ECE 514 Project: Part I

1. Simulating Random Variables

- Simulate random variates using both Matlab routines as well as the rejection method, for $\{X_i\}_{i=1,\cdots T}, T = 100, 1000, 10000$ with a PDF that is
  - Normal with mean= 2 and variance=2
  - Uniform on [2, 4]
  - Exponential with parameter 2
- Compute the histograms for each of the cases, and estimate the parameters of each of the populations in each of the observation length cases.
- Compare these empirical/computed parameters for each of the populations, to the theoretical ones. How do they compare?
- If they are somewhat different, can you explain these differences? What are they due to?

2. Transforming Random Variables

- Define $Y_i = \frac{1}{2i}\sum_i X_i\,, i = 1, \ldots, T$, for the THREE different distributions of X_i in Q1, and compute the associated histograms for $\{Y_i\}_{i=1,\cdots T}$ for each T.
- By consulting standard probability density functions (PDF), find the closest PDF which matches each of the histograms for each of the T's.
- How does the matching vary with T? How can you explain the variation?

3. Convergence of Random Variables

Following the paper “Understanding Convergence Concepts: A Visual-Minded and Graphical Simulation-Based Approach”, establish a demo by GUI of MATLAB to show and answer the following questions based on Y_T in Q2:

- Does $Y_T \xrightarrow{P} 0$? Why?
- Does $Y_T \xrightarrow{a.s.} 0$? Why?
- Does $Y_T \xrightarrow{2} 0$? Why?
- Does $Y_T \xrightarrow{L} X$? Why?

Reference:

https://www.mathworks.com/discovery/matlab-gui.html