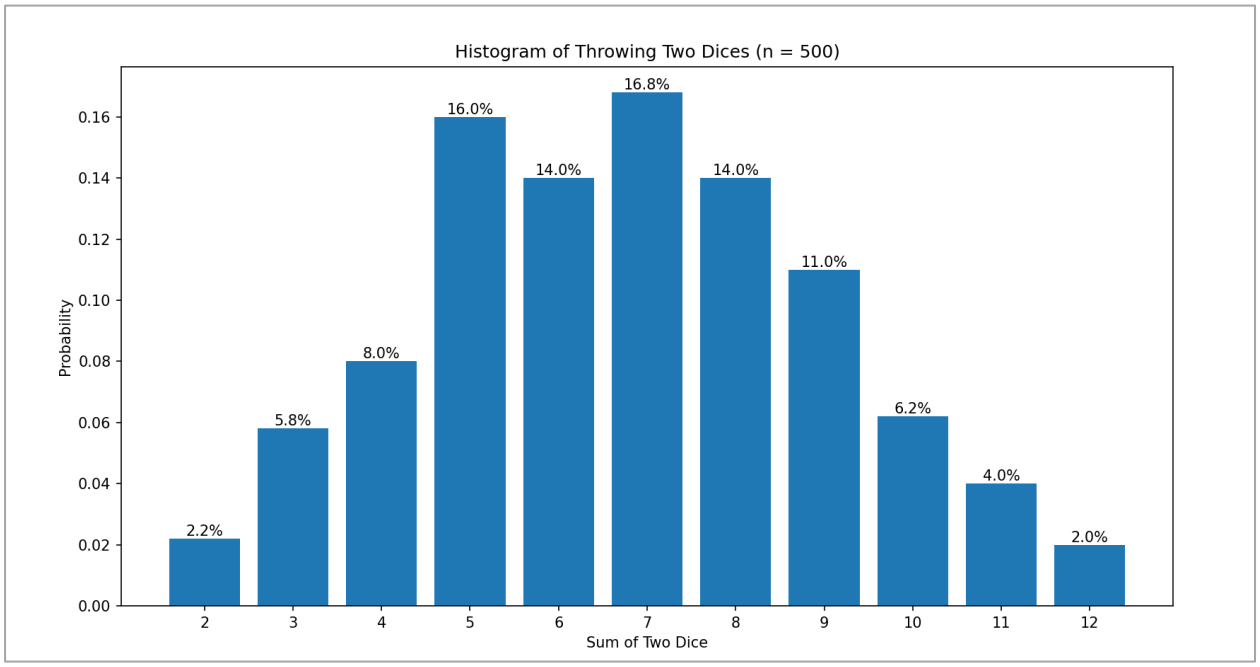
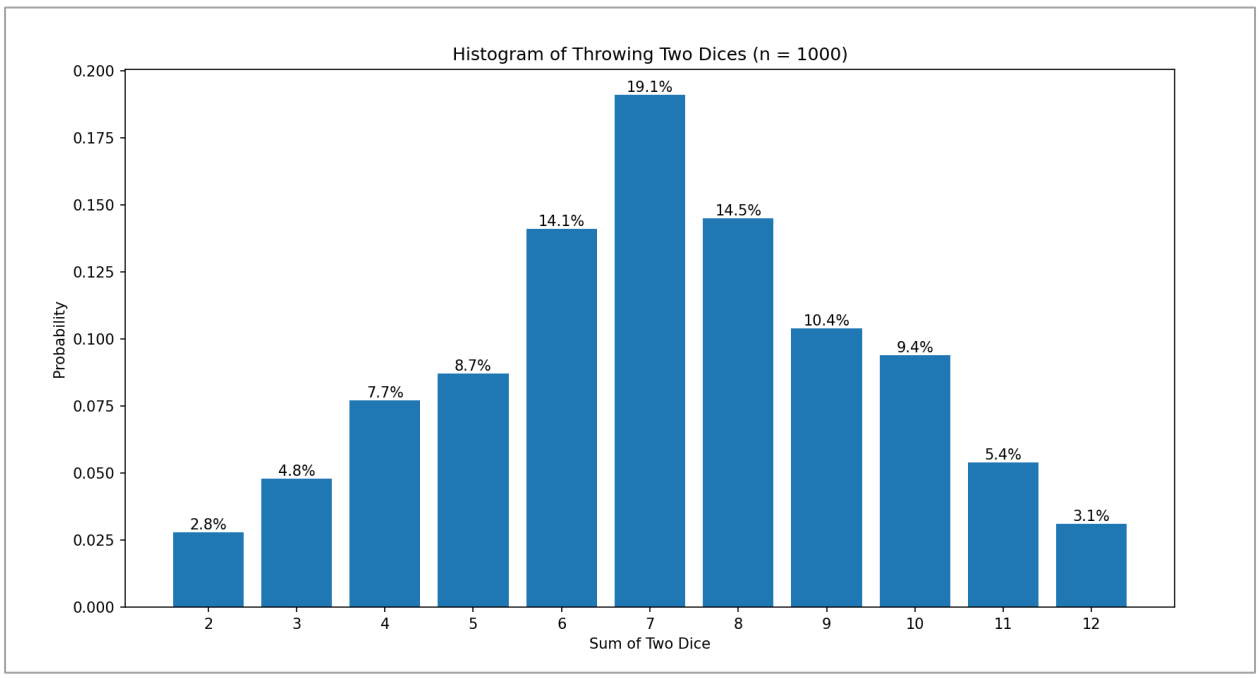
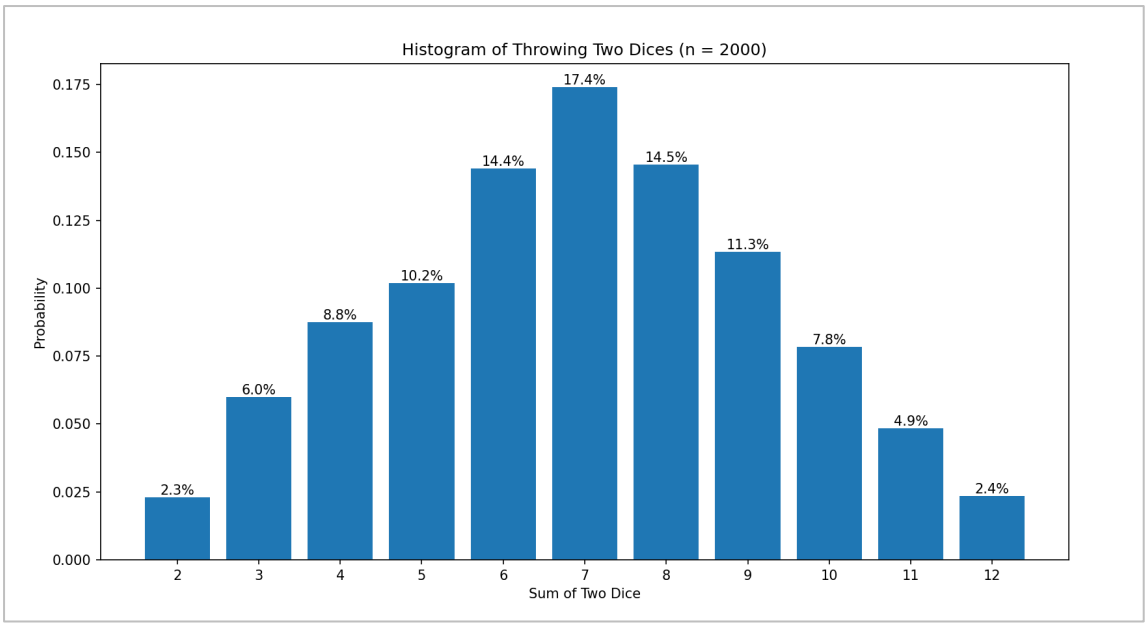
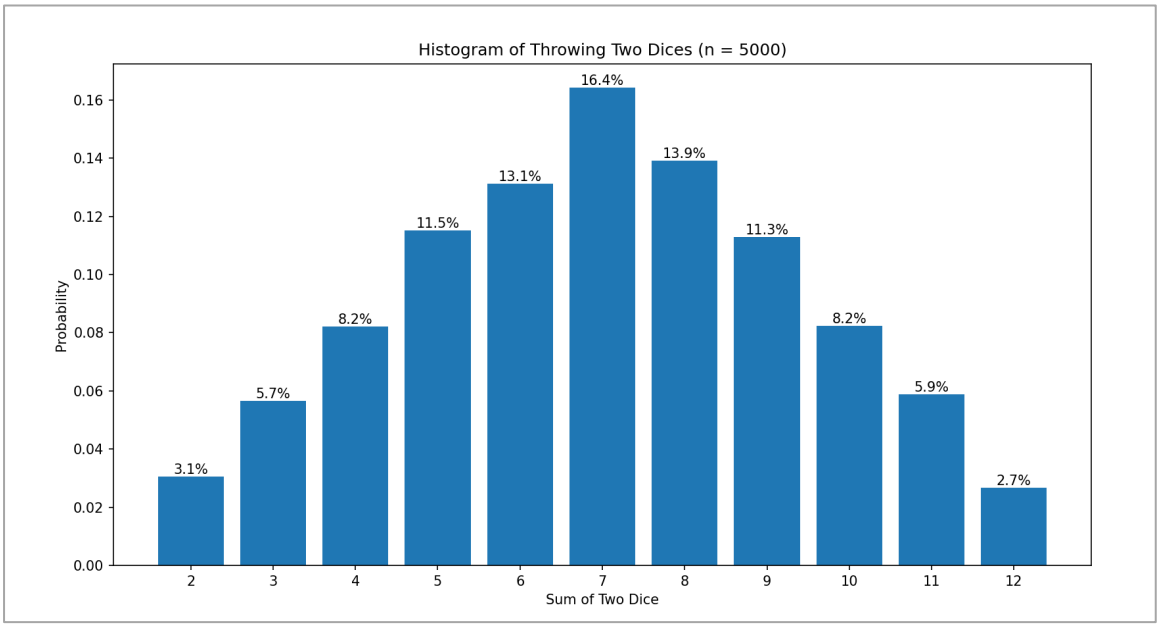
Exercise 1:

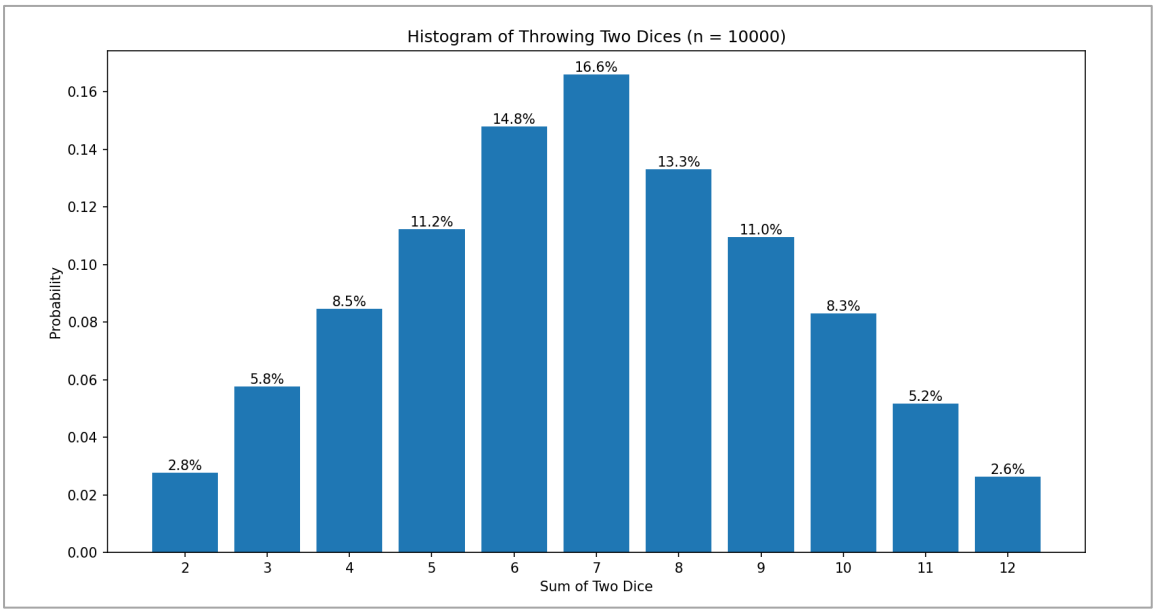
When the size of experiment i.e., n is smaller (e.g., 500, 1000, 2000, 5000, or even 10000), the histogram does not match the theoretical probabilities as given in the question. However, as the experiment increases, the histogram begins to look similar to the one given in the question i.e., the probabilities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

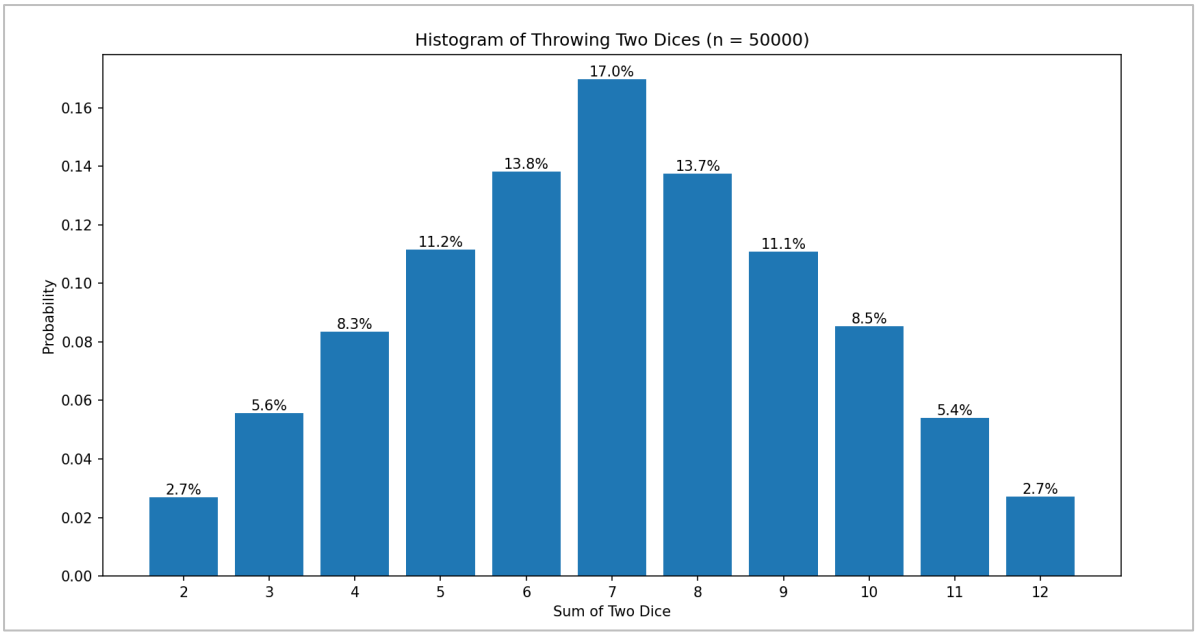


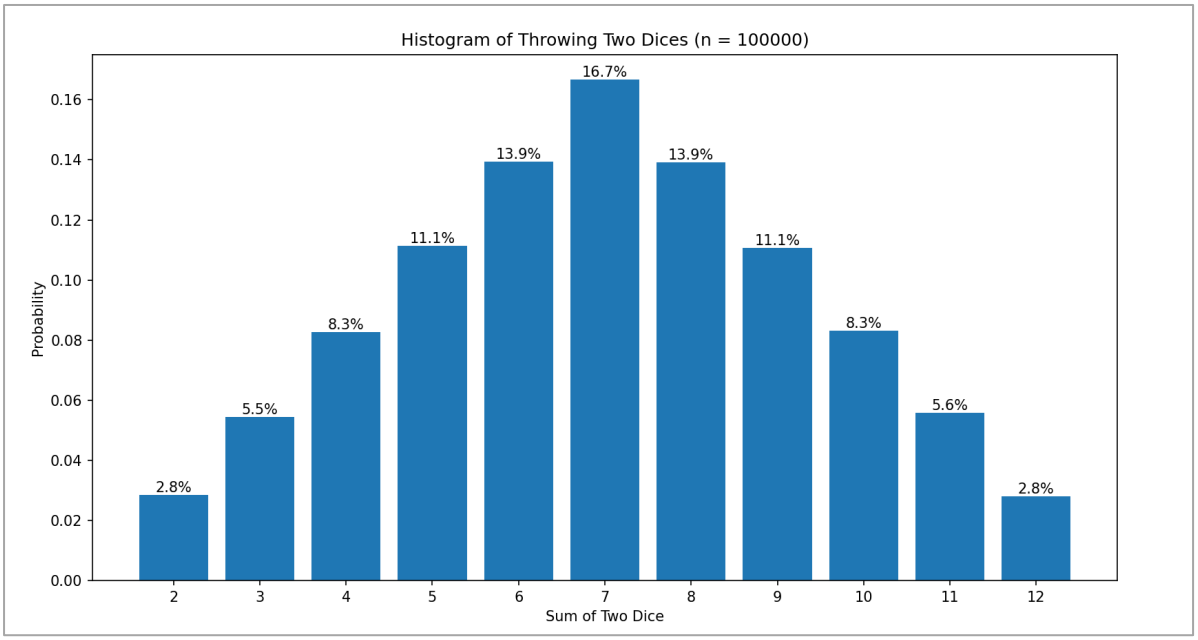



Histogram of Throwing Two Dices (n = 2000)
Probability
Sum of Two Dice
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
2.3%
6.0%
8.8%
10.2%
14.4%
17.4%
14.5%
11.3%
7.8%
4.9%
2.4%
2
3
4
5
6
7
8
9
10
11
12


Histogram of Throwing Two Dices (n = 5000)
Probability
Sum of Two Dice
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
3.1%
5.7%
8.2%
11.5%
13.1%
16.4%
13.9%
11.3%
8.2%
5.9%
2.7%
2
3
4
5
6
7
8
9
10
11
12


Histogram of Throwing Two Dices (n = 10000)
Probability
Sum of Two Dice
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
2.8%
5.8%
8.5%
11.2%
14.8%
16.6%
13.3%
11.0%
8.3%
5.2%
2.6%
2
3
4
5
6
7
8
9
10
11
12

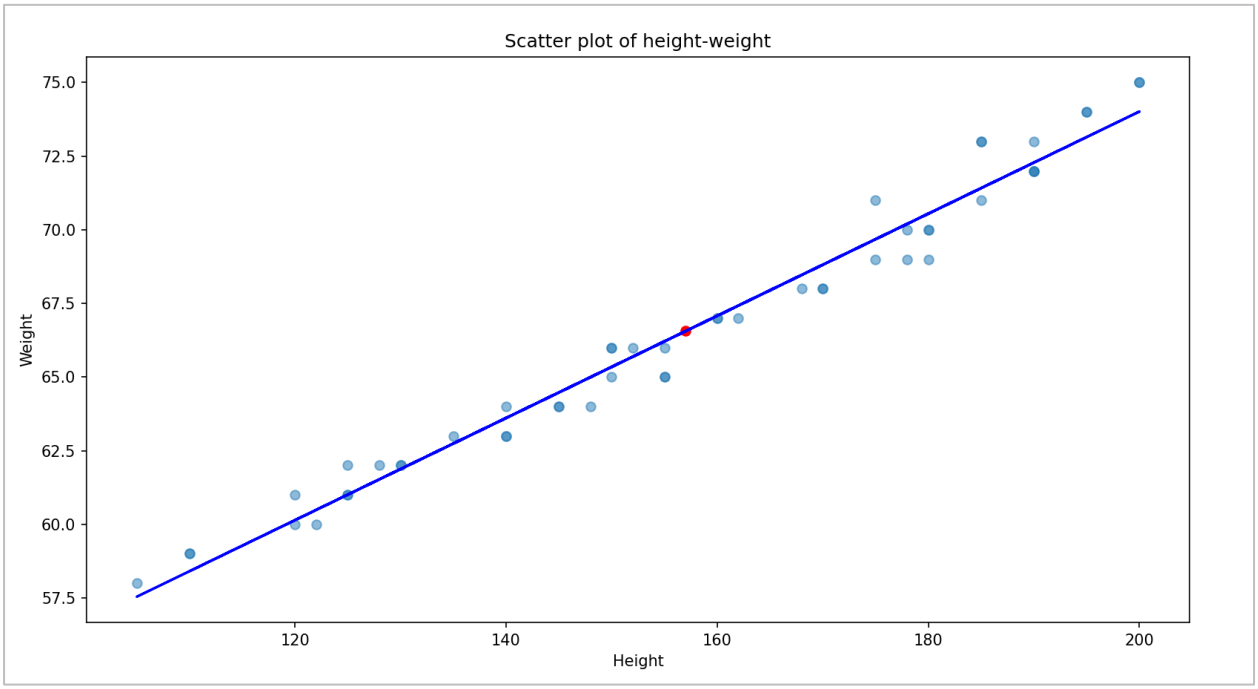




The “regression to the mean” refers to a statistical phenomenon where the extreme (i.e., very high or very low) values tend to move closer to the average. In the dice experiment, when the experiment size was low, the outcome of each possible result (i.e., 2 – 12) was far from the theoretical probability. As the size increased, the outcome moved closure to the theoretical probability i.e., the observed outcome/frequencies “regress” toward the theoretical probability. This is because that the initial extreme variations are balanced out and the outcomes “regress” toward the theoretical probabilities.

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, RSME is 0.7397866705418076 which means that the predicted value is very close to the actual ones; the value predicted by the model would be more or less 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 can not be predicted using their heights because their weight can differ by the reasons other than height. Hence, RSME, and R^2 show that the model is strong in predicting the weight based on height.