MATHS MINIPROJECT
GROUP NUMBER : C6

Group members:

Gaurav Mishra - 41

Merwin Rebello - 52

Noel Sangle - 58

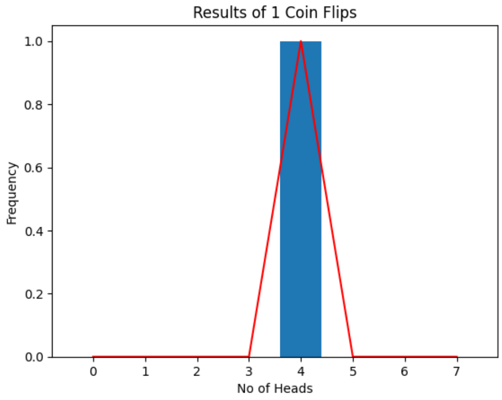
Aditya Singh - 65

Sahil Singh - 66

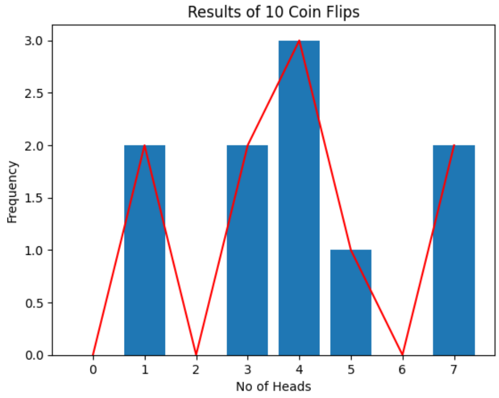
PROBLEM STATEMENT:

Toss 7 fair coins simultaneously.
Record the number of heads.
Perform 5 trials of this process of tossing 7 coins.
Step 1: Record the number of heads you received in each trial - that is, Count
Step 2: Draw the graph of Count vs frequency for all the trials put together.
Now perform 10 trials of this process of tossing 7 coins.
Repeat Steps 1 and 2. Increase the number of trials to 20, 30, 40, · · ·, 100, 200, · · · , 1000, · · ·
Repeat Steps 1 and 2 in each case.
What do you observe?- Can you identify the distribution?

Number of trials 1:

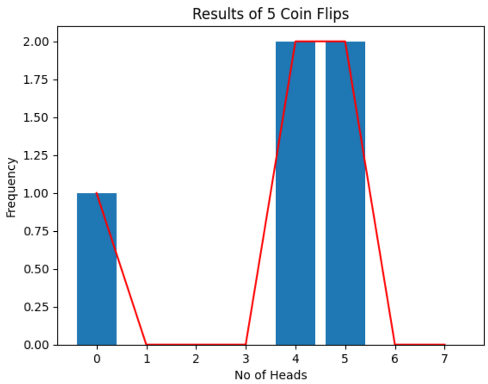


Number of trials 10:

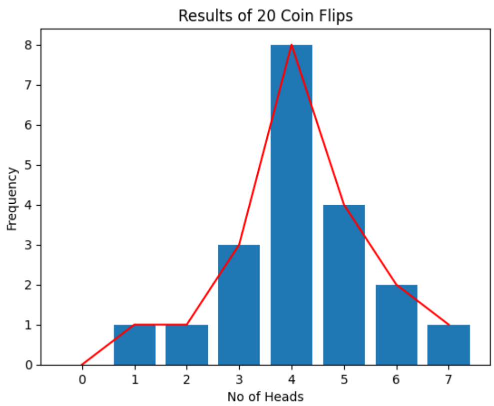


MATHS MINIPROJECT
GROUP NUMBER : C6

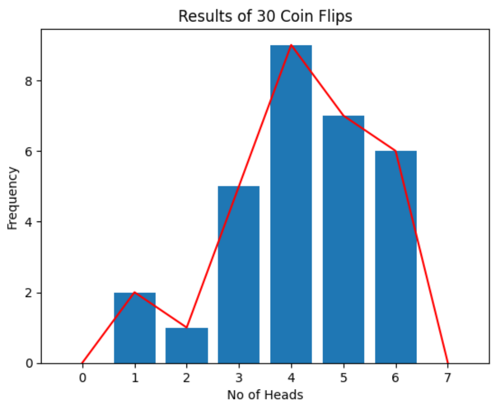
Number of trials 5:



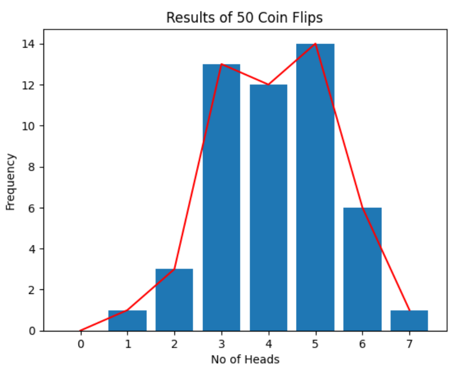
Number of trials 20:



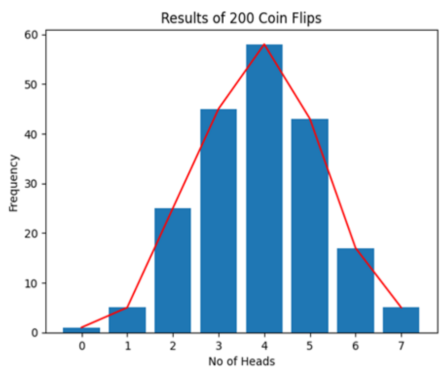
Number of trials 30:



Number of trials 50:

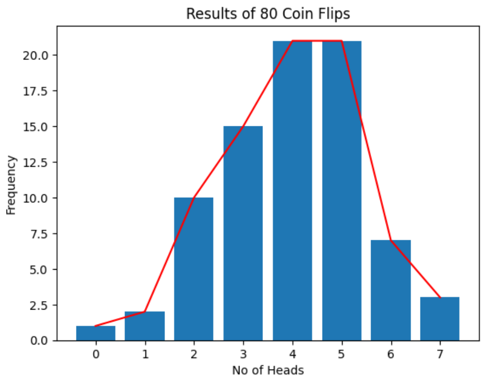


Number of trials 200:

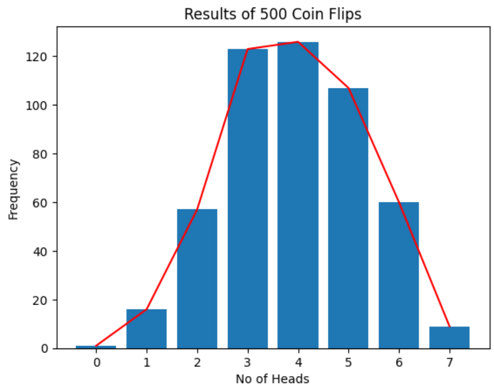


MATHS MINIPROJECT
GROUP NUMBER : C6

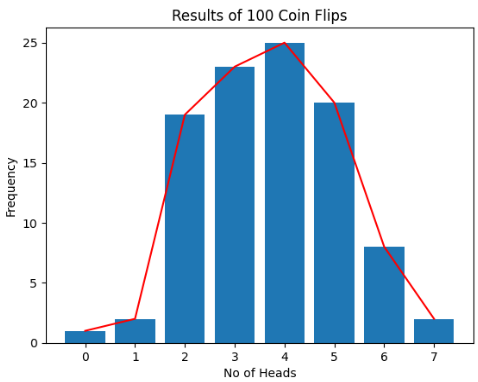
Number of trials 80:



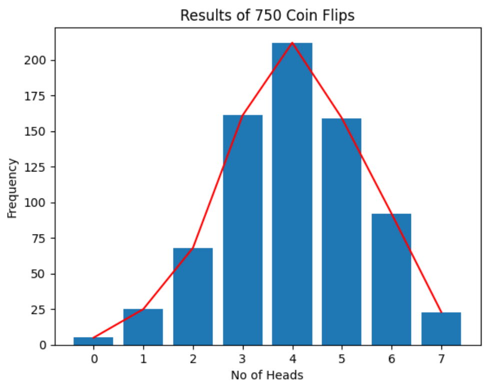
Number of trials 500:



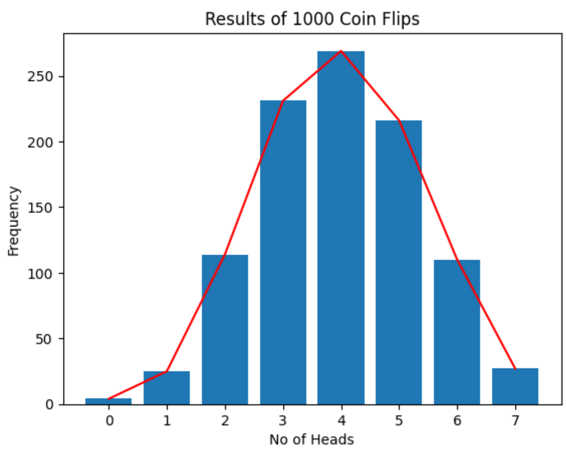
Number of trials 100:



Number of trials 750:

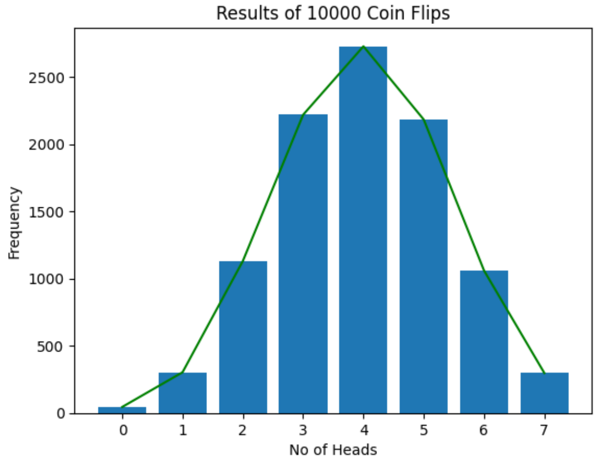


Number of iteration 1000:

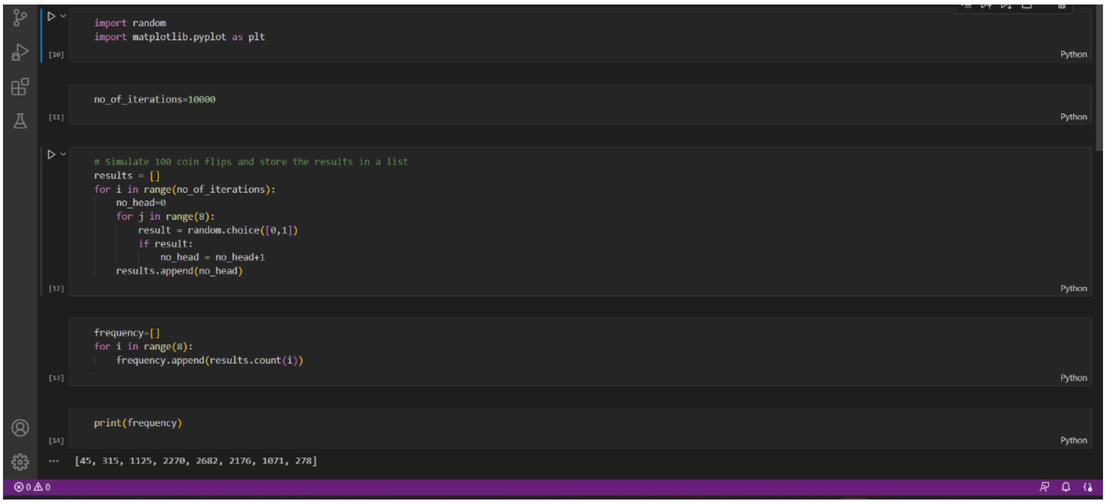


MATHS MINIPROJECT
GROUP NUMBER : C6

Number of trials 10000:



Code:



```python
import random
import matplotlib.pyplot as plt
```

```python
no_of_iterations=10000
```

```python
# Simulate 100 coin flips and store the results in a list
results = []
for i in range(no_of_iterations):
    no_head=0
    for j in range(8):
        result = random.choice([0,1])
        if result:
            no_head = no_head+1
    results.append(no_head)
```

```python
frequency=[]
for i in range(8):
    frequency.append(results.count(i))
```

```python
print(frequency)
```

```
[45, 315, 1125, 2270, 2682, 2176, 1071, 278]
```

```python
# Plot the results on a bar graph
x = [0,1,2,3,4,5,6,7]
y = frequency
plt.bar(x, y)
plt.title('Results of '+str(no_of_iterations)+' Coin Flips')
plt.xlabel('No of Heads')
plt.ylabel('Frequency')
plt.plot(x,y)
plt.show()
```

MATHS MINIPROJECT
GROUP NUMBER : C6

Resources used:

Python,
Python library used: Matplotlib, Random

Matplotlib is a plotting library for Python that provides a wide range of 2D and 3D visualization tools for creating publication-quality plots, graphs, and figures. It is one of the most popular and widely used visualization libraries in Python.

Matplotlib provides a variety of APIs for creating different types of plots, including line plots, scatter plots, bar charts, histograms, and more. The library allows users to customize nearly every aspect of their plots, including colors, line styles, axis labels, legends, and more.

Random
The random library in Python is a built-in module that provides a set of functions for generating random numbers and sequences. It is often used in simulations, games, cryptography, and other applications where randomization is required.

(Note that the random numbers generated by the random library are not truly random, but rather pseudorandom numbers that are generated using a deterministic algorithm. To generate truly random numbers, you may need to use external sources of randomness, such as physical random number generators or atmospheric noise.)

Binomial Distribution:

In probability theory and statistics, the binomial distribution with parameters n and p is the discrete probability distribution of the number of successes in a sequence of n independent experiments, each asking a yes–no question, and each with its own Boolean-valued outcome: success (with probability p) or failure (with probability q = 1 - p). A single success/failure experiment is also called a Bernoulli trial or Bernoulli experiment, and a sequence of outcomes is called a Bernoulli process; for a single trial, i.e., n = 1, the binomial distribution is a Bernoulli distribution. The binomial distribution is the basis for the popular binomial test of statistical significance.

The binomial distribution is frequently used to model the number of successes in a sample of size n drawn with replacement from a population of size N. If the sampling is carried out without replacement, the draws are not independent and so the resulting distribution is a hypergeometric distribution, not a binomial one. However, for N much larger than n, the binomial distribution remains a good approximation, and is widely used.

Normal Distribution:

The graph we obtained from the experiment of tossing 7 fair coins simultaneously and recording the number of heads is not a normal distribution.

A normal distribution has a bell-shaped curve that is symmetric around its mean, and the probability density function of a normal distribution is given by the bell-shaped equation known as the Gaussian function.

The distribution of the number of heads we obtained from our experiment is a binomial distribution, which is a discrete probability distribution. The binomial distribution has a different shape than the normal distribution and is not continuous.

However, as we perform more trials, the distribution of the number of heads tends to become more symmetric and concentrated around its expected value, which is 3.5 for this experiment. This phenomenon is known as the Central Limit Theorem, which states that the distribution of the sample mean of a large number of independent and identically distributed random variables tends to approach a normal distribution regardless of the underlying distribution of the variables.

Therefore, even though the distribution of the number of heads we obtained is not a normal distribution, as the number of trials increases, the distribution becomes more normal-like, which is why we often use the normal distribution as an approximation for many practical purposes.

Conclusion:

The experiment of tossing 7 fair coins simultaneously and recording the number of heads follows a binomial distribution. The binomial distribution describes the number of successes (heads) in a fixed number of independent trials (coin tosses), where each trial has the same probability of success (probability of getting heads).

As we perform more and more trials of tossing 7 coins, we should expect to see the frequency distribution of the number of heads approach the binomial distribution. Specifically, the mean of the distribution should be equal to the expected number of heads, which is 7/2 = 3.5, and the variance of the distribution should be equal to the expected variance of the binomial distribution, which is np(1-p), where n is the number of trials (7 in this case) and p is the probability of success (0.5 in this case).

As we increase the number of trials, we should observe that the histograms become more and more peaked around the expected value of 3.5, and the spread of the distribution becomes narrower and narrower. This is consistent with the expected behavior of the binomial distribution.

In summary, the experiment of tossing 7 fair coins simultaneously and recording the number of heads follows a binomial distribution. As we perform more and more trials, we should observe that the frequency distribution of the number of heads converges towards the expected binomial distribution with a mean of 3.5 and a variance of 7/4.

References:

[1] https://matplotlib.org/stable/index.html

[2] https://docs.python.org/3/library/random.html

[3] https://en.wikipedia.org/wiki/Binomial_distribution