

**Math 263: Excel Assignment 5 on Confidence Intervals and Estimates:****Coin Tosses**

***Due Thursday March 27, at the start of class. Hand in a paper printout of your work.***

**Purpose of Assignment: Making Estimates from Samples of Means and Proportions**

In this assignment, you will look at samples of coin tosses and calculate confidence intervals for the proportions of heads. You will also identify coins that are apparently biased and experimenters who appear to have faked data.

First you will calculate what is expected from theory; then you will compare the results with simulated results from 15 students who each tossed a coin.

**Theory: What We Expect**

A student tosses a fair coin 30 times and records the number of heads. Consider the *sampling distribution* of the *proportion* of heads in all samples of size 30.

1. What is the shape of the sampling distribution?
2. What is the mean of the sampling distribution?
3. What is the standard deviation (standard error) of the sampling distribution?
4. Now suppose the coin is not fair and has a 60% probability of coming up heads. Consider the sampling distribution of the proportion of heads in samples of 30 tosses of this coin. What is
  - (a) The mean of this distribution
  - (b) The standard error (standard deviation) of this distribution.

**Simulation: What We See in the Data**

The Excel sheet *CoinTosses.xlsx* shows the results of coin tosses by 15 students. Each student tossed a coin 30 times and recorded the number of heads under “Sample 1” on the *Numbers* sheet. Each student repeated this procedure to get the number of heads in 20 such samples; the results are in the *Numbers* sheet.

5. Find the *proportion* of heads in each sample represented. Put the result in the *Proportions* sheet that has been laid out to receive them. (Nothing to hand in here.)

A good way to do this: You can get data from cell B4 in the Numbers sheet using “=Numbers!B4”. To calculate the proportion for Student 1, Sample 1, we want to divide the number by 30. Thus, type “=Numbers!B4/30” in cell B4 in the Proportions sheet. Then fill Right and Down.

6. For each student, find the mean proportion of heads in the student's 20 samples. Put the result in Column V. ((Use =AVERAGE(array). Nothing to hand in here.)
7. For each student, find the standard deviation of the proportion of heads in the student's 20 samples. Put the result in Column W. (Use =STDEV.S(array). Nothing to hand in here.)
8. Suppose one student had a biased coin. Which student do you think it was? Explain how you chose.
9. Suppose a different student found doing all the coin flips too much work and made up the data instead. Which student would you suspect? Explain what tipped you off.

(Work done by psychologists suggests that people do not make up "random" data very well, so it can sometimes be identified like this, by looking at statistics.)

### Creating Confidence Intervals

Each student now has 20 pieces of *quantitative* data from an approximately normal distribution—from the sampling distribution of proportions of heads.

10. For each student, create a 95% confidence interval for the *mean* of the sampling distribution. Use the formula for the confidence interval for means. Put the lower limit of the confidence interval in Column X and the upper limit of the confidence interval in Column Y.

***Paste a copy of Columns V through Y, Rows 3-18, in your solutions.***

11. Consider the 14 confidence intervals created by the unbiased coins. How many of these 14 confidence intervals contain the true mean? (We exclude the confidence interval for the student with the biased coin, as we do not know the mean of that distribution.)
12. For the biased coin, find
  - (a) The proportion of tosses that the coin turns up heads. (Give a single number estimate.)
  - (b) The 95% margin of error for your estimate.