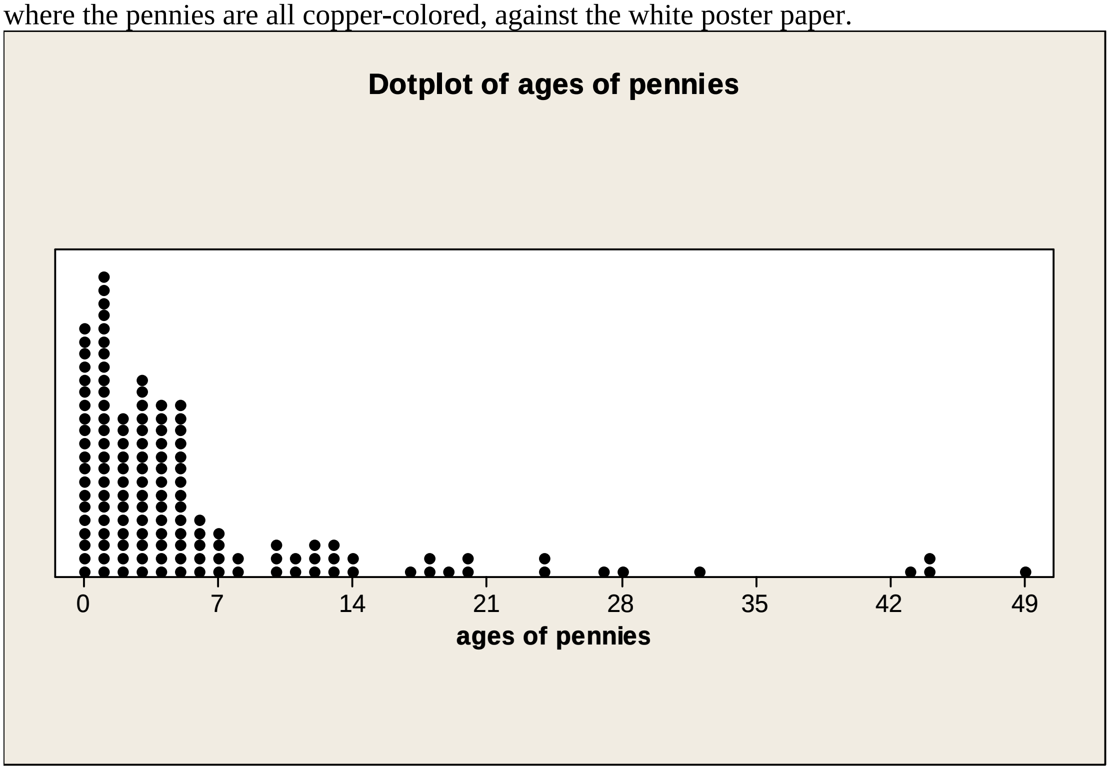
Activity to Motivate Discussion of Sampling Distributions.
(Adapted from an activity I use in the classroom.)

1. Find five pennies in your purse or pocket.
2. For each penny, determine its age.
   Instructions: Each penny has a year it was made. So take the current year and subtract the date of the penny. Example: If this is the year 2007, and the penny had date 2003, then the age of the penny is 2007 – 2003 = 4 years)
3. Write down your five ages of your five pennies.
   Example: When I did this, I had 3, 1, 18, 23, 2
   Your pennies' ages:

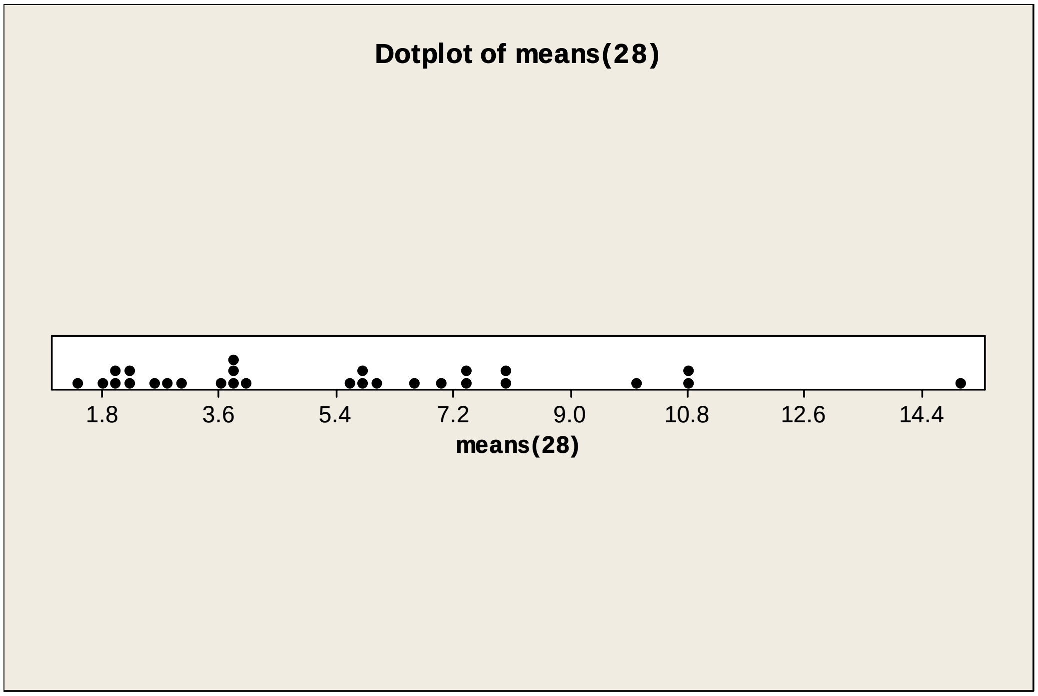
4. Next, find the mean of those five ages.
   Example: My five pennies have mean age of (3+1+18+23+2)/5 = 9.4
   Your pennies' mean age:

5. In the classroom, I have two different posters with the horizontal scale for a histogram on each. I ask the students to bring up their pennies and put a penny on each of the five ages of their pennies, so we build up the histogram as a group. Here is a graph that is very similar to one my class produced. Please add dots to it for your pennies. And then visualize this in the classroom, where the pennies are all copper-colored, against the white poster paper.



6. Does this distribution of ages surprise you? When I think of all the pennies that get lost in the floor of the car or the sidewalk, etc, it doesn't surprise me that most pennies in our pockets or purses are less than five years old. In almost every class, I am surprised that someone has a penny that is 40 years old or more.

7. Now I have the students in my classroom make a histogram of the means of the ages of five pennies. I ask them to take a nickel from my bowl of nickels and put it on the other histogram poster paper at the mean age of their five pennies. Since the class I'm describing here had 28 students, there are only 28 means and this is a rather small number to illustrate the ideas here, I will give you an additional graph on the next pages.



8. Put a dot on this plot for the mean of your five pennies.

9. Now we can notice several things about this graph of means.
   a. It is not nearly as spread out as the distribution of the individual ages. (Look carefully at the scale along the horizontal axis to see this.) So the standard deviation is smaller.
   b. The center of it is about the same as the center of the distribution of the individual ages.
   c. It is still skewed, but not nearly as skewed as the distribution of the individual ages.

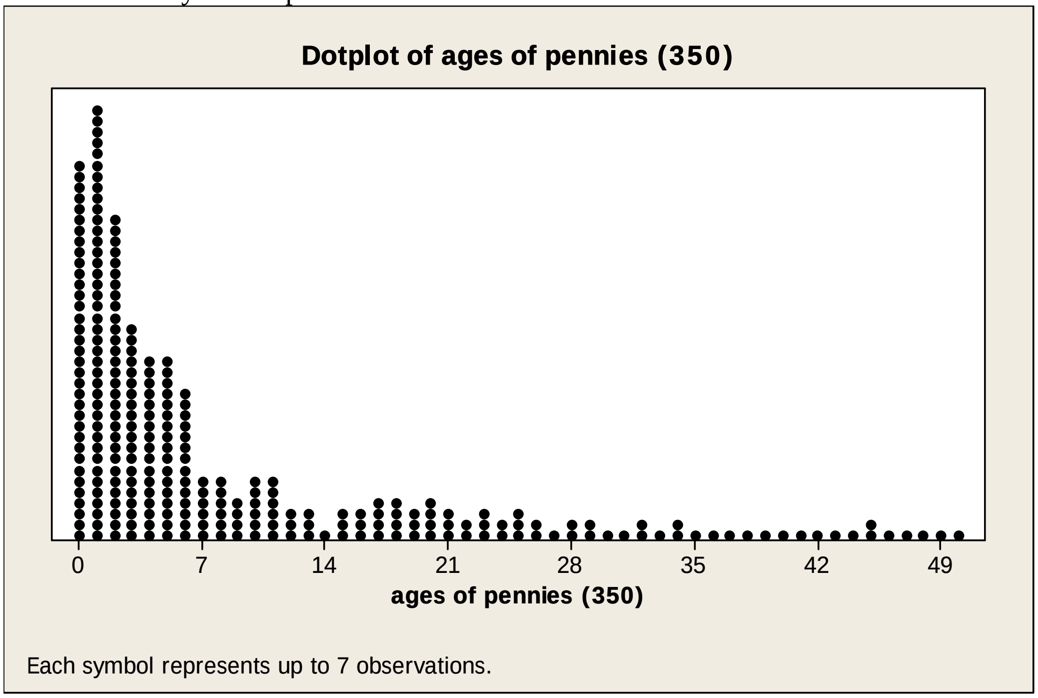
10. Actually, in my class, I have the students round their mean to a whole number and then make the scale of this histogram the same as the scale of the histogram of pennies. That makes it MUCH more obvious that this distribution of means is much less spread out than the distribution of ages of individual pennies. You could sketch these two graphs yourself, by hand, and make the scales the same. That would help you visualize this.

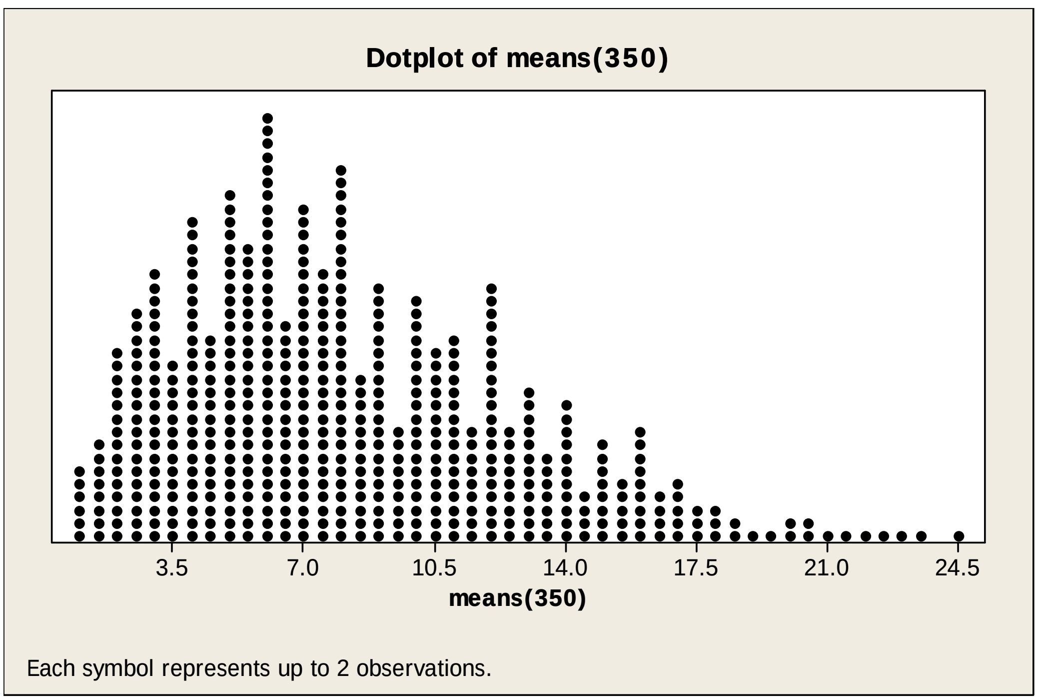
11. Here's the point of this activity:
    The histogram of the ages of the individual pennies is the graph of the population. Visualize that as copper-colored pennies on white posterboard.
    The histogram of the means of the five ages is the graph of the sampling distribution of the sample mean for samples of size 5. Visualize that as the grey-colored nickels on white poster board.
    The grey-colored distribution is NOT THE SAME as the copper-colored distribution. Sampling distributions are DIFFERENT DIST'Ns than population distributions.

12. The three facts listed in number 9 above are the three facts that make up the Central Limit Theorem. But before we discuss that in more detail, let's look at a what a larger class would have seen if they did the same activity.

13. Now suppose my class had 350 students in it, and each of them did the same activity. So there are 5*350 = 1750 pennies. And there are 350 means. We find the same skewed shape for the ages of pennies that we saw in the smaller class. But now there are enough means that we can

see more clearly the shape of the distribution of means.





14. Now we can notice several things about this graph of means.
    a. It is not nearly as spread out as the distribution of the individual ages. (Look carefully at the scale along the horizontal axis to see this.) That means the standard deviation is smaller.
    b. The center of it is about the same as the center of the distribution of the individual ages.
    c. It is still skewed, but not nearly as skewed as the distribution of the individual ages. With this many observations, it is clear that it looks more normally distributed than the distribution of individual ages.
15. Read the Central Limit Theorem. It has all three of these parts.