Math3810 - Probability
Section 001 - Fall 2025
Introductory Homework #4

University of Colorado Denver / College of Liberal Arts and Sciences

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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. **Continuous Random Variable Simulation**

   (a) Simulate 500 samples from $X \sim N(5, 4)$.
   (b) Compute sample mean and variance.
   (c) Plot histogram and overlay the theoretical density curve.

2. **Linear Transformation of RV**

   (a) Define $Y = 3X - 2$.
   (b) Compute mean and variance of Y empirically.
   (c) Compare to theoretical $E[Y]$ and $Var(Y)$.

3. **CDF Comparison**

   (a) Compute empirical CDF of X and Y.
   (b) Plot both on the same graph with theoretical CDF curves.

4. **Standardization**

   (a) Standardize X to $Z = (X - \bar{X})/s_X$.
   (b) Verify mean and variance of Z.
   (c) Plot histogram of Z and overlay standard normal density.

5. **Discussion**

   - Explain the effect of linear transformations on mean and variance.
   - Explain why standardization produces mean 0 and variance 1.