7.SP – Tetrahedral Dice

Task

Many games use dice which are six-sided and fair (meaning each face on the die is equally likely to land face up). Many games also use the sum of two dice rolled at the same time to determine movement of game pieces. However, not all dice are six-sided. Imagine a game in which two fair four-sided (tetrahedral) dice are rolled simultaneously. These dice are in the shape of a pyramid, and when a die is rolled, the outcome is determined by the side that lands face down. Suppose that for these two dice, the possible values (corresponding to the four sides of the die) that can be obtained from each die are as follows:

Die #1: 1, 2, 3, or 4
Die #2: 2, 4, 6, or 8

a. A certain game determines the movement of players' game pieces based on the SUM of the numbers on the face down sides when two dice are rolled. There are 10 distinct sum values that can occur, and some of those sums occur more often than others.

i. Using an organized list, table, tree diagram, or method of your choosing, develop a list of all 16 possible outcomes (for example, Die #1 = 1 and Die #2 = 2 for a sum of 3; Die #1 = 1 and Die #2 = 4 for a sum of 5; and so on).

ii. From your work in part i, determine the 10 **distinct sum values** that are possible and calculate the probability of obtaining each sum value. Note: as mentioned above, some values will occur more frequently than others.

iii. Using your work in part ii, answer the following questions:
What is the probability of obtaining a sum of 5?
What is the probability of obtaining a sum that is more than 5?
What is the probability of obtaining a sum that is at most 5?
What is the probability of obtaining a sum that is at least 5?
What is the probability of obtaining a sum that is no less than 5?

b. Now consider the case where the DIFFERENCE in the numbers on the face down sides when two dice are rolled is important to the game. Unless the two die values are the same (in which case the difference is 0), the difference for purposes of this game will always be computed as the larger number value rolled minus the smaller number value rolled. In this way, the difference value for any roll of the two dice will always be positive or 0.

i. Using an organized list, table, tree diagram, or method of your choosing, develop a list of all 16 possible outcomes (for example, Die #1 = 1 and Die #2 = 2 for a difference of 1; Die #1 = 1 and Die #2 = 4 for a difference of 3; and so on).

ii. From your work in part i, determine the 8 distinct difference values that are possible and calculate the probability of obtaining each difference value. Note: as mentioned above, some values will occur more frequently than others.

iii. Using your work in part e, answer the following questions:
What is the probability of obtaining a difference of 5?
What is the probability of obtaining a difference that is more than 5?
What is the probability of obtaining a difference that is less than or equal to 5?