Question 5

Python Code

import random

import matplotlib.pyplot as plt

def sim(n):

res = []

for i in n:

res.append(4 \* (sum(1 for \_ in range(i) if random.uniform(-1, 1)\*\*2 + random.uniform(-1, 1)\*\*2 < 1)) / i)

print(i, 4 \* (sum(1 for \_ in range(i) if random.uniform(-1, 1)\*\*2 + random.uniform(-1, 1)\*\*2 < 1)) / i)

plt.plot(n, res, marker='.')

plt.xlabel('n')

plt.ylabel('4 \* count / n')

plt.title('Simulation')

plt.show()

sim([50, 100, 500, 1000, 2000, 5000, 10000, 20000])

Output:

50 3.2

100 3.16

500 3.208

1000 3.212

2000 3.16

5000 3.1312

10000 3.1412

20000 3.1212

Table:

|  |  |
| --- | --- |
| **N** | **4count/n** |
| 50 | 3.2 |
| 100 | 3.16 |
| 500 | 3.208 |
| 1000 | 3.212 |
| 2000 | 3.16 |
| 5000 | 3.1312 |
| 10000 | 3.1412 |

Plot:

A graph with a line and numbers

Description automatically generated

As n increase, the plot converges, and the value approaches the value of π, and estimations become more accurate for the ratio . The rate of increase of the ratio is not constant as evident from the plot and is slowing down as the n increases. The more simulations we run; the accurate estimations are produced. Due to randomization, we observe variability at each step of the simulation.