earth & expected value hand in
Dr. Sarah's 1010: Introduction to Mathematics

goals:

- utilize technology to answer real-world questions and interpret results
- critically analyze the role of probability and chance in real world situations
- communicate statistics and probability information using a variety of representations, including numerical, visual and tables, in written documents.

1. Go to `https://www.random.org/coins/` select a coin from a country other than the United States, and write down what country and coin you selected.

2. In a simulation, we can have a computer mimic real-life scenarios so that we can quickly understand the likelihood of an event happening and the relationship to expected values. Next to Flip change the number 2 to 4 and Flip Coin(s). Circle which outcome you obtained (where H is head/obverse side):

   HHHH   HHHT   HHTH   HTHH   THHH   HHTT   HTHT   HTTH   THHT   THTH
   TTHH   HTTT   THTT   TTHT   TTTH   TTTT

3. How many total heads (obverse sides) were in the outcome from your simulation.

4. On *pollev*, at our usual class link, select the number of total heads from your simulation:
   A for 4 heads   B for 3 heads   C for 2 heads   D for 1 head   E for 0 heads

5. Next, back in the simulation `https://www.random.org/coins/` just above the Flip settings, read about the Coin Flipper—where does the randomness in the coin flipping generator come from—how does this relate to the earth and is it better or worse than pseudo-random number algorithms that are used in other programs?

6. If we are expecting the earth to be perfectly round, that isn't correct, as on a local scale we have mountains and more. Even on a global scale, there are some variations from a perfect sphere. Search the web for the smallest radius of the earth. List the number and the units (*km* or *mile*).

7. Search the web for the largest radius of the earth in the same units as the last question and list.

8. What is the difference between the two?

9. Compute the ratio of your last two responses $\dfrac{\#8}{\#7}$ and write as a decimal.

10. Change the last response to a percentage, which provides a quantification of % error in assuming the earth is a perfect sphere (an expected value of 0% difference for a perfect sphere).

11. Next multiply the reciprocals of your responses in #6 and #7 together: $\dfrac{1}{\#6}\dfrac{1}{\#7}$. This gives a rough estimate of the earth's curvature per miles^2 or km^2 (depending on which measurement you worked in) via $\frac{1}{r^2}$. Recall that scientific notation of 10^{-8} means that the decimal moves to the left 8 additional places. Write your response (scientific notation is fine) and notice how small this is—not curvy at all!

12. Using the sixteen equally likely outcomes that are listed in #2, count how many outcomes have exactly each number of heads, and fill in, so how many different ones have exactly 3 heads, etc:

4 heads: <u>1 outcome</u>   3 heads: _____   2 heads: _____   1 head: _____   0 heads: _____

Check that the sum of these responses add to all 16 of the outcomes.

13. Start by filling in the first two columns of this table. Once the class has completed the *pollev* activity and I've showed the totals, complete the last two columns.

heads	outcomes from #12	probability (divide by 16)	expected people on *pollev* (probability × total people who responded)	actual *pollev*
4	1	$\frac{1}{16} = .0625$		
3				
2				
1				
0				
add column	16	1		

14. Compare the last 2 columns of the above table. For each bar below on this visual representation of the theoretical relative proportions of expected people for each number of heads, just above it, label whether the actual people on our *pollev* was above, below, or matching what we would expect for each head count. So, compare the last 2 columns of the above table and if the actual was greater, write "above", less than, write "below", or equal to, write "same." You will have 5 labels:
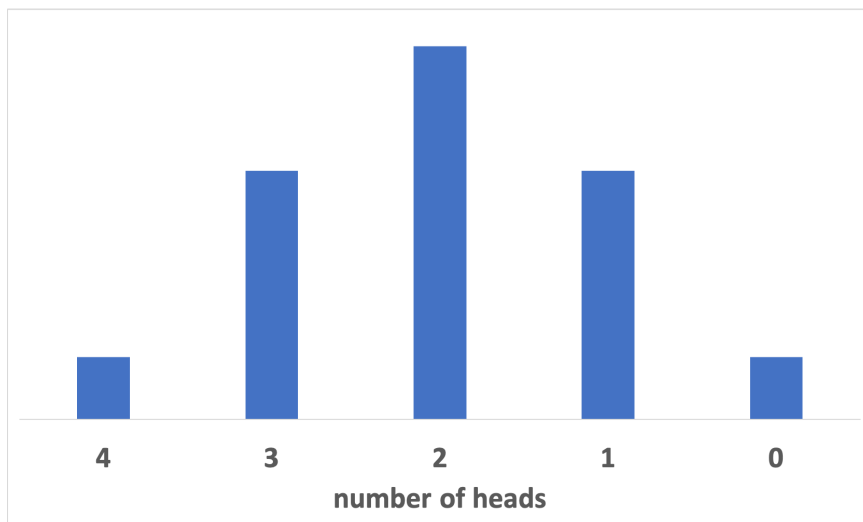
number of heads

15. Change Flip to 100. Count the number of heads you obtain and compare to the expected value (which is 50% of 100). Is yours greater than, less than or the same?

16. Collate your handwritten responses, preferably on this handout, into one full size multipage PDF for submission in the ASULearn assignment.