**Roll of the Dice Activity**

This goal of this activity is to demonstrate the law of large numbers and help students distinguish between empirical and theoretical probabilities. Students should have already been introduced to empirical and theoretical probabilities and the law of large numbers before completing this activity.

**Materials required for this activity:**

Assign each group a number 1 -15. The number is solely for entering their data into the excel spreadsheet.

Each group will need

1. A pair of dice.

2. A worksheet

3. A calculator

**Excel Spreadsheet document**

The excel spreadsheet is set up for 15 groups. If you use less, you will need to change the formula for the last “Totals” column. The default denominator is 15, but can be changed to however many groups that you end up with. The students can then enter their rounded empirical probabilities into the spreadsheet so they can see how close their results are to the theoretical probabilities.

Instructor Instructions

1. Divide students into groups of 2 or 3.

2. Have students complete the rest of the table that represents the sum of the two dice.

3. Have the students calculate the theoretical probabilities and their corresponding rounded probabilities. They should check both columns to make sure that each column sums to 1.

\*\*\* Note\*\*\* the rounded probabilities will sum to 1.001

5. Hand out the dice to each group and have them roll the dice 40 times and tally the sum they roll.

6. The student will then calculate their empirical probabilities and check that they sum to 1.

7. Have each group go to the computer and enter in their empirical probabilities into a column in the excel spreadsheet.

8. Discuss with the students the results of the probabilities they found with their 40 rolls and the probabilities when all the groups are combined. This should help them see that the more experiments completed (rolls of the die) the closer the empirical probabilities mirror the theoretical probabilities (The law of large numbers).

A Roll of the Dice ANSWER KEY

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** |
| **1** | 2 | 3 | 4 | 5 | 6 | 7 |
| **2** | 3 | 4 | 5 | 6 | 7 | 8 |
| **3** | 4 | 5 | 6 | 7 | 8 | 9 |
| **4** | 5 | 6 | 7 | 8 | 9 | 10 |
| **5** | 6 | 7 | 8 | 9 | 10 | 11 |
| **6** | 7 | 8 | 9 | 10 | 11 | 12 |

* 1. The table to the right represents the sum of two dice; the first row has been done for you. Complete the rest of the table.
  2. Now, to calculate the theoretical probability of rolling any given sum on the table you will need to know the total number of outcomes and the number of times a particular sum is rolled.
  3. Hopefully you can see that there are 36 possibilities (using the counting principle). So for example, there is only 1 way to roll a sum of 2. Therefore, the probability of rolling a sum of two is 1/36 or .028 to the nearest thousandth. Determine the rest of the probabilities and fill in the chart below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sum | Probability (in fractional form) | Probability (to the nearest thousandth) | Your group’s experimental probability (as a fraction) | Your group’s experimental probability (to the nearest thousandth ) |
| 2 | 1/36 | .028 |  |  |
| 3 | 2/36 | .056 |  |  |
| 4 | 3/36 | .083 | Answers will | vary |
| 5 | 4/36 | .111 | by group |  |
| 6 | 5/36 | .139 |  |  |
| 7 | 6/36 | .167 |  |  |
| 8 | 5/36 | .139 |  |  |
| 9 | 4/36 | .111 |  |  |
| 10 | 3/36 | .083 |  |  |
| 11 | 2/36 | .056 |  |  |
| 12 | 1/36 | .028 |  |  |
| Check your result: | 36/36=1 | 1.001 |  |  |

* 1. How can you check your results? Do this in the bottom row.
  2. Now roll the dice 40 times and write down your results on the next page.
  3. Complete the chart with your results. For example, if you rolled a sum of 5 twice out of the 40 times you rolled, your experimental probability will be 2/40 or .05.

Please tally the sum each time you roll the die. You should roll the pair of dice 40 times.

|  |  |
| --- | --- |
| Sum | Tally |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |
| 12 |  |