PROBABILITY AND STATISTICS

LAB ASSIGNMENT - 3

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(1) Roll 12 dice simultaneously, and let X denotes the number of 6's that appear. Calculate 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 trials; thus $X \sim$ binom(size=12, prob=1/6) and we are looking for $P(7 \leq X \leq 9)$.

```
# q1
pbinom(9,12,1/6) - pbinom(6,12,1/6)
# or
dbinom(7,12,1/6) + dbinom(8,12,1/6) + dbinom(9,12,1/6)
```

Output :

```
> # q1
> pbinom(9,12,1/6) - pbinom(6,12,1/6)
[1] 0.001291758
> # or
> dbinom(7,12,1/6) + dbinom(8,12,1/6) + dbinom(9,12,1/6)
[1] 0.001291758
```

(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?

```
# q2
pnorm(84,72,15.2,lower.tail=FALSE)
```

Output :

```
> # q2
> pnorm(84,72,15.2,lower.tail=FALSE)
[1] 0.2149176
```

(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 $X \sim$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 $Y \sim$ Poisson($\lambda = 5 \times 10 = 50$). What is the probability that there are between 48 and 50 customers, inclusive?

```
# q3 i)
dpois(0,5)

# ii)
ppois(50,50) - ppois(47,50)
# or
dpois(48,50) + dpois(49,50) + dpois(50,50)
```

Output :

```
> # q3
> dpois(0,5)
[1] 0.006737947
>
> ppois(50,50) - ppois(47,50)
[1] 0.1678485
> # or
> dpois(48,50) + dpois(49,50) + dpois(50,50)
[1] 0.1678485
```

(4) Suppose in a certain shipment of 250 Pentium processors there are 17 defective processors. 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 $P(X = 3)$.

```
# q4
dbinom(3,5,17/250)
```

Output :

```
> # q4
> dbinom(3,5,17/250)
[1] 0.002731232
```

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(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.

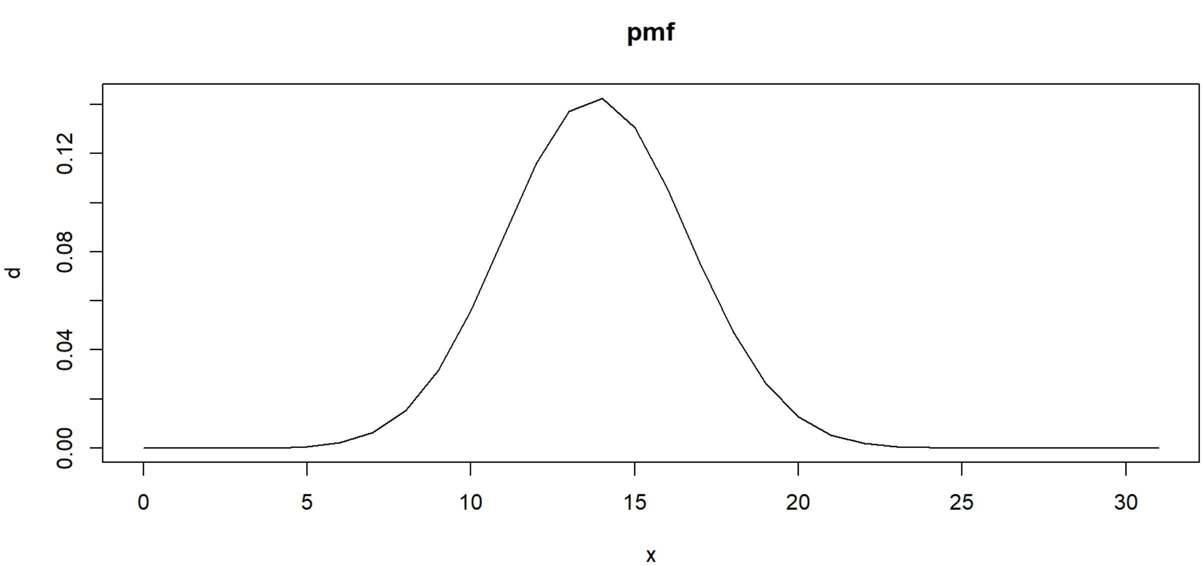
(d) Find mean, variance and standard deviation of X.

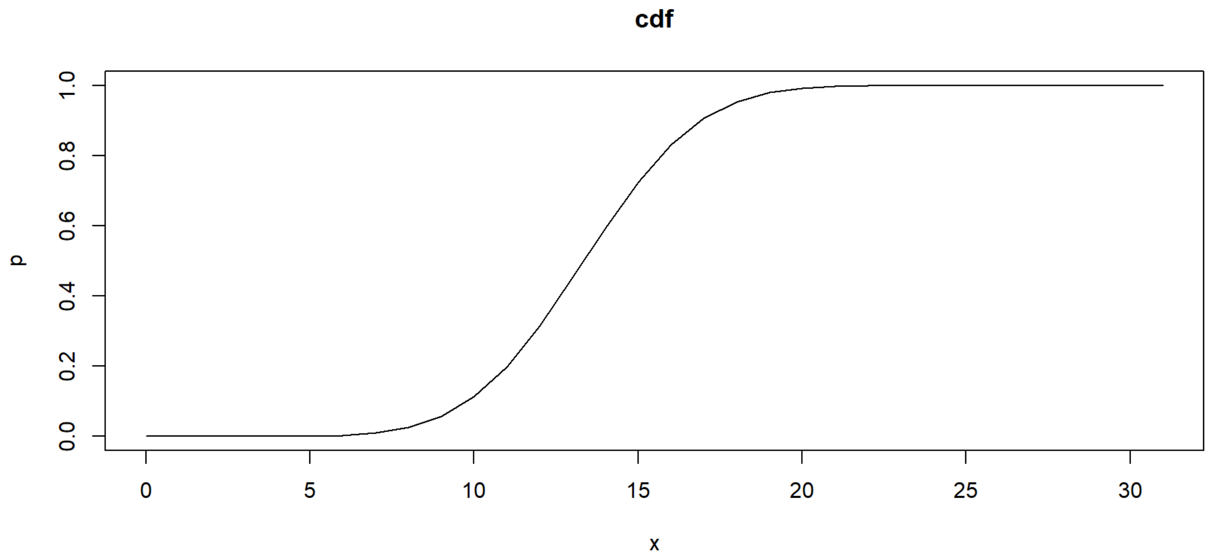
```
# q5 -> binomial distribution
x <- 0:31
p <- pbinom(x,31,0.447)
d <- dbinom(x,31,0.447)
print(p)
print(d)
plot(x,d,type='l',main='pmf') #pmf
plot(x,p,type='l',main='cdf') #cdf
mean = 31*0.447 # = sum(d*x)
var = 31*0.447*(1-0.447)
sd = sqrt(var)
mean
```

```
var
sd
```

Output :

```
> x <- 0:31
> p <- pbinom(x,31,0.447)
> d <- dbinom(x,31,0.447)
> print(p)
 [1] 1.057984e-08 2.756880e-07 3.490065e-06 2.860638e-05 1.707202e-04
 [6] 7.910356e-04 2.963822e-03 9.236332e-03 2.444689e-02 5.586736e-02
[11] 1.117424e-01 1.979661e-01 3.141265e-01 4.513570e-01 5.939760e-01
[16] 7.246284e-01 8.302372e-01 9.055597e-01 9.529143e-01 9.791043e-01
[21] 9.918062e-01 9.971842e-01 9.991602e-01 9.997852e-01 9.999536e-01
[26] 9.999917e-01 9.999988e-01 9.999999e-01 1.000000e+00 1.000000e+00
[31] 1.000000e+00 1.000000e+00
> print(d)
 [1] 1.057984e-08 2.651082e-07 3.214377e-06 2.511632e-05 1.421138e-04
 [6] 6.203153e-04 2.172786e-03 6.272510e-03 1.521055e-02 3.142047e-02
[11] 5.587504e-02 8.622373e-02 1.161604e-01 1.372305e-01 1.426190e-01
[16] 1.306524e-01 1.056088e-01 7.532248e-02 4.735464e-02 2.618995e-02
[21] 1.270189e-02 5.378041e-03 1.975986e-03 6.250013e-04 1.684000e-04
[26] 3.811382e-05 7.109560e-06 1.064220e-06 1.228898e-07 1.027594e-08
[31] 5.537484e-10 1.443887e-11
```






```
> mean
[1] 13.857
> var
[1] 7.662921
> sd
[1] 2.768198
```