Binomial distribution using Python

1) A perfect dice is tossed a large number of times in sets of 8. The occurence of 5 and 6 is considered a success. Then in what proportion of sets would you expect three successes?

In [1]:
```
from scipy import stats
```

given n= 8, p =2/6 =1/3 , q=(1-(1/3)) = 2/3 x = 3

In [2]:
```
prob_success = stats.binom.pmf(3,8,1/3)
prob_success
```

Out[2]:
```
0.2731290961743638
```

```
Thus the three successes will be expected in 0.2731 or 27.31 percent of cases.
```

2) The probability that an invoice contains an error is 6%. If an audit of the 10 invoices is taken, what is the probability that less than 3 incorrect invoices will be found?

```
n = 10, p = 0.06, q = .94
By question, we need to find P(x<3) = P(0) + P(1) + P(2)
```

In [3]:
```
stats.binom.cdf(2,10,.06) #less than 3 means maximum 2
```

Out[3]:
```
0.9811621634757249
```

```
The required probability is .98117
```

3) Good bank of india is considering opening a special teller window for female customers only. A recent study has shown that on an average 40% of the customers of the bank are female clients. Assuming that conditions for binomial distribution are satisfied, determine the probability distribution that describes the next 8 customers. What is the expected number of female clients? what is the variance and standard deviation of this distribution?

```
n = 8, p=.4, q=.6
```

In [4]:
```
# printing the probability distribution for next 8 customers
X_0 = stats.binom.pmf(0,8,.4) #probability when no. of female clients(x)=0
X_1 = stats.binom.pmf(1,8,.4)
X_2 = stats.binom.pmf(2,8,.4)
X_3 = stats.binom.pmf(3,8,.4)
X_4 = stats.binom.pmf(4,8,.4)
X_5 = stats.binom.pmf(5,8,.4)
X_6 = stats.binom.pmf(6,8,.4)
X_7 = stats.binom.pmf(7,8,.4)
X_8 = stats.binom.pmf(8,8,.4)

a = (X_0,X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8)
a
```

Out[4]:
```
(0.016796159999999994,
 0.08957951999999998,
 0.20901888000000005,
 0.2786918400000002,
 0.23224320000000012,
 0.12386304000000009,
 0.041287680000000035,
 0.007864320000000008,
 0.0006553600000000003)
```

In [5]:
```
mean,var=stats.binom.stats(8,.4)
print("Average: ", mean)
print("variance: ", var)
print("Standard deviation: ",var**(1/2))
```

```
Average:  3.2
variance:  1.92
Standard deviation:  1.3856406460551018
```

```
Average is 3.2 and standard deviation is 1.386 and probability distribution table
is given above.
```

4) An auditor is preparing for a physical count of inventory as a means of verifying its value. Items counted are reconciled with a list prepared by the store room supervisor. Normally 20% of the items counted cannot be reconciled without reviewing invoices. The auditor selects 10 items. What is the probability that up to 4 items cannot be reconciled, and between 4 and 6 items (inclusive) cannot be reconciled? If it normally takes 20 minutes to review the invoice for an item that cannot be reconciled and one hour for the balance of the count, how long should the auditor expect the physical count to take?

```
n = 10, p = .20, q = 1-.20 = .8
```

```
probability up to 4 items can't be reconciled- P(x<=4) = P(0) + P(1) + P(2) + P(3)
+ P(4)
probability between 4 and 6 items(inclusive) can't be reconciled
P(4 <= x <= 6) = P(4) + P(5) + P(6)
```

In [6]:
```
X_4 = stats.binom.cdf(4,10,.20) #probability up to x = 4
X_4
```

Out[6]:
```
0.9672065024000001
```

In [7]:
```
#probability from 4 to 6 items inclusive
X_4_6 = stats.binom.pmf(4,10,.2)+stats.binom.pmf(5,10,.2)+stats.binom.pmf(6,10,.2)
X_4_6
```

Out[7]:
```
0.12000952320000013
```

In [8]:
```
# Expected number of items that cannot be reconciled
mean,var = stats.binom.stats(10,.2)
print("average: ", mean)
```

```
average:  2.0
```

In [9]:
```
#time required for physical count
time = 20*2 + 60 #since 20 mins to review items that can't be reconciled and 1 hour
time
```

Out[9]: 100

```
P(x<=4) = .9672
P(4<=x<=6) = .120
expected time = 100 mins
```

5) According to an article in a magazine, 60% of the 15-18 years old who use internet do their homework online. If 8 kids within this age group who use the internet are randomly selected, what is the probability that no more than 5 of them do their homework online?

```
n = 8, p = 0.6, q = 0.4
P(X<=5) = 1 - [P(6) + P(7) + P(8)]
```

In [10]:
```
1 - (stats.binom.pmf(6,8,.6) + stats.binom.pmf(7,8,.6) + stats.binom.pmf(8,8,.6))
```

Out[10]: 0.6846054399999999

```
the required probability is  .68461
```

In [ ]: