
PROGRAMMING ASSIGNMENT - 1

AI1110 - PROBABILITY AND RANDOM VARIABLES

B

INSTRUCTIONS

1. The submission deadline on 9 February 25 is firm, i.e. no extensions will be permitted.
2. Submitting late will cost you 25% penalty per day.
3. Only Jupyter notebooks (.ipynb) should be submitted.
4. The code should be neatly documented. This includes proper variable names and functions. Comments should be used effectively.
5. Avoid usage of external libraries apart from `numpy`, `matplotlib`, `pandas`. Usage of other libraries may lead to a penalty.
6. Plagiarism in any form will result in an F-grade.

QUESTIONS

1. FLIPPING THE ODDS: BIASED DECISIONS WITH A FAIR COIN

Alice and Bob need to make decisions for their plans. They have a fair coin but they want to make a decision that is **biased towards playing video games**. Specifically:

- **Movies** should be chosen with probability $p = \frac{1}{8}$.
- **Video Games** should be chosen with probability $p = \frac{7}{8}$.
- write a function `flip_coin()` that simulates a fair coin toss and returns:
 - True for heads.
 - False for tails.
- Write a function `biased_decision_with_fair_coin(flip_coin, p)` that `flip_coin` function and returns a biased decision with head probability being p .
- The function should simulate a **biased decision** using the fair coin and return:
 - True for video games.
 - False for movies.

Ensure your solution satisfies the following:

- It works correctly for the given $p = \frac{1}{8}$.

In addition to implementing the function, you must complete the following task:

- Using Python's `matplotlib`, plot the approximate **Probability Mass Function (PMF)** for:
 - The outcomes of the `flip_coin()` function.
 - The outcomes of your `biased_decision_with_fair_coin()` function.

Ensure your plot demonstrates that the fair coin produces almost equal probabilities, while your fair decision function produces unequal probabilities.

Hints: For plotting the PMFs, run multiple simulations (e.g., 10,000 trials) and count the frequencies of outcomes. Normalize the frequencies to approximate the probabilities.

Optional: Try to extend your solution to work for other probabilities as well.

2. ANALYZING DATA

- (a) Titanic Dataset: Given that the person survived, what is the probability that his ticket Class is two?
- (b) Height-Weight Dataset: Number of people with a weight greater than 170 whose index is lesser than 4? (Index : 0 - Extremely Weak, 1 - Weak, 2 - Normal, 3 - Overweight, 4 - Obesity, 5 - Extreme Obesity)

Datasets: *Titanic-Survival.csv*, *Height-Weight.csv*