Nithin S
221IT085

IT302 Lab Assignment 2

Q1. Suppose that a random variable X represents the daily percentage change in the stock price of a certain company. The probability distribution of X is given by

x (%)	-2	-1	0	1	2	3
p(x)	0.08	0.15	0.23	0.3	0.19	0.05

(a) The mean of the random variable X.

Code

```
x<-c(-2,-1,0,1,2,3)
px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
expectation=weighted.mean(x, px)
print(expectation)
```

Output

```
> x<-c(-2,-1,0,1,2,3)
> px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
> expectation=weighted.mean(x, px)
> print(expectation)
[1] 0.52
```

(b) The variance and standard deviation of the random variable X.

Code

```
x<-c(-2,-1,0,1,2,3)
px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
expectation=weighted.mean(x, px)
variance<-sum((x-expectation)^2 * px)
cat("Variance of X = ",variance)
standard_deviation=sqrt(variance)
cat("\nStandard Deviation of X = ",standard_deviation)
```

Output

```
> x<-c(-2,-1,0,1,2,3)
> px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
> expectation=weighted.mean(x, px)
> variance<-sum((x-expectation)^2 * px)
> cat("Variance of X = ",variance)
Variance of X =  1.7096> standard_deviation=sqrt(variance)
> cat("\nStandard Deviation of X = ",standard_deviation)

Standard Deviation of X =  1.307517
```

(c) The probability that the stock price increases by at least 1%

Code

```
x<-c(-2,-1,0,1,2,3)
px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
prob_oneper=sum(px[x>=1])
cat("probability that the stock price increases by at least 1% = ",prob_oneper)
```

Output

```
> x<-c(-2,-1,0,1,2,3)
> px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
> prob_oneper=sum(px[x>=1])
> cat("probability that the stock price increases by at least 1% = ",prob_oneper)
probability that the stock price increases by at least 1% =  0.54
```

(d) The probability that the stock price changes (increases or decreases) by less than 2%

Code

```
x<-c(-2,-1,0,1,2,3)
px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
prob=sum(px[x<2 & x>-2])
cat("The probability that the stock price changes (increases or decreases) by
less than 2% = ",prob)
```

Output

```
> x<-c(-2,-1,0,1,2,3)
> px<-c(0.08,0.15,0.23,0.3,0.19,0.05)
> prob=sum(px[x<2 & x>-2])
> cat("The probability that the stock price changes (increases or decreases) by
+ less than 2% = ",prob)
The probability that the stock price changes (increases or decreases) by
less than 2% =  0.68
```

Q2. A car hire firm has two cars which it hires out every day. The number of demands for a car on each day is Poisson random variable with an average of 1.5. Find the percentages of days on which

(a) Neither car is hired?

Code

```
avg<-1.5
prob=ppois(0,lambda = avg)
cat("Neither car is hierd: ",prob*100,"%")
```

Output

```
> avg<-1.5
> prob=ppois(0,lambda = avg)
> cat("Neither car is hierd: ",prob*100,"%")
Neither car is hierd:  22.31302 %
>
```

(b) Some demand is refused?

Code

```
avg<-1.5
prob<-ppois(2,lambda = avg,lower=FALSE)
cat("Some demand is refused = ",prob*100,"%")
```

Output

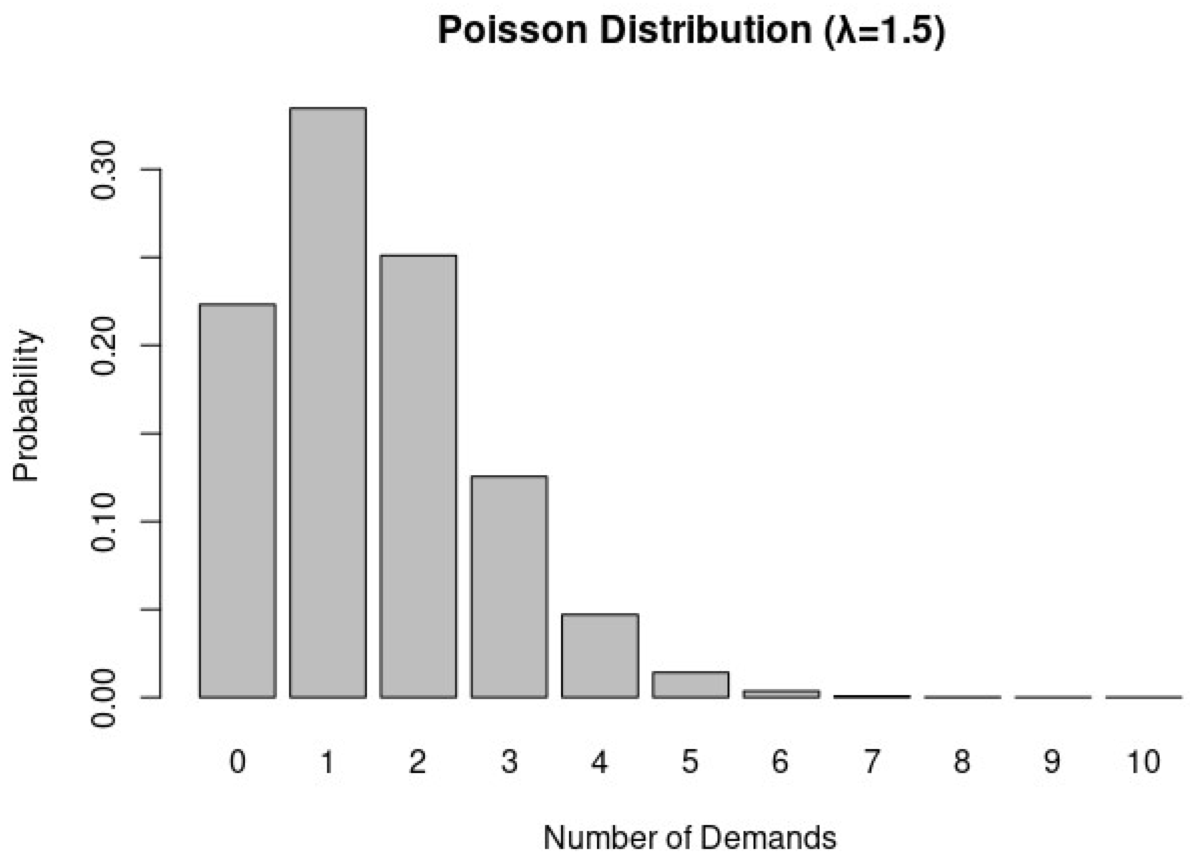
```
> avg<-1.5
> prob<-ppois(2,lambda = avg,lower=FALSE)
> cat("Some demand is refused = ",prob*100,"%")
Some demand is refused =  19.11532 %
```

(c) Plot the histogram of the corresponding distribution.

Code

```
lambda_value <- 1.5
values <- 0:10
probabilities <- dpois(values, lambda_value)
barplot(probabilities, names.arg=values,
        xlab="Number of Demands", ylab="Probability",
        main="Poisson Distribution (λ=1.5)")
```

Output



Q3. Let X be a continuous random variable having p.d.f

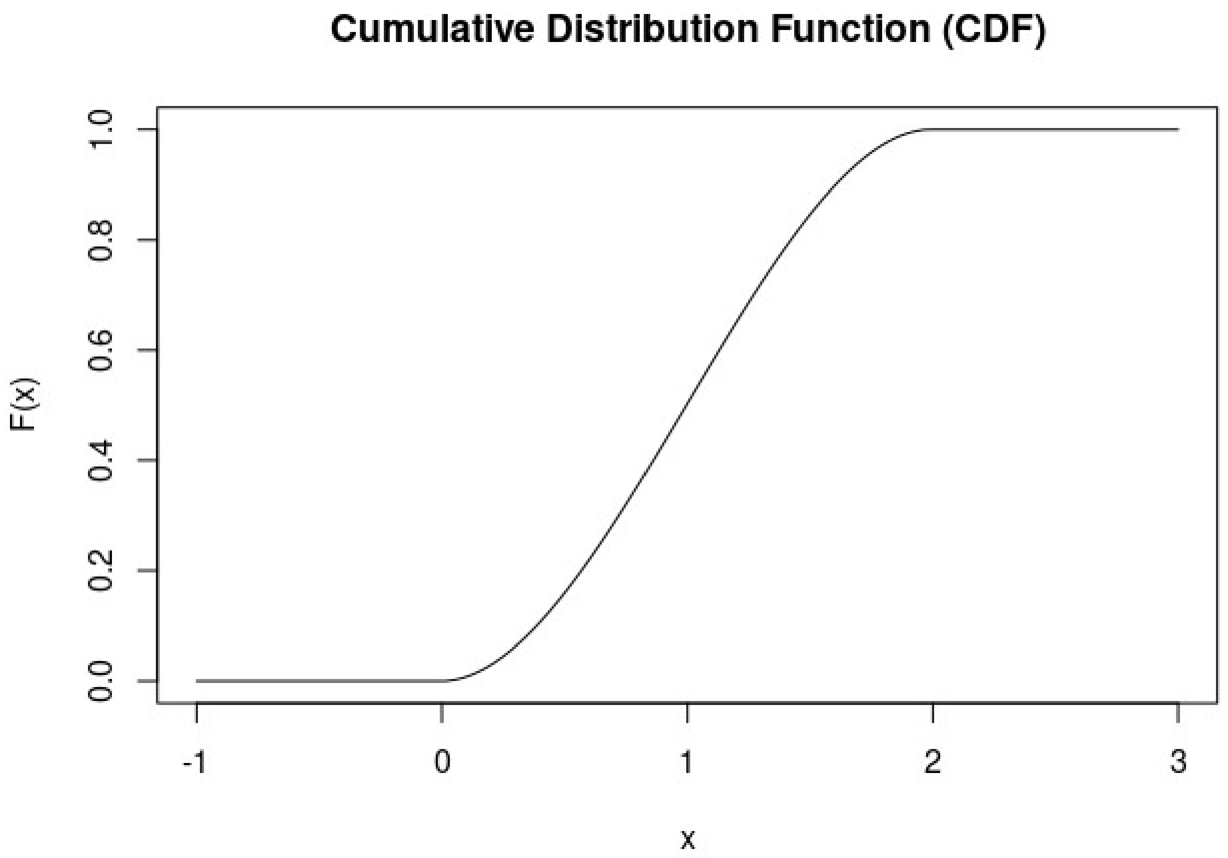
$$f(x) = \begin{cases} \frac{3x}{4}(2-x), & 0 < x < 2 \\ 0 & , \ otherwise \end{cases}.$$

Using R/Python, find
(a) Cumulative distribution function (c.d.f.) of X.

Code

```
pdf <- function(x) {
  ifelse(x > 0 & x < 2, (3 * x / 4) * (2 - x), 0)
}
integrate(pdf,1,2)
plot(seq(-1,3,by=0.01), cumsum(pdf(seq(-1,3,by=0.01))*0.01 ), type="l",main = "Cumulative Distribution Function (CDF)",
     xlab = "x", ylab = "F(x)" )
```

Output



(b) Mean of X

Code

```r
pdf <- function(x) {
  ifelse(x > 0 & x < 2, (3 * x / 4) * (2 - x), 0)
}

mean <- integrate(function(x) x * pdf(x), lower = 0, upper = 2)$value
cat("Mean of X = ",mean)
```

Output

```
> pdf <- function(x) {
+   ifelse(x > 0 & x < 2, (3 * x / 4) * (2 - x), 0)
+ }
>
> mean <- integrate(function(x) x * pdf(x), lower = 0, upper = 2)$value
> cat("Mean of X = ",mean)
Mean of X =  1
>
```

(c) Variance of X

Code

```
pdf <- function(x) {
  ifelse(x > 0 & x < 2, (3 * x / 4) * (2 - x), 0)
}

mean <- integrate(function(x) x * pdf(x), lower = 0, upper = 2)$value
mean_square <- integrate(function(x) x^2 * pdf(x), lower = 0, upper = 2)$value
variance <- mean_square - mean^2
cat("Variance of X = ",variance)
```

Output

```
> pdf <- function(x) {
+   ifelse(x > 0 & x < 2, (3 * x / 4) * (2 - x), 0)
+ }
>
> mean <- integrate(function(x) x * pdf(x), lower = 0, upper = 2)$value
> mean_square <- integrate(function(x) x^2 * pdf(x), lower = 0, upper = 2)$value
> variance <- mean_square - mean^2
> cat("Variance of X = ",variance)
Variance of X =  0.2
>
```

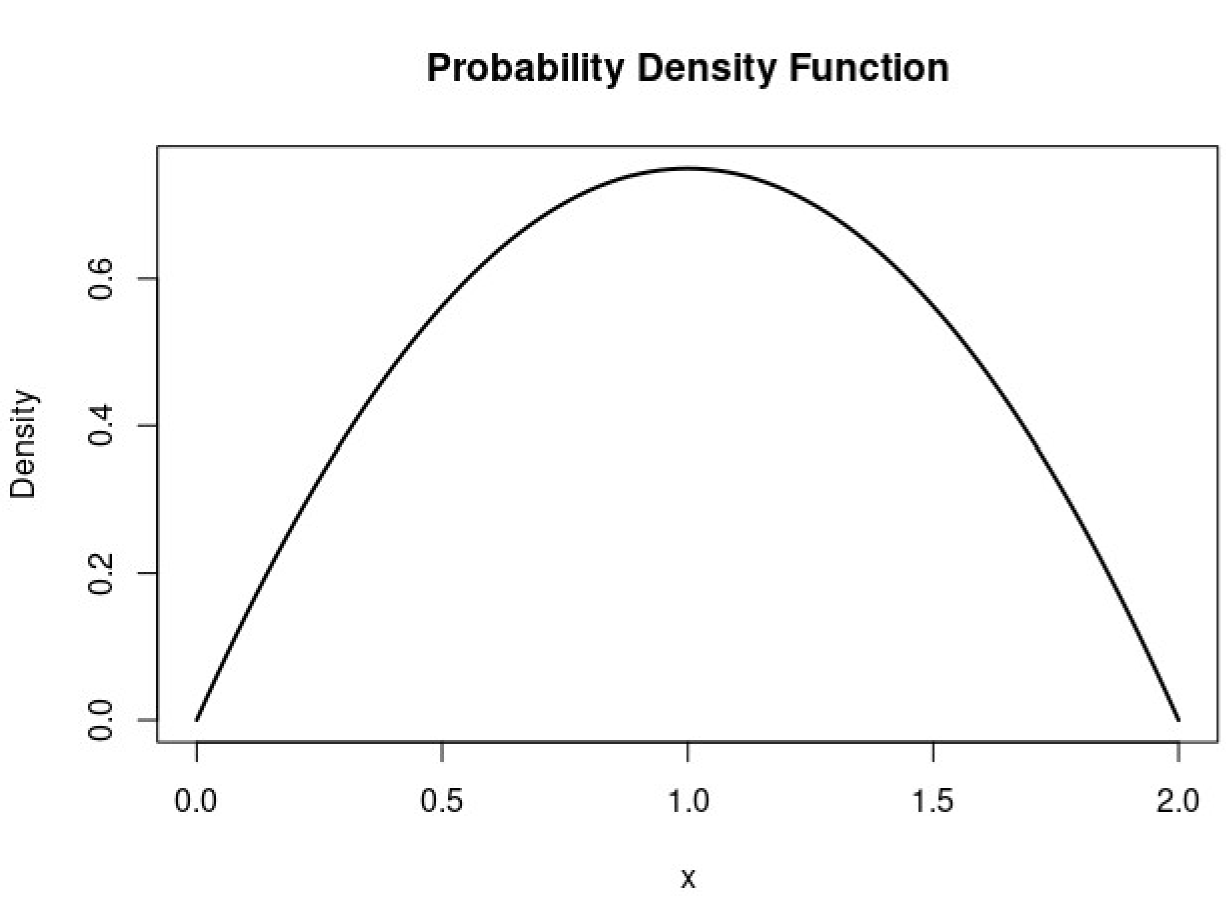
(d) Plot the p.d.f. function of the distribution.

Code

```r
pdf <- function(x) {
  ifelse(x > 0 & x < 2, (3 * x / 4) * (2 - x), 0)
}

curve(pdf, from = 0, to = 2, lwd = 2, ylab = "Density", xlab = "x",
      main = "Probability Density Function")
```

Output



Q4. A new surgical procedure is said to be successful 80% of the time. Suppose the operation is performed five times and the results are to be independent of one another. Write a R/Python code to find the probability that

(a) All five operations are successful.

Code

```r
p<-0.8
n<-5
cat("Probability that All five operations are successful = ",p^5)
```

Output

```
> p<-0.8
> n<-5
> cat("Probability that All five operations are successful = ",p^5)
Probability that All five operations are successful =  0.32768
```

(b) Exactly four are successful.

Code

```r
p <- 0.8
n <- 5
k <- 4
prob <- choose(n, k) * p^k * (1 - p)^(n - k)
cat("Probability that exactly", k, "are successful =", prob, "\n")
```

Output

```
> p <- 0.8
> n <- 5
> k <- 4
> prob <- choose(n, k) * p^k * (1 - p)^(n - k)
> cat("Probability that exactly", k, "are successful =", prob, "\n")
Probability that exactly 4 are successful = 0.4096
```

(c) Less than two are successful

Code

```
p<-0.8
n<-5
prob<-choose(5,0)*0.8^0*0.2^5 + choose(5,1)*0.8^1*0.2^4
cat("Probability that Less than two are successful = ",prob)
```

Output

```
> p<-0.8
> n<-5
> prob<-choose(5,0)*0.8^0*0.2^5 + choose(5,1)*0.8^1*0.2^4
> cat("Probability that Less than two are successful = ",prob)
Probability that Less than two are successful =  0.00672
```

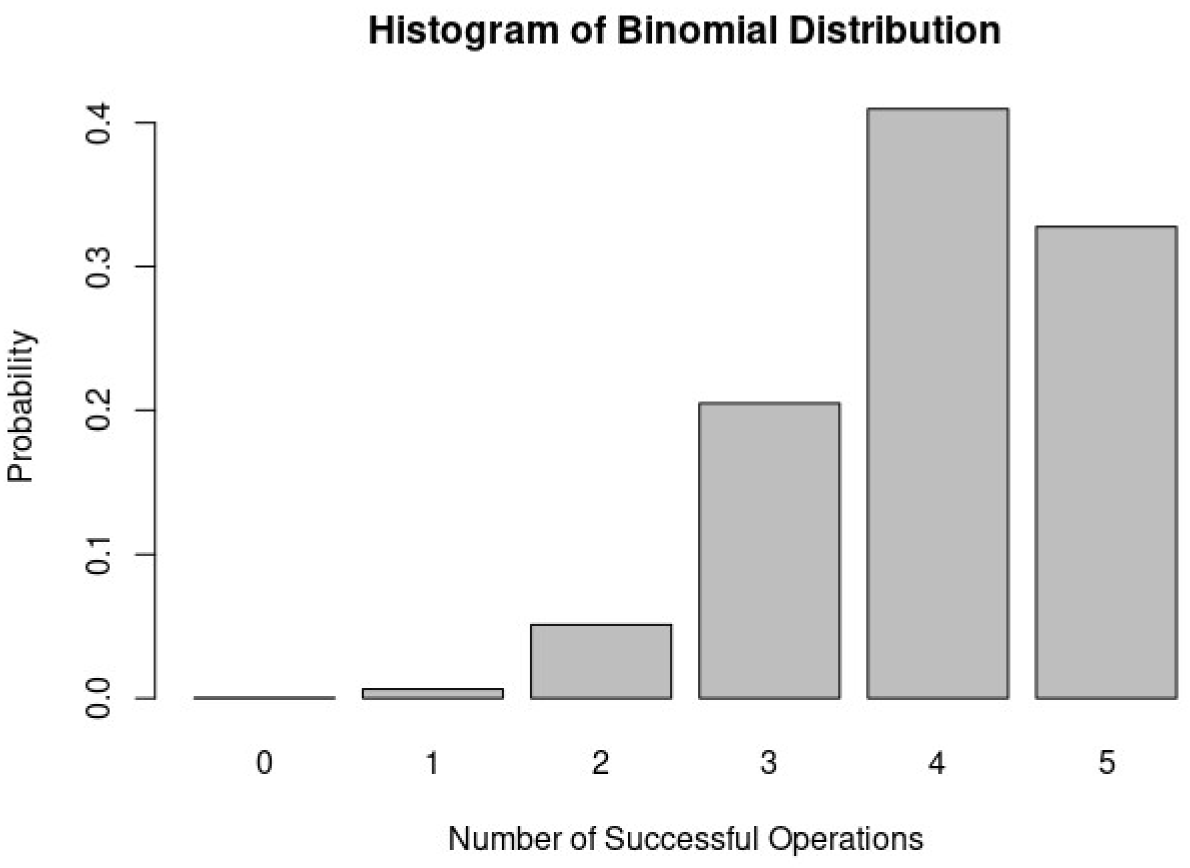
(d) Plot the histogram of the corresponding distribution.

Code

```
n <- 5
p <- 0.8
successes <- 0:n
probabilities <- dbinom(successes, n, p)

barplot(probabilities, names.arg=successes,
        main="Histogram of Binomial Distribution",
        xlab="Number of Successful Operations", ylab="Probability")
```

Output


Histogram of Binomial Distribution
Probability
0.0
0.1
0.2
0.3
0.4
0
1
2
3
4
5
Number of Successful Operations