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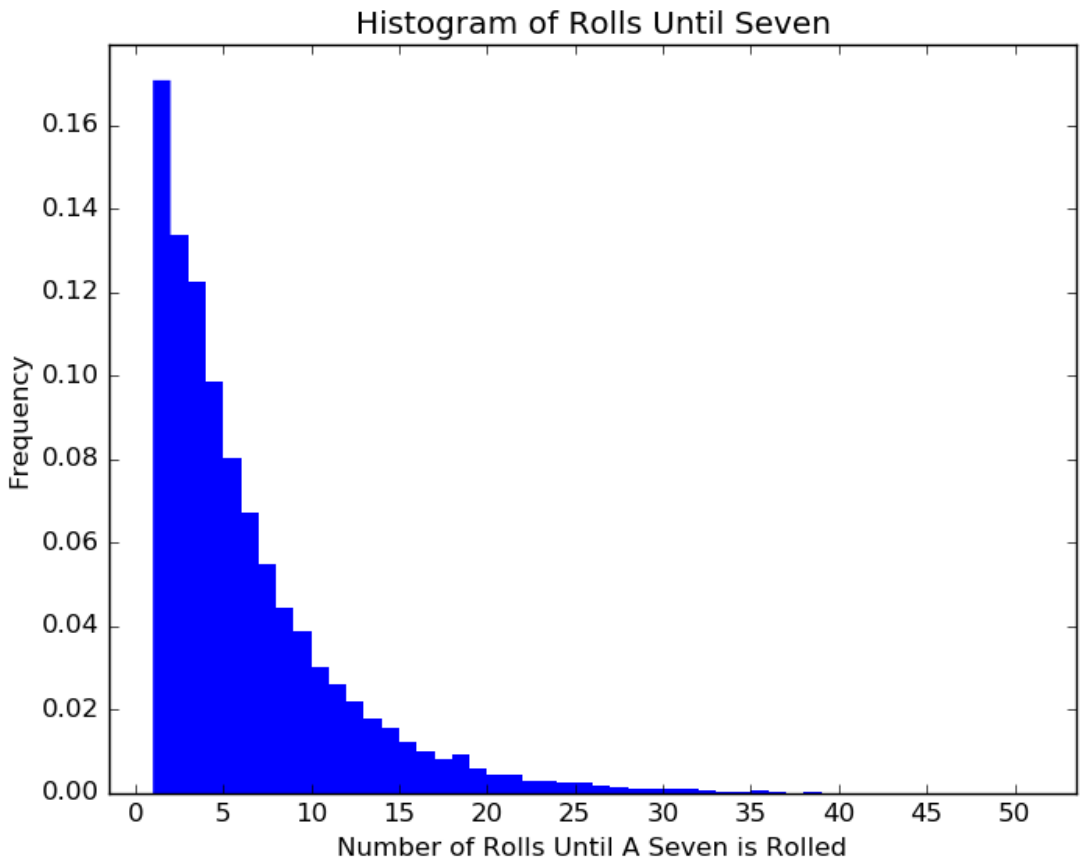
EE 380

Lab 1

1.)




```
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

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:

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

By Simulation (10000 Trials): 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.)

Mathematically:

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

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

By Simulation (100000 Trials): 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
    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)
```