

Math3810 - Probability
Section 001 - Fall 2025
Introductory Homework #2

University of Colorado Denver / College of Liberal Arts and Sciences

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Name:

Student Number:

- This is an open note introductory homework. You may use your notes and your book.
- Show your work clearly.
- Table for total points:

Problem	Points	Score/10
1	10	
2	12	
3	8	
4	10	
5	5	
Total	45	

Total Score: _____ / 10

Instructions

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

Problems

1. Vector and Sequence Operations

- (a) Create a numeric vector containing the numbers 1 through 10.
- (b) Compute the sum and mean of the vector.
- (c) Create a sequence from 0 to 5 in increments of 0.5.
- (d) Compute the sum of the squares of this sequence.

2. Simulating Two Dice Rolls

- (a) Simulate a single roll of two fair six-sided dice.
- (b) Simulate 1000 rolls of two dice.
- (c) Compute the proportion of times the sum is 7.
- (d) Compare your result to the theoretical probability.

3. Empirical Distribution of a Die

- (a) Simulate 600 rolls of a fair six-sided die.
- (b) Compute the empirical probability of each face.
- (c) Create a barplot of the frequencies.
- (d) Compare the empirical probabilities to the theoretical probability of $1/6$ for each face.

4. Simulating a Biased Coin

- (a) Simulate 100 coin tosses where $P(\text{Heads}) = 0.7$.
- (b) Compute the proportion of heads and tails.
- (c) Repeat this simulation three times and observe the variation.
- (d) Discuss why the results differ slightly across trials.

5. Conceptual Question In your own words, explain:

- The difference between theoretical and empirical probabilities,
- Why simulations can be used to estimate probabilities,
- How increasing the number of trials affects the estimates.