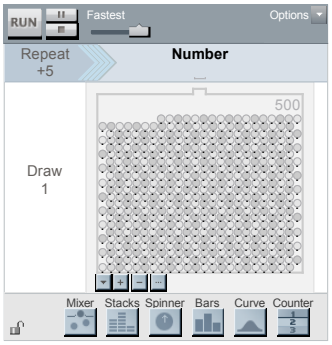
Hand out the Mystery Mixers worksheet.

Have students work in pairs answering the worksheet questions, discussing and deciding when to stop paying for extra data and make a guess for the location of the center clump.

Discussion (10 minutes)

On a projected computer screen, show the elements of Mystery Mixer 1. To do this, first unlock the sampler by clicking the Lock icon. Then choose **Show Contents** from the **Device Options** menu (found by clicking the arrow at bottom left of the device). Next, choose **Replacement | Without Replacement** from the **Device Options** menu.



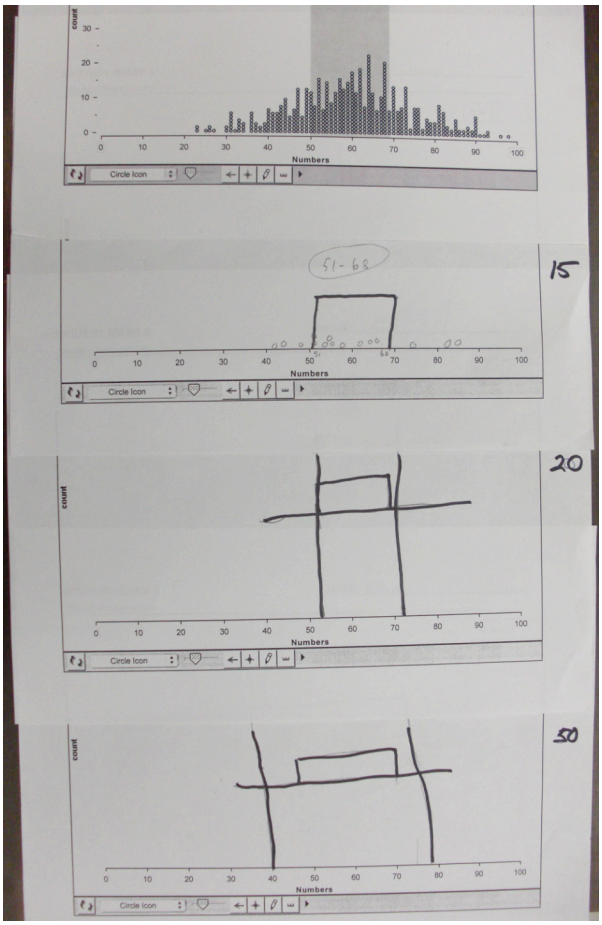


Change Repeat to 500 and click the **RUN** button to draw out all of the data without replacement to create the actual distribution.

You might collect and look through student worksheets for Mystery Mixer 1 and discuss how well they match the actual distribution, as well as identify who was able to predict it with good accuracy for the least amount of money.

You can repeat this process for the other three mixers, or just display the actual distributions.

A powerful way to demonstrate to students that even small samples can be very informative is to post one of the distributions on a classroom wall, and below it completed worksheets from several students. Here you can see the distribution for Mystery Mixer 3 along with sample work from three students. The sample size each student used is shown to the right.



You may need to cut sections from students' worksheets to do this, so consider presenting this the day following the activity. It is an excellent illustration of how consistently the students' answers capture the center clump of the distribution, even when students drew only a small sample.

Wrap-Up (5 minutes)

Ask students what they have learned. Direct the discussion to the observation that you can get a reasonable idea of where data are centered even from small samples. Often sample sizes between 15 and 30 are large enough to give a good sense.

ANSWERS

The characteristics of the Mystery Mixers are summarized in this table.

Note: The terms used to describe the shape may not be meaningful to your students, so you may choose not to use them.

Left wall means the distribution appears as if it was shoved up against a wall located on the left (0) end of the axis, which caused the values to bunch up on the left. Traditionally, this type of distribution is described as "skewed right." But students often have trouble remembering whether a particular distribution is skewed right or skewed left.

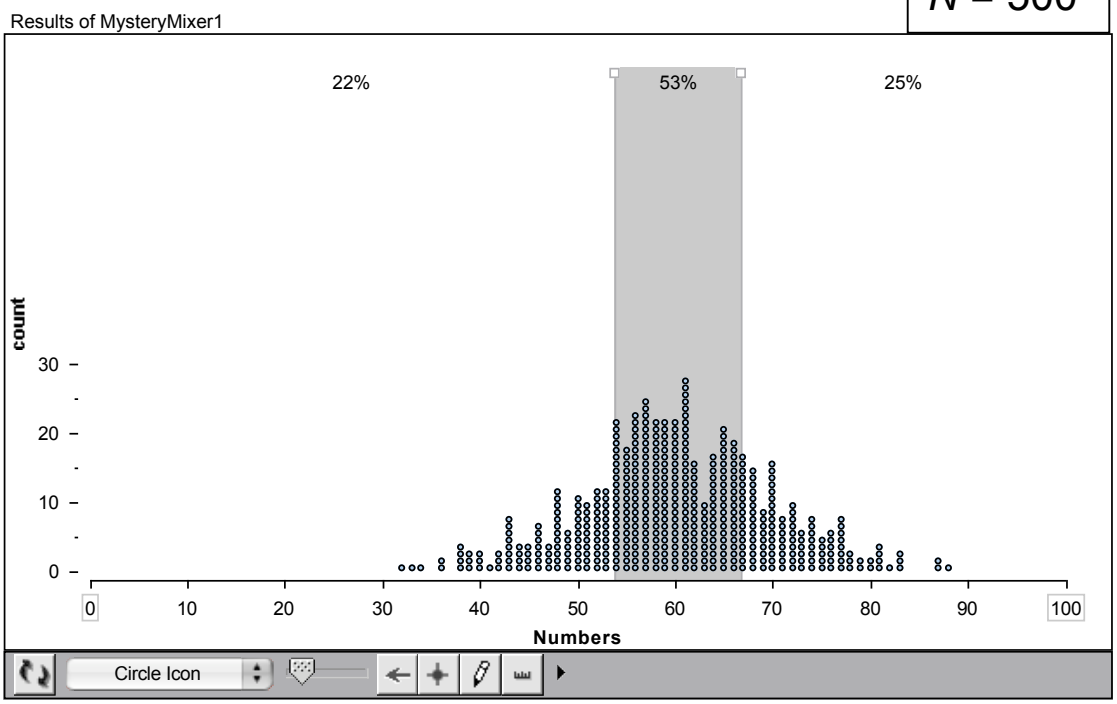
The descriptors *left wall* and *right wall* have two advantages. First, it is easy to remember when you use left and when you use right. Second, and more importantly, it provides an explanation for why distributions in the real world are skewed the way they are. The distribution of wealth has a left wall because you can't go lower than zero, but there is no known upper limit. There really is a left wall. A test that is too easy has a right wall (you can't get higher than 100%). Of course there is also a real left wall (0%), but because the test is too easy, students bunch up on the high end, and no one gets close to 0. This causes the distribution to bunch up on the right (high) side and tail off (skew) towards the left (low) end.

Mixer	Shape	Median	Interquartile Range (IQR)
1	Normal, narrow	60	54–67
2	Left wall (skewed right)	14	10–20
3	Normal, wide	60	51–70
4	Right wall (skewed left)	85	80–89

The specific distributions are shown over the next two pages.

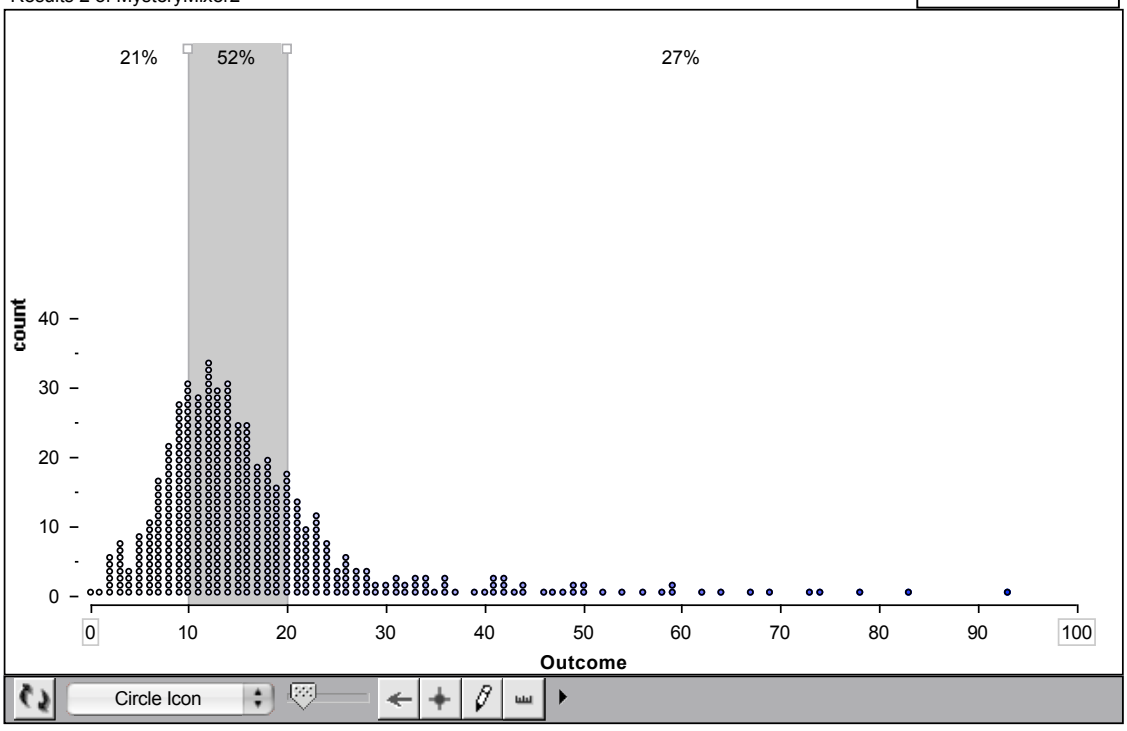
Mystery Mixer 1

N = 500



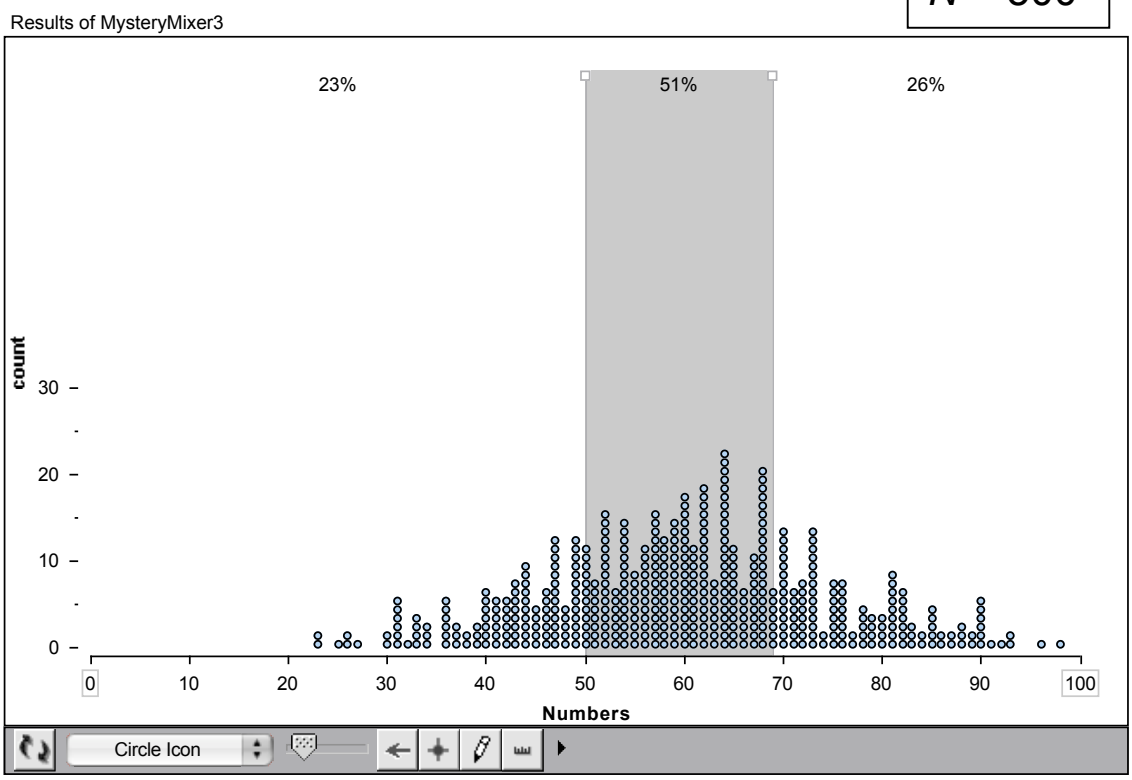
Mystery Mixer 2

N = 500



Mystery Mixer 3

N = 500



Mystery Mixer 4

N = 500