Math3810 - Probability
Section 001 - Fall 2025
Introductory Homework #1

University of Colorado Denver / College of Liberal Arts and Sciences

Department of Mathematics - Dr. Robert Rostermundt

Name: **Student Number:**

- This is an open note introductory homework. You may use your notes and your book on this introductory homework.

- Throughout the introductory homework, show your work so that your reasoning is clear. Otherwise no credit will be given.

- If you are asked to *find* or *write* a formula or an expression without proof, you do not need to show any work but must present your solution using correct mathematical notation.

- If you are asked to *give* or *cite* a definition or a result that we discussed in class, you must use complete sentences, correct mathematical notation, and state all conditions or assumptions.

- If you are asked to *prove* or *show* a formula or a result, you must give a proof using complete sentences and correct mathematical notation. If you can correctly cite a result that we have proved in class or that is proven in the book, you can use it and do not have to prove it again.

- The following table gives the total points for each problem on this introductory homework.

Problem	Points	Score/10	Problem	Points	Score/10
1	12		6	8	
2	12		7	8	
3	8		8	6	
4	6		9	6	
5	17		*	*	
Total	55			28	

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. **Basic R Warm-Up**

   (a) Use R to compute:
   $$2^5, \qquad \frac{17}{3}, \qquad \sqrt{2}.$$

   (b) Store the value of $\sqrt{2}$ in a variable x and compute $x^2 - 2$.

2. **Simulating a Coin Toss**

   (a) Use `sample()` to simulate one fair coin toss with outcomes H and T.

   (b) Simulate 10 independent coin tosses and store the outcomes.

   (c) Count the number of heads.

3. **Empirical Probability**

   (a) Simulate 100 independent coin tosses.

   (b) Compute the empirical proportion of heads.

   (c) Repeat the experiment three times.

   (d) Comment on whether the empirical proportions are identical or different.

4. **Dice Experiment**

   (a) Simulate 60 rolls of a fair six-sided die.

   (b) Estimate the probability that the outcome is greater than 4.

   (c) Compare your estimate to the theoretical probability.

5. **Conceptual Question**

   In your own words, explain:

   - What an empirical probability is,
   - Why empirical probabilities vary from run to run,
   - How this connects to the idea of long-run frequency.