Practical Discrete Mathematics (CSE 1402)

MINOR ASSIGNMENT-4: DISCRETE PROBABILITY

1. Write a code to simulate tossing a fair coin 1000 times. Count and display the number of heads and tails.

2. Write a program to simulate rolling a six-sided die 1000 times and calculate the probability of rolling a 6.

3. Write a program to simulate the birthday problem to find out the probability that in a group of 23 people, at least 2 share the same birthday.

4. Given a bag with 3 red balls and 2 blue balls, write a program to find the probability of drawing 2 red balls without replacement.

5. Write a code to simulate the rolling of two six-sided dice 5000 times. Compute the experimental probability of getting a sum of 7.

6. For a given finite sample space and equally likely outcomes, write a function that computes the probability of any event (subset of the sample space).

7. Write a code to compute the probability of getting exactly k heads in n coin tosses for a fair coin.

8. Plot the distribution of the number of heads when tossing 50 coins. Use `matplotlib` to visualize the results.

9. A sports analyst provides the following probabilities for an upcoming soccer match:

   - Probability that Real Madrid wins: $P(R) = 0.40$
   - Probability that FC Barcelona wins: $P(B) = 0.50$

   The only other possible outcome is a draw. Write a Python program that:

   (a) Stores the probabilities of Real Madrid and Barcelona winning.

   (b) Calculates and prints the probability of a draw.
   (Hint: Use the fact that the sum of all disjoint outcomes must be 1.)

10. Given a dataset of weather (e.g., temperature and rainfall), write a program to calculate the conditional probability that it rained given a certain temperature range.

11. Write a code to implement a function that uses Bayes' Theorem to compute $P(A \mid B)$ given $P(B \mid A)$, $P(A)$, and $P(B)$.

12. Given a dictionary with temperature ranges and corresponding rain frequencies, write a code to calculate the conditional probability that it rained, given a specific temperature range.

13. **Spam Filter Analyzer:** Given the following probabilities:

    - $P(T) = 0.1$
    - $P(F \mid T) = 0.95$
    - $P(F \mid T^c) = 0.05$

    Write a Python script to compute $P(T \mid F)$ using Bayes' Theorem.

14. Given a discrete probability mass function (PMF), write a program to simulate the random variable and estimate its expected value through trials.

15. Using data from rolling a biased 10-sided die 1000 times, write a program to compute the expected value and variance.

16. Given a network of 5 web pages and their links (from a reference book), write code to perform two iterations of the PageRank algorithm.

17. Write a code to simulate a random surfer clicking links across a small internet of pages using a damping factor. Estimate and plot the visit frequency for each page.