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 [12]:   import numpy as np
           import numpy.random as npr
           import random
```

```
In [128]: def rejectk(k=5, batchnum=100): #k= the number of defectives in the batch
              num_sims = 1000
              # Create a list of items using booleans, 0 for non-defective, 1 for defective,
              batch = []
              result = []
              counter = 0
              reject = ['D','N']
              for i in range(batchnum):
                  temp = random.choice(reject)
                  if temp == 'D' and counter < 5:
                      counter += 1
                      batch += [1]
                  else:
                      batch += [0]

              for sim in range(num_sims):
                  check = 'Approve'
                  # implement sampling from the batch.
                  for i in range(4):
                      if batch[npr.randint(100)] == 1:
                          check = 'defective'
                          break
                  # determine if it shall be rejected.
                  if check == 'defective':
                      result += [0]
                  else:
                      result += [1]


              #calculate and print out the relative frequency.
              print('Relative Frequency: ', np.sum(result)/len(result))

          rejectk()

Relative Frequency:  0.821
```

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

          allcoins
```

```
Out[131]: 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 [132]: count = 0
          for i in range(len(allcoins)):
              if allcoins[i] < 0.5:
                  count += 1
          print('Relative Frequency: ', count/len(allcoins))
```

Relative Frequency: 0.39215686274509803

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 [158]: import math
          blocks = math.factorial(4)
          math_b = math.factorial(4)
          chem = math.factorial(3)
          phy = math.factorial(2)
          bio = 1

          print(blocks*math_b*chem*phy*bio)
```

6912

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 [162]: import math
          men = math.comb(10,2)
          women = math.comb(8,2)

          men*women
```

Out[162]: 1260

Submit Your Solutions

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

```
In [ ]:
```