Feels Like Rolling Dice: Understanding Probability with Two Six-Sided Dice

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Abstract:

Two six-sided dice are rolled 100 times, and the occurrence of each sum is counted as a tangible example of probability. The pair of dice was used in four sample sizes of 25 rolls and then counted as a total sample size of 100 rolls. The most frequently counted sum was 8, followed closely by the sum of 7, which correlated closely with the higher numbers of unique dice combinations of each sum in comparison to other sums, and served as an example of how probability determines the likelihoods of different outcomes.

Introduction:

When playing a game that needed the use of dice, a player may feel a sense of luck and ask themselves, “what are the chances of rolling a 7?” On the surface, it may appear that luck is on their side, but it may simply be probability working in their favor. According to author, and Ancaster, Ontario Redeemer University affiliate, Jonathan D. Baker (2013), in his article “Rolling the Dice,” he provides a chart, “Figure 1,” using a pair of dice to display all combinations to roll a range of sums. Based on this chart, there are more unique combinations, or number of permutations, to roll a sum of seven than any other sum (Baker, 2013). In this experiment, a digital pair of six-sided dice will serve as a demonstration of how probability decides the outcome of events, and since the sum of 7 has the most unique combinations, it is hypothesized that after rolling a pair of two-sided dice 100 times, most outcomes will be a sum of seven.

Material:

- Virtual dice roller (https://www.calculator.net/dice-roller.html)

Method:

1. Use the provided link to reach the virtual dice roller site.
2. Set the number of six-sided dice to 50.
3. Click “Roll Dice.”
4. Count the sum of each pair of dice in each column. In total, there will be a sample size of 25 pairs of dice divided into three columns.
5. Repeat steps three and four until a sample size of at least 100 sums have been counted.

Results:

The results of each sample size of 25 rolls, and the occurrence of each sum counted to a total of 100 rolls, are displayed below. The total occurrences of each sum were graphed to show which sums occurred most frequently in comparison to other sums within the range of the two six-sided dice.

Dice Sums	Sample 1	Sample 2	Sample 3	Sample 4	Total Occurrences
2	0	1	0	1	2
3	0	2	0	0	2
4	2	2	1	2	7
5	4	4	3	4	15
6	4	3	4	5	16
7	4	6	7	3	20
8	5	5	4	7	21
9	4	0	0	1	5
10	1	1	4	1	7
11	1	0	2	1	4
12	0	1	0	0	1

Figure 1. Number of occurrences of each sum in their individual sample sizes of 25 rolls, and their combined totals.

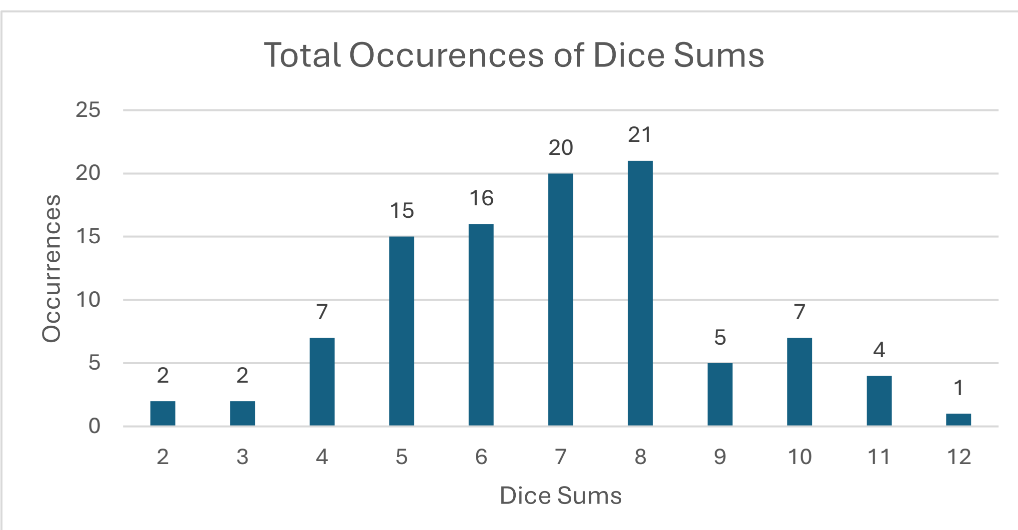

Figure 2. Total amount of occurrences for each dice sum.

Analysis:

At the conclusion of the experiment, the sum that appeared the most times was a sum of 8. The originally hypothesized sum of 7 was the second-most common sum with one less occurrence than the leading sum of 8. Despite the most common sum being different than predicted, the total results follow a pattern that closely relates to the reasoning behind the hypothesis. Between the possible sums ranging from 2 to 12, the sum of 7 has six unique ways of occurring, which is the most unique combinations of any sum of two six-sided dice followed by the sums of 8, and 6, with each having five unique combinations. As the sums reach closer to each end of the range, the number of unique combinations decreases (Baker, 2013). This pattern is reflected in the number of occurrences of each sum, with the three most common sums of 8, 7, and 6. Combined with the three least frequently produced sums of 2, 3, and 12, each having the least amounts of combinations, the results shows a positive relationship between the number of unique combinations to produce a sum, and the frequency of occurrences of each sum. However, despite having one less unique combination than the sum of 7, the sum of 8 occurred more frequently, showing that a higher probability at first glance doesn't guarantee that it will be the outcome.

Furthermore, the slightly differing results from the hypothesis in this experiment is comparable to another dice rolling experiment conducted in a classroom setting. In the article, "Roll the Dice – an Introduction to Probability," authored by Andrew Freda (1998), a teacher at the Greenwich Country Day School in Greenwich, Connecticut, he conducted a dice rolling probability experiment in which 11 pairs of students, with each student having one six-sided die, rolled the pair of dice ten times and calculated the difference of the numbers of the pair of dice. In this experiment, student A won when the value of the difference was 0, 1, or 2, and student B won when the value was 3, 4, or 5, evenly dividing all possible differences between the two dice. Although students initially believed that six possible differences divided evenly across two opposing students would allow a fifty-percent chance of each student winning, the A group won a cumulative total of 64 times, and group B won the remaining 46 times. The results of this experiment aligns with the number of unique ways each difference can be shown which is displayed in the chart, “Figure 1”, showing 12 ways to get the differences of 3, 4 and 5, and there being twice as many unique combinations for the differences of 0, 1, and 2 (Freda, 1998). However, similarly to the results of this dice rolling experiment producing the sum of 8 more than any other sum, despite the sum of 7 having the most unique combinations, there were pairs in which student B won as many as seven rounds out of ten, leaving student A with only three victories, as outlined in the chart, “Figure 2,” by a participating student (Freda, 1998). Similarly, given the results of this experiment being divided into groups of 25 sums, there were two groups in which the sum of 7 appeared most and another two with the sum of 8 having the most occurrences. In both experiments, there is a contrast in results between the smaller, and larger, sample sizes, due to a larger margin of error across smaller sample sizes which can be calculated by the formula $1/\sqrt{n}$, in which the variable “n” represents the sample size (Freda, 1998).

Conclusion:

To reflect, there are a range of popular games that require the use of dice, and the results of this experiment depict how probability determines the outcome. As previously stated, the results showed a pattern in which sums with more unique combinations of two six-sided dice appeared more frequently than sums with less combinations, showing that outcomes with more possible causes are more likely to occur than other outcomes. Although it was hypothesized that the sum of 7, having the most unique combinations of the two dice, would occur the most, the sum of 8 led with one more occurrence, despite having one less unique combination. Based on these results, it is concluded that while probability determines the likelihood of an outcome, especially an outcome with strong probability of occurring, it does not guarantee that it will happen. This can be applied to the methods in which real-world company regulations are created by accounting for the possibilities of both desired, and undesired outcomes, and creating contingency plans for possible adverse events. Probability can also be tested through different forms of dice with more than six sides to check how the likelihood of a sum is affected by a wider range of sums, or through additional six-sided dice in a similar experiment for a more complex understanding of unique combinations in dice rolling probability. Further understanding of the complexities of dice rolling probability allows for a deeper understanding of the likelihood of events, leading to more effective methods of prediction.

Works Cited:

Baker, J. D. (2013). Rolling the Dice. *Mathematics Teacher*, *106*(7), 551–556. https://doi-org.ccny-proxy1.libr.ccny.cuny.edu/10.5951/mathteacher.106.7.0551

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