27/02/2024

Twenty students graduates and undergraduates were enrolled in a statistics course.Their ages were 18,19,19,19,19,20,20,20,20,20,21,21,21,21,21,22,23,24,27,30,36

Q1)Find mean age,median age,modal age and standard deviation of all students.

```
> a<-scan()
1: 18 19 19 19 19 20 20 20 20 20 21 21 21 21 22 23 24 27 30 36
21:
Read 20 items
```

#MEAN

```
> mean(a)
[1] 22
```

#MEDIAN

```
> median(a)
[1] 20.5
```

#MODE

```
> at<-table(a)
> at
a
18 19 20 21 22 23 24 27 30 36
 1  4  5  4  1  1  1  1  1  1

> mode<-which(at==max(at))
> mode
20
```

```
 3
#3 is the position
```

#STANDARD DEVIATION

```
> sd(a)
[1] 4.388981
```

Q2)Find median age of all students under 25 years.

```
> b<-a[a<25]
> b
 [1] 18 19 19 19 19 20 20 20 20 20 21 21 21 21 22 23 24
> median(b)
[1] 20
```

Q3)Two more students enter the class.age of both the students is 19.What is mean,median and mode?

```
> new_age<-c(19,19)
> a<-c(a,new_age)
> a
 [1] 18 19 19 19 19 20 20 20 20 20 21 21 21 21 22 23 24 27 30 36 19 19

> mean(a)
[1] 21.72727

> median(a)
[1] 20

> xt<-table(a)
> xt
a
18 19 20 21 22 23 24 27 30 36
```

```
 1  6  5  4  1  1  1  1  1  1

> mode<-which(xt==max(xt))
> mode
19
 2
```

Find mean,median,mode and standard deviation of the following frequency distribution.

X	f
0	8
1	11
2	5
3	1

```
> x<-c(0,1,2,3)
> f<-c(8,11,5,1)
> y<-rep(x,f)
> y
 [1] 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 3
> #0 is repeated 8 times,1 is repeated 11 times and so on.
```

#MEAN

```
> mean(y)
[1] 0.96
```

#MEDIAN

```
> median(y)
[1] 1
```

#MODE

```
> yt<-table(y)
> yt
y
 0  1  2  3
 8 11  5  1
> mode<-which(yt==max(yt))
> mode
1
2
```

#STANDARD DEVIATION

```
> sd(y)
[1] 0.8406347
```

Find mean,median,mode and standard deviation of the following frequency distribution

Height in cm	No. of adult men
145-150	4
150-155	6
155-160	28
160-165	58
165-170	64
170-175	30
175-180	5
180-185	5

```
> upper <- c(150,155,160,165,170,175,180,185)
> lower <- c(145,150,155,160,165,170,175,180)
> x<-(upper+lower)/2
> x
[1] 147.5 152.5 157.5 162.5 167.5 172.5 177.5 182.5
#OR
> #midx <- seq(147.5,182.5)


> f <- c(4,6,28,58,64,30,5,5)
> f
[1]  4  6 28 58 64 30  5  5
```

```
> data.frame(x,f)
      x  f
1 147.5  4
2 152.5  6
3 157.5 28
4 162.5 58
5 167.5 64
6 172.5 30
7 177.5  5
8 182.5  5
#n is the sum of frequency
> n <- sum(f)
> n
[1] 200

> mean<-sum(x*f)/n
> mean
[1] 165.175

> c1<-cumsum(f)
> c1
[1]   4  10  38  96 160 190 195 200

> data.frame(x,f,c1)
      x  f  c1
1 147.5  4   4
2 152.5  6  10
3 157.5 28  38
4 162.5 58  96
5 167.5 64 160
6 172.5 30 190
7 177.5  5 195
```

```
8 182.5    5    200

> mc<-min(which(c1>=n/2))
> mc
[1] 5
> #5th row is the median class

> #to find the lower limit of median class
> h<-5
> l<-x[mc]-h/2
> l
[1] 165

> c<-c1[mc-1]
> c
[1] 96

> f1<-f[mc]
> f1
[1] 64
> #f1 is the frequency of the median class

> median <- l+((n/2-c)/f1)*h
> median
[1] 165.3125

> #To find modal class
> modc<-which(f==max(f))
> modc
[1] 5

> ld<-x[modc]-h/2
> ld
```

```
[1] 165
> fm<-f[modc]
> fm
[1] 64
> f1<-f[modc-1]
> f1
[1] 58
> f2<-f[modc+1]
> f2
[1] 30
> mod<-ld+((fm-f1)/(2*fm-f1-f2))*h
> mod
[1] 165.75
```

Q:2.1

- A committee of university teachers consists of 3 professors,5 readers and 2 lecturers.A subcommittee of 6 is selected.What is the probability that the subcommittee is composed of 2 professors,3 readers and one lecturer?

10C6
3C2 x 5C3 x 2C1

```
> pr<-choose(3,2)*choose(5,3)*choose(2,1)/choose(10,6)
> pr
[1] 0.2857143
```


```
> pr<-choose(3,2)*choose(5,3)*choose(2,1)/choose(10,6)
> pr
[1] 0.2857143
>
```

- A box contains 4 red and 5 white flowers.A random sample of 6 flowers is drawn without replacement from the box.Find the probability that the sample contains 3 red flowers.

  9C6
  4C3 x 5C3

```
> pr<-choose(4,3)*choose(5,3)/choose(9,6)
> pr
[1] 0.4761905
```

```
> pr<-choose(4,3)*choose(5,3)/choose(9,6)
> pr
[1] 0.4761905
>
```

- Obtain probability distribution of X, where X is the number of spots showing when a six-sided symmetric die is rolled. Simulate random samples of sizes 100,200 and 500 respectively and verify the frequency interpretation of probability.

```
> x1<-sample(1:6,100,replace=T)
> x1
  [1] 6 1 1 2 5 4 5 2 1 6 3 3 2 6 6 6 5 4 6 2 3 2 1 1 5 1 1 1 5 3 1 3 6 4 3 1 4
 [38] 3 6 4 6 6 5 4 1 5 6 5 3 5 4 5 3 3 5 5 3 1 3 1 6 5 4 2 3 2 4 3 4 2 3 2 4 2
 [75] 1 1 1 6 2 2 2 1 1 5 1 5 6 5 2 2 1 6 1 2 3 4 4 6 6 4

> n<-100
>  xt1<-table(x1)
> xt1

x1
 1  2  3  4  5  6 
21 16 16 14 16 17 

> rxt1<-xt1/n
> rxt1

x1
   1    2    3    4    5    6 
```

```
0.21 0.16 0.16 0.14 0.16 0.17

> x1<-sample(1:6,500,replace=T)
> x1

  [1] 4 3 6 5 3 4 1 6 3 5 6 1 2 2 6 2 1 4 3 6 4 1 4 2 3 1 5 5 1 3 2 4 1 4 4 3 6
 [38] 2 6 3 2 3 6 4 4 5 2 2 6 5 1 5 2 1 2 3 6 2 6 6 2 1 3 5 2 4 4 5 1 2 1 6 5 5
 [75] 3 1 1 3 5 6 5 1 5 3 2 2 2 4 3 1 6 2 1 4 1 6 2 4 1 2 4 2 3 6 2 3 6 3 5 1 6
[112] 5 2 4 4 5 1 2 4 2 4 5 2 1 6 3 6 1 3 2 1 3 6 2 3 3 3 1 4 3 4 6 5 4 2 1 5 1
[149] 2 3 2 2 2 4 6 1 6 5 4 4 2 3 4 3 4 1 2 6 6 4 6 5 4 4 3 3 3 2 1 1 1 2 1 1 6
[186] 4 6 6 6 6 2 5 2 5 1 5 3 5 4 2 2 5 1 3 4 1 1 6 2 1 5 3 4 1 1 4 3 5 2 4 5 6
[223] 3 1 1 4 2 6 4 3 1 5 1 3 4 6 4 5 3 4 1 4 4 3 5 1 2 4 3 6 6 3 2 2 3 4 4 1 4
[260] 2 3 4 4 3 2 5 3 5 4 6 2 5 3 4 4 1 3 4 6 6 3 3 1 3 3 3 5 1 4 4 2 6 4 6 2 1
[297] 6 2 3 2 5 2 2 4 1 4 2 5 1 2 1 5 2 2 6 6 5 4 5 1 4 1 5 4 5 5 5 4 3 6 3 3 5
[334] 1 3 3 2 3 6 1 1 3 6 6 5 6 2 1 2 1 2 4 1 2 6 4 4 5 2 1 3 6 6 6 6 5 4 2 5 3
[371] 4 6 1 4 2 6 5 1 6 6 4 1 5 3 2 4 2 5 6 1 4 2 3 5 3 3 3 2 5 2 3 1 3 5 4 1 4
[408] 5 3 3 1 5 1 6 1 2 5 1 4 4 2 6 3 5 5 3 3 5 3 4 6 3 3 1 6 3 2 4 1 1 1 5 6 3
[445] 5 4 1 6 6 3 3 4 6 2 1 5 5 6 5 1 1 4 6 2 2 5 3 5 5 6 3 6 1 4 5 2 5 1 3 6 1
[482] 4 5 6 3 2 5 2 4 3 3 1 1 4 6 1 2 3 2 6
> n<-500
> xt1<-table(x1)
> xt1

x1
 1  2  3  4  5  6
88 85 89 85 75 78

> rxt1<-xt1/n
> rxt1

x1
    1     2     3     4     5     6
0.176 0.170 0.178 0.170 0.150 0.156
```

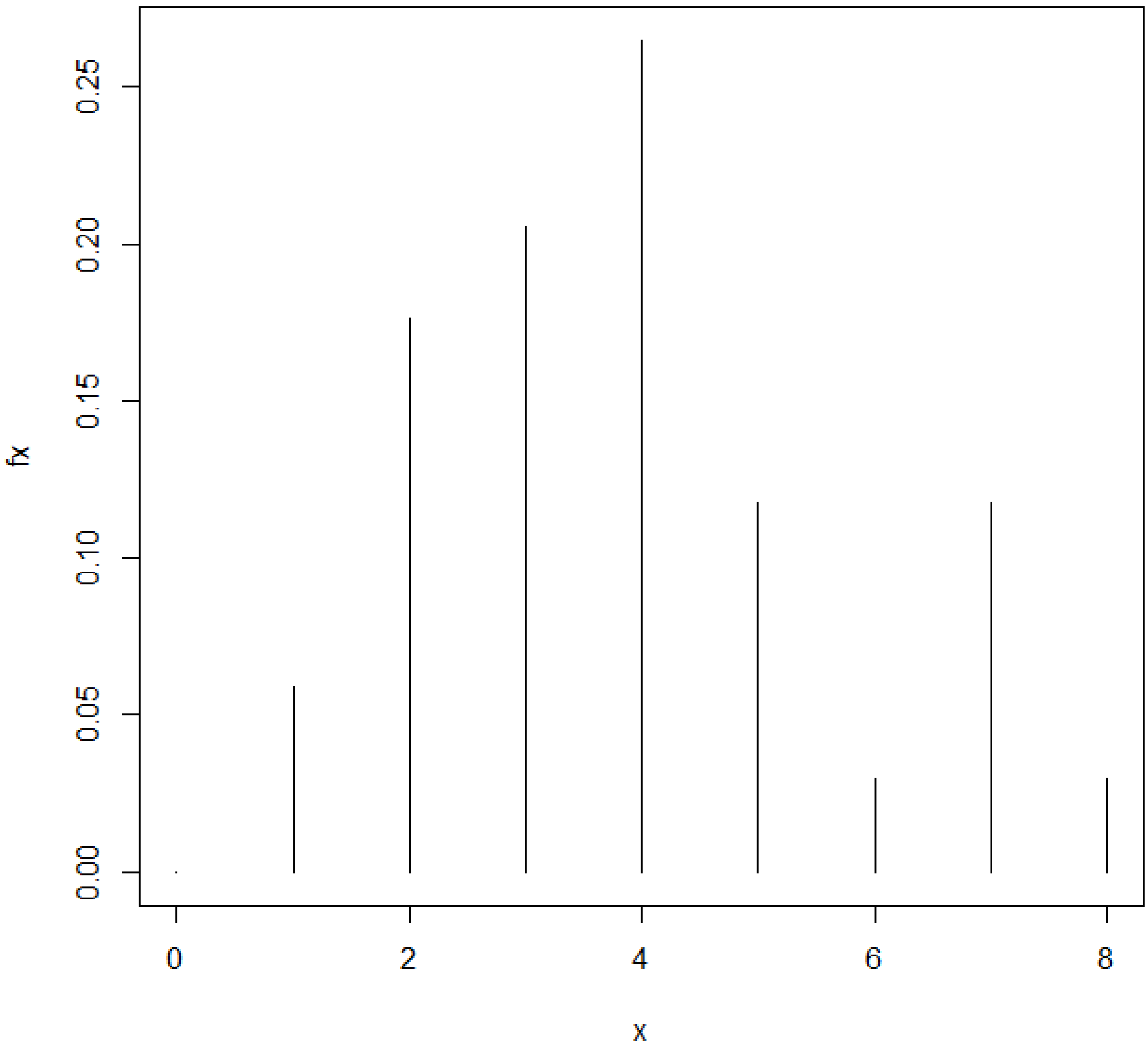
```
> xl<-sample(1:6,100,replace=T)
> xl
  [1] 6 1 1 2 5 4 5 2 1 6 3 3 2 6 6 6 5 4 6 2 3 2 1 1 5 1 1 1 5 3 1 3 6 4 3 1 4
 [38] 3 6 4 6 6 5 4 1 5 6 5 3 5 4 5 3 3 5 5 3 1 3 1 6 5 4 2 3 2 4 3 4 2 3 2 4 2
 [75] 1 1 1 6 2 2 2 1 1 5 1 5 6 5 2 2 1 6 1 2 3 4 4 6 6 4
> n<-100
>  xtl<-table(xl)
> xtl
xl
 1  2  3  4  5  6
21 16 16 14 16 17
> rxtl<-xtl/n
> rxtl
xl
   1    2    3    4    5    6
0.21 0.16 0.16 0.14 0.16 0.17
> xl<-sample(1:6,500,replace=T)
> xl
  [1] 4 3 6 5 3 4 1 6 3 5 6 1 2 2 6 2 1 4 3 6 4 1 4 2 3 1 5 5 1 3 2 4 1 4 4 3 6
 [38] 2 6 3 2 3 6 4 4 5 2 2 6 5 1 5 2 1 2 3 6 2 6 6 2 1 3 5 2 4 4 5 1 2 1 6 5 5
 [75] 3 1 1 3 5 6 5 1 5 3 2 2 2 4 3 1 6 2 1 4 1 6 2 4 1 2 4 2 3 6 2 3 6 3 5 1 6
[112] 5 2 4 4 5 1 2 4 2 4 5 2 1 6 3 6 1 3 2 1 3 6 2 3 3 3 1 4 3 4 6 5 4 2 1 5 1
[149] 2 3 2 2 2 4 6 1 6 5 4 4 2 3 4 3 4 1 2 6 6 4 6 5 4 4 3 3 3 2 1 1 1 2 1 1 6
[186] 4 6 6 6 6 2 5 2 5 1 5 3 5 4 2 2 5 1 3 4 1 1 6 2 1 5 3 4 1 1 4 3 5 2 4 5 6
[223] 3 1 1 4 2 6 4 3 1 5 1 3 4 6 4 5 3 4 1 4 4 3 5 1 2 4 3 6 6 3 2 2 3 4 4 1 4
[260] 2 3 4 4 3 2 5 3 5 4 6 2 5 3 4 4 1 3 4 6 6 3 3 1 3 3 3 5 1 4 4 2 6 4 6 2 1
[297] 6 2 3 2 5 2 2 4 1 4 2 5 1 2 1 5 2 2 6 6 5 4 5 1 4 1 5 4 5 5 5 4 3 6 3 3 5
[334] 1 3 3 2 3 6 1 1 3 6 6 5 6 2 1 2 1 2 4 1 2 6 4 4 5 2 1 3 6 6 6 6 5 4 2 5 3
[371] 4 6 1 4 2 6 5 1 6 6 4 1 5 3 2 4 2 5 6 1 4 2 3 5 3 3 3 2 5 2 3 1 3 5 4 1 4
[408] 5 3 3 1 5 1 6 1 2 5 1 4 4 2 6 3 5 5 3 3 5 3 4 6 3 3 1 6 3 2 4 1 1 1 5 6 3
[445] 5 4 1 6 6 3 3 4 6 2 1 5 5 6 5 1 1 4 6 2 2 5 3 5 5 6 3 6 1 4 5 2 5 1 3 6 1
[482] 4 5 6 3 2 5 2 4 3 3 1 1 4 6 1 2 3 2 6
> n<-500
> xtl<-table(xl)
> xtl
xl
 1  2  3  4  5  6
88 85 89 85 75 78
> rxtl<-xtl/n
> rxtl
xl
    1     2     3     4     5     6
0.176 0.170 0.178 0.170 0.150 0.156
> 
```

Q:2.3

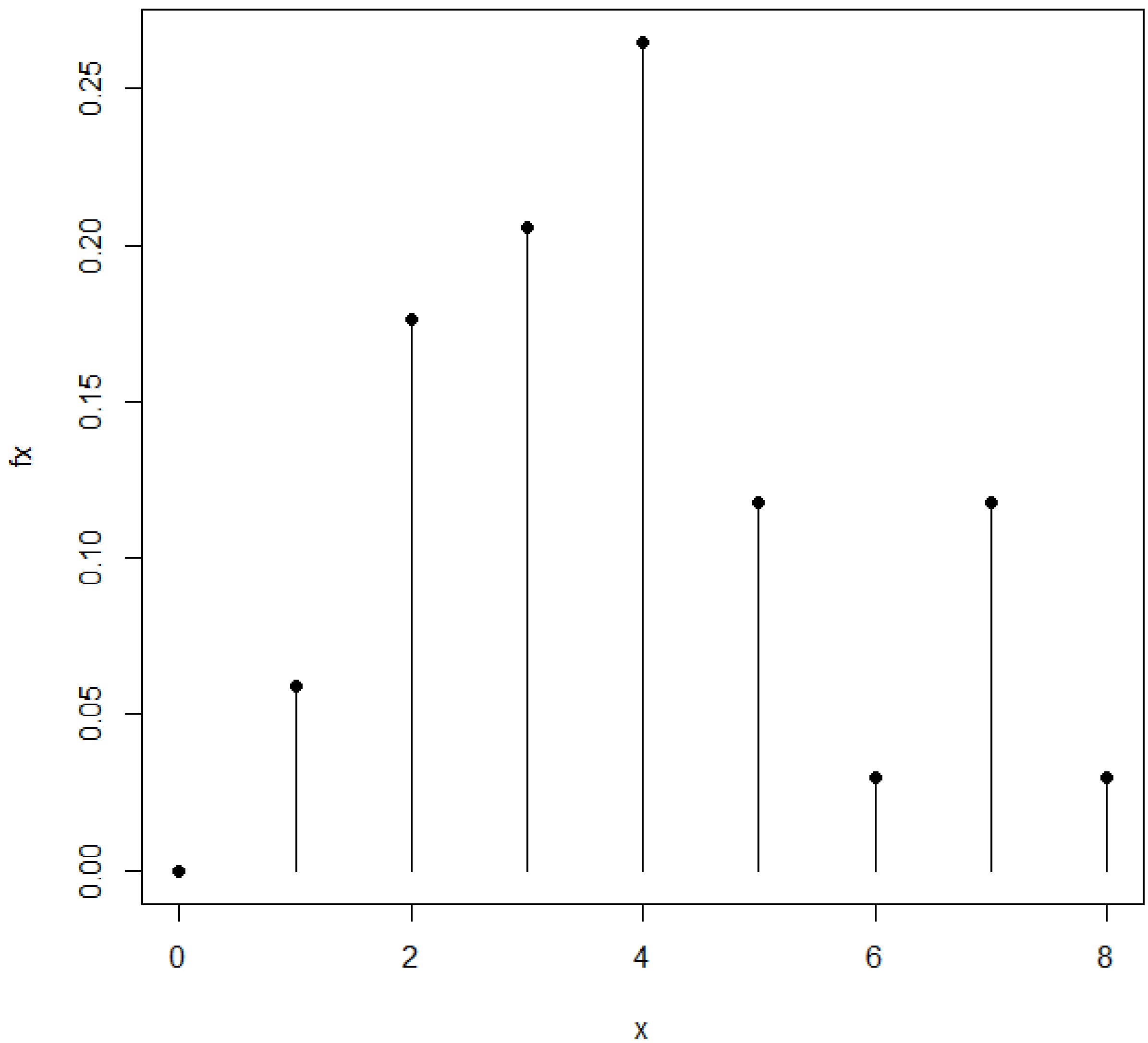
- Following table shows the number of floods recorded per year at a gauging station in some country. Represent it by a rod or spike plot.
- Obtain F(x) and plot F(x) versus x.

X=x	0	1	2	3	4	5	6	7	8
f(x)	0	2/34	6/34	7/34	9/34	4/34	1/34	4/34	1/34

```
> x<-c(0:8)

> x

[1] 0 1 2 3 4 5 6 7 8

> fx<-c(0,2/34,6/34,7/34,9/34,4/34,1/34,4/34,1/34)

> fx

[1] 0.00000000 0.05882353 0.17647059 0.20588235 0.26470588
 0.11764706 0.02941176

[8] 0.11764706 0.02941176

> plot(x,fx,type="h")
```

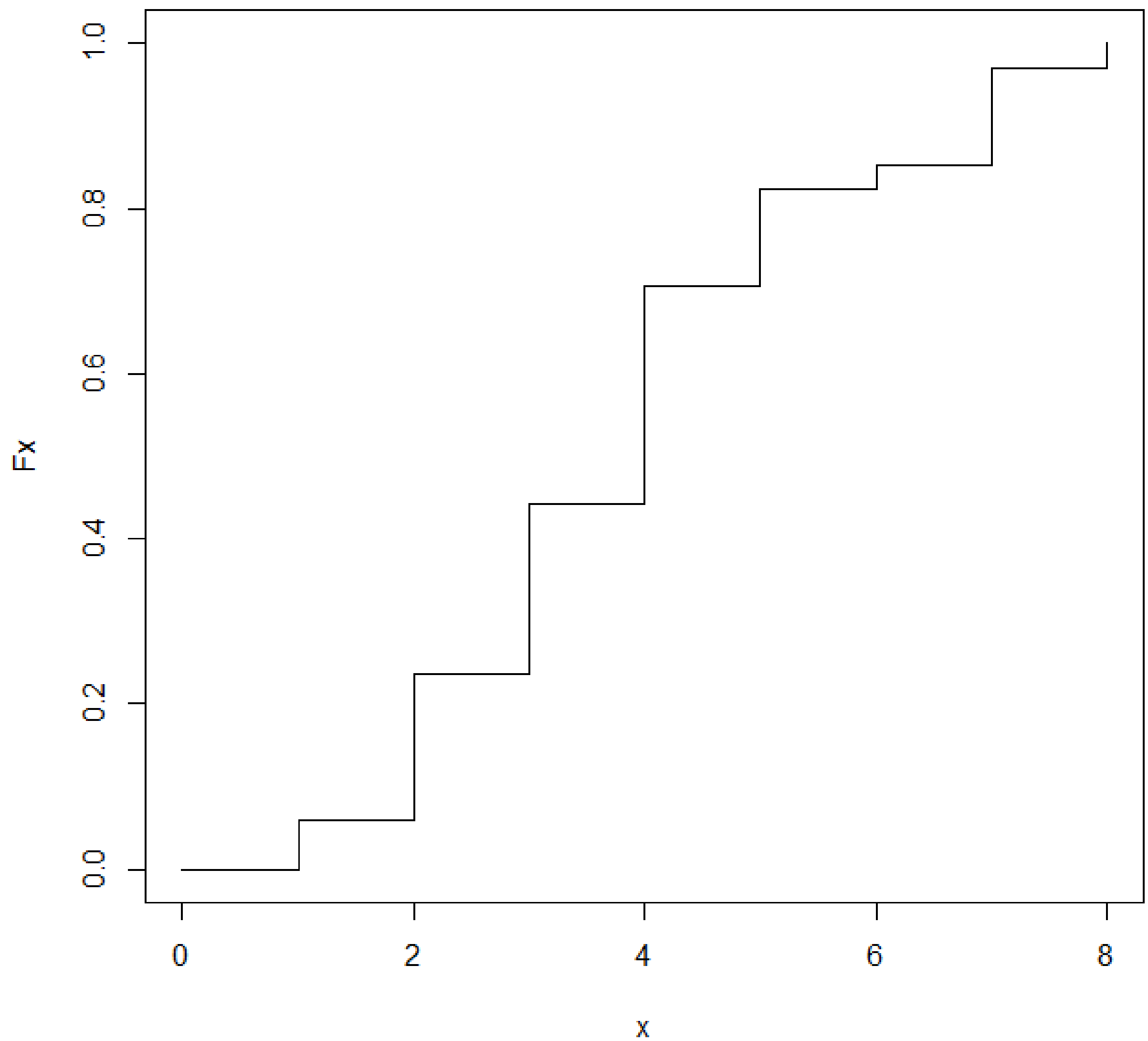


> points(x,fx,pch=16)

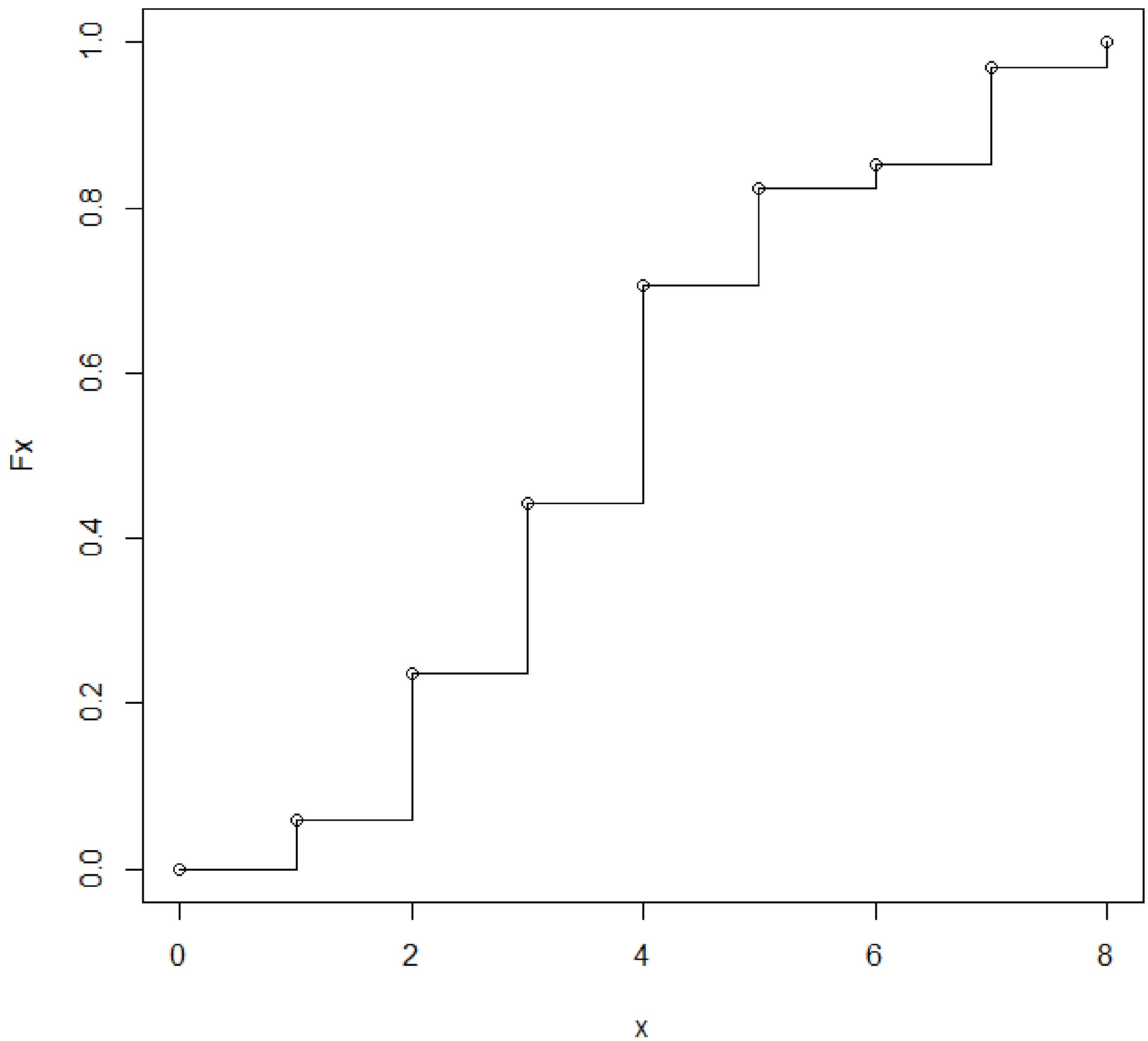



```
> Fx<-cumsum(fx)
> cdf<-data.frame(x,Fx)
> cdf
  x         Fx
1 0 0.00000000
2 1 0.05882353
3 2 0.23529412
```

```
4 3 0.44117647
5 4 0.70588235
6 5 0.82352941
7 6 0.85294118
8 7 0.97058824
9 8 1.00000000
> plot(x,Fx,type="s")
```




```
> points(x,Fx)
```



Fx
0.0
0.2
0.4
0.6
0.8
1.0
0
2
4
6
8
x

```
> x<-c(0:8)
> x
[1] 0 1 2 3 4 5 6 7 8
> fx<-c(0,2/34,6/34,7/34,9/34,4/34,1/34,4/34,1/34)
> fx
[1] 0.00000000 0.05882353 0.17647059 0.20588235 0.26470588 0.11764706 0.02941176
[8] 0.11764706 0.02941176
> plot(x,fx,type="h")
> points(x,fx,pch=16)
> Fx<-cumsum(fx)
> cdf<-data.frame(x,Fx)
> cdf
  x         Fx
1 0 0.00000000
2 1 0.05882353
3 2 0.23529412
4 3 0.44117647
5 4 0.70588235
6 5 0.82352941
7 6 0.85294118
8 7 0.97058824
9 8 1.00000000
> plot(x,Fx,type="s")
> points(x,Fx)
> 
```

Q:2.5

- As part of a pollution survey, an investigator decides to inspect the exhaust of 8 trucks out of a company's 16 trucks. He suspects that 5 of the trucks emit excessive amounts of pollutants. What is the probability that, if his suspicion is correct, his sample will catch at least 3 of these 5 trucks?

```
> N<-16
> n<-8
> k<-5
> x<-3
> F3<-(choose(k,x)*choose(N-k,n-x))/choose(N,n)
> F3
[1] 0.3589744
> x<-4
```

> F4<-(choose(k,x)*choose(N-k,n-x))/choose(N,n)

> F4

[1] 0.1282051

> x<-5

> F5<-(choose(k,x)*choose(N-k,n-x))/choose(N,n)

> F5

[1] 0.01282051

> Pro<-F3+F4+F5

> Pro

[1] 0.5

```
> N<-16
> n<-8
> k<-5
> x<-3
> F3<-(choose(k,x)*choose(N-k,n-x))/choose(N,n)
> F3
[1] 0.3589744
> x<-4
> F4<-(choose(k,x)*choose(N-k,n-x))/choose(N,n)
> F4
[1] 0.1282051
> x<-5
> F5<-(choose(k,x)*choose(N-k,n-x))/choose(N,n)
> F5
[1] 0.01282051
> Pro<-F3+F4+F5
> Pro
[1] 0.5
>
```

- A coin is tossed 5 times.What is the probability of getting one head,2 heads and 3 heads?

n=5,p=0.5

P(X=1)=5C1(0.5)(0.5)^4=0.15

Probability at a point = dbinom(x,size,prob)

> n<-5

> p<-0.5

> dbinom(x=0,size=5,prob=0.5)

[1] 0.03125

> dbinom(x=1,size=5,prob=0.5)

[1] 0.15625

> dbinom(1,5,0.5)

[1] 0.15625

> dbinom(2,5,0.5)

[1] 0.3125

> dbinom(3,5,0.5)

[1] 0.3125


```
> n<-5
> p<-0.5
> dbinom(x=0,size=5,prob=0.5)
[1] 0.03125
> dbinom(x=1,size=5,prob=0.5)
[1] 0.15625
> dbinom(1,5,0.5)
[1] 0.15625
> dbinom(2,5,0.5)
[1] 0.3125
> dbinom(3,5,0.5)
[1] 0.3125
>
```

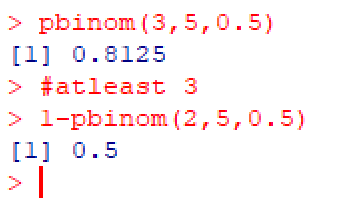

Cumulative probability = pbinom(x,size,prob)

> pbinom(3,5,0.5)

[1] 0.8125

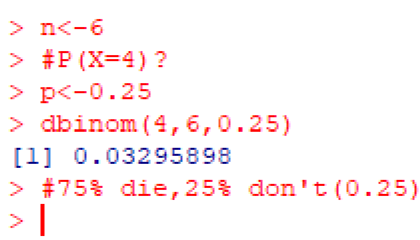
> #atleast 3

```
> 1-pbinom(2,5,0.5)
[1] 0.5
```



- Hospital records show that of patients suffering from a certain disease,75% die of it.What is the probability that of 6 randomly selected patients, 4 will recover?

```
> n<-6
> #P(X=4)?
> p<-0.25
> dbinom(4,6,0.25)
[1] 0.03295898
> #75% die,25% don't(0.25)
```



- Find the probability of getting 26 or less heads from 51 tosses of a coin.

```
> pbinom(26,51,0.5)
[1] 0.610116
```

```
> pbinom(26,51,0.5)
[1] 0.610116
>
```

- How many heads will have a probability of 0.25 will come out when a coin is tossed 51 times ?

qbinom→ reverse case

> qbinom(p=0.25,51,0.5)

[1] 23

```
> qbinom(p=0.25,51,0.5)
[1] 23
>
```

Q:2.7

- According to the Mendelian theory of inheritance, a cross fertilization of related species of red and white flowered plants produces offspring of which 25% are red flowered plants. Suppose that a horticulturist wishes to cross 5 pairs of red and white flowered plants. Of the 5 offspring, what is the probability that (i) there will be no red flowered plants? (ii) there will be 4 or more red flowered plants?

  - P=0.25,n=5
  - (i) P(0)
  - (ii) P(x>=4)

> P<-0.25
> n<-5

(i)

> dbinom(0,n,P)
[1] 0.2373047

(ii)

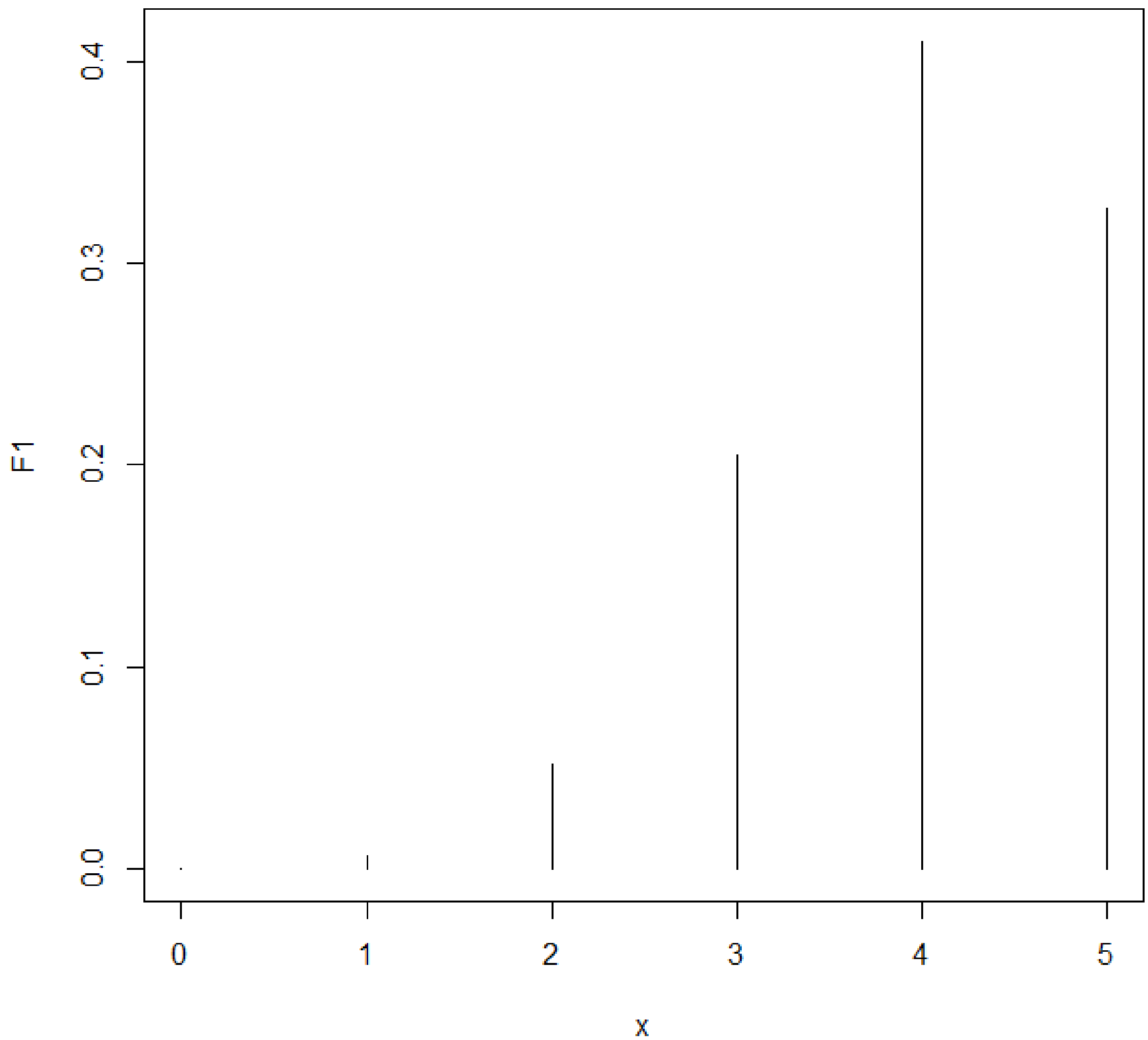
> 1-pbinom(3,n,P)

[1] 0.015625

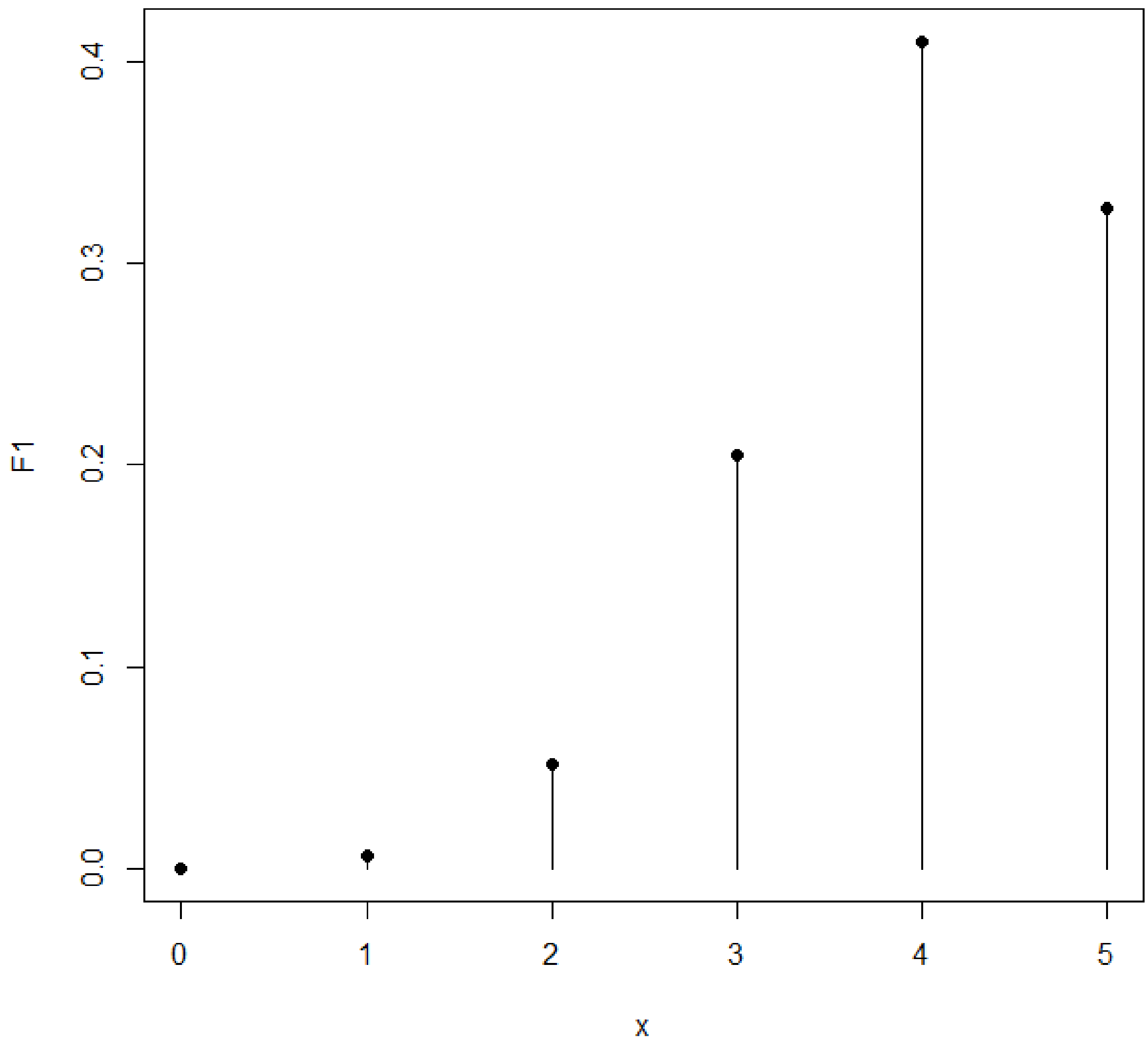
Q:2.8

- Consider 3 binomial with n=5 and p=0.8,0.5 and 0.2. Plot the spike plots to represent the pmfs of the three distributions. Draw sample of size 100 from each of the three distributions and plot spike plots for the relative frequency distributions.

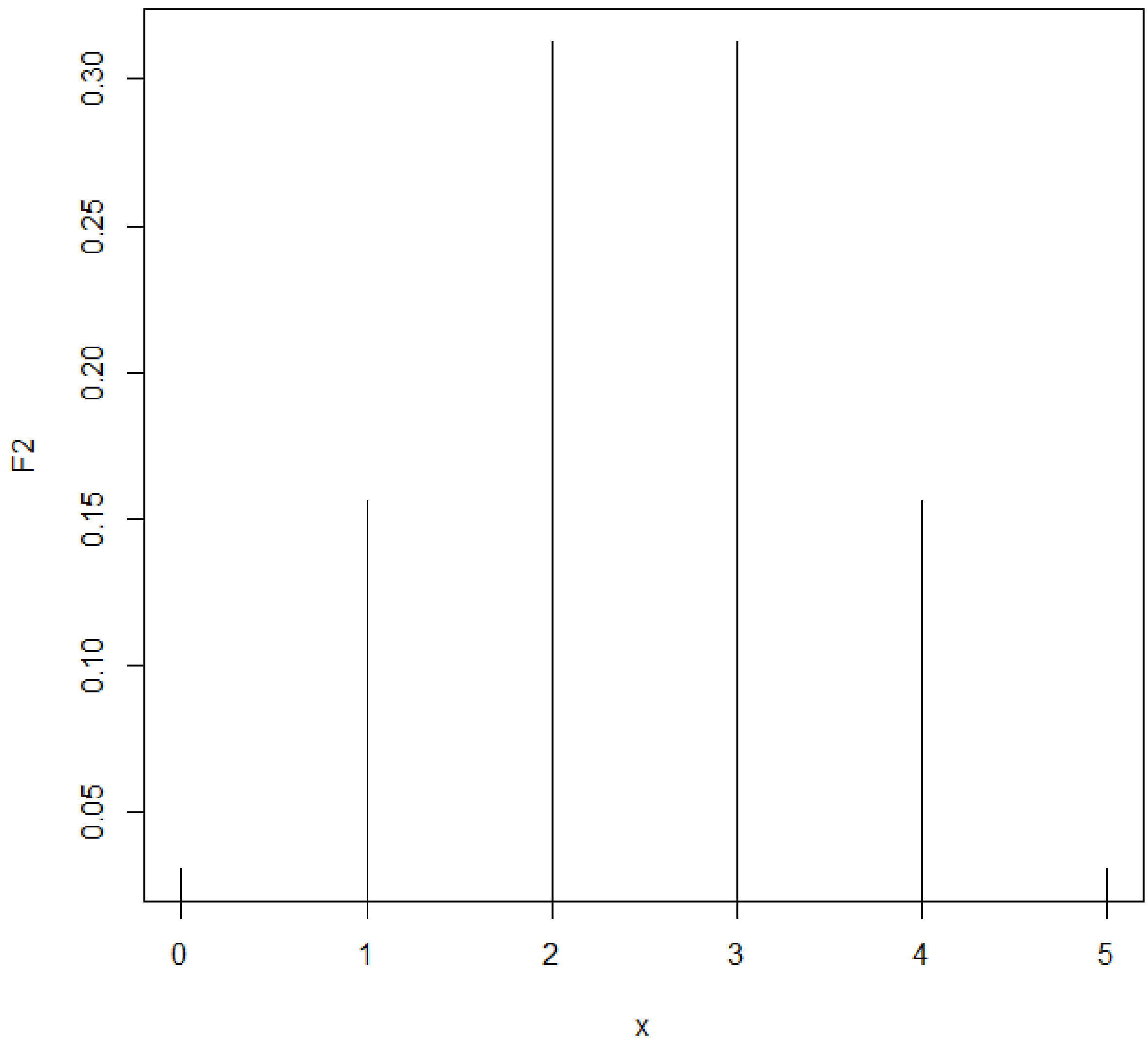
```
> x<-0:5
> F1<-dbinom(x,5,0.8)
>
> x<-0:5
> F1<-dbinom(x,5,0.8)
> F2<-dbinom(x,5,0.5)
> F3<-dbinom(x,5,0.2)
> plot(x,F1,"h")
```



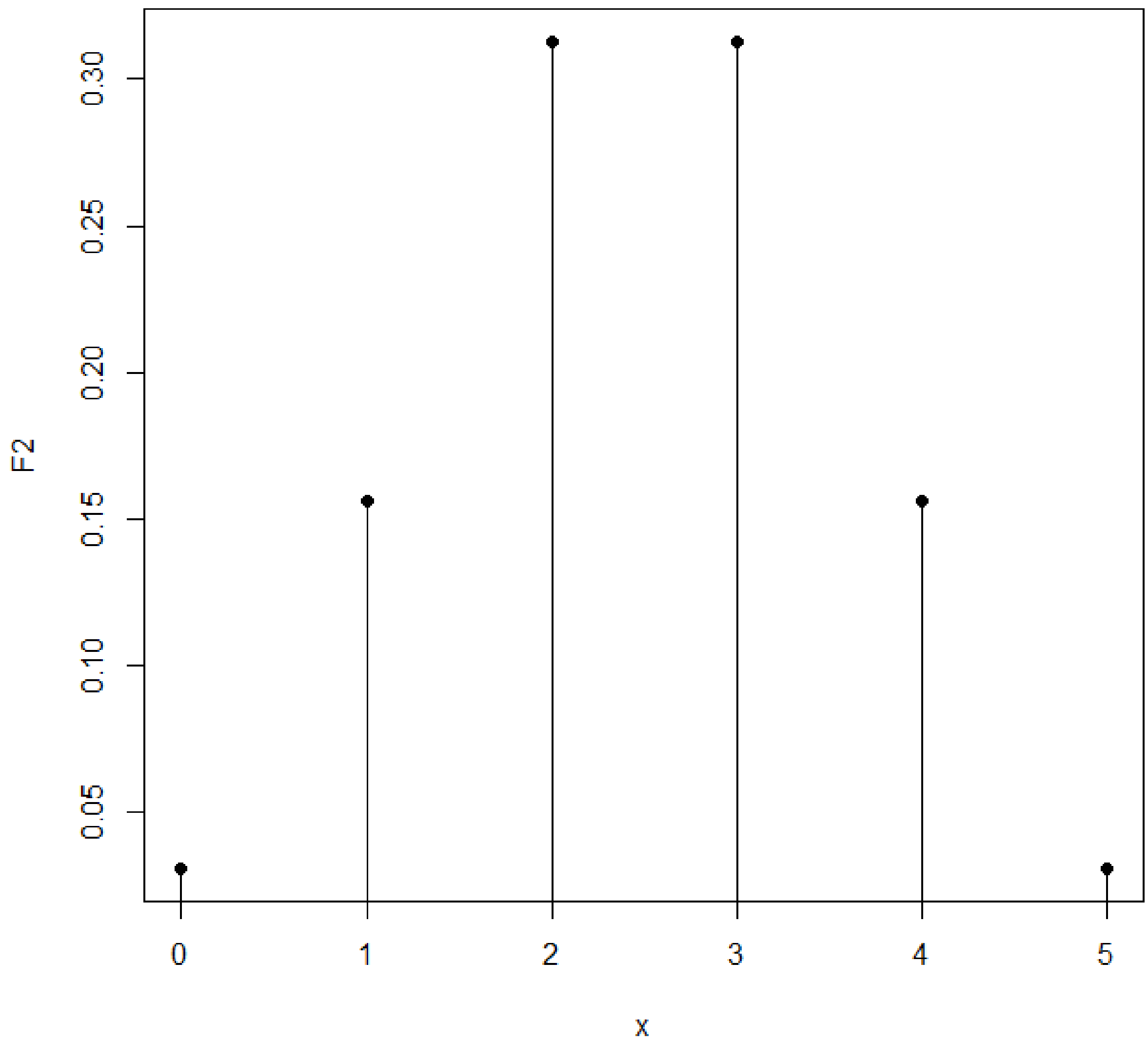
> points(x,F1,pch=16)



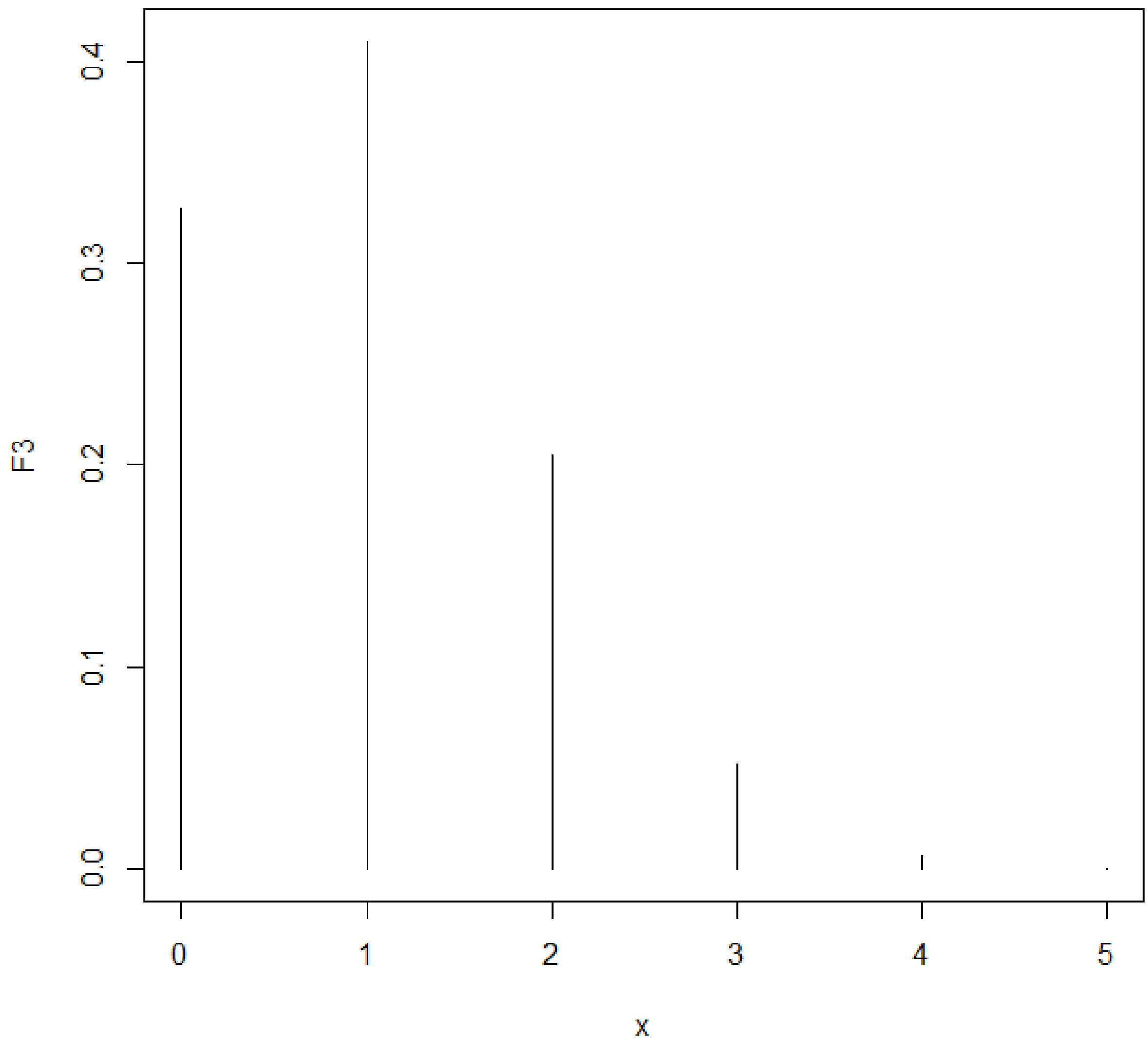
> plot(x,F2,"h")



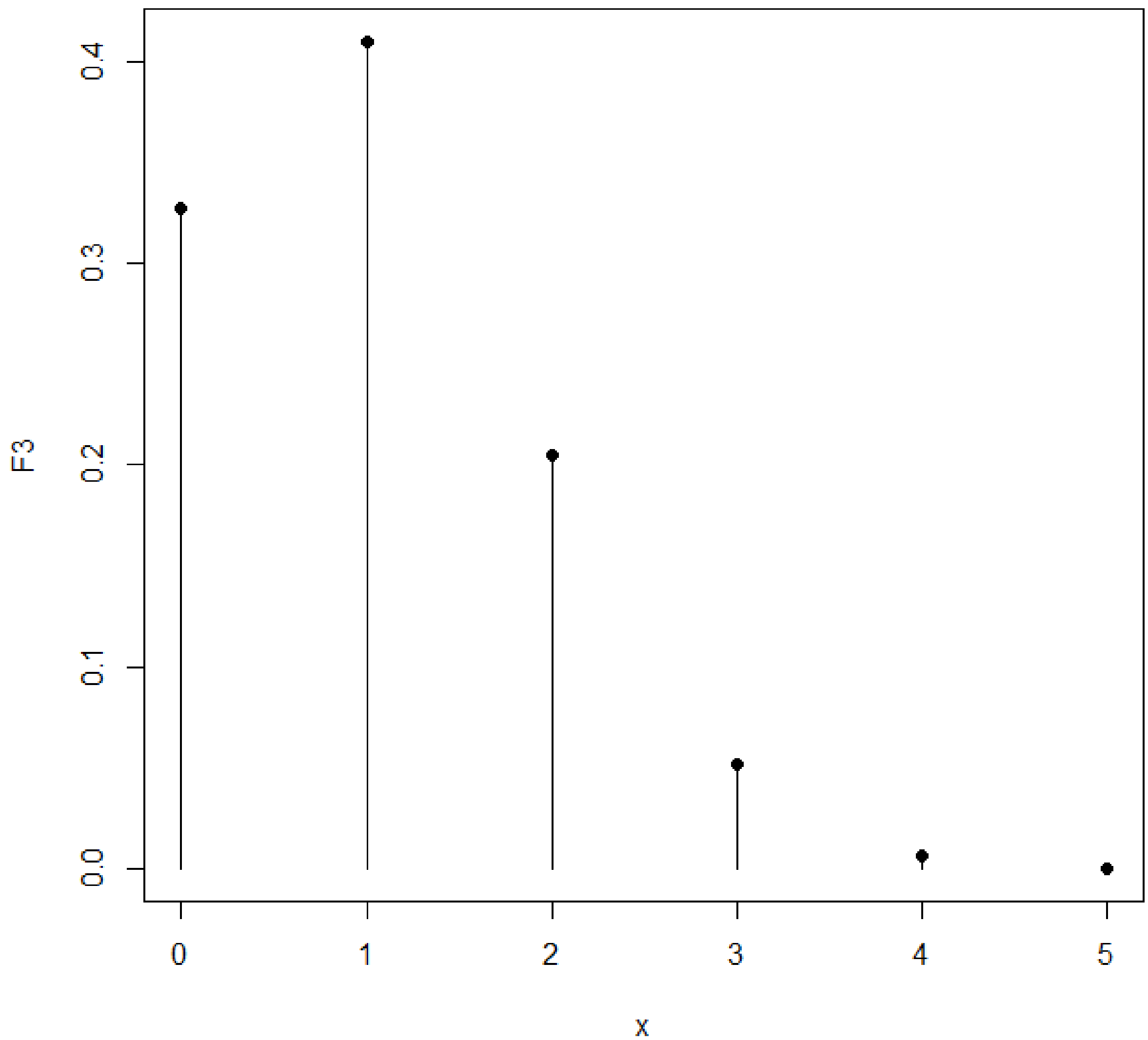

```
> points(x,F2,pch=16)
```




```
> plot(x,F3,"h")
```



> points(x,F3,pch=16)


0.0
0.1
0.2
0.3
0.4
F3
0
1
2
3
4
5
x

```
> x<-0:5
> F1<-dbinom(x,5,0.8)
>
> x<-0:5
> F1<-dbinom(x,5,0.8)
> F2<-dbinom(x,5,0.5)
> F3<-dbinom(x,5,0.2)
> plot(x,F1,"h")
> points(x,F1,pch=16)
> plot(x,F2,"h")
> points(x,F2,pch=16)
> plot(x,F3,"h")
>
> points(x,F3,pch=16)
>
```

Qn) Draw a random sample of size 20 from N(5,2) distribution.Find mean,median and sd of sample.

Suppose X follows a standard normal distribution.Determine the following probabilities.
(i) P(X<=2) (ii) P(0.84<=2.5) (iii) P(X>=2)
=P(X<2.5)-P(X<0.84)
=pnorm(2.5)-pnorm(0.84)

(i)
> pnorm(2)
[1] 0.9772499

(ii)> pnorm(2.5)-pnorm(0.84)
[1] 0.1942445

(iii)> 1-pnorm(2)
[1] 0.02275013

Qn) Suppose X follows normal distribution with mean 30 and SD 4.Find
(i) P(X<30) (ii) P(30<X<35) (iii) P(X<40)

(i)
> #mean=30 and SD=4
> #P(X<30)
> pnorm(30,30,4)
[1] 0.5

(ii)
```
> #pnorm(x,mean,sd)
> #P(30<x<35)
> pnorm(35,30,4)-pnorm(30,30,4)
[1] 0.3943502
```

(iii)
```
> #P(X>40)
> 1-pnorm(40,30,4)
[1] 0.006209665
```

Qn) Suppose Z is a standard normal variable.In each of the following cases, find c such that
(i) P(Z<=c) = 0.1151 => c=qnorm(0.1151)
(ii) P(1<=Z<=c) = 0.1525 => P(Z<c) - P(Z<1) = 0.1525
=> P(Z<c) = 0.1524 + P(Z<1)
=> P(Z<c) = 0.1524 + pnorm(1)
=> c=qnorm(0.1525 + pnorm(1))
(iii) P(-c<=Z<=c) = 0.8164

(i)
```
> #P(Z<c) = 0.1151
> c=qnorm(0.1151)
> c
[1] -1.199844
```

(ii)
```
> c=qnorm(0.1525 + pnorm(1))
> c
[1] 2.503116
```

(iii)
```
> #P(Z<c)-P(Z<-c)=0.8164
> #P(Z<-c) = 1-P(Z<c)
> #P(Z<c) - (1-P(Z<c))=0.8164
> #2P(Z<c) = 0.8164+1
> #P(Z<c) = (0.8164+1)/2
> c<-qnorm((1+.8164)*1/2)
> c
[1] 1.329752
```

Q) A large survey conducted in a city revealed that 30% of adult males were found to be smokers.What is the probability that in a random sample of 1000 adults from the same city,there will be
(i) more than 315 smokers? =>1-pnorm(315,300,14.5)
(ii) less than 280 smokers? =>pnorm(280,300,14.5)

n=1000 p=0.3
mean=np=1000x0.3 = 300
var=npq=1000x0.3x0.7 = 14.5
sd = 14.5

Q)A random blood sample for test of fasting sugar for 10 boys gave the following data in mg/dl 70,120,110,101,88,83,95,107,100,98.Does this support the assumption of population of 100 mg/dl? Find a reasonable range in which most of the mean fasting sugar test of the 10 boys lie.

- Testing
- Null hypothesis is H0: μ=100
- Alternate hypothesis Ha: $\mu \neq 100$
- Mean,variance

```
> x<-c(70,120,110,101,88,83,95,107,100,98)
> t.test(x,mu=100)

        One Sample t-test

data:  x
t = -0.62034, df = 9, p-value = 0.5504
alternative hypothesis: true mean is not equal to 100
95 percent confidence interval:
  86.98934 107.41066
sample estimates:
mean of x
    97.2
> #reject H0 if p-value is less than or equal to 0.5
```

Q)Consider the following observations on glycerol concentration for samples of standard quality white wines : 2.67,4.62,4.14,3.81,3.83.Suppose the desired concentration value

```
> x<-c(2.67,4.62,4.14,3.81,3.83)
> t.test(x,mu=4)

        One Sample t-test

data:  x
t = -0.57886, df = 4, p-value = 0.5937
alternative hypothesis: true mean is not equal to 4
95 percent confidence interval:
 2.921875 4.706125
sample estimates:
mean of x
    3.814

>#if mu is less than 4
> t.test(x,mu=4,alt="less")

        One Sample t-test

data:  x
t = -0.57886, df = 4, p-value = 0.2969
alternative hypothesis: true mean is less than 4
95 percent confidence interval:
     -Inf 4.499003
sample estimates:
mean of x
    3.814


>#if mu is greater than 4
> t.test(x,mu=4,alt="greater")

        One Sample t-test

data:  x
t = -0.57886, df = 4, p-value = 0.7031
alternative hypothesis: true mean is greater than 4
95 percent confidence interval:
 3.128997      Inf
sample estimates:
mean of x
    3.814
```

Q)Food legumes contain a substance called saponin which has been credited with lowering plasma cholesterol in animals. Twenty samples of high yielding variety of chick-peas were laboratory tested for saponin content. The observations are
3366,3337,3361,3410,3316,3357,3348,3356,3376,3382,3377,3355,3408,3401,3390,3424,3383,3374,3484,3390
Test the claim that true mean saponin is less than 3400

H0: μ=3400 (is rejected if p-value < 0.5)
H1: μ<3400

```
> x<-
c(3366,3337,3361,3410,3316,3357,3348,3356,3376,3382,3377,3355,3408,3
401,3390,3424,3383,3374,3484,3390)
> t.test(x,mu=3400,alt="less")

        One Sample t-test

data:  x
t = -2.5268, df = 19, p-value = 0.01027
alternative hypothesis: true mean is less than 3400
95 percent confidence interval:
     -Inf 3393.607
sample estimates:
mean of x
  3379.75
```