Assignment – 4
Name – Sukhmandeep Singh
Roll No. – 102003144
Batch – COE7

Probability and Statistics (UCS410)

Experiment 4

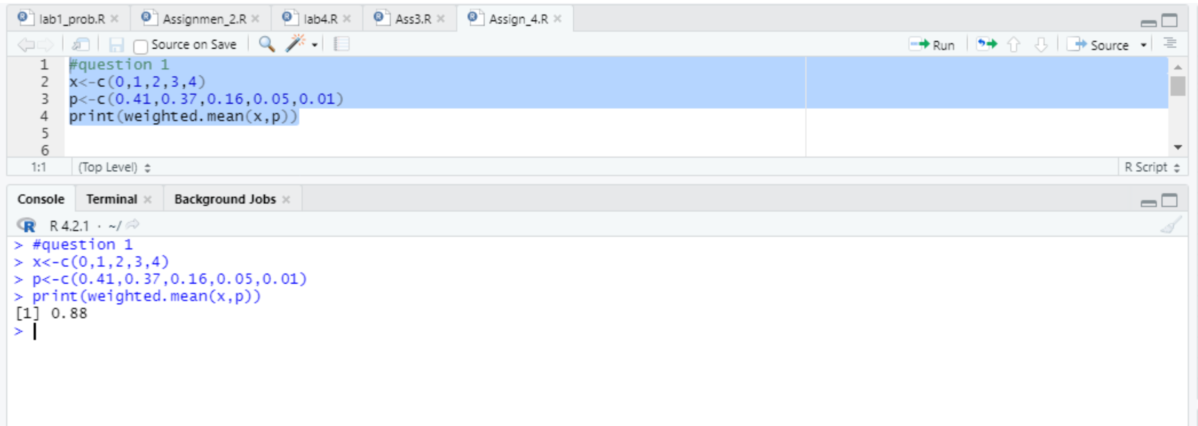
(Mathematical Expectation, Moments and Functions of Random Variables)

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

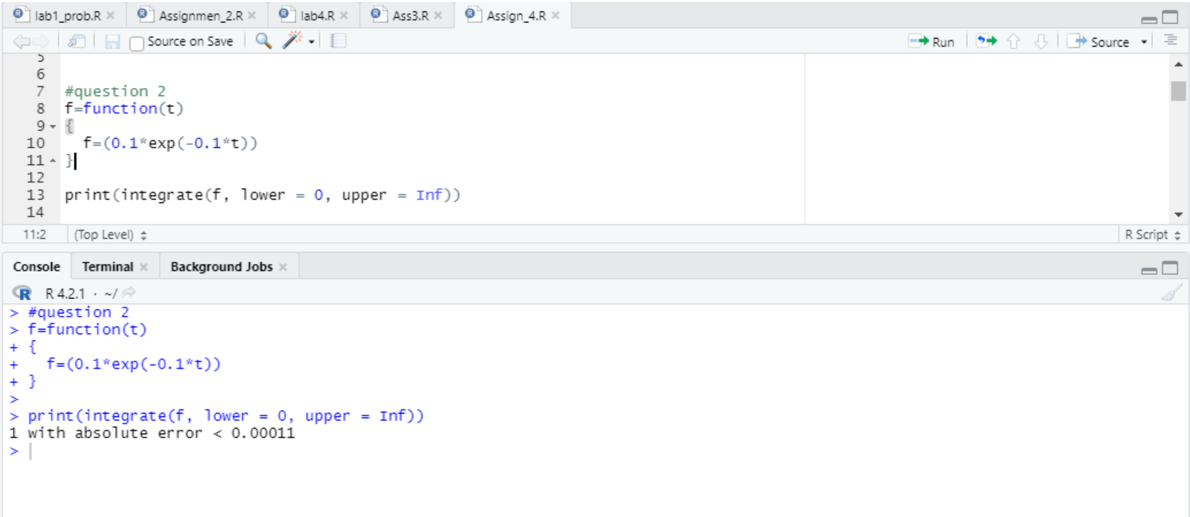
Find the average number of imperfections per 10 meters of this fabric.

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



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.

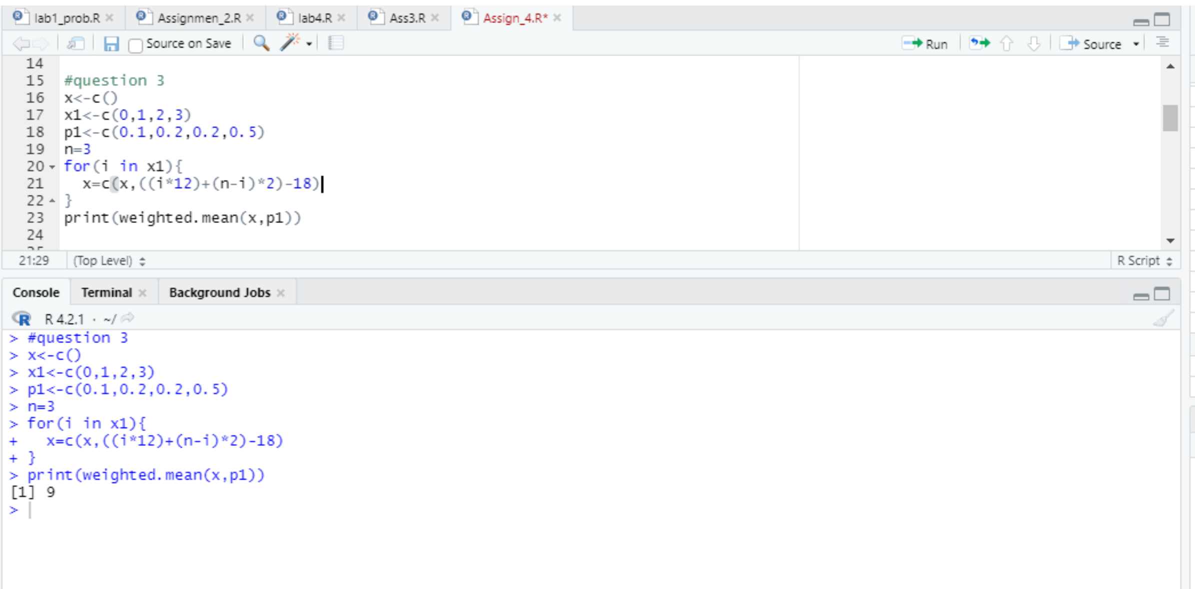
Use function **integrate( )** to find the expected value of continuous random variable T.



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

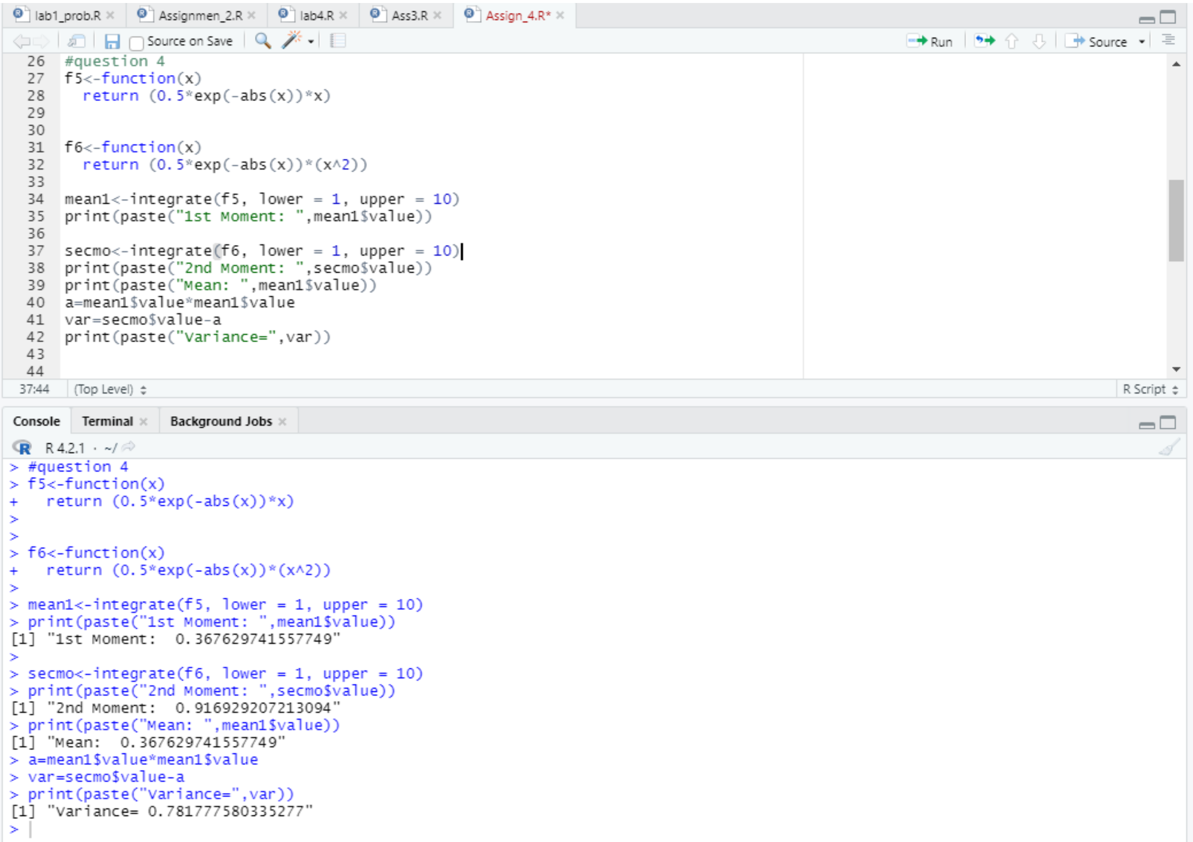
x	0	1	2	3
$p(x)$	0.1	0.2	0.2	0.5

Find the expected value of Y.



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.

   (kth moment = $E(X^k)$, Mean = first moment and Variance = second moment – Mean^2.



```
#question 4
f5<-function(x)
  return (0.5*exp(-abs(x))*x)


f6<-function(x)
  return (0.5*exp(-abs(x))*(x^2))

mean1<-integrate(f5, lower = 1, upper = 10)
print(paste("1st Moment: ",mean1$value))

secmo<-integrate(f6, lower = 1, upper = 10)
print(paste("2nd Moment: ",secmo$value))
print(paste("Mean: ",mean1$value))
a=mean1$value*mean1$value
var=secmo$value-a
print(paste("variance=",var))
```

```
> #question 4
> f5<-function(x)
+   return (0.5*exp(-abs(x))*x)
>
>
> f6<-function(x)
+   return (0.5*exp(-abs(x))*(x^2))
>
> mean1<-integrate(f5, lower = 1, upper = 10)
> print(paste("1st Moment: ",mean1$value))
[1] "1st Moment:  0.367629741557749"
>
> secmo<-integrate(f6, lower = 1, upper = 10)
> print(paste("2nd Moment: ",secmo$value))
[1] "2nd Moment:  0.916929207213094"
> print(paste("Mean: ",mean1$value))
[1] "Mean:  0.367629741557749"
> a=mean1$value*mean1$value
> var=secmo$value-a
> print(paste("variance=",var))
[1] "variance= 0.781777580335277"
>
```

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.

```r
f<- function(x) (3/4)*(1/4^(x-1))
y<- function(x) (x^2)
x<-c(1,2,3,4,5)
f(x)

distr<-data.frame(x,f3(x))
distr
ans=f(1)*y(1)+f(2)*y(2)+f(3)*y(3)+f(4)*y(4)+f(5)*y(5)
ans

ans=f(3)*y(3)
ans
x<-c(1,2,3,4,5)
f(x)

mean<-weighted.mean(x,f(x))
mean

var<-ans-mean^2
var
```

62:1 (Top Level) R Script

Console Terminal Background Jobs

R 4.2.1 · ~/

```
> f<- function(x) (3/4)*(1/4^(x-1))
> y<- function(x) (x^2)
> x<-c(1,2,3,4,5)
> f(x)
[1] 0.750000000 0.187500000 0.046875000 0.011718750 0.002929688
>
> distr<-data.frame(x,f3(x))
> distr
  x       f3.x.
1 1 0.750000000
2 2 0.187500000
3 3 0.046875000
4 4 0.011718750
5 5 0.002929688
> ans=f(1)*y(1)+f(2)*y(2)+f(3)*y(3)+f(4)*y(4)+f(5)*y(5)
> ans
[1] 2.182617
>
> ans=f(3)*y(3)
> ans
[1] 0.421875
> x<-c(1,2,3,4,5)
> f(x)
[1] 0.750000000 0.187500000 0.046875000 0.011718750 0.002929688
>
> mean<-weighted.mean(x,f(x))
> mean
[1] 1.328446
>
> var<-ans-mean^2
> var
[1] -1.342893
>
```