6.3B Cents-tral Limit Theorem

Purpose: To see how the sampling distribution of the sample mean behaves as the sample size increases and see how this relates to the Central Limit Theorem

Materials: You will need to bring 20 pennies, 4 or more nickels and two or more dimes for this lab.

Reading Assignment: Read through section 6.3.

Note: Unless your instructor says otherwise, you will not need to use your computer for this lab (although a calculator would be helpful).

Problem Description: In section 6.3, the Central Limit Theorem is introduced which basically says that the sampling distribution for the sample mean will be approximately normal provided the sample size is large enough. We will investigate the sampling distribution for the sample mean when taking samples that consist of ages of pennies. (This lab is based on a lab from the book "Activity- Based Statistics" by Scheaffer, Gnanadesikan, Watkins, and Witmer, published by Springer, 1996.)

Step 1: Record the ages of all your pennies on a sheet of paper. For instance, if a penny was minted in the current year, then its age is 0, if it was minted in last year, then its age is 1, and so on. On a sheet of paper, draw a plot of what you think the distribution of penny ages will look like for the population of all pennies in circulation.

STOP AND THINK: Describe the shape of the distribution you have just drawn. Discuss with your lab partner and others in the class why you think the distribution of penny ages has the shape you drew in step 1.

Step 2: We will make a 'histogram' using your pennies. On one of the large tables in the front of the room, your instructor has placed a long piece of tape on one edge of the table. On the tape, you should see marked from left to right the numbers 0, 1, 2, 3, ... Place your pennies on the table. If you have a penny that is one year old, place it above the 1 on the tape; if you have a penny that is 2 years old, place it above the 2 on the tape, and so on. You may have to take turns with other students placing your pennies on the table. Once all of the students have placed their pennies, what one will see is a 'histogram' of penny ages constructed from the actual pennies.

STOP AND THINK: Describe the shape of the histogram of pennies you see on the table. Does it match the plot of the distribution you sketched in Step 1? Is the penny age distribution normal? Looking at the penny histogram, estimate what the average age of the pennies. That is, what do you think the mean of the distribution of penny ages is from looking at the penny histogram. Write this number down.

Step 3: From the sheet of paper on which you wrote the age of all your pennies, calculate the average age of the first 5 pennies and record this value. Calculate the average age of the second 5 pennies and record this value as well. Do the same for pennies 11-15 and for 16-20.

Step 4: Now construct a histogram using nickels (this can be done on the same table with the pennies if there is room above the penny histogram). For each average of 5 pennies that you computed in step 3, place a nickel over the corresponding value on the table with the tape. ***Note: Ignore the date on the nickels! We are only interested in the ages of the original pennies.***

STOP AND THINK: After all the students have placed their nickels, describe the shape of the histogram of nickels on the table. Estimate the mean of the distribution of the nickels from looking at the histogram of the nickels.

Step 5: From the sheet of paper with the penny ages from step 1, compute the average of the first 10 pennies. Compute the average of pennies 11-20 as well and record these values on your paper.

Step 6: Above the histogram of nickels, on the same table (if there is room), make a histogram of the averages of 10 pennies using dimes to represent the average of each set of 10 pennies. Again, we ***ignore the actual date on the dime.***

STOP AND THINK: Describe the shape of the histogram of dimes. From looking at the histogram, what would you estimate the average of the dime distribution to be? Compare the spread of the penny, nickel, and dime distributions. Which is most spread out? Which has the least variability and why?

Once this lab is finished, please collect the coins you contributed to the 'histograms.'

Lab Report: Referring to the central limit theorem, explain why the shape of the histograms of pennies, nickels, and dimes differ. Make a sketch of the histograms the class constructed for the pennies, nickels, and dimes and mark the average you computed for each on the corresponding sketches. Also, make a sketch of what you think a histogram of averages of 25 pennies would look like if it were constructed with quarters. Finally, you were asked to give an estimate of the average or mean for the histograms involving pennies, nickels, and dimes. Compare these 3 'estimated' means. How should these three means compare to each other?