Probability and Statistics (UCS410)
Experiment 3: Probability distributions

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(1) Roll 12 dice simultaneously, and let X denotes the number of 6's that appear. Calcu- late the probability of getting 7, 8 or 9, 6's using R. (Try using the function **pbinom**; If we set $S = \{\text{get a 6 on one roll}\}$, $P(S) = 1/6$ and the rolls constitute Bernoulli tri-als; thus X ~ binom(size=12, prob=1/6) and we are looking for $P(7 \leq X \leq 9)$.

code:-

```
#Q1 Gomsi
a<-dbinom(7,12,prob = (1/6))
b<-dbinom(8,12,prob = (1/6))
c<-dbinom(9,12,prob = (1/6))
d<-a+b+c
d

sum=0
for (i in 7:9) {
  sum=sum+dbinom(i,12,prob = (1/6))
}
sum

f<-pbinom(9,size = 12,prob = (1/6))-pbinom(6,size = 12,prob = (1/6))

diff(pbinom(c(6,9),12,prob = (1/6)))

qbinom(0.9999992,12,prob = (1/6))
```

Input:-

```
#Q1 Gomsi
a<-dbinom(7,12,prob = (1/6))
b<-dbinom(8,12,prob = (1/6))
c<-dbinom(9,12,prob = (1/6))
d<-a+b+c
d

sum=0
for (i in 7:9) {
   sum=sum+dbinom(i,12,prob = (1/6))
}
sum

f<-pbinom(9,size = 12,prob = (1/6))-pbinom(6,size = 12,prob = (1/6))

diff(pbinom(c(6,9),12,prob = (1/6)))

qbinom(0.9999992,12,prob = (1/6))
```

```
> #Q1 Gomsi
> a<-dbinom(7,12,prob = (1/6))
> b<-dbinom(8,12,prob = (1/6))
> c<-dbinom(9,12,prob = (1/6))
> d<-a+b+c
> d
[1] 0.001291758
```

output

```
> sum=0
> for (i in 7:9) {
+    sum=sum+dbinom(i,12,prob = (1/6))
+ }
> sum
[1] 0.001291758
>
> f<-pbinom(9,size = 12,prob = (1/6))-pbinom(6,size = 12,prob = (1/6))
>
> diff(pbinom(c(6,9),12,prob = (1/6)))
[1] 0.001291758
>
> qbinom(0.9999992,12,prob = (1/6))
[1] 9
```

(2) Assume that the test scores of a college entrance exam fits a normal distribution. Furthermore, the mean test score is 72, and the standard deviation is 15.2. What is the percentage of students scoring 84 or more in the exam?

code:-

pnorm(84,72,15.2,lower.tail=FALSE)

diff(pnorm(c(81,84),72,15.2))

m=dnorm(82,72,15.2)

n=dnorm(83,72,15.2)

o=dnorm(84,72,15.2)

s=m+n+o

s

a1=pnorm(85,72,15.2,lower.tail=FALSE)

a2=pnorm(58,72,15.2)

a3=a1+a2

a3

input:-

```
#Q2Gomsi

pnorm(84,72,15.2,lower.tail=FALSE)

diff(pnorm(c(81,84),72,15.2))

m=dnorm(82,72,15.2)
n=dnorm(83,72,15.2)
o=dnorm(84,72,15.2)
s=m+n+o
s

a1=pnorm(85,72,15.2,lower.tail=FALSE)
a2=pnorm(58,72,15.2)
a3=a1+a2
a3
```

output

```r
#Q2Gomsi

pnorm(84,72,15.2,lower.tail=FALSE)

diff(pnorm(c(81,84),72,15.2))

m=dnorm(82,72,15.2)
n=dnorm(83,72,15.2)
o=dnorm(84,72,15.2)
s=m+n+o
s

a1=pnorm(85,72,15.2,lower.tail=FALSE)
a2=pnorm(58,72,15.2)
a3=a1+a2
a3
```

(3) On the average, five cars arrive at a particular car wash every hour. Let X count the number of cars that arrive from 10AM to 11AM, then X Poisson($\lambda = 5$). What is probability that no car arrives during this time. Next, suppose the car wash above is in operation from 8AM to 6PM, and we let Y be the number of customers that appear in this period. Since this period covers a total of 10 hours, we get that Y Poisson($\lambda = 5 \times 10 = 50$). What is the probability that there are between 48 and 50 customers, inclusive?

code:-

dpois(0,5)

m<-ppois(50,50)

n<-ppois(47,50)

m1<-m-n

m1

```r
#Q3Gomsi
dpois(0,5)
m<-ppois(50,50)
n<-ppois(47,50)
m1<-m-n
```

output:-

```
> m<-ppois(50,50)
> n<-ppois(47,50)
> m1<-m-n
> m1
[1] 0.1678485
```

(4) Suppose in a certain shipment of 250 Pentium processors there are 17 defective pro- cessors. A quality control consultant randomly collects 5 processors for inspection to determine whether or not they are defective. Let X denote the number of defectives in the sample. Find the probability of exactly 3 defectives in the sample, that is, find $P(X = 3)$.

code:-

dhyper(3,17,233,5)

```
#Q4Gomsi
dhyper(3,17,233,5)
```

output:-

```
> #Q4Gomsi
> dhyper(3,17,233,5)
[1] 0.002351153
```

(5) A recent national study showed that approximately 44.7% of college students have used Wikipedia 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 = 31 who have used Wikipedia as a source.

(a) How is X distributed?

(b) Sketch the probability mass function.

(c) Sketch the cumulative distribution function.

(d) Find mean, variance and standard deviation of X .

code:-

```
x<-0:31
px<-dbinom(x,31,0.447)
plot(x,px)
dx<-pbinom(x,31,0.447)
plot(x,dx)
meanx<-sum(x*px)
varx<-sum((x-meanx)^2*px)
```

print(paste("Variance: ",varx))

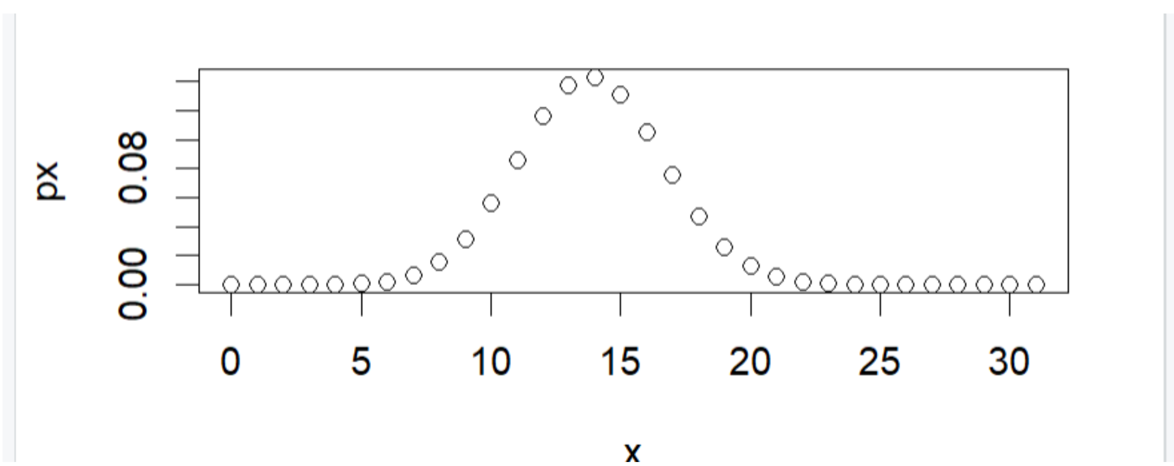
sdx<-sqrt(varx)

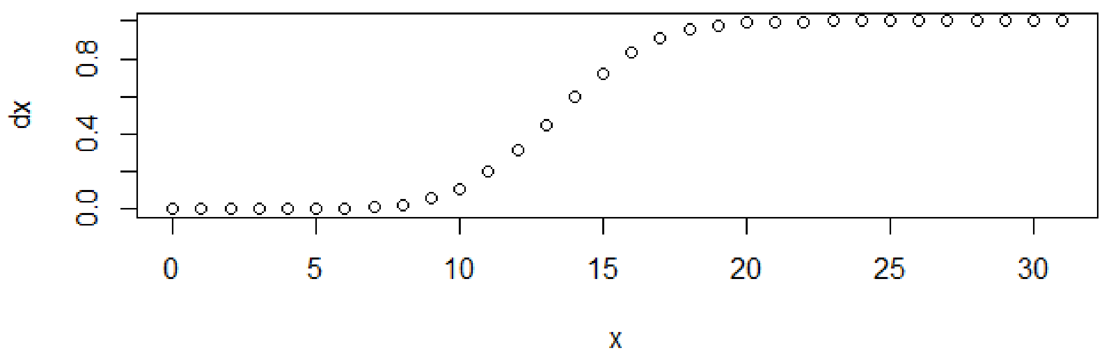
print(paste("Standard Deviation : ",sdx))

```
#Q5Gomsi
x<-0:31
px<-dbinom(x,31,0.447)
plot(x,px)
dx<-pbinom(x,31,0.447)
plot(x,dx)
meanx<-sum(x*px)
varx<-sum((x-meanx)^2*px)
print(paste("Variance: ",varx))
sdx<-sqrt(varx)
print(paste("Standard Deviation : ",sdx))
```

output:-

```
> #Q5Gomsi
> x<-0:31
> px<-dbinom(x,31,0.447)
> plot(x,px)
> dx<-pbinom(x,31,0.447)
> plot(x,dx)
> meanx<-sum(x*px)
> varx<-sum((x-meanx)^2*px)
> print(paste("Variance: ",varx))
[1] "Variance:  7.66292099999999"
> sdx<-sqrt(varx)
> print(paste("Standard Deviation : ",sdx))
[1] "Standard Deviation :  2.76819815042204"
```




dx
0.0
0.4
0.8
0
5
10
15
20
25
30
x