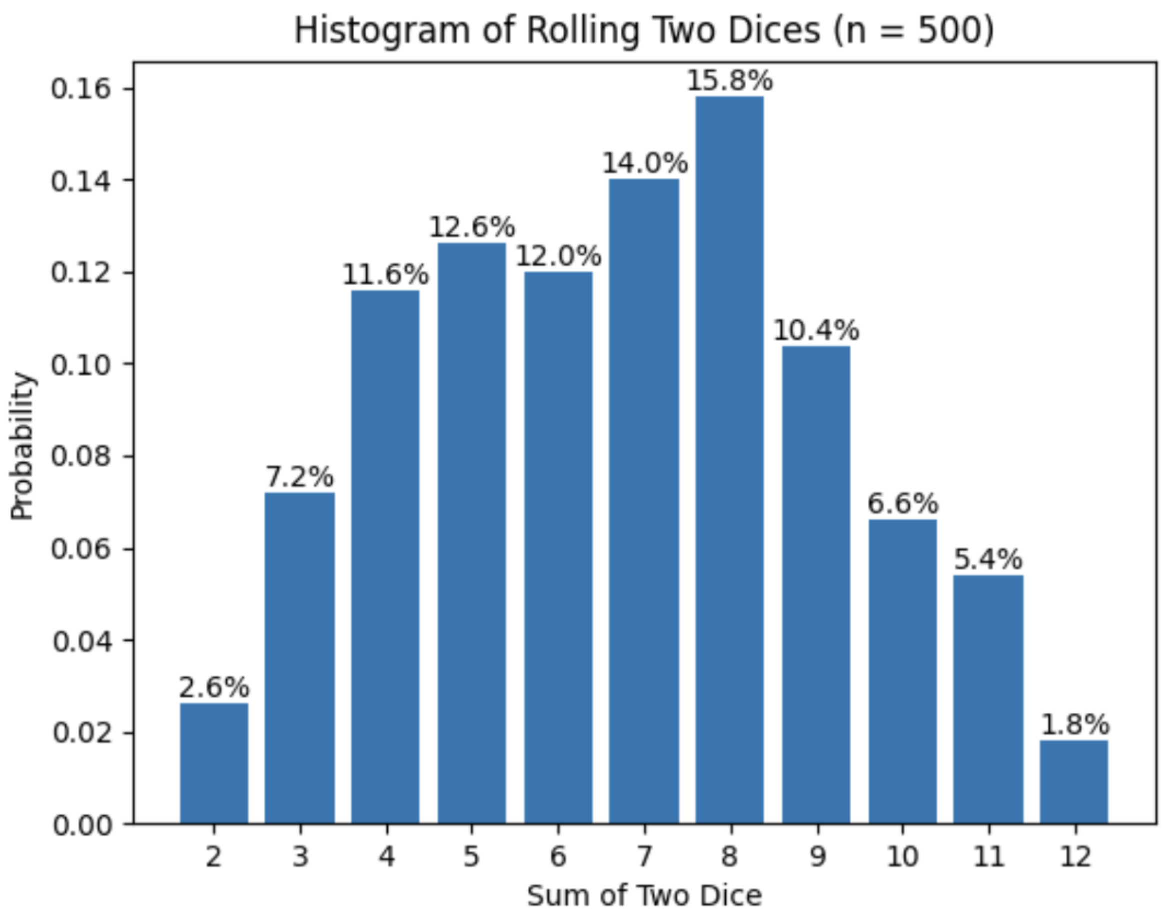
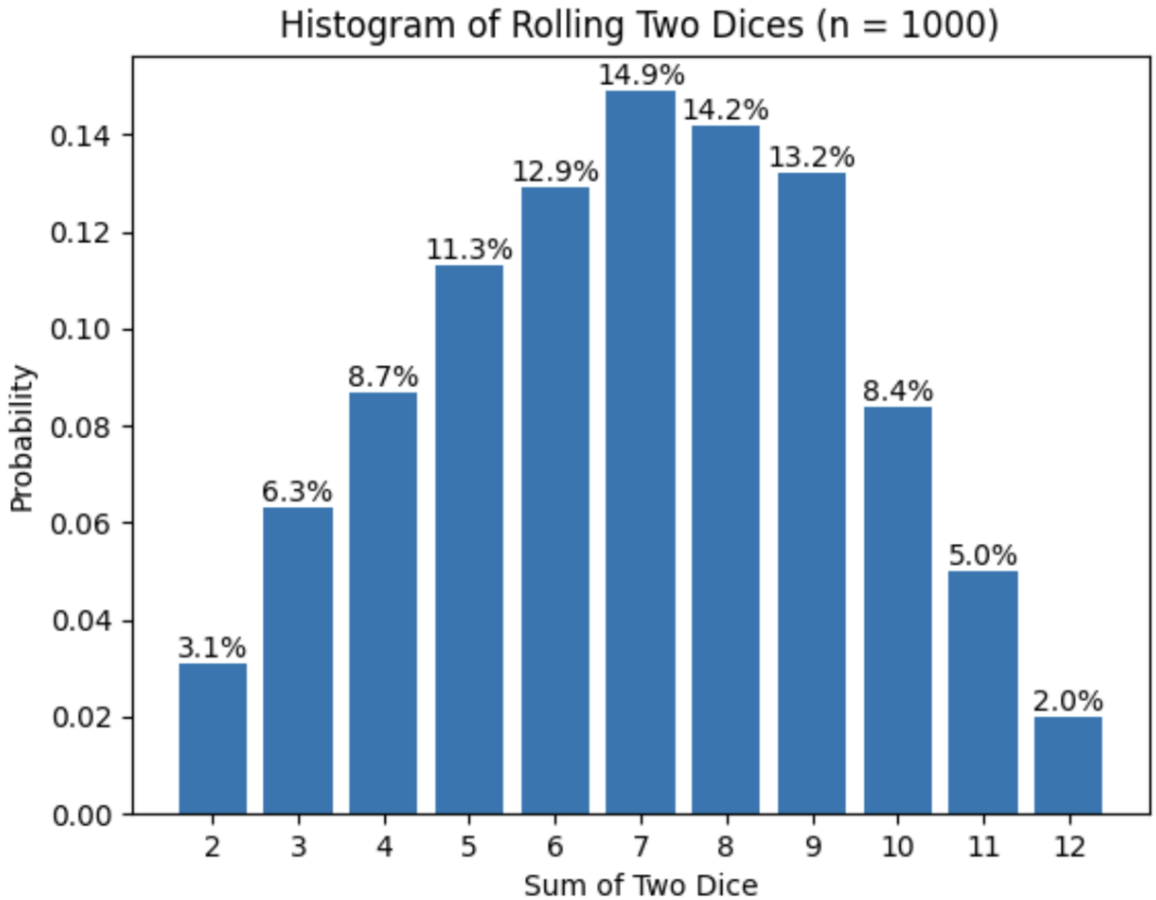
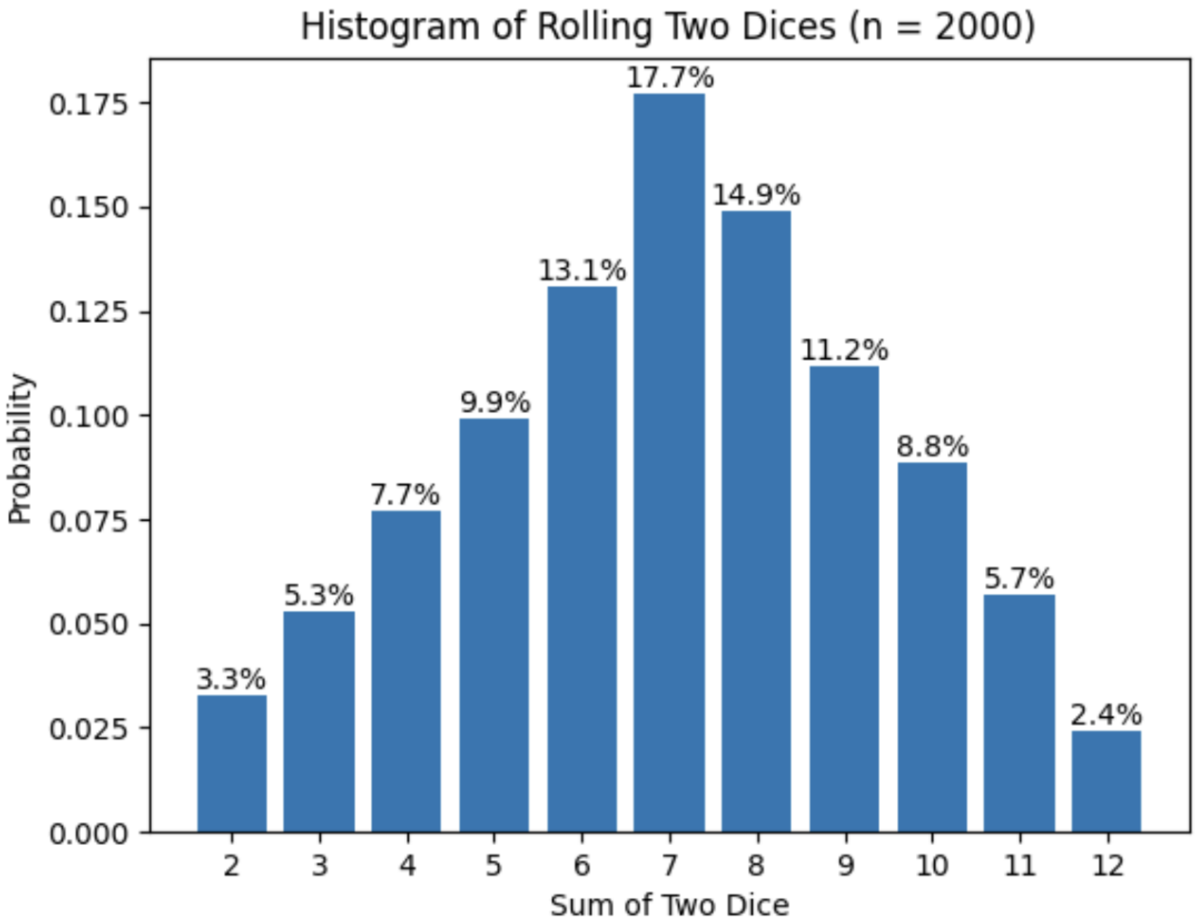
Exercise 1:

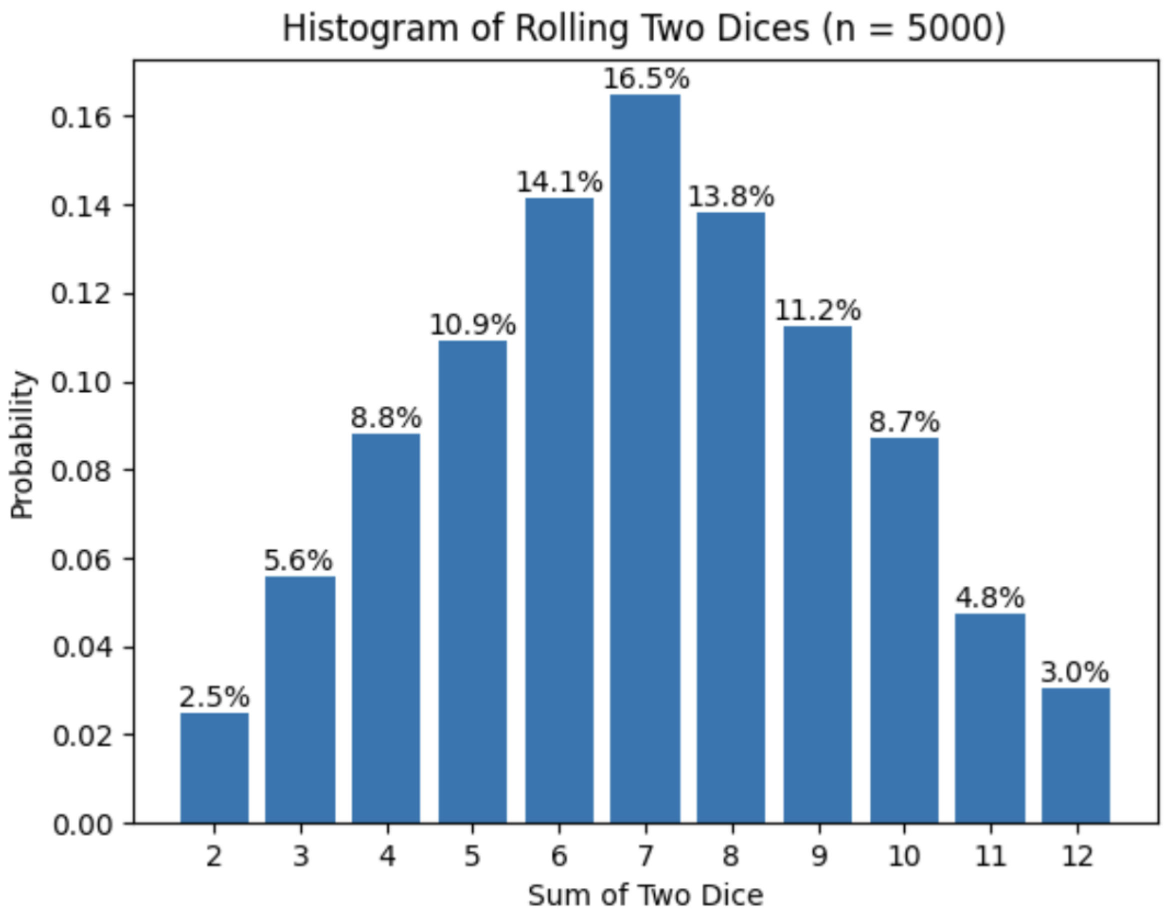
When the size of experiment i.e., n is smaller (e.g., 500, 1000, 2000, 5000, or even 10000), the histogram does not match the theoretical probabilities as given in the question. However, as the experiment increases, the histogram begins to look similar to the one given in the question i.e., the probabilities come closer to the theoretical probabilities. Refer to the following images of different experiment sizes:



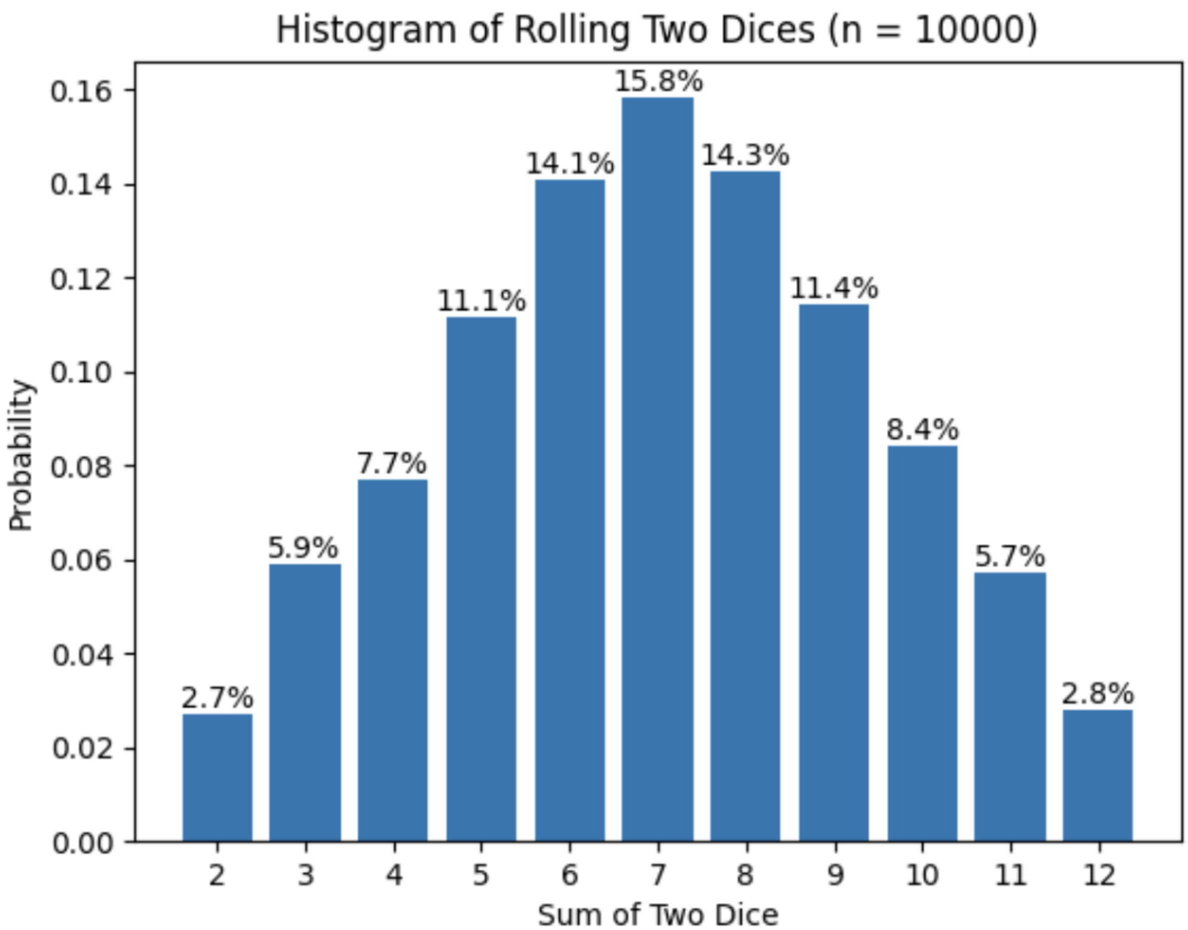

Histogram of Rolling Two Dices (n = 1000)
Probability
Sum of Two Dice
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
2
3
4
5
6
7
8
9
10
11
12
3.1%
6.3%
8.7%
11.3%
12.9%
14.9%
14.2%
13.2%
8.4%
5.0%
2.0%



Histogram of Rolling Two Dices (n = 2000)
Probability
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
3.3%
5.3%
7.7%
9.9%
13.1%
17.7%
14.9%
11.2%
8.8%
5.7%
2.4%
2
3
4
5
6
7
8
9
10
11
12
Sum of Two Dice



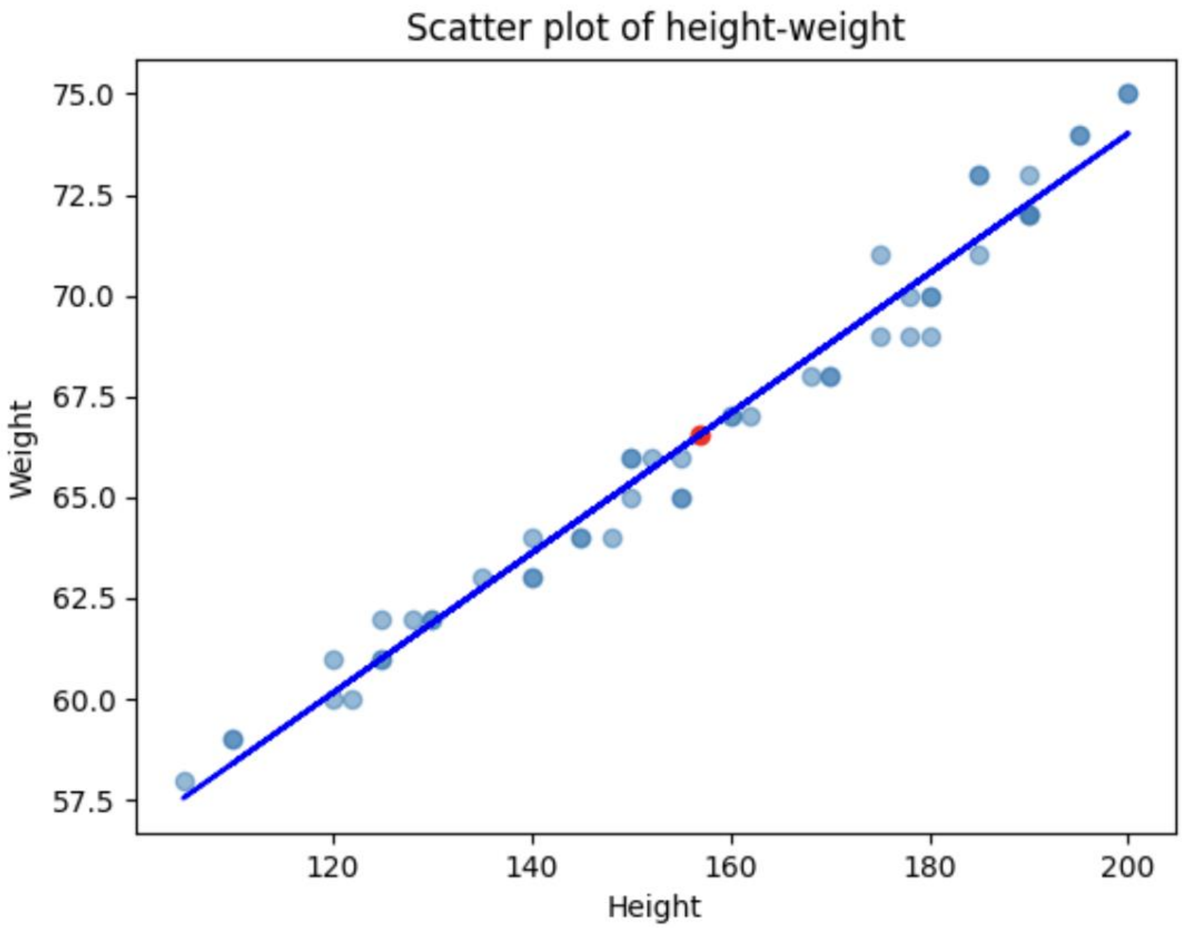
Histogram of Rolling Two Dices (n = 5000)
Probability
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2.5%
5.6%
8.8%
10.9%
14.1%
16.5%
13.8%
11.2%
8.7%
4.8%
3.0%
2
3
4
5
6
7
8
9
10
11
12
Sum of Two Dice



Regression to the mean in our dice experiment refers to how probabilities from smaller samples tend to move closer to the theoretical probabilities as we increase the sample size. When we make only 500 throws, we might see unusually high or low probabilities for certain sums due to random chance. However, as we increase to thousands of throws, these extreme values naturally "regress" or move back toward the true theoretical probabilities, showing that initial extreme results were just random variations rather than reflecting the true underlying distribution.

Exercise 2:

As seen in the picture below, the regression line closely follows the trend of the data points in scatter plot. This signifies that there's a strong linear relationship between length and weight; the quality of regression is good.



In numerical terms, the quality of the regression can be measured by RMSE, and R^2 (in addition to other error measurements). RMSE measures the average difference between the actual values and the predicted values; R^2 measures the proportion of dependent variables that can be measured using independent variables. In our case, RMSE is 0.7397866705418076 which means that the predicted value is very close to the actual ones; the value predicted by the model would be by 0.7397866705418076 pounds. Similarly, value of R^2 is 0.9748564614308598 which means ~97.49% of the weights can be predicted using their height; only 2.51% of the weights cannot be predicted using their heights because their weight can differ by the reasons other than height. Hence, RMSE, and R^2 show that the model is strong in predicting the weight based on height.