Exercise: Probability with Dice

(3/3 points)
Let random variable X be the sum of rolls of two fair six-sided dice with faces numbered 1 through 6.

- How many different values can X can take on?

11 ✔ **Answer:** 11

- What is the probability that $X = 7$? (Hint: An earlier exercise asked you for the event that the two faces sum to 7.)

1/6 ✔ **Answer:** 1/6

- Express the probability table p_X for X as a Python dictionary. (Your answer should be the Python dictionary itself, and *not* the dictionary assigned to a variable, so please do not include, for instance, "`prob_space =`" before specifying your answer. You can use fractions. If you use decimals instead, please be accurate and use at least 5 decimal places.)

  Note: While you could do this by hand, you could also write code that populates a Python dictionary and then prints the dictionary. You could then copy and paste the dictionary you print to the answer box below.

{2: 0.027777777777777 ✔

Answer: {2: 1/36, 3: 2/36, 4: 3/36, 5: 4/36, 6: 5/36, 7: 6/36, 8:5/36, 9: 4/36, 10: 3/36, 11: 2/36, 12: 1/36}

Solution:

- How many different values can X can take on? **11**. The possible sums: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.

- What is the probability that $X = 7$? (Hint: An earlier exercise asked you for the event that the two faces sum to 7.) **1/6**. Reasoning: We use the probability space from the two dice probability space exercise. Note that "$X = 7$" corresponds to the event that the two rolls sum to 7 from a previous exercise: $\mathcal{A}_{\text{sum-to-7}} = \{(1,6),(2,5),(3,4),(4,3),(5,2),(6,1)\}$. Then

$$\mathbb{P}(X = 7) = \mathbb{P}(\mathcal{A}_{\text{sum-to-7}})$$

$$= \mathbb{P}\big(\{(1,6),(2,5),(3,4),(4,3),(5,2),(6,1)\}\big)$$

$$= \underbrace{\mathbb{P}\big((1,6)\big)}_{\frac{1}{36}} + \underbrace{\mathbb{P}\big((2,5)\big)}_{\frac{1}{36}} + \underbrace{\mathbb{P}\big((3,4)\big)}_{\frac{1}{36}} + \underbrace{\mathbb{P}\big((4,3)\big)}_{\frac{1}{36}} + \underbrace{\mathbb{P}\big((5,2)\big)}_{\frac{1}{36}} + \underbrace{\mathbb{P}\big((6,1)\big)}_{\frac{1}{36}} = \frac{6}{36} = \frac{1}{6}$$

- Express the probability table p_X for X as a Python dictionary. (While you could do this by hand, you could also write code that populates a Python dictionary and then prints the dictionary. You could then copy and paste the dictionary you print to the answer box below.)

  The pattern to notice is as follows:

  There is 1 way to sum to 2: (1,1)
  There are 2 ways to sum to 3: (1,2), (2,1)
  There are 3 ways to sum to 4: (1,3), (2,2), (3,1)
  There are 4 ways to sum to 5
  5 ways to sum to 6
  6 ways to sum tp 7
  5 ways to sum to 8
  4 ways to sum to 9

3 ways to sum to 10
2 ways to sum to 11
1 ways to sum to 12

Each of the possible outcomes is equally likely with probability 1/36. Thus: $X = 1$ has 1 outcome associated with it (1,1): probability = 1/36 $X = 2$ has 2 outcomes assoociated with it (1,2), (2,1): probability = 2/36 And so forth.

Thus, the answer is: **{2: 1/36, 3: 2/36, 4: 3/36, 5: 4/36, 6: 5/36, 7: 6/36, 8:5/36, 9: 4/36, 10: 3/36, 11: 2/36, 12: 1/36}**

If you went the coding route, here's a way to build up the probability table/PMF:

```
pmf = {}  # start with empty pmf
for x in range(1, 7):
    for y in range(1, 7):
        if (x+y) in pmf:
            pmf[x+y] += 1/36
        else:
            pmf[x+y] = 1/36
```

You can then print out the PMF, copy, and paste to the answer box.

You have used 1 of 5 submissions


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