Math3810 - Probability
Section 001 - Fall 2025
Introductory Homework #6

University of Colorado Denver / College of Liberal Arts and Sciences

Department of Mathematics - Dr. Robert Rostermundt

Name: **Student Number:**

Instructions

Show all reasoning clearly. All simulation results should be reproducible and clearly labeled. You may use R for all computations.

Problems

1. **Simulating Exponential Random Variables**
   (a) Simulate 1000 samples from an exponential distribution with rate $\lambda = 0.5$.
   (b) Plot the histogram and overlay the theoretical density.
   (c) Compute the sample mean and compare with theoretical mean.
2. **Transformations**
   (a) Let $Y = 2X + 3$. Simulate Y from your X samples.
   (b) Compute the sample mean and variance of Y and compare with theoretical values.
   (c) Plot the histogram of Y.
3. **Probability Computation**
   (a) Estimate $P(X > 3)$ using your simulated samples.
   (b) Compare with the exact probability $P(X > 3) = \exp(-0.5 * 3)$.
4. **CDF Comparison**
   (a) Plot the empirical CDF of X.
   (b) Overlay the theoretical CDF.
   (c) Comment on the convergence.
5. **Discussion**
   - Explain how linear transformations affect the exponential distribution.
   - Discuss the difference between empirical and theoretical probabilities.