Discussion Section #4
Due: To be submitted to CatCourses by 11:59pm.

Instructions:

This week you will use R to study a game of chance consisting of many consecutive die rolls and money changing hands!

You will receive some basic guidance in R from your TAs and a piece of code that you will only need to slightly modify. You are welcome to work alone or in small groups but everyone is responsible for turning in their own code/assignment.

This week, you are responsible for submitting a single PDF file containing the following:

- Your R Code.
- Plots of the 3 empirical probability mass functions and the 3 empirical cumulative distribution functions. (1 Points for each PMF/CDF pair = 3 Points Total)
- Your answers to the questions posed. These answers must be written – in complete sentences and referring to the figures you created.

The easiest way to do submit all these required documents is to your write-up Word and then copy/paste code/figures/etc from R.

Note: If you can not submit as a PDF you should get permission for a different file format from your TA.

Simply providing the correct answer, without justification, is not considered complete. For credit you **must** either show you steps (if it's a calculation problem) or explain/justify your reasoning (if it's a short answer problem).

Assignment:

This Lab considers the following scenario:

- Peter and Paul play a simple game involving repeated tosses of a fair coin.
- A single "game" is 20 successive tosses.
- Each round in the gams the fair coin is tossed.
  - Head: Peter wins $\$1$ from Paul.
  - Tails: Peter gives $\$1$ to Paul.
- Note: Both Peter and Paul are allowed to go into debt! (They trust each other enough to settle their debts like adults.)
- Peter starts with zero dollars and we are interested in his change in fortune during this 20 toss game.

The R code you receive (Lab04.R) has all the components of simulating many trials of the same 20 round game. You only need to change 3 lines of the code to determine:

- The number of heads in a game.
- The total winnings Peter has at the end of the game.
- Peter's maximum fortune during the game.

1. (2 Points) Use the empirical probability mass function for Number of Wins (Heads) you've simulated to answer the following question:
   (a) Describe the distribution of the number of wins (heads) in a single game? (Symmetric, Skew, etc)
   (b) This distribution fits one of the special ones we learned about in Chapter 4. Please describe it in detail. *For full credit you must explicitly give the name of the distribution and its probability mass function with the parameters corresponding to this specific problem.*
   (c) (Extra Credit: 1 Point): Plot the theoretical probability mass function on the same plot as the empirical probability mass function and explain how well they agree.
2. (3 Points) Use the probability mass function for Total Winnings you've simulated to answer the following questions:
   (a) What is the probability that Peter will break even (i.e., have exactly $\$0$) after 20 tosses?
   (b) What is the probability that Peter will have $\$1$ at the end of 20 tosses?
   (c) Is there anything special about the total winnings that Peter can have? Are all values possible? If not all values are possible, explain why.
3. (2 Points) Use the probability mass function for Maximum Fortune you've simulated to answer the following question:
   (a) Describe the probability mass function of Peter's maximum fortune in a single game? (Symmetric, Skew, etc)
   (b) On average, what will Peter's best fortune be during a 20-toss game?
4. (Extra Credit: 2 Points): On average, in a 20-toss game, for what fraction of the time will Peter be in the lead?

   Note: There may be different ways to interpret this question. Part of your answer must explain how you are interpreting it.

   You will receive 1 point for your coding and 1 point for your explanation/write-up.