DIGITAL ASSIGNMENT 3

(MAT2001-ELA DA3)

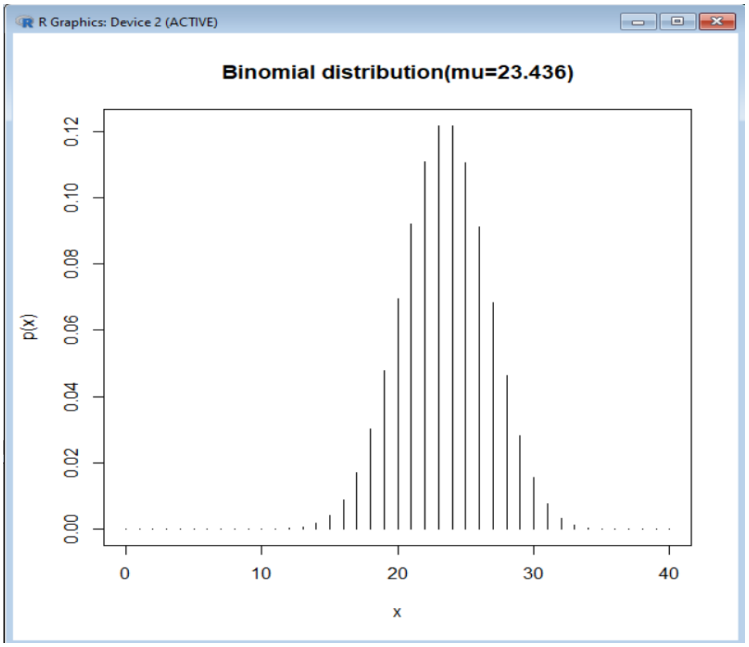
Problem 1:

A recent national study showed that approximately 55.8% of college students have used Google as a source in at least one of their term papers. Let X equal the number of students in a random sample of size n = 42 who have used Google as a source:

1. **Sketch the probability mass function (roughly).**
2. **Sketch the cumulative distribution function (roughly).**
3. **Find the probability that X is equal to 17.**
4. **Find the probability that X is at most 13.**
5. **Find the probability that X is bigger than 11.**
6. **Find the probability that X is at least 15.**
7. **Find the probability that X is between 16 and 19, inclusive**
8. **Give the mean of X, denoted IE X.**
9. **Give the variance of X.**

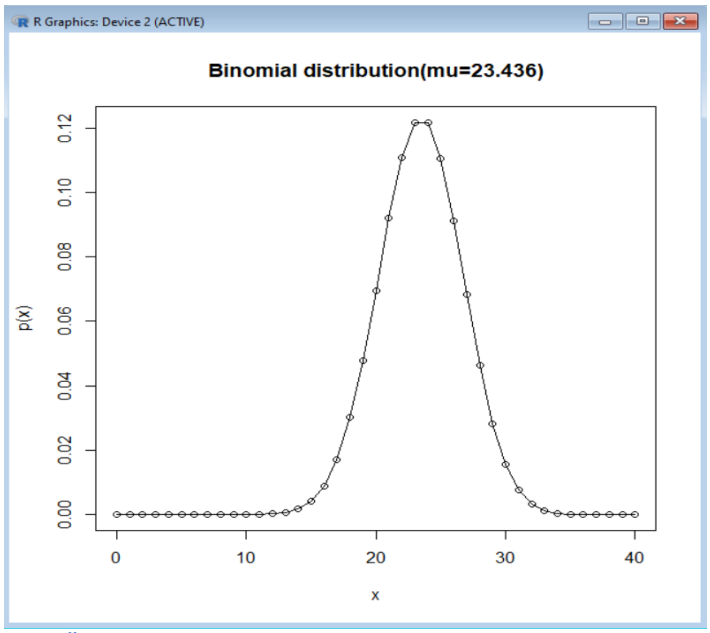
R code:

```
> p=55.8/100
> p
[1] 0.558
> n=42
> n
[1] 42
> mu=n*p
> mu
[1] 23.436
> #Probability mass function graph
>
```

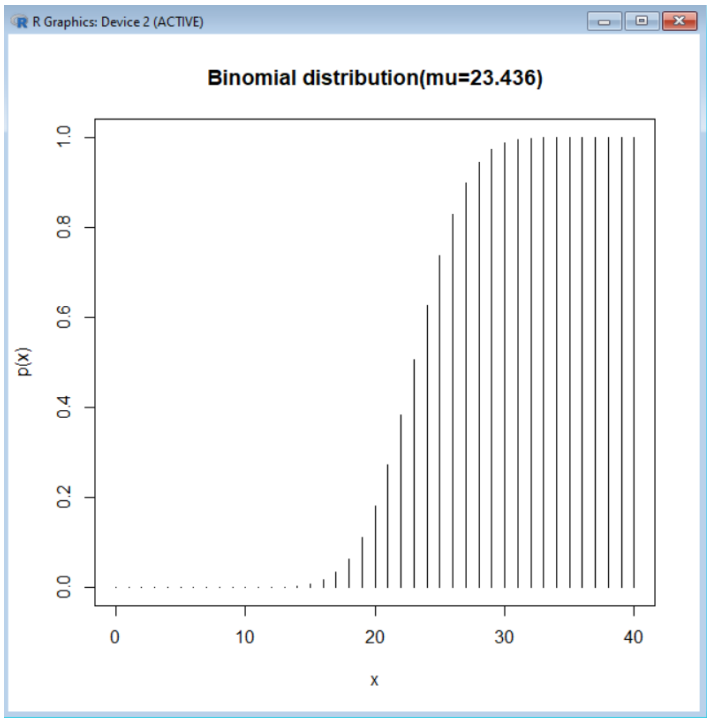



```
plot(0:40,dbinom(0:40,42,0.558),type="h",xlab="x",ylab="p(x)",main="Binomial distribution(mu=23.436)")
```

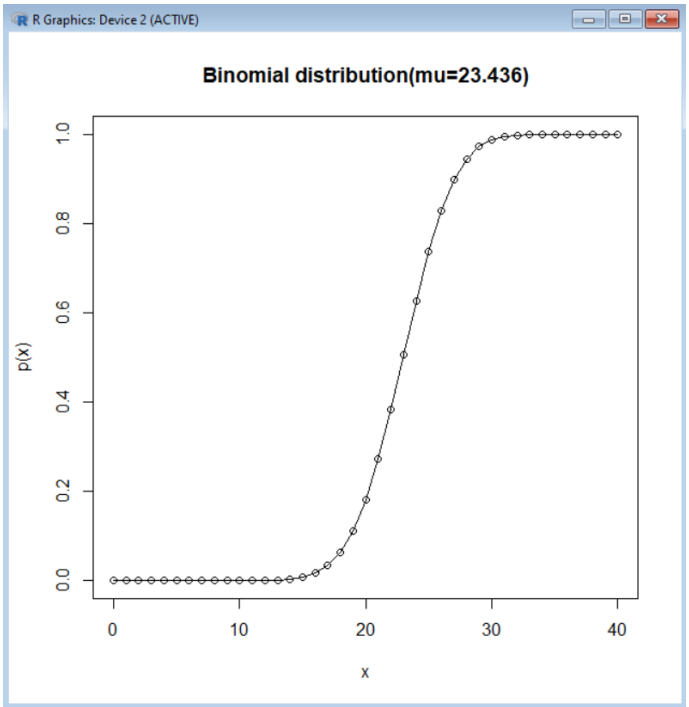
```
>
plot(0:40,dbinom(0:40,42,0.558),type="o",xlab="x",ylab="p(x)",main="Binom
ial distribution(mu=23.436)")
```




```
> #Cumulative distribution function graph
>
plot(0:40,pbinom(0:40,42,0.558),type="h",xlab="x",ylab="p(x)",main="Binom
ial distribution(mu=23.436)")
```




```
>
plot(0:40,dbinom(0:40,42,0.558),type="o",xlab="x",ylab="p(x)",main="Binom
ial distribution(mu=23.436)")
```




```
> dbinom(17,42,0.558)
[1] 0.0171515
> round(dbinom(17,42,0.558),3)
[1] 0.017
> #probability that X is equal to 17, i.e., P(X=17)=0.017
>
> round(pbinom(13,42,0.558))
[1] 0
> round(pbinom(13,42,0.558),3)
[1] 0.001
> #probability that X is atmost 13, i.e., P(X≤13)=0.001
>
> 1-pbinom(11,42,0.558)
[1] 0.9999036
> round(1-pbinom(11,42,0.558),3)
[1] 1
> #probability that X is bigger than 11, i.e., P(X>11)=0.999
>
> 1-pbinom(15,42,0.558)
[1] 0.9930555
> round(1-pbinom(15,42,0.558))
[1] 1
> #probability that X is atleast 15, i.e., P(X≥15)=0.993
>
> pbinom(19,42,0.558)-pbinom(16,42,0.558)
[1] 0.09518174
> round((pbinom(19,42,0.558)-pbinom(16,42,0.558)),3)
[1] 0.095
> #probability that X is between 16 and 19, inclusive, i.e.,
P(16≤X≤19)=0.095
>
> x.val=0:42
> p.val=dbinom(x.val,42,0.558)
> EX=sum(x.val*p.val)      #mean
```

```
> EX
[1] 23.436
> #mean=23.436 for given binomial distribution
> sum((x.val-EX)^2*p.val)                    #variance
[1] 10.35871
> #variance=10.35871 for given binomial distribution
```

Problem 2(Traffic accident problem):

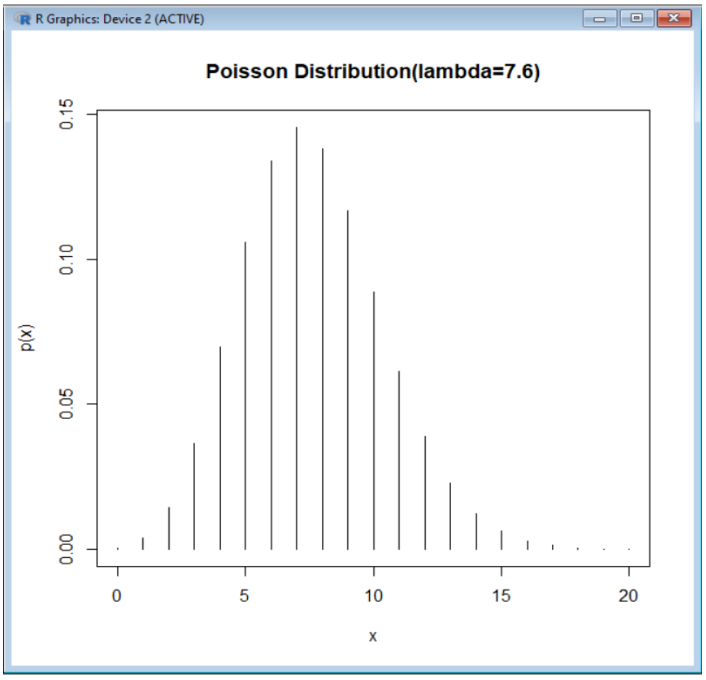
The number of traffic accidents that occur on a particular stretch of road during a month follows a Poisson distribution with a mean of 7.6.

1. **Find the probability that less than three accidents will occur next month on this stretch of road.**
2. **Find the probability of observing exactly three accidents on this stretch of road next month.**
3. **Find the probability that the next two months will both result in four accidents each occurring on this stretch of road.**
4. **Check the mean and variance of the Poisson distribution**
5. **Plot the Poisson distribution and compare with binomial distribution**

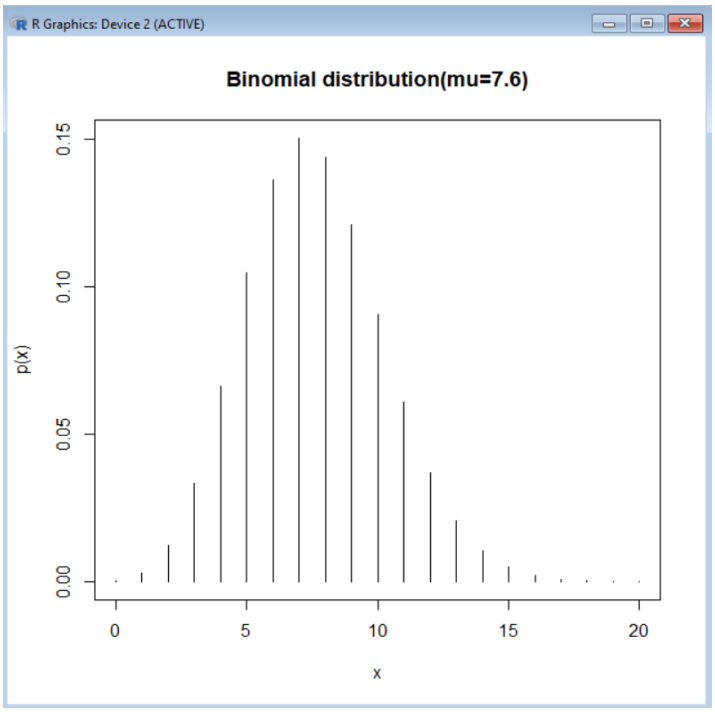
R code:

```
> lambda=7.6
> ppois(3,lambda=7.6)
[1] 0.05537128
> round(ppois(3,7.6),3)
[1] 0.055
> #probability that less than 3 accidents will occur next month is 0.055
> dpois(3,lambda=7.6)
[1] 0.03661436
> round(dpois(3,7.6),3)
[1] 0.037
> #probability that exactly 3 accidents will occur next month is 0.037
> #for 1 month,
> dpois(4,lambda=7.6)
[1] 0.06956729
> round(dpois(4,7.6),4)
[1] 0.0696
> #probability that exactly 4 accidents will occur next month is 0.0696
> #for 2 months,
> (dpois(4,lambda=7.6))*dpois(4,lambda=7.6)
[1] 0.004839607
```

```
> round(dpois(4,7.6)^2,3)
[1] 0.005
> #probability that next two months will both result in four accidents each is 0.005
> x.val=0:100
> p.val=dpois(x.val,7.6)
> ex=sum(x.val*p.val)                    #mean
> ex
[1] 7.6
> mean=7.6 for given poisson distribution
> sum((x.val-ex)^2*p.val)        #variance
[1] 7.6
> variance=7.6 for given poisson distribution
> #plotting of poisson distribution
> plot(0:20,dpois(0:20,7.6),type="h",xlab="x",ylab="p(x)",main="Poisson Distribution(lambda=7.6)")
```




```
> lambda=7.6
> n=100
> #since, lambda = n * p
> p=lambda/n
> p
[1] 0.076
> #plotting of binomial distribution
>
plot(0:20,dbinom(0:20,100,0.076),type="h",xlab="x",ylab="p(x)",main="Binomial distribution(mu=7.6)")
```




```
> #comparison between binomial and poisson distribution
>
data.frame(0:20,round(dbinom(0:20,100,0.076),3),round(dpois(0:20,7.6),3))
   X0.20 round.dbinom.0.20..100..0.076...3. round.dpois.0.20..7.6...3.
1      0                              0.000                       0.001
2      1                              0.003                       0.004
3      2                              0.012                       0.014
4      3                              0.033                       0.037
5      4                              0.066                       0.070
6      5                              0.105                       0.106
7      6                              0.136                       0.134
8      7                              0.150                       0.145
9      8                              0.144                       0.138
10     9                              0.121                       0.117
11    10                              0.091                       0.089
12    11                              0.061                       0.061
13    12                              0.037                       0.039
14    13                              0.021                       0.023
15    14                              0.011                       0.012
16    15                              0.005                       0.006
17    16                              0.002                       0.003
18    17                              0.001                       0.001
19    18                              0.000                       0.001
20    19                              0.000                       0.000
21    20                              0.000                       0.000
>
```

Problem 3(Normal distribution):

1000 students had written an examination, the mean of test is 35 and standard deviation is 5. Assuming the test marks are normally distributed, find:

i) How many students Marks Lie between 25 and 40?

ii) How many students get more than 40?

iii) How many students get below 20?

iv) How many students get 50?

R code:

```
> 1000*(pnorm(40,mean=35,sd=5)-pnorm(25,mean=35,sd=5))
[1] 818.5946
> #818 students got marks between 40 and 35
> 1000*(1-pnorm(40,mean=35,sd=5))
[1] 158.6553
> #158 students got marks above 40
> 1000*pnorm(20,mean=35,sd=5)
[1] 1.349898
> #1 student got marks below 20
> 1000*dnorm(50,mean=35,sd=5)
[1] 0.8863697
> #No student got 50 marks
>
```