Math3810 - Probability
Section 001 - Fall 2025
Introductory Homework #7

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. **Joint Distribution Simulation**
   (a) Simulate 5000 pairs (X, Y) where $X \sim N(0, 1)$, $Y \sim N(0, 1)$ independent.
   (b) Plot the scatterplot of (X, Y) and comment on independence.
   (c) Compute sample covariance and correlation.
2. **Dependent Variables**
   (a) Create $Z = X + Y$. Plot histogram of Z.
   (b) Compute sample mean and variance.
   (c) Compare with theoretical mean and variance.
3. **Bivariate Normal**
   (a) Simulate 5000 pairs from bivariate normal with $\rho = 0.7$.
   (b) Plot scatterplot and overlay marginal densities.
   (c) Compute sample correlation.
4. **Conditional Probability**
   (a) Estimate $P(Y > 1 \mid X > 0)$ from simulations.
   (b) Compare with theoretical conditional probability for independent X, Y.
5. **Discussion**
   - Explain how correlation affects scatterplots.
   - Discuss the effect on variance of the sum $Z = X + Y$.