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EE 380

Lab 1

1.)

Histogram of Rolls Until Seven
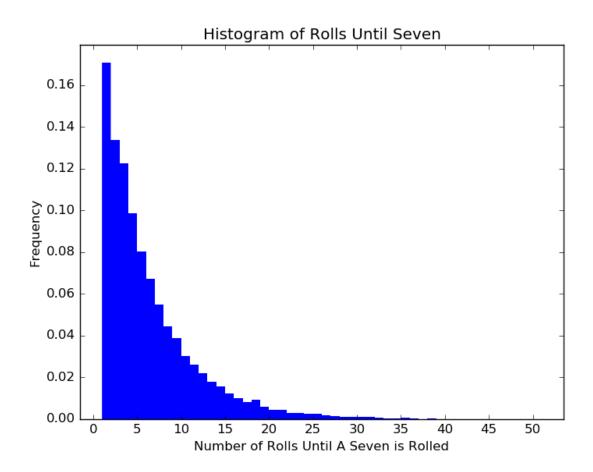

import matplotlib.pyplot as plt

import numpy as np

die1 = 0

die2 = 0

A = np.zeros(10000)

numRolls = 0

```
for i in range(10000):

    numRolls = 0

    die1 = 0

    die2 = 0

    while(die1 + die2 != 7):

        die1 = np.random.randint(1,7)

        die2 = np.random.randint(1,7)

        numRolls += 1

    A[i] = numRolls


print(A)


plt.hist(A, bins = 50, normed = True)

plt.title("Histogram of Rolls Until Seven")

plt.xlabel("Number of Rolls Until A Seven is Rolled")

plt.ylabel("Frequency")


plt.show()
```

2.) Mathematically:

$$\frac{\binom{100}{50}\binom{50}{50}}{2^{100}} = \frac{\frac{100!}{(100-50)!50!}}{2^{100}} \sim \frac{1.0089 * 10^{29}}{1.2677 * 10^{30}} = 0.0796$$

<u>By Simulation (10000 Trials)</u>: Probability of 0.0806

```
import matplotlib as plt

import numpy as np


fiftyHeads = 0

rounds = 10000
```

```
for i in range(rounds):

    instances = 0;

    for i in range(100):

        if(np.random.randint(0,2) == 0):

            instances = instances + 1

    if(instances == 50):

        fiftyHeads = fiftyHeads + 1


probability = fiftyHeads / rounds


print(probability)
```

3.)

<u>Mathematically</u>:

13 kinds of cards; choose one of each suit. 1 card of any other kind; choose 1 of any suit

$$\frac{\binom{13}{1}\binom{4}{4}\binom{12}{1}\binom{4}{1}}{\binom{52}{5}} = \frac{13*12*4}{52!/(52-5)!\,5!} = \frac{624}{2598960} = 0.00024009603$$

<u>By Simulation (100000 Trials)</u>: Probability of 0.00025

```
import matplotlib as plt

import numpy as np


rounds = 100000

A = np.arange(1,53)

B = np.zeros(5)

fourOfAKind = 0

instances = 0


for i in range(rounds):

    A = np.random.permutation(A)

    instances = 0
```

```python
    for i in range(5):

        B[i] = A[i] % 13

    B = np.sort(B)

    for i in range(5):

        if B[i] == B[3]:

            instances = instances + 1

    if instances == 4:

        fourOfAKind = fourOfAKind + 1


probability = fourOfAKind / rounds

print(probability)
```