Section 1 Report:

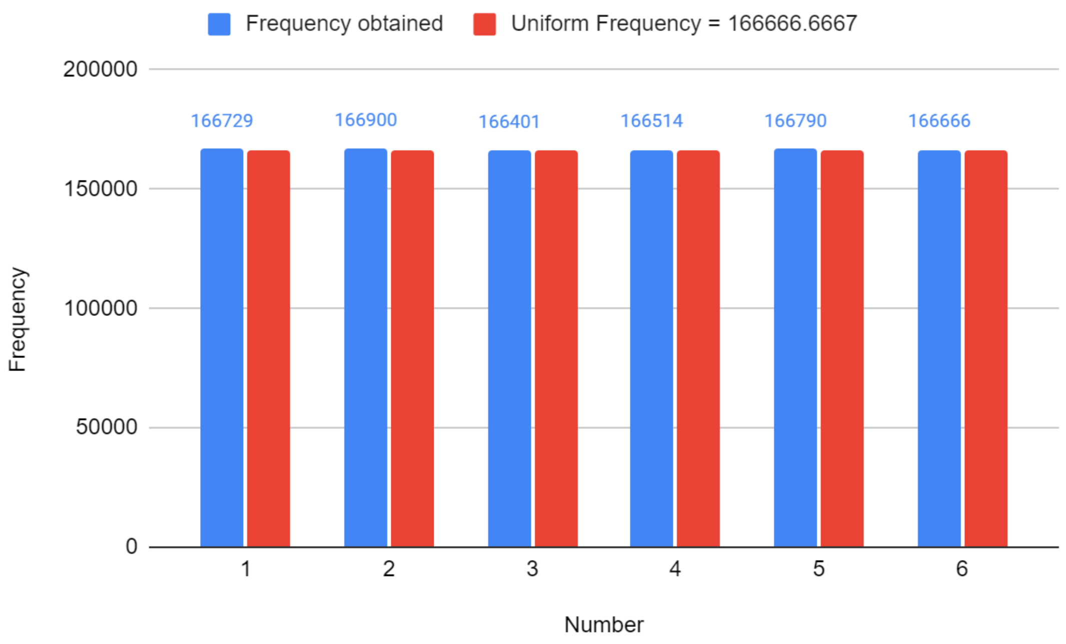
Randomness in Computation

Question 1:

We wrote a program to throw a dice a million times and randomly generate one of the 6 faces of the dice (from 1 to 6). The frequency of each face was obtained as shown below:

Number	Frequency obtained	Uniform Frequency
1	166729	166666.6667
2	166900	166666.6667
3	166401	166666.6667
4	166514	166666.6667
5	166790	166666.6667
6	166666	166666.6667

Then, we plotted a histogram to check how far off these obtained frequencies were from the ideal frequency ($\frac{1000000}{6} = 166666.67$)



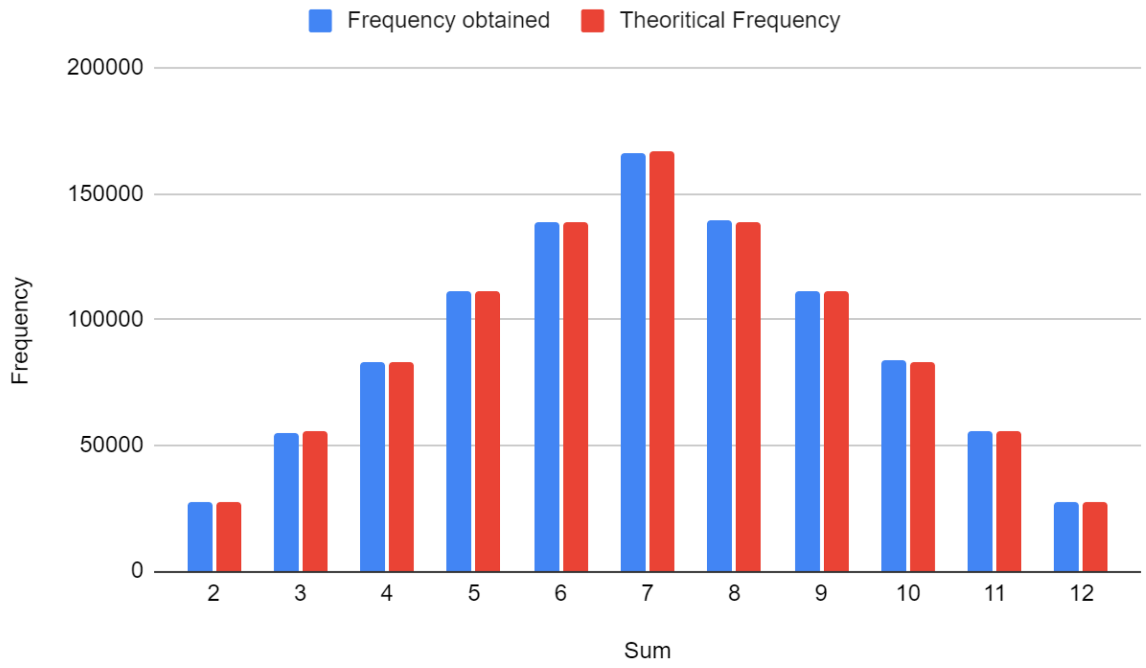
So, we can see and conclude from the histogram plotted above that the distribution obtained using computation of random numbers is almost identical to the theoretical distribution.

Question 2:

We wrote a program to throw a pair of dice a million times and randomly generate one of the 6 faces of the dice for each (from 1 to 6). The frequency of the sum of the values of their face was obtained as shown below:

Sum	Frequency obtained	Theoritical Frequency
2	27740	27777.77778
3	55221	55555.55556
4	83398	83333.33333
5	110918	111111.1111
6	139043	138888.8889
7	166455	166666.6667
8	139300	138888.8889
9	111031	111111.1111
10	83577	83333.33333
11	55490	55555.55556
12	27827	27777.77778

Then, we plotted a histogram to check how far off these obtained frequencies were from the ideal frequencies, which we calculated manually using basic math.



So, we can see and conclude from the histogram plotted above that the distribution obtained using computation of random numbers is almost identical to the theoretical distribution.

Question 3:

We wrote a program to empirically estimate the value of π using the following method:

We considered a square with its centre at origin and corners at (1,1), (-1,1), (1,-1) and (-1,-1). A unit circle with centre at origin is now considered. If a random point is chosen within the square, the probability that it falls within the circle

$$= \frac{area\ of\ circle}{area\ of\ square}$$

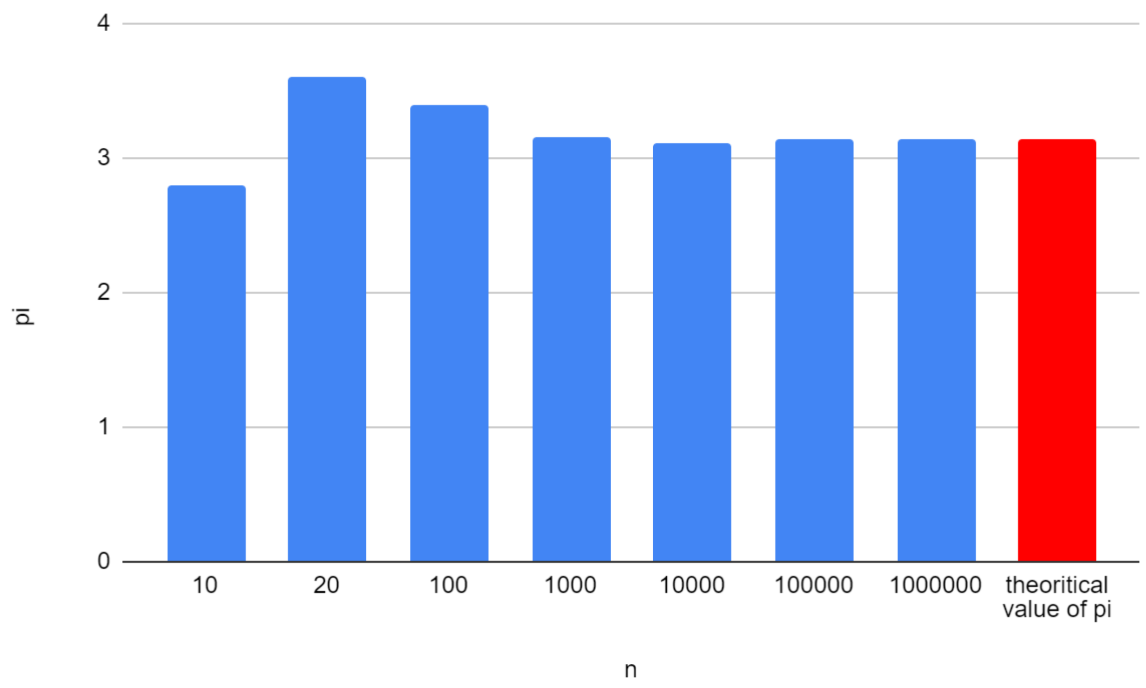
$$= \frac{\pi \cdot 1^2}{2^2}$$

$$= \frac{\pi}{4}$$

So, we computed random points within the square and checked if they were within the circle and thus, obtained the probability for various lengths of data and multiplied them by 4 to calculate an estimated value of pi for that set of data, as shown below

n	pi
10	2.8
20	3.6
100	3.4
1000	3.16
10000	3.1148
100000	3.14812
1000000	3.141132
theoritical value of pi	3.141592654

Then, we plotted these value on a histogram to observe how the estimate of π changes with the change in n(the number of points sampled).



So, we can see and conclude from the histogram plotted above that the estimate value of π gets closer and closer to the theoretical value of π
