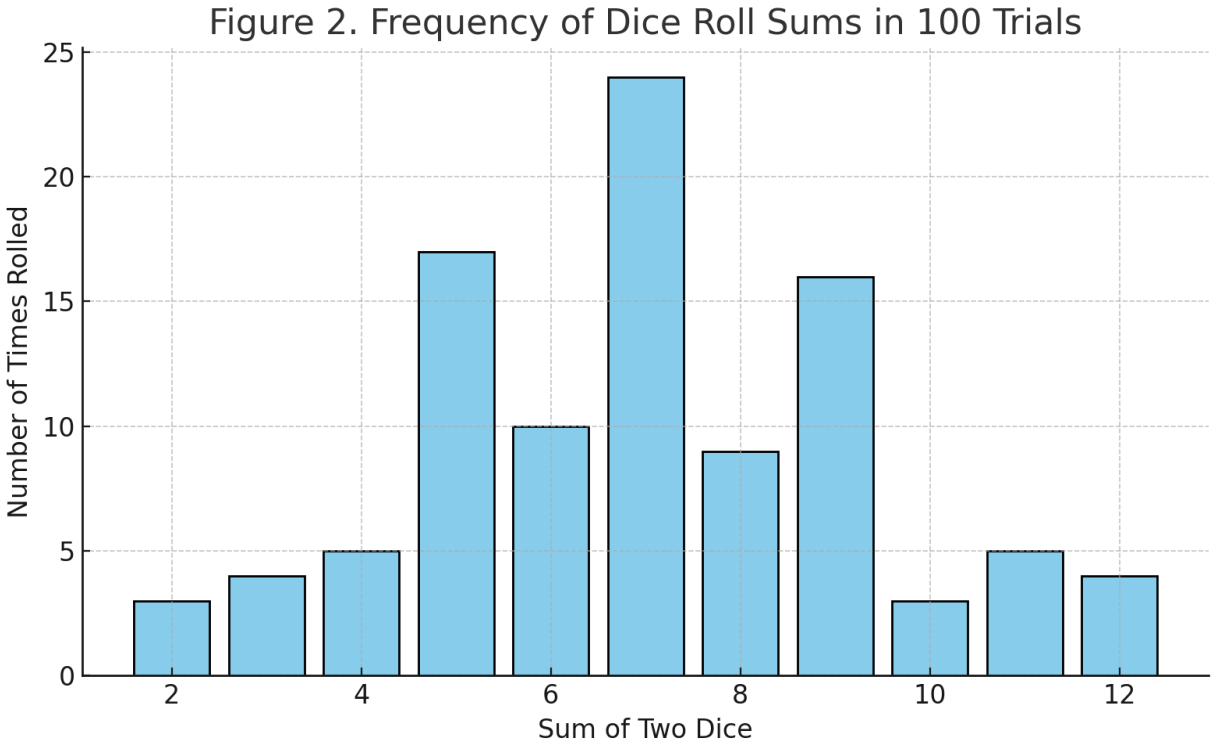
Theory vs Reality: A Dice Roll Experiment

An experiment to test the reality of randomness and probability



Tasnim Fahad
10/22/2025

Abstract Summary

The theoretical probability distribution for rolling a pair of fair six-sided dice was tested in this experiment. It was found that the outcome of 7 was the most common result, and its occurrence had a close alignment with the theoretical probabilities associated with that value.

Introduction

Probability theory examines the likelihood of an event occurring under a specific set of conditions. In our experiment with a pair of six-sided dice, the fact that there were two dice, each with six sides, remained constant. Given that we calculate mathematically the probability of each distinct sum that we can roll, then we compare it to actually rolling the dice to observe any distinctions. Rolling dice is a very common method of testing probability, as the outcomes of the sum of the dice are from 2 to 12, but not all outcomes are the same. In theory, we use math to determine the most likely outcome of the sum of a pair of dice, while in practice, we physically roll them to determine the outcome. I believe that the number 7 will be the most common result, as it has the most combinations that can lead to the sum of two dice being seven. This is because out of 36 combinations, six of them equal seven.

Materials and Methods

Required Materials

- One pair of standard six-sided dice

- Recordkeeping device (pen and paper, or digital spreadsheet such as Microsoft Excel or Google Sheets)

- AI or generative software (for simulation and data visualization)

Procedure

Step 1: Determine the theoretical probabilities for each possible sum of two dice (2–12) by dividing the number of possible combinations for each sum by 36.

Step 2: Roll both dice and record the sum of the two faces.

Step 3: Repeat the rolling and recording process 100 times, ensuring accurate and consistent data entry.

Step 4: Compile all results in a data chart for later analysis.

Alternative Materials

- Random Number Generator (to simulate dice rolls)

- Google Sheets or Microsoft Excel (for automated data collection and analysis)

Alternative Methods

1. Set the range of the random number generator from 2 to 12 to represent all possible dice sums.

2. Generate a random number and record it in the designated spreadsheet.

3. Repeat this process 100 times to produce a complete dataset.

4. Use spreadsheet formulas or software tools to organize, visualize, and analyze the resulting data.

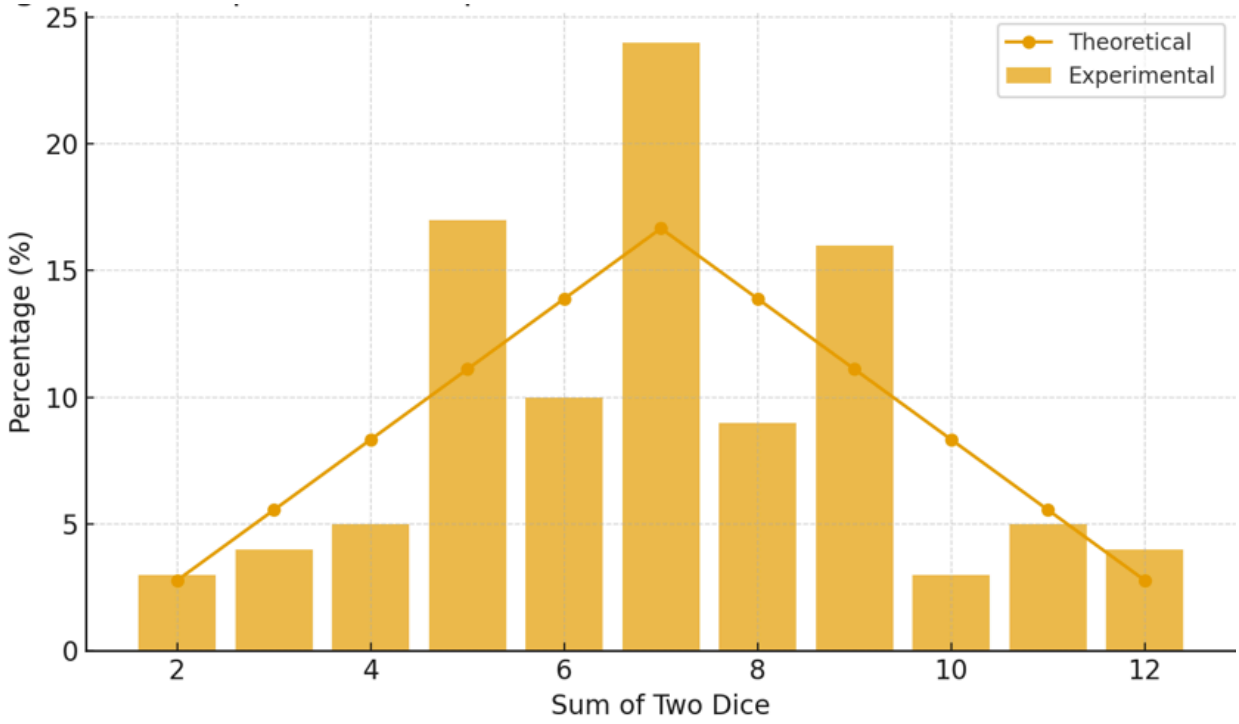
Results

The frequencies and percentages of sums from 2 to 12 that were observed were contrasted with what was expected theoretically. These values are summarized in Table 1. The comparison between the theoretical and experimental probabilities is illustrated in Figure 1.

Table 1. Comparison of theoretical and experimental dice roll probabilities.

Sum	Theoretical %	Experimental %	Difference
2	2.78	3	0.22
3	5.56	4	-1.56
4	8.33	5	-3.33
5	11.11	17	5.89
6	13.89	10	-3.89
7	16.67	24	7.33
8	13.89	9	-4.89
9	11.11	16	4.89
10	8.33	3	-5.33
11	5.56	5	-0.56
12	2.78	4	1.22

Figure 1. Comparison of Experimental and Theoretical Dice Roll Probabilities.



Analysis

For our experiment to work, we first calculate the probability of each possible sum that can be a result of rolling a pair of 6-sided dice. It can be anywhere from 2 to 12. We can calculate the possibility of each of those numbers by dividing the number of combinations that lead to that sum by 36. 36 is the total number of distinct combinations; thus, by dividing the possible number of combinations for a sum by 36, we get the percentage, which is the probability it will be that number. This is our theoretical % as shown in both Table 1 and Figure 1. The calculations allow us to compare what should happen with what actually happened in the experiment. If our results differ significantly, it may indicate an error in the experiment. This way, the theoretical number provides a basis to measure the accuracy and reliability of results.

The outcome of 7 showed up most often, just like the probability theory said it would. This can be compared to Campbell's 2022 study, "Dice Testing with the Running Chi-Square Distribution," which explored how real-world dice rolls tend to follow through on the theoretical predictions when the dice are fair and the sample size is big enough. Campbell mentions that with smaller experiments, the result may vary due to the dice not being rolled enough for a fair experiment. Inaccuracy in this experiment is also highly likely, and some numbers rolled more or less. This experiment also highlights the difference between theoretical probability and experimental probability because even though the theoretical probability tells us what "should" happen, the experimental probability shows what actually happens when it's put into the experiment. It reinforced Campbell's point that randomness has its own way of balancing out towards the end.

Conclusion

This experiment demonstrated the connection between theoretical and experimental probability using a pair of six-sided dice. By calculating the theoretical probability of each possible sum and comparing it to the observed outcomes, we confirmed that the sum of 7 appeared most frequently, being very close to the accuracy of the predicted numbers. This supports the reliability of the dice and experimental method and aligns with Campbell's 2022 observation that larger sample sizes allow experimental results to approach theoretical expectations. With these results, are can view the world through a completely different lens as anything that could be calculated with set conditions can also be predicted fairly accurately. As we further advance technology, predictions will continue to be more accurate and may even be fully accurate.

Work cited

Campbell, Warren, and Wimsatt, Hunter, "Dice Testing with the Running Chi-Square Distribution" (2022). *SEAS Faculty Publications.* Paper 7.