Project 1

This project is based on topics covered in Chapters 7 and 8.

Information:

Chapters 7 and 8 covers limiting and sampling distributions. These are very important results for later chapters and also to understand the behavior (distribution) of certain statistics (functions of random variables). One way to investigate this is to do a simulation study. Most theoretical results can be shown to hold empirically through simulation, and some results that are hard to derive theoretically can be established with simulation.

Question 1

Explain the construct and purpose of a simulation study in around 300-400 words.
Include the following ideas:
1. What is the purpose of a simulation study?
2. What makes a good simulation study?
3. What should we be careful of when setting up a simulation study?
4. How large is large enough?

Question 2

Design a simulation study to empirically show the result of Example 7.2.7.
Include the theoretical methodology and design, the code and results (include graphics) as well as a discussion of the results.

Question 3

Design a simulation study to empirically show the result of Theorem 7.3.2. (CLT), based on data from a Gamma distribution (you can choose your own parameters).
Include the theoretical methodology and design, the code and results (include graphics) as well as a discussion of the results.

Question 4

Variation in data can be very important to bound as to make more accurate inferences about means. Suppose we have two machines in a factory that manufactures drink cans. It would be important for us to make sure that the variation in the can sizes are not too big.

Suppose we have two independent samples from a Normal distribution with the same mean and variances $\sigma_1^2 = 1$ and $\sigma_2^2 = 3$.

Use a simulation study to get the distribution of $S_1^2+S_2^2$, and use it to calculate the probability $P(S_1^2+S_2^2 < 4.2)$. Include the theoretical methodology and design, the code and results (include graphics) as well as a discussion of the results.