Probablity and Statistics
Assignment 3

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-3CS3

(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 = {get a 6 on one roll}, P(S) = 1/6 and the rolls constitute Bernoulli trials; thus X ~ binom(size=12, prob=1/6) and we are looking for $P(7 \leq X \leq 9)$.

Solution:

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

```
> pbinom(9,size=12,prob = 1/6)-pbinom(6,12,1/6)
[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?

Solution:

mean = 72
sd = 15.2
pnorm(84, mean = 72, sd=15.2, lower.tail=FALSE)-pnorm(100,mean=72, sd=15.2, lower.tail=FALSE)

```
> pnorm(84, mean = 72, sd=15.2, lower.tail=FALSE)-pnorm(100,mean=72, sd=15.2, lower.tail=FALSE)
[1] 0.1821877
>
```

(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(λ = 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(λ = 5×10 = 50). What is the probability that there are between 48 and 50 customers, inclusive?

Solution:

```
ppois(0, 5)
ppois(50, 50) - ppois(47, 50)
```

```
> ppois(0, 5)
[1] 0.006737947
> ppois(50, 50) - ppois(47, 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).

Solution:

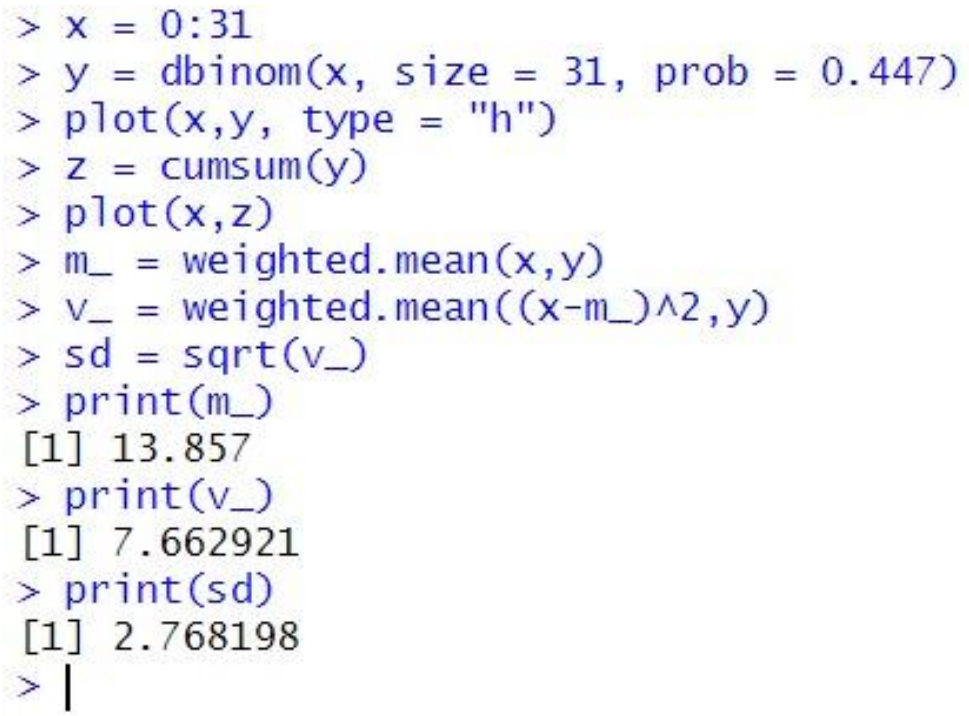
```
prob = dhyper(3, m = 17, n = 233, k = 5)
print(prob)
```

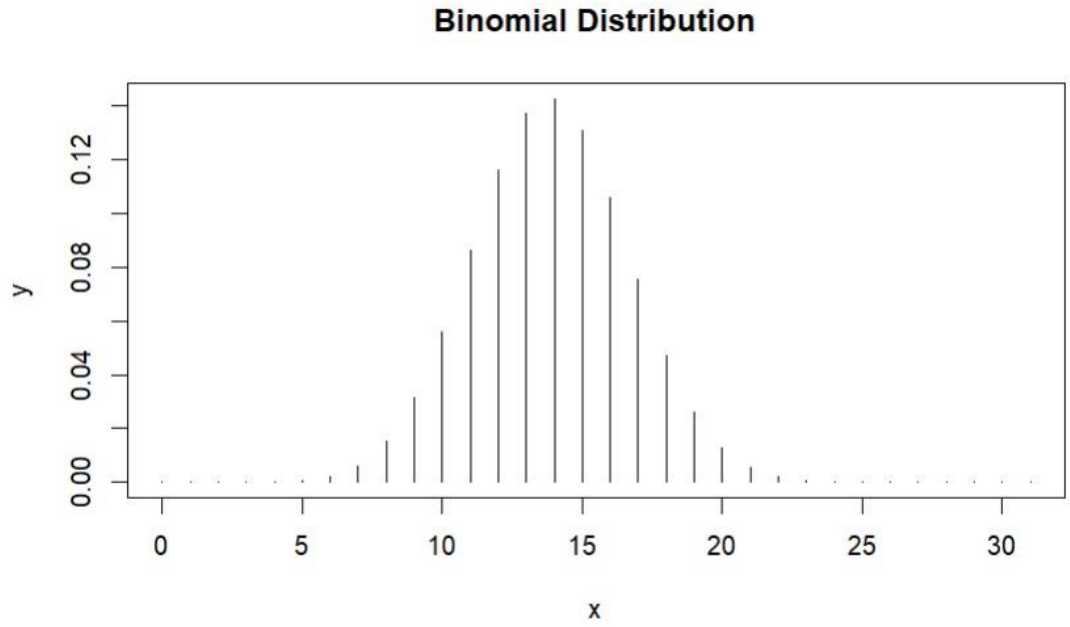
```
> prob = dhyper(3, m = 17, n = 233, k = 5)
> print(prob)
[1] 0.002351153
>
```

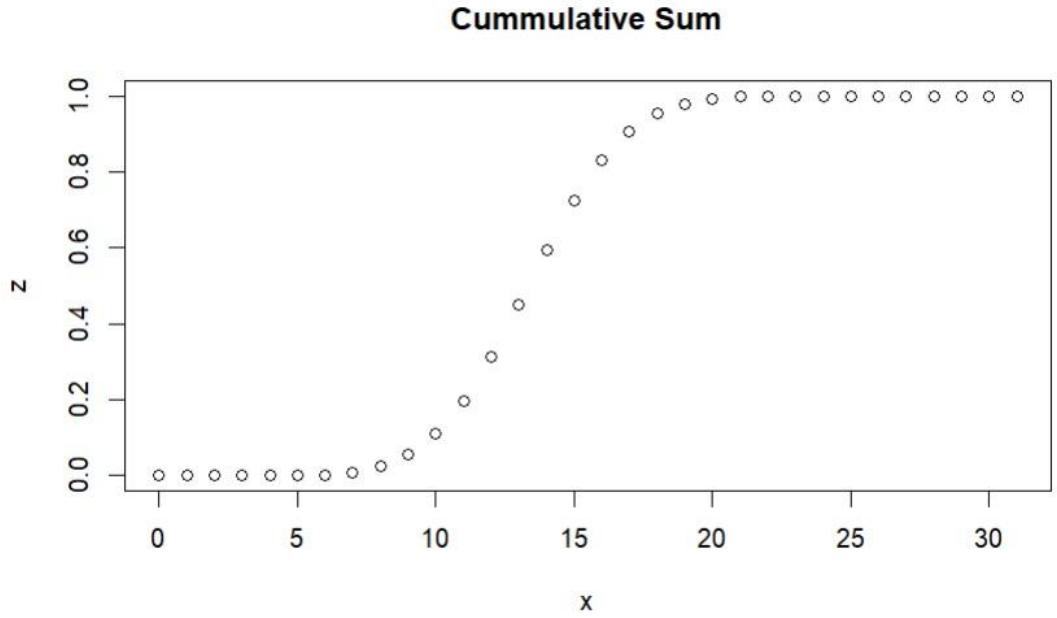
(5) A recent national study showed that approximately 44.7% of college students have used Wikipedia as a source in at least one of their term papers. Let X equal the number of students in a random sample of size n = 31 who have used Wikipedia as a source.
(a) How is X distributed?
(b) Sketch the probability mass function.
(c) Sketch the cumulative distribution function.
(d) Find mean, variance and standard deviation of X.

Solution:

```
x = 0:31
y = dbinom(x, size = 31, prob = 0.447)
plot(x,y, type = "h",main = "Binomial Distribution")
z = cumsum(y)
plot(x,z, main= "Cummulative Sum")
m_ = weighted.mean(x,y)
v_ = weighted.mean((x-m_)^2,y)
sd = sqrt(v_)
print(m_)
print(v_)
print(sd)
```




Binomial Distribution
y
0.00
0.04
0.08
0.12
0
5
10
15
20
25
30
x


Cummulative Sum
z
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
x