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Alliance School of Advance Computing

Mean and Variance of a Random Variable Independent Events MATLAB Mini Project

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MATLAB Mini Project

SUBMITTED TO

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Mean and Variance of a Random Variable
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AIM: Implement the concept of Independent event and Mean and Variance of a random variable by using the MATLAB Program

OBJECTIVE:

- Understanding Probability and Independent Events
- Computing Mean and Variance of a Random Variable
- Practical Application of MATLAB in Probability Theory
- Comparison of Theoretical and Computational Results

INTRODUCTION

Probability theory plays a crucial role in statistical analysis and real-world decision-making. In this project, we aim to implement the concepts of Independent Events, Mean (Expected Value), and Variance of a random variable using MATLAB.

An independent event is a probability event where the occurrence of one event does not affect the probability of another. Mathematically, two events AAA and BBB are independent if:

$$P(A \cap B) = P(A) \times P(B)$$

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STATEMENT:

1. Independence of Events
   - Simulate a two-coin toss experiment to verify the independence of two events:
     - Event A: The first coin shows Heads.
     - Event B: The second coin shows Heads.
   - Use probability calculations to determine if P(A∩B)=P(A)×P(B)P(A \cap B) = P(A) \times P(B)P(A∩B)=P(A)×P(B), confirming statistical independence.
2. Mean and Variance of a Random Variable
   - Given a discrete random variable XXX with a defined probability distribution, compute:
     - Mean (Expected Value):

E(X)=∑XiP(Xi)E(X) = \sum X_i P(X_i)E(X)=∑XiP(Xi)

     - Variance:

Var(X)=E(X2)−(E(X))2Var(X) = E(X^2) - (E(X))^2Var(X)=E(X2)−(E(X))2

   - Verify the correctness of the computed values using MATLAB.

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PROBLEM 1: Given a discrete random variable \(X \) with the following probability distribution:

X	0	1	2	3
P(X)	0.1	0.3	0.4	0.2

MATLAB CODE:

```
% Define the values of X and their corresponding probabilities

X = [0 1 2 3];

P = [0.1 0.3 0.4 0.2];

% Calculate Mean

mean_X = sum(X .* P);

% Calculate E(X^2)

EX2 = sum((X.^2) .* P);

% Calculate Variance

var_X = EX2 - mean_X^2;
```

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% Display results

fprintf('Mean of X = %.2f\n', mean_X);

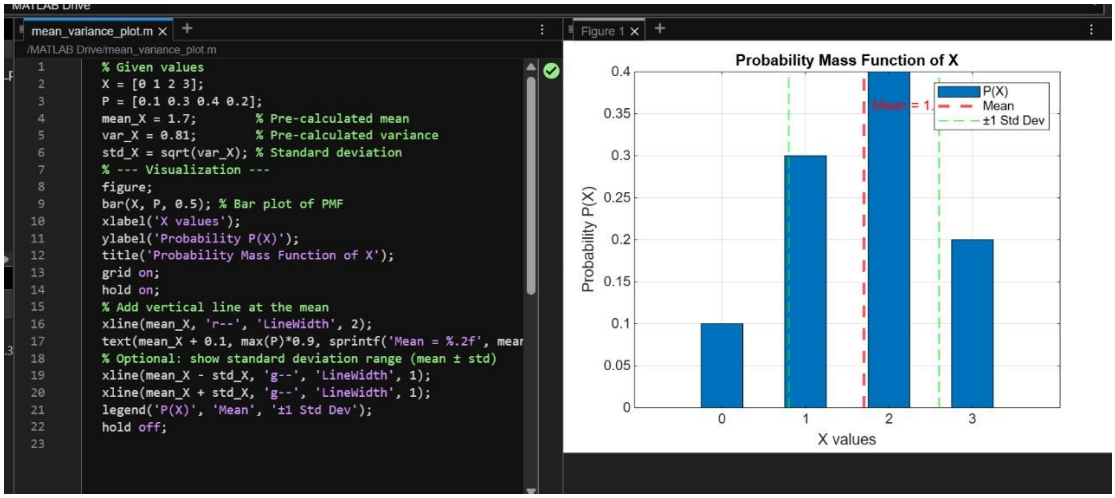
fprintf('Variance of X = %.2f\n', var_X);

OUTPUT:

Mean of X = 1.70

Variance of X = 0.81

VISUALIZATION:



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PROBLEM 2: Two fair coins are tossed. Let:

- Event A: The first coin shows Heads.
- Event B: The second coin shows Heads.

Are events A and B independent?

MATLAB CODE:

```
% Simulation to verify independence of two coin toss events

N = 100000; % number of trials

outcomes = randi([0, 1], N, 2); % 0 = Tails, 1 = Heads

% Event A: First coin is Heads

A = outcomes(:,1) == 1;

% Event B: Second coin is Heads

B = outcomes(:,2) == 1;

% P(A)

P_A = sum(A) / N;

% P(B)
```

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```
P_B = sum(B) / N;

% P(A ∩ B)

P_A_and_B = sum(A & B) / N;

% Check independence

is_independent = abs(P_A_and_B - (P_A * P_B)) < 0.01;

% Display results

fprintf('P(A) = %.4f\n', P_A);

fprintf('P(B) = %.4f\n', P_B);

fprintf('P(A ∩ B) = %.4f\n', P_A_and_B);

fprintf('P(A)*P(B) = %.4f\n', P_A * P_B);

fprintf('Are A and B independent? %s\n', string(is_independent));
```

OUTPUT:

```
P(A) = 0.501890
P(B) = 0.500900
P(A n B) = 0.250870
P(A)*P(B) = 0.251397
Are A and B independent? true
```

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VISUALIZATION: