Homework 2

(Total: 50pt)

This is an individual assignment. Related knowledge:

- Bayes theorem
- Independence
- Combinatorics

Problem 1

(20 pt)

Implement a function to evaluate the relative frequency of a batch being accepted if it contains k defectives.

A batch of one hundred items is inspected by testing four randomly selected items. If one of the four is defective, the batch is rejected. What is the probability that the batch is accepted if it contains five defectives?

In [19]:
```
import random
import numpy as np
import numpy.random as npr

def rejectk(k=5, batchnum=100): #k= the number of defectives in the batch
    num_sims = 1000
    goodBatch = 0


    for sim in range(num_sims):
        finalChoice = 0

        batch = [0]*(batchnum-k)+[1]*k
         # implement sampling from the batch.
        # determine if it shall be rejected.
        for i in range(4):
            batchtest = random.choice(batch)
            batch.remove(batchtest)
            if batchtest == 1:
                finalChoice += 1
        if finalChoice == 0:
            goodBatch += 1

    print('The relative frequency of a batch being accepted with 5 defectives is', goo

    #calculate and print out the relative frequency.
```

In [20]:
```
rejectk(5, 100)
```

```
The relative frequency of a batch being accepted with 5 defectives is 0.813
```

Problem 2

(20 pt)

Suppose you have an assortment of coins: 51 coins each with probability of flipping heads p, in the interval $[0.3,0.8]$, defined below:

In [34]:
```
import numpy as np
allcoins = np.linspace(0.3,0.8,51)  # set of coins

allcoins
```

Out[34]:
```
array([0.3 , 0.31, 0.32, 0.33, 0.34, 0.35, 0.36, 0.37, 0.38, 0.39, 0.4 ,
       0.41, 0.42, 0.43, 0.44, 0.45, 0.46, 0.47, 0.48, 0.49, 0.5 , 0.51,
       0.52, 0.53, 0.54, 0.55, 0.56, 0.57, 0.58, 0.59, 0.6 , 0.61, 0.62,
       0.63, 0.64, 0.65, 0.66, 0.67, 0.68, 0.69, 0.7 , 0.71, 0.72, 0.73,
       0.74, 0.75, 0.76, 0.77, 0.78, 0.79, 0.8 ])
```

Consider the experiment where you pick a coin at random and flip it 8 times, and the event "all tails" occurs.

What is the probability that the coin has a probability of tail smaller than 0.5?

Implement simulation to evaluate the relative frequency

In [41]:
```
num_sims=10000
allTails = 0
smallProb = 0
for sim in range(num_sims):
    coin = random.choice(allcoins)
    headCount = 0
    for i in range(8):
        heads = 0
        for j in range(round(coin*100)):
            outcome = random.choice(range(1,3))
            if outcome == 1:
                heads += 1
        if heads > 25:
            headCount += 1
        elif heads == 25:
            randomFlip = random.choice(range(1,3))
            if randomFlip == 1:
                headCount += 1

    if headCount == 0:
        allTails += 1
        if coin > 0.5:
            smallProb += 1


print('The probability that the coin has a probablility of tails smaller than 0.5 is',
```

```
The probability that the coin has a probablility of tails smaller than 0.5 is 0.00044
4247001332741
```

Problem 3

(5 pt) Using python to perform the counting

How many ways can one arrange 4 math books, 3 chemistry books, 2 physics books, and 1 biology book on a bookshelf so that all the math books are together, all the chemistry books are together, and all the physics books are together?

In [44]:
```
import math

mathBooks = 4
chemBooks = 3
physicsBooks = 2
bioBooks = 1
typeBooks = 4

arrangements = math.factorial(mathBooks) * math.factorial(chemBooks) * math.factorial(

print('You can arrange the books so they are all together in',arrangements,'different
```

```
You can arrange the books so they are all together in 6912 different ways.
```

Problem 4

(5 pt) Using python to perform the counting

Suppose there are 10 men and 8 women. How many ways can we choose a committee that has 2 men and 2 women?

In [49]:
```
import math



def committeePick(total, needed):
    ways = math.factorial(total)/(math.factorial(total-needed)*math.factorial(needed))
    return ways
print('There are',committeePick(10,2)*committeePick(8,2),'ways to choose a committee w
```

```
There are 1260.0 ways to choose a committee with 2 men and 2 women
```

Submit Your Solutions

Confirm that you've successfully completed the assignment. submit both the notebook files and a PDF printout

In [ ]:
```

```