Neil Ghugare

Physics 3700

Lab 1 Report

This lab's purpose was to show how the precision of measurement increases as the sample size increases using dice. We rolled a single die 100 times and recorded the face value of the die each roll, and then rolled two dice 100 times and recorded the sum of the face values each roll. We created a computer program that could simulate rolling a single die or two dice 1000, 10,000, and 100,000 times. We plotted the results of the 100 hand rolls along with the three simulations and the theorized probabilities for each result on a graph as a probability of rolling said result.

For rolling a single die, there are six total possibilities that the face value could be— the discrete values from one to six. Therefore, we expect the probability for each value to be one-sixth, or about 0.17. For the 100 hand rolls, there is considerable error between the expected and observed probabilities. For example, instead of the expected 0.17, we get a probability of 0.23 for rolling a six. We get similar discrepancies for the other face values. As indicated in Fig. 1, the scatter of the data from the theorized probability gets smaller as the total rolls increase from 100 to 100,000.

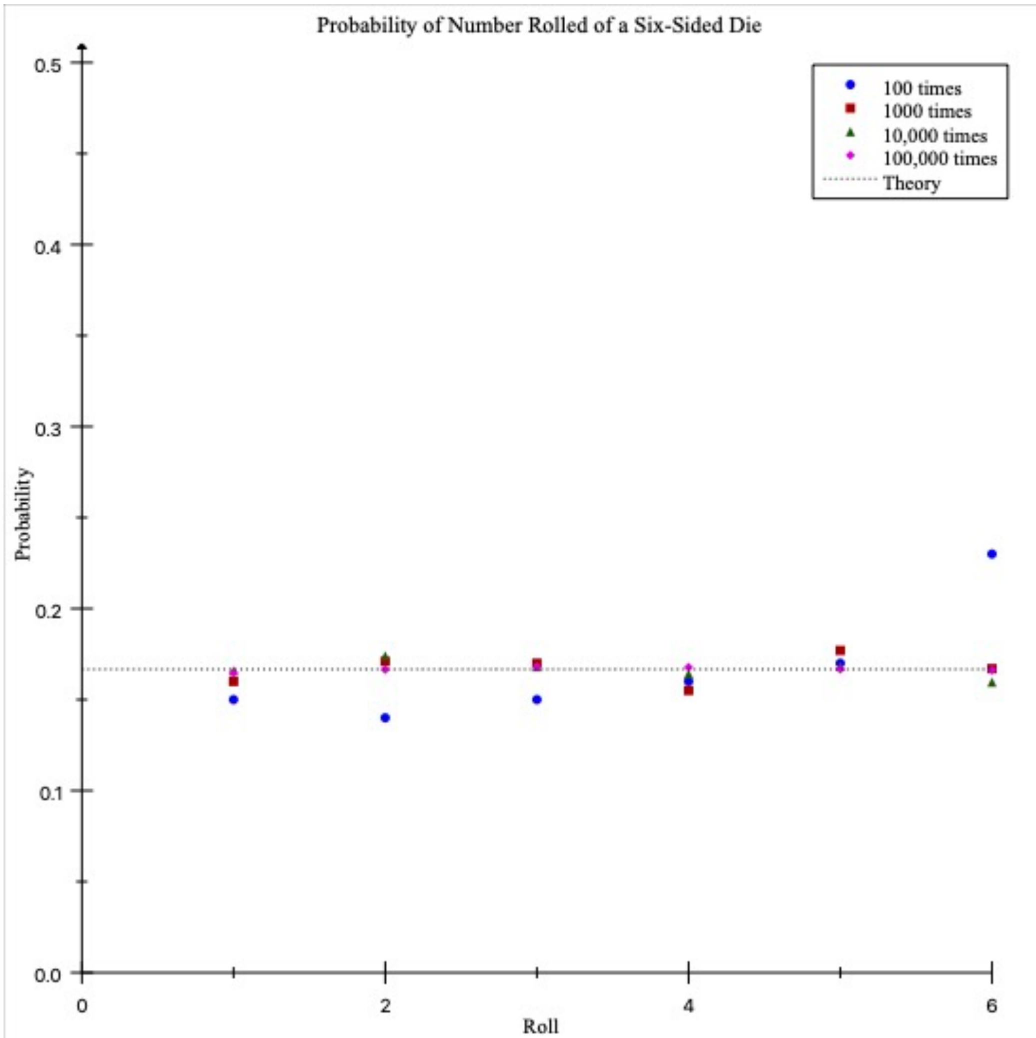

Figure 1: Probability of Number Rolled of a Six-Sided Die, From 100 to 100,000 times

The experiment involving the two dice followed similar logic as the prior experiment. However, with two dice, the calculation of the expected probability becomes more complicated, as some sums have multiple ways to attain them. For example, the sum eight has five possible ways to achieve it (2+6, 3+5, 4+4, 5+3, and 6+2). Since we have two dice, each with six faces, there are six times six, or 36, possible combinations. So, for each sum, the expected probability is the number of ways to achieve it divided by 36. For the sum eight, its expected probability is five divided by 36, or about 0.14. We can repeat this process for all the other sums, which are the discrete integers between two and twelve (inclusive), and we get a probability function that is a downwards-facing absolute value function. Like the experiment with one die, the error between the expected value and the observed value is distinct for the 100 hand rolls. For the sum eight, we calculated the expected probability to be about 0.14, but the observed value for the 100 hand rolls was 0.16. Similar scattering is found for the other sum values as well. As shown in Fig. 2, the discrepancies between the observed and expected probabilities for the sums decrease as the total number of rolls increases.

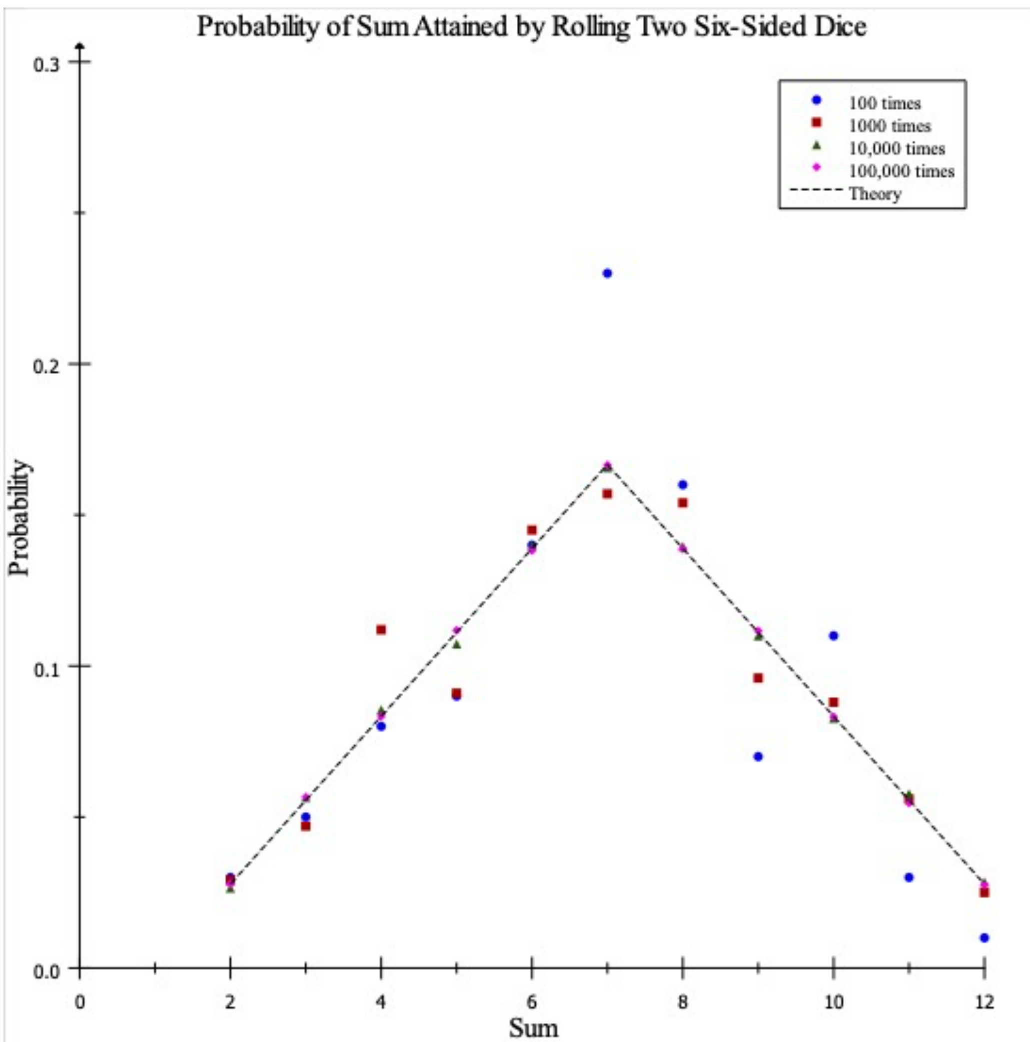

Figure 2: Probability of Sum Attained by Rolling Two Six-Sided Dice, From 100 to 100,000 Times

Appendix A: Code Snippets

```python
from random import randint

def simulate_single_die(n: int) -> dict:
    """
    Simulates rolling a single die n times
    :param n: The number of times to roll
    :return: The face value and amount of times rolled as key-value pairs
    """
    times = {1: 0, 2: 0, 3: 0, 4: 0, 5: 0, 6: 0}
    for _ in range(n):
        roll = randint(1, 6)
        times[roll] += 1
    return times

def simulate_two_dice(n: int) -> dict:
    """
    Simulates rolling two dice n times
    :param n: The number of times to roll
    :return: The sum of the dice and the amount of times rolled as key-value pairs
    """
    total = {2: 0, 3: 0, 4: 0, 5: 0, 6: 0, 7: 0, 8: 0, 9: 0, 10: 0, 11: 0, 12: 0}
    for _ in range(n):
        roll = randint(1, 6) + randint(1, 6)
        total[roll] += 1
    return total
```