# Assignment – 4

Parth Vohra 102016044 3CS10

1. The probability distribution of X, the number of imperfections per 10 meters of a synthetic fabric in continuous rolls of uniform width, is given as

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $p(x)$ | 0.41 | 0.37 | 0.16 | 0.05 | 0.01 |

Find the average number of imperfections per 10 meters of this fabric.

(Try functions **sum( )**, **weighted.mean( )**, c(a **%*%** b) to find expected value/mean.

**Code:**

```
x <- c(0,1,2,3,4)

y <- c(0.41,0.37,0.16,0.05,0.01)


print(sum(x*y))

print(weighted.mean(x,y))

print(c(x%*%y))
```

**Ans:**

```
Console   Terminal ×   Background Jobs ×
R 4.2.1 · ~/
> source("C:/Users/parth/OneDrive/Desktop/Sem 5/Probability Statistics (UCS410)/Lab/Lab_04/Q1.R")
[1] 0.88
[1] 0.88
[1] 0.88
>
```

2. The time T, in days, required for the completion of a contracted project is a random variable with probability density function $f(t) = 0.1\ e^{(-0.1t)}$ for $t > 0$ and 0 otherwise. Find the expected value of T.
Use function **integrate( )** to find the expected value of continuous random variable T.

**Code:**

```
f <- function(x)

{0.1*x*exp(-0.1*x)}


Exp <- integrate(f,0,Inf)

print(Exp$value)
```

**Ans:**

```
Console   Terminal ×   Background Jobs ×
R 4.2.1 · ~/
> source("C:/Users/parth/OneDrive/Desktop/Sem 5/Probability Statistics (UCS410)/Lab/Lab_04/Q2.R")
[1] 10
>
```

3. A bookstore purchases three copies of a book at \$6.00 each and sells them for \$12.00 each. Unsold copies are returned for \$2.00 each. Let X = {number of copies sold} and Y = {net revenue}. If the probability mass function of X is

| $x$ | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| $p(x)$ | 0.1 | 0.2 | 0.2 | 0.5 |

Find the expected value of Y.

**Code:**

```
x <- c(0,1,2,3)

f <- c(0.1,0.2,0.2,0.5)

ans = sum(x*f)

print(10*ans-12)
```

**Ans:**

```
Console   Terminal ×   Background Jobs ×
R 4.2.1 · ~/
> source("C:/Users/parth/OneDrive/Desktop/Sem 5/Probability Statistics (UCS410)/Lab/Lab_04/Q3.R")
[1] 9
>
```

4. Find the first and second moments about the origin of the random variable X with probability density function $f(x) = 0.5e^{-|x|}$, $1 < x < 10$ and 0 otherwise. Further use the results to find Mean and Variance.
($k$th moment = E($X^k$), Mean = first moment and Variance = second moment – Mean$^2$.

**Code:**

```
first_moment <- function(x)

{0.5*x*exp(-abs(x))}


f.mean <- integrate(first_moment,1,10)

print(paste("Mean is:",f.mean$value))


second_moment <- function(x)

{0.5*x*x*exp(-abs(x))}
```

```
s <- integrate(second_moment,1,10)

f.variance <- (s$value) - (f.mean$value)^2

print(paste("Variance is:",f.variance))


fifth_moment <- function(x)

{0.5*(x^5)*exp(-abs(x))}


f <- integrate(fifth_moment,1,10)

f.v <- (f$value) - (f.mean$value)^5

print(paste("Value is:",f.v))
```

**Ans:**

```
Console   Terminal ×   Background Jobs ×
R 4.2.1 · ~/
> source("C:/Users/parth/OneDrive/Desktop/Sem 5/Probability Statistics (UCS410)/Lab/Lab_04/Q4.R")
[1] "Mean is: 0.367629741557749"
[1] "Variance is: 0.781777580335277"
[1] "Value is: 55.9324760272228"
>
```

5. Let X be a geometric random variable with probability distribution

$$f(x) = \frac{3}{4}\left(\frac{1}{4}\right)^{x-1}, x = 1,2,3, \ldots$$

Write a function to find the probability distribution of the random variable $Y = X^2$ and find probability of Y for X = 3. Further, use it to find the expected value and variance of Y for X = 1,2,3,4,5.

**Code:**

```
f <- function(y)

{(3/4)*(1/4)^(sqrt(y)-1)}


x <- 3

y <- x^2


print(f(y))
```

```
f <- function(y)
{(3/4)*(1/4)^(sqrt(y)-1)}

x <- c(1,2,3,4,5)
y <- x^2
Exp <- sum(y*f(y))
print(Exp)

Exp2 <- sum(y*y*f(y))
Var <- Exp -(Exp2)^2
print(Var)
```

**Ans:**

```
> source("C:/Users/parth/OneDrive/Desktop/Sem 5/Probability Statistics (UCS410)/Lab/Lab_04/Q5.R")
[1] 0.046875
[1] 2.182617
[1] -151.0305
>
```