AGEC 622
06_simulation_basics Exercises
Due before the beginning of the next class

- Complete the exercises in the provided notebook "06_exercises_LASTNAME_FIRSTNAME.xlsx".
- **Rename your file, replacing "LASTNAME_FIRSTNAME" with your actual names.**
- If there is more than one question, note that each will have its own tab in the workbook.
- **Work vertically down the sheet** within your notebook. Separate the individual parts of the question(s) (a, b, c, . . .) using dividing rows like the blue example dividers in the file.
- Submit this homework by emailing your xlsx file to henry@tamu.edu, **with the subject "AGEC 622 exercises 06"**.

1) **Question 1**

The overall objective of this question is to characterize the risk of ruin for a series of coin toss bets. Suppose that you are betting on tosses of an *un*fair coin. Specifically, suppose you are betting on heads every toss, and the probability of heads is 0.55. You will bet on heads for 20 sequential coin tosses. You start with $5, and bet one dollar every toss. If you win, you increase your cash by one dollar. If you lose, you decrease your cash by one dollar.

a) **Setup the random draws**. Represent each individual coin toss with a Bernoulli random draw. Put one toss per row in your sheet (run the tosses down the page, not across).

b) **Track your cash balance**. Set up another column that tracks your cash balance over time. The last value of this is referred to below as the *unrestricted ending cash balance.*

c) **Create an indicator of ruin**. If your cash balance falls to zero *at any time*, you can no longer bet. Create a single cell that is a binary indicator of ruin. For example, perhaps make it take a value of one if you have gone broke, or zero if you have not.

d) **Create a restricted ending balance variable**. This should be equal to the unrestricted ending cash balance if you have not gone broke, or zero if you have.

e) **Simulate three values**. Simulate the unrestricted and restricted ending cash balances, and the ruin indicator variable.

Good news! Because the coin is unfair in your favor, each bet has a positive expected value for you. For the unrestricted ending cash balance, the mean simulated value should be approximately equal to the starting balance plus twenty times the expected value of each toss:

$$E(UECB) \approx \$5 + 20 \times \$\left(0.55 - 0.45\right) = \$7$$

Answer the following questions:

- What is the probability of ruin?
- What is your actual expected ending balance, considering the possibility of ruin?

2) **Question 2** The objective of this question is to characterize the *power* of various normality tests in a particular circumstance. Recall that power is one minus the probability of making a type II error.

a) **Set up a random data sample**. Create a random sample of 20 observations of draws from a beta distribution. Draw each value from a beta distribution with the following parameters:

- $\alpha = 1$

- $\beta = 1$
- $min = -2$
- $max = 2$

b) **Apply the normality tests** Apply Simetar's battery of normality tests to the random sample you created in part a), but ignore the results of the Kolmogorov-Smirnov and χ^2 tests. For each of the other three tests, set up an indicator variable that is one if the test is rejected at the 10% significance level, and zero otherwise.

c) **Identify the correct answers**. What is the null hypothesis? Is it true or false?

d) **Simulate**. Simulate the three indicator values. The mean simulated values for these indicator variables are the probabilities of rejecting the null for each test.

e) **Determine power for each test**. What is the power of each test?

f) **Ponder**. How much confidence do you have in these tests in making the correct determination in these circumstances? What factors do you think contributed to the empirical power you found for these tests? Under what circumstances do you think the tests might have improved power?