# Math3810 - Probability
# Section 001 - Fall 2025
# Introductory Homework #10

University of Colorado Denver / College of Liberal Arts and Sciences

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**Name:** **Student Number:**

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## Instructions

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

## Problems

1. **Covariance and Correlation**
   (a) Simulate 5000 pairs $(X, Y)$ with $X \sim N(0, 1)$, $Y \sim N(0, 1)$ independent.
   (b) Compute sample covariance and correlation.
   (c) Create $Z = X + Y$ and compute mean, variance, and correlation with $X$.
2. **Dependent Variables**
   (a) Simulate $Y = 0.5X + \epsilon$ with $\epsilon \sim N(0, 1)$.
   (b) Compute sample covariance and correlation between $X$ and $Y$.
   (c) Plot scatterplot.
3. **Linear Combinations**
   (a) Compute $W = 2X - 3Y$ and its sample mean and variance.
   (b) Compare with theoretical values using variance formulas.
4. **Discussion**
   - Explain how covariance and correlation describe linear dependence.
   - Discuss how correlation affects variance of sums and differences.

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**Please let me know if you have any questions, comments, or corrections!**