

# Assignment – 4

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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.

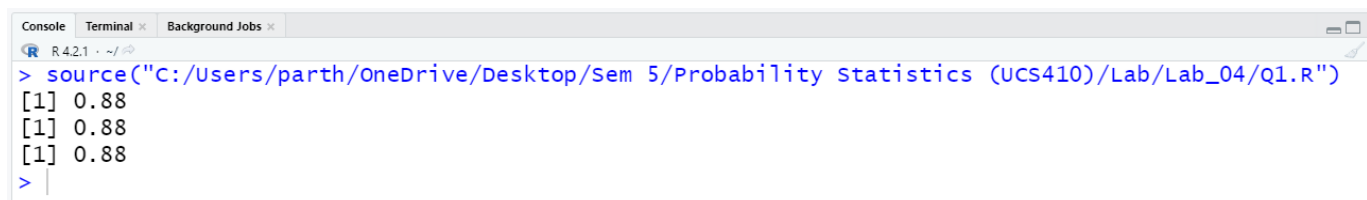
(Try functions **sum()**, **weighted.mean()**, `c(a %*% b)` to find expected value/mean.

**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  $X = \{\text{number of copies sold}\}$  and  $Y = \{\text{net revenue}\}$ . 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<sup>2</sup>).

**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))

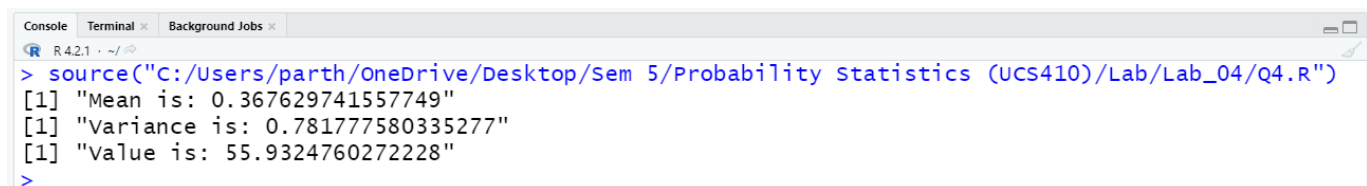
second_moment <- function(x)
{0.5*x*x*exp(-abs(x))}
```

```
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:**



```
> 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

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

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
```

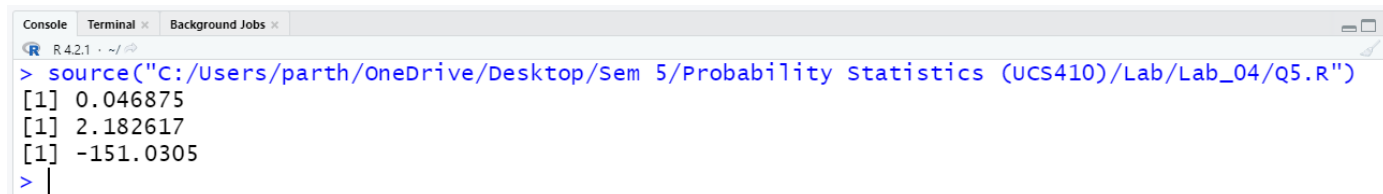
```
print(f(y))
```

```
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:**



The screenshot shows an R console window with the following content:

```
R 4.2.1 ~ /
> 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
> |
```