Practical Assignment No. 1	
Title:	Probability distribution of Fair Dice
Problem Statement:	Given a 6-sided fair dice, compute the mean and variance for the probability distribution that models said dice. Plot the probability mass function for the sum of two 6-sided fair dice when you throw it twice using any programming language.
Objective:	To apply mathematical concepts in computer science for solving the problems.
Outcome:	CO505.1: Implement the program to solve the problems using probability.
Software or Hardware Requirements:	Anaconda/Java/GCC
Theory:	**Dice problem-** Usually dice can have different numbers of sides and can be either fair or loaded. ● A fair dice has equal probability of landing on every side. ● A loaded dice does not have equal probability of landing on every side. Usually one (or more) sides have a greater probability of showing up than the rest. A standard 6-sided die, for example, can be considered "fair" when each of the faces has the same probability of ⅙. A fair 6-sided die is typically numbered from 1 through 6 (standard), meaning that a single roll will give you one of any of those numbers: 1, 2, 3, 4, 5, or 6. This fair 6-sided die consists of a 1/6 chance of a 2 and a 1/6 chance of a 5, and because they're mutually exclusive, you just add them together to obtain a 1/3 chance of obtaining either a 2 or 5. **How to Calculate Probability?** Step 1 - Determine a single event with a single outcome. Step 2 - Identify the total number of outcomes that can occur. Step 3 - Divide the number of events by the number of possible outcomes. There are six possible outcomes: 1, 2, 3, 4, 5, or 6 for a fair die. The probability mass function for a single die could be given by the following table.

Outcome	Probability
1	1/6
2	1/6
3	1/6
4	1/6
5	1/6
6	1/6

The PMF could also be given by the equation Pr($D = k$) = 1/6, for k = 1, 2, 3, ... , 6, where D denotes the random variable associated with rolling a fair die once.

Important terms-

Suppose that the observations in a sample are $x_1, x_2, \ldots, x_n$. The **sample mean**, denoted by $\bar{x}$, is

$$\bar{x} = \sum_{i=1}^{n} \frac{x_i}{n} = \frac{x_1 + x_2 + \cdots + x_n}{n}.$$

The **sample variance**, denoted by s^2, is given by

$$s^2 = \sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n-1}.$$

The **sample standard deviation**, denoted by s, is the positive square root of s^2, that is,

$$s = \sqrt{s^2}.$$

The set of all possible outcomes of a statistical experiment is called the **sample space** and is represented by the symbol S.

An **event** is a subset of a sample space.

For any non-negative integer n, $n!$, called "n factorial," is defined as

$$n! = n(n-1)\cdots(2)(1),$$

with special case $0! = 1$.

The number of permutations of n objects is $n!$.

The number of permutations of n distinct objects taken r at a time is

$${}_nP_r = \frac{n!}{(n-r)!}.$$

The number of ways of partitioning a set of n objects into r cells with n_1 elements in the first cell, n_2 elements in the second, and so forth, is

$$\binom{n}{n_1, n_2, \ldots, n_r} = \frac{n!}{n_1! n_2! \cdots n_r!},$$

where $n_1 + n_2 + \cdots + n_r = n$.

The number of combinations of n distinct objects taken r at a time is

$$\binom{n}{r} = \frac{n!}{r!(n-r)!}.$$

The **probability** of an event A is the sum of the weights of all sample points in A. Therefore,

$$0 \leq P(A) \leq 1, \quad P(\phi) = 0, \quad \text{and} \quad P(S) = 1.$$

Furthermore, if A_1, A_2, A_3, $\ldots$ is a sequence of mutually exclusive events, then

$$P(A_1 \cup A_2 \cup A_3 \cup \cdots) = P(A_1) + P(A_2) + P(A_3) + \cdots.$$

If an experiment can result in any one of N different equally likely outcomes, and if exactly n of these outcomes correspond to event A, then the probability of event A is

$$P(A) = \frac{n}{N}.$$

The conditional probability of B, given A, denoted by $P(B|A)$, is defined by

$$P(B|A) = \frac{P(A \cap B)}{P(A)}, \quad \text{provided} \quad P(A) > 0.$$

A **random variable** is a function that associates a real number with each element in the sample space.

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If a sample space contains a finite number of possibilities or an unending sequence with as many elements as there are whole numbers, it is called a **discrete sample space**.

The set of ordered pairs $(x, f(x))$ is a **probability function**, **probability mass function**, or **probability distribution** of the discrete random variable X if, for each possible outcome x,

1. $f(x) \geq 0$,
2. $\sum_x f(x) = 1$,
3. $P(X = x) = f(x)$.

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<td>Input/Datasets/Test Cases:</td>
<td>Random Input from (1,..,6) using Random Number generators like <u>numpy.random.choice</u>.</td>
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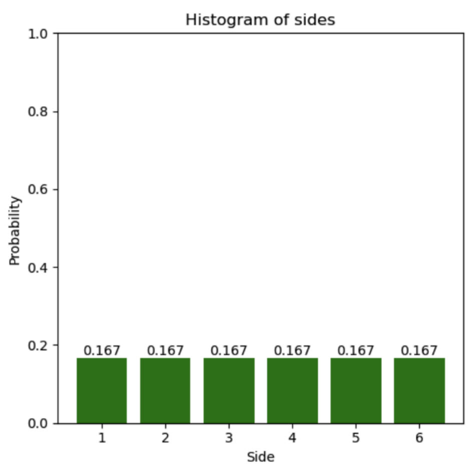
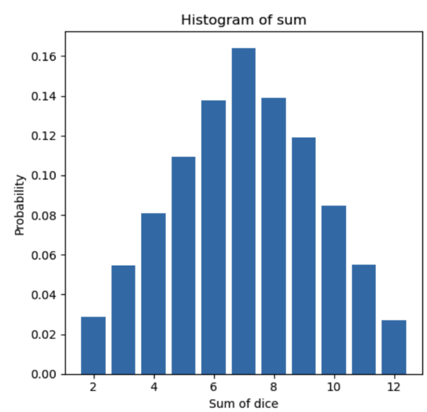
<td>Results:</td>
<td>





Write result values in table

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<td>Analysis and conclusion:</td>
<td>Write your own analysis of output and conclusion(Minimum 1 statement Analysis, Minimum 1 Statement Conclusion)</td>
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<td>References:</td>
<td>Reference Links(Any 2)</td>
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