11.16.3.8.3

EE24BTECH11047 - Niketh Prakash Achanta

Question:
Three coins are tossed once. Find the probability of getting at least 2 heads.
Solution:
Computational solution:

Introduction

This document explains the computational process of determining the probability distribution of obtaining at least 2 heads when three coins are tossed. The implementation involves two components:

- A **C program** to perform the simulation, calculate the probabilities (PMF), and the cumulative distribution function (CDF).
- A **Python** script to use the results from the C program and generate a plot of the probability.

Definitions

Let the random variable X represent the number of heads when three coins are tossed. The possible values of X are:

$$X \in \{0, 1, 2, 3\}.$$

We are interested in the probability:

$$P(X \geq 2) = P(X = 2) + P(X = 3).$$

C Program Implementation

The C program performs the following steps:

1) Simulate n trials of tossing three coins using the `rand()` function to generate random outcomes (head or tail).
2) Count the occurrences of 2 and 3 heads across all trials.
3) Compute the probability:

$$P(X \geq 2) = \frac{\text{Number of occurrences of 2 or 3 heads}}{n}.$$

Python Script Implementation

The Python script:

1) Loads the shared object file (`.so`) created by the C program.
2) Calls the `calculate_probabilities` function in the C program, passing the number of trials (n) and retrieving the PMF.
3) Plots the PMF as a stem plot, showing the probabilities for each outcome (0, 1, 2, and 3 heads).

Visualization

The Python script generates a stem plot of the PMF, illustrating the probabilities for each outcome:

$$P(X = 0), P(X = 1), P(X = 2), P(X = 3).$$

Conclusion

The probability of getting at least 2 heads is computed as:

$$P(X \geq 2) = P(X = 2) + P(X = 3).$$

This computational process combines the efficiency of C for numerical simulation and the versatility of Python for visualization.

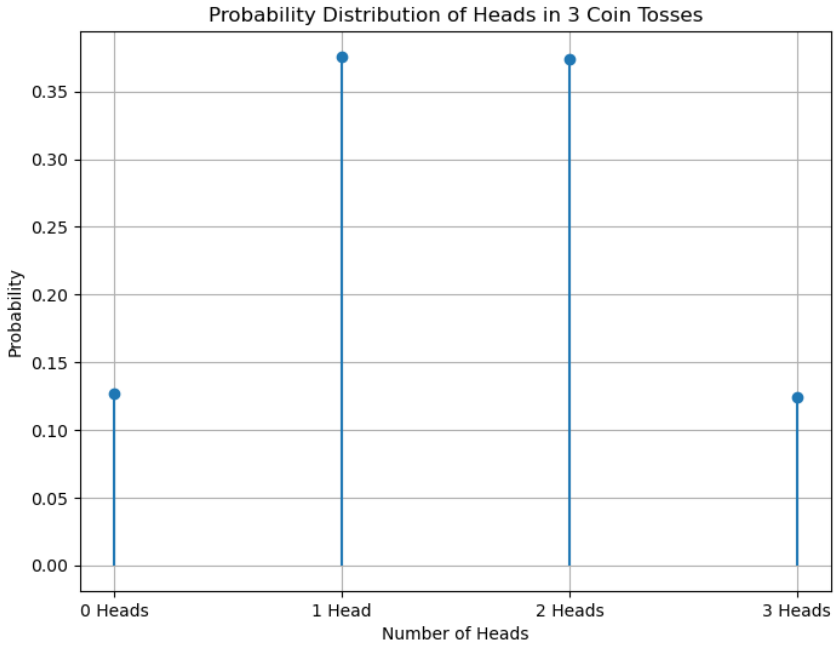

Fig. 3.1: Probability distribution of the number of heads when three coins are tossed