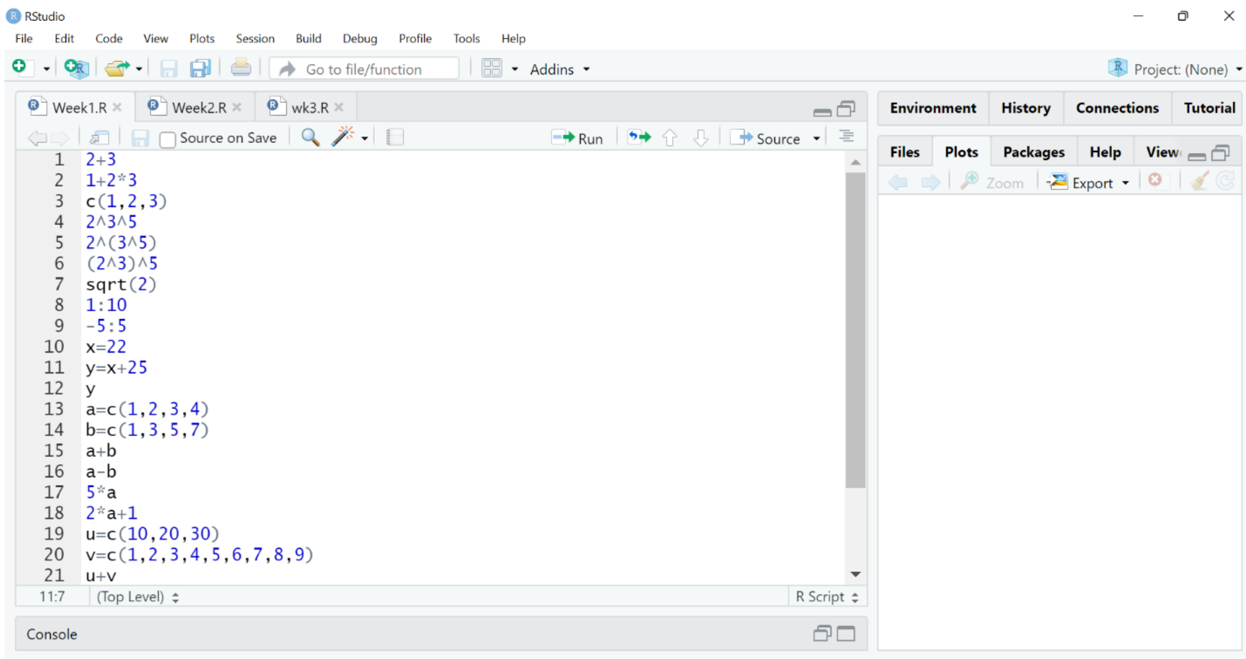
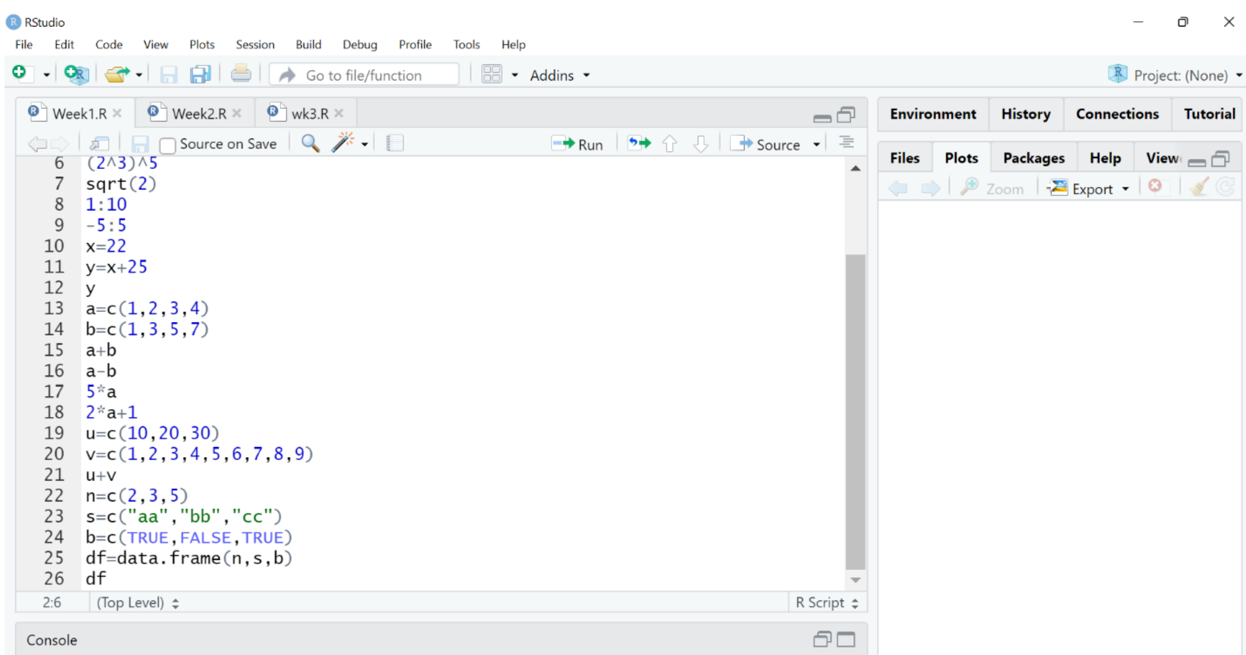
Week – 1

Aim: To understand the basics of R- Programming Language.

Program Code:

```
2+3

1+2*3

c(1,2,3)

2^3^5

2^(3^5)

(2^3)^5

sqrt(2)

1:10

-5:5

x=22

y=x+25

y

a=c(1,2,3,4)

b=c(1,3,5,7)

a+b

a-b

5*a

2*a+1

u=c(10,20,30)

v=c(1,2,3,4,5,6,7,8,9)

u+v

n=c(2,3,5)

s=c("aa","bb","cc")

b=c(TRUE,FALSE,TRUE)

df=data.frame(n,s,b)

df
```



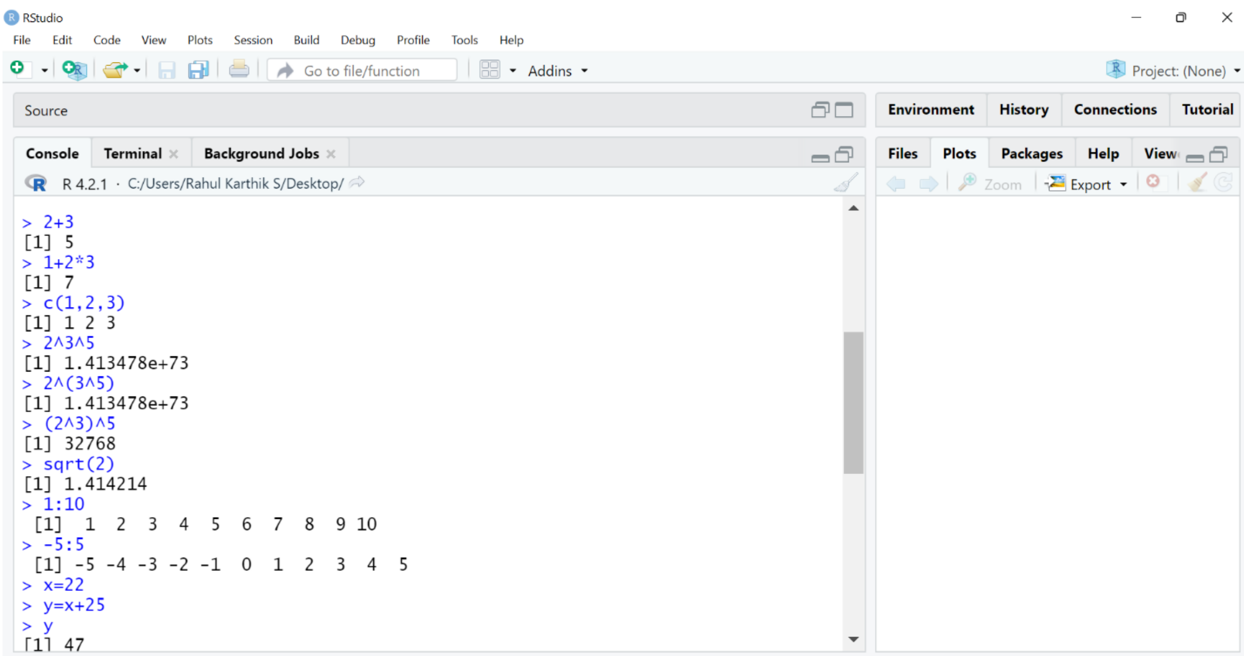


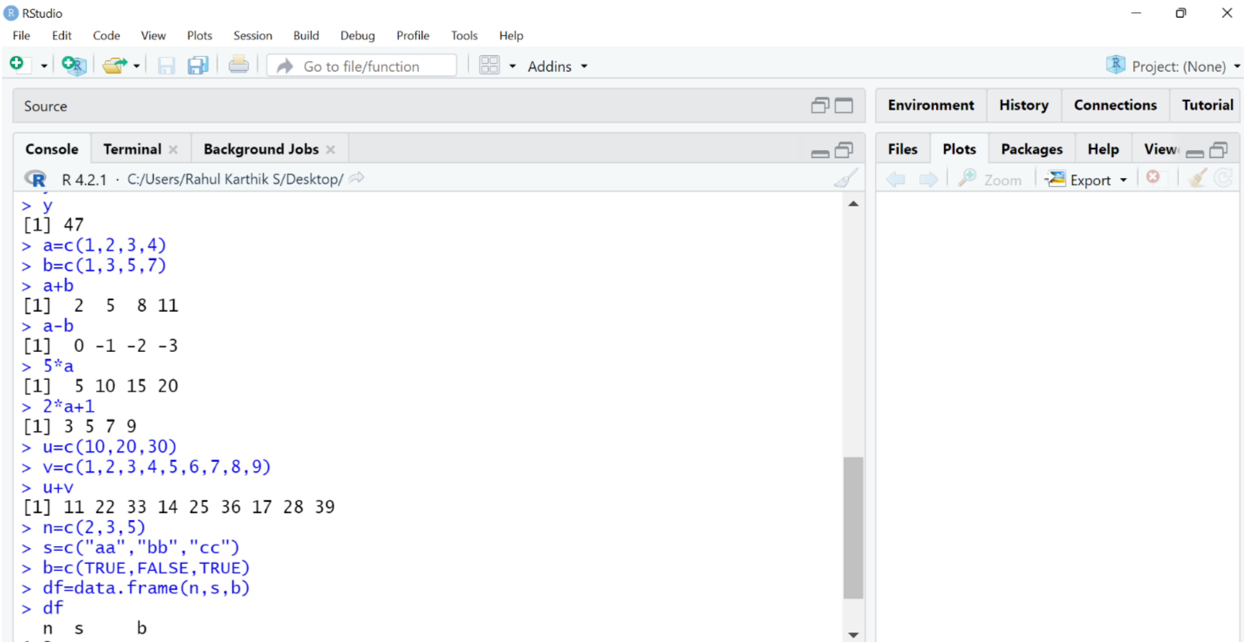
Output:

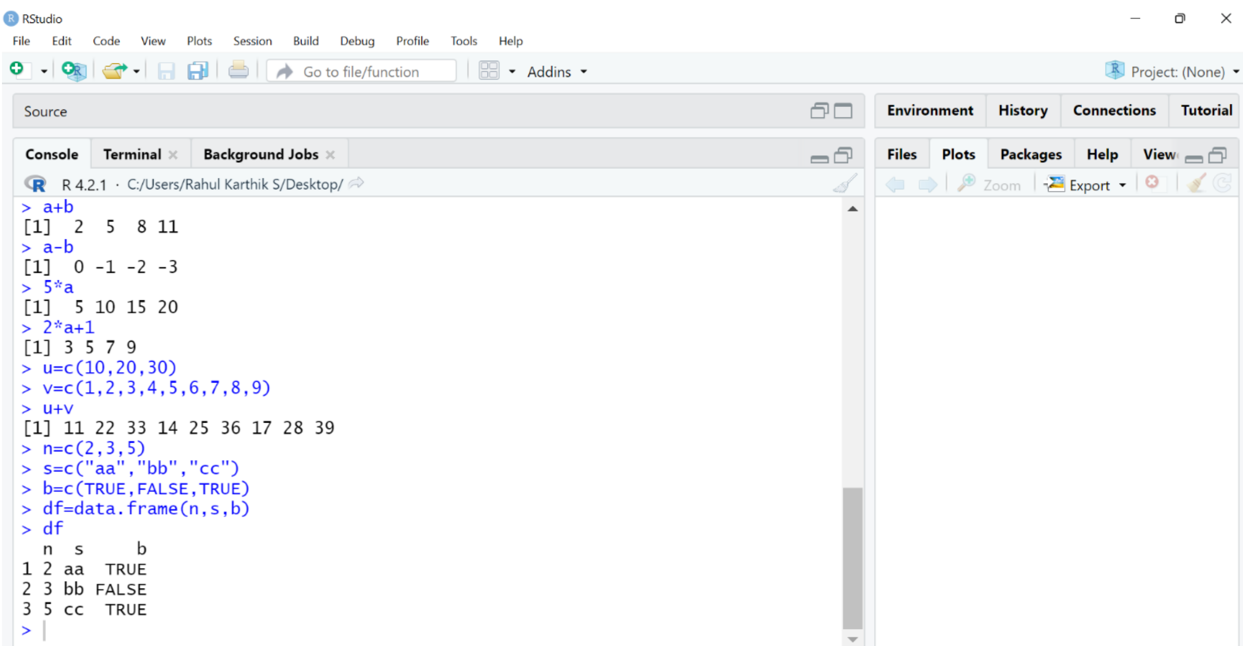
```
> 2+3

[1] 5

> 1+2*3

[1] 7

> c(1,2,3)
```

```
[1] 1 2 3
> 2^3^5
[1] 1.413478e+73
> 2^(3^5)
[1] 1.413478e+73
> (2^3)^5
[1] 32768
> sqrt(2)
[1] 1.414214
> 1:10
 [1]  1  2  3  4  5  6  7  8  9 10
> -5:5
 [1] -5 -4 -3 -2 -1  0  1  2  3  4  5
> x=22
> y=x+25
> y
[1] 47
> a=c(1,2,3,4)
> b=c(1,3,5,7)
>a+b
[1]  2  5  8 11
> a-b
[1]  0 -1 -2 -3
> 5*a
[1]  5 10 15 20
> 2*a+1
[1] 3 5 7 9
> u=c(10,20,30)
> v=c(1,2,3,4,5,6,7,8,9)
>u+v
```

```
[1] 11 22 33 14 25 36 17 28 39
> n=c(2,3,5)
> s=c("aa","bb","cc")
> b=c(TRUE,FALSE,TRUE)
> df=data.frame(n,s,b)
> df
  n  s     b
1 2 aa  TRUE
2 3 bb FALSE
3 5 cc  TRUE
```




RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Source
Console Terminal Background Jobs
R 4.2.1 · C:/Users/Rahul Karthik S/Desktop/
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
> y
[1] 47
> a=c(1,2,3,4)
> b=c(1,3,5,7)
> a+b
[1] 2 5 8 11
> a-b
[1] 0 -1 -2 -3
> 5*a
[1] 5 10 15 20
> 2*a+1
[1] 3 5 7 9
> u=c(10,20,30)
> v=c(1,2,3,4,5,6,7,8,9)
> u+v
[1] 11 22 33 14 25 36 17 28 39
> n=c(2,3,5)
> s=c("aa","bb","cc")
> b=c(TRUE,FALSE,TRUE)
> df=data.frame(n,s,b)
> df
  n s   b


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Source
Console Terminal Background Jobs
R 4.2.1 · C:/Users/Rahul Karthik S/Desktop/
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
> a+b
[1] 2 5 8 11
> a-b
[1] 0 -1 -2 -3
> 5*a
[1] 5 10 15 20
> 2*a+1
[1] 3 5 7 9
> u=c(10,20,30)
> v=c(1,2,3,4,5,6,7,8,9)
> u+v
[1] 11 22 33 14 25 36 17 28 39
> n=c(2,3,5)
> s=c("aa","bb","cc")
> b=c(TRUE,FALSE,TRUE)
> df=data.frame(n,s,b)
> df
  n s   b
1 2 aa TRUE
2 3 bb FALSE
3 5 cc TRUE
>

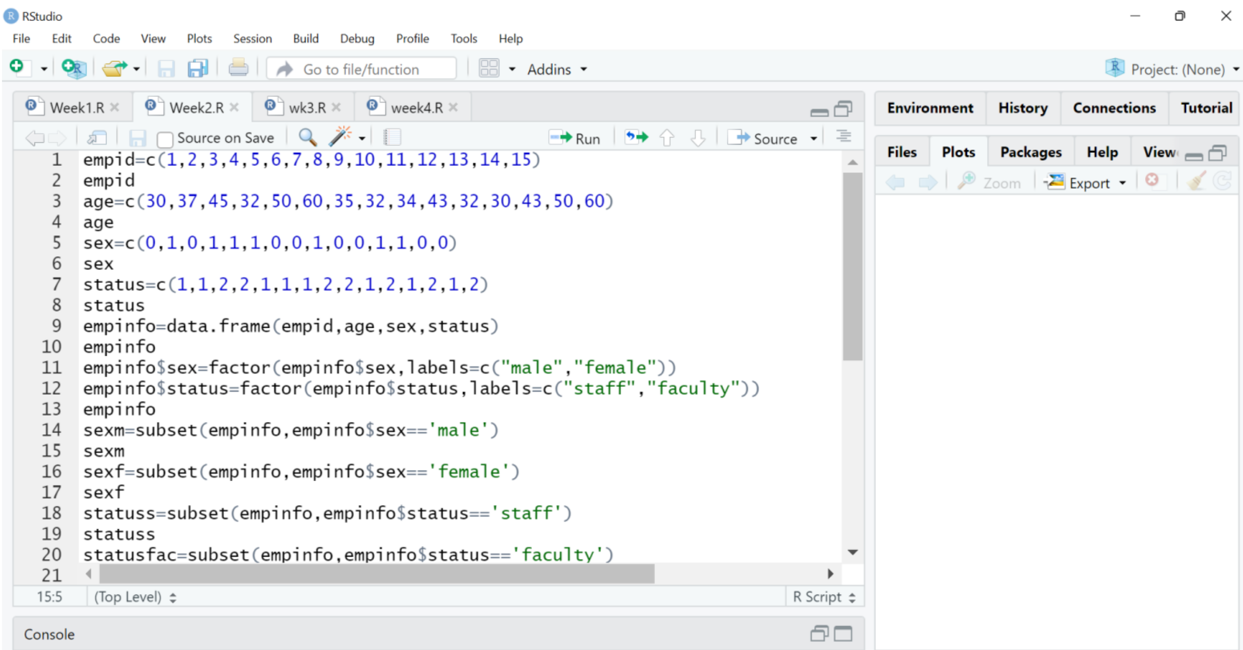
Week – 2

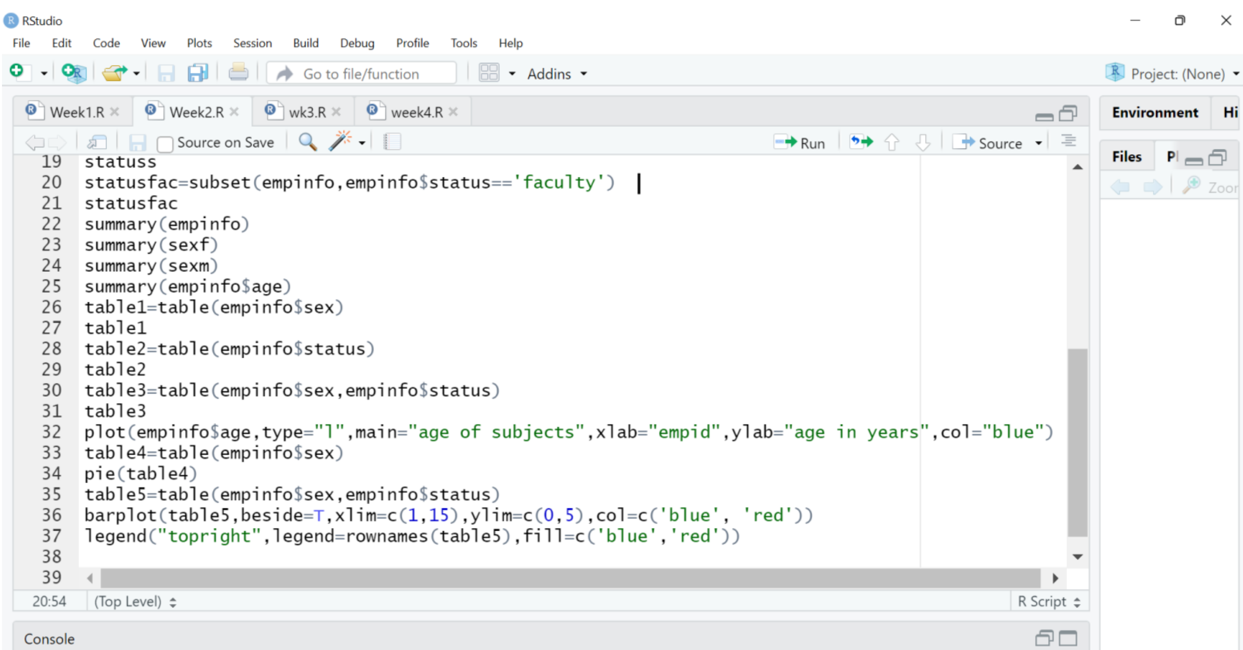
Aim: Computation of tables and graphs – summary statistics for employee data.

Program Code:

```
empid=c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15)
empid
age=c(30,37,45,32,50,60,35,32,34,43,32,30,43,50,60)
age
sex=c(0,1,0,1,1,1,0,0,1,0,0,1,1,0,0)
sex
status=c(1,1,2,2,1,1,1,2,2,1,2,1,2,1,2)
status
empinfo=data.frame(empid,age,sex,status)
empinfo
empinfo$sex=factor(empinfo$sex,labels=c("male","female"))
empinfo$status=factor(empinfo$status,labels=c("staff","faculty"))
empinfo
sexm=subset(empinfo,empinfo$sex=='male')
sexm
sexf=subset(empinfo,empinfo$sex=='female')
sexf
statuss=subset(empinfo,empinfo$status=='staff')
statuss
statusfac=subset(empinfo,empinfo$status=='faculty')
statusfac
summary(empinfo)
summary(sexf)
summary(sexm)
summary(empinfo$age)
table1=table(empinfo$sex)
table1
table2=table(empinfo$status)
table2
table3=table(empinfo$sex,empinfo$status)
table3
```

```
plot(empinfo$age,type="l",main="age of
subjects",xlab="empid",ylab="age in years",col="blue")

table4=table(empinfo$sex)

pie(table4)

table5=table(empinfo$sex,empinfo$status)

barplot(table5,beside=T,xlim=c(1,15),ylim=c(0,5),col=c('blue', 'red'))

legend("topright",legend=rownames(table5),fill=c('blue','red'))
```





Output:

```
> empid=c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15)
> empid
 [1] 1 2 3 4 5 6 7 8 9 10 11 12 13 14
15
>
age=c(30,37,45,32,50,60,35,32,34,43,32,30,43,5
0,60)
> age
 [1] 30 37 45 32 50 60 35 32 34 43 32 30 43 50
60
> sex=c(0,1,0,1,1,1,0,0,1,0,0,1,1,0,0)
> sex
 [1] 0 1 0 1 1 1 0 0 1 0 0 1 1 0 0
> status=c(1,1,2,2,1,1,1,2,2,1,2,1,2,1,2)
> status
 [1] 1 1 2 2 1 1 1 2 2 1 2 1 2 1 2
> empinfo=data.frame(empid,age,sex,status)
> empinfo
 empid age sex status
1 1 30 0 1
2 2 37 1 1
3 3 45 0 2
4 4 32 1 2
5 5 50 1 1
6 6 60 1 1
7 7 35 0 1
8 8 32 0 2
9 9 34 1 2
10 10 43 0 1
11 11 32 0 2
12 12 30 1 1
13 13 43 1 2
14 14 50 0 1
15 15 60 0 2
>
```

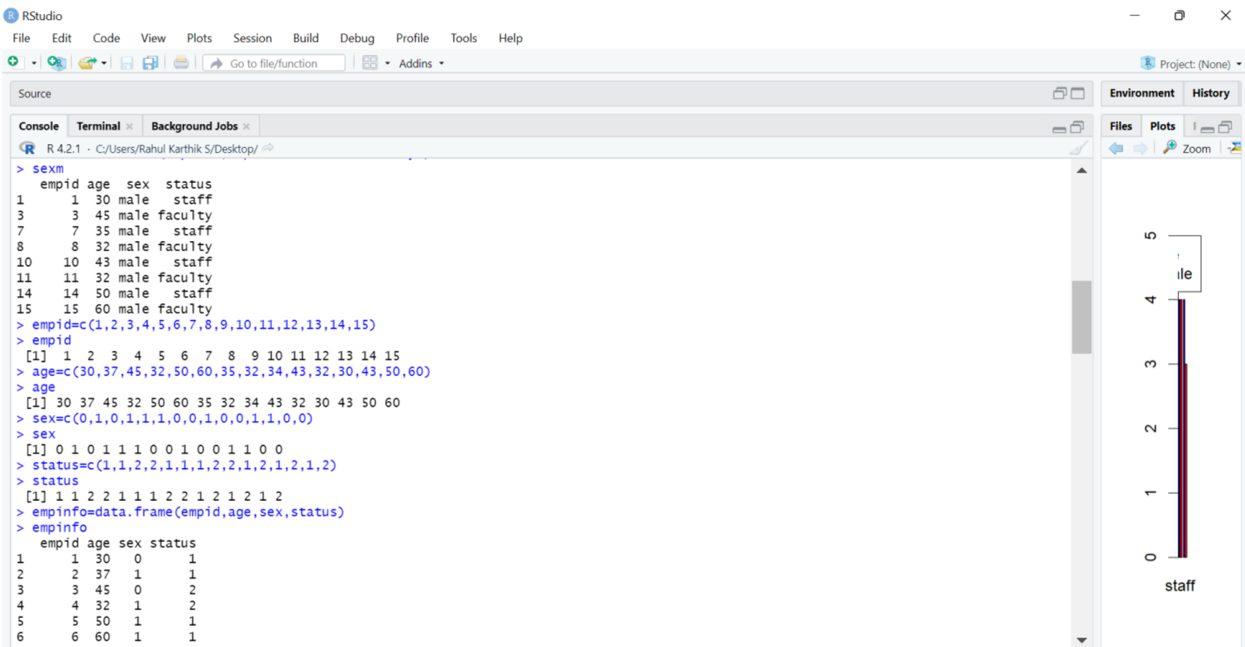
```
empinfo$sex=factor(empinfo$sex,labels=c("male"
,"female"))
>
empinfo$status=factor(empinfo$status,labels=c(
"staff","faculty"))
> empinfo
 empid age sex status
1 1 30 male staff
2 2 37 female staff
3 3 45 male faculty
4 4 32 female faculty
5 5 50 female staff
6 6 60 female staff
7 7 35 male staff
8 8 32 male faculty
9 9 34 female faculty
10 10 43 male staff
11 11 32 male faculty
12 12 30 female staff
13 13 43 female faculty
14 14 50 male staff
15 15 60 male faculty
> sexm=subset(empinfo,empinfo$sex=='male')

> sexm
 empid age sex status
1 1 30 male staff
3 3 45 male faculty
7 7 35 male staff
8 8 32 male faculty
10 10 43 male staff
11 11 32 male faculty
14 14 50 male staff
15 15 60 male faculty
> sexf=subset(empinfo,empinfo$sex=='female')
```

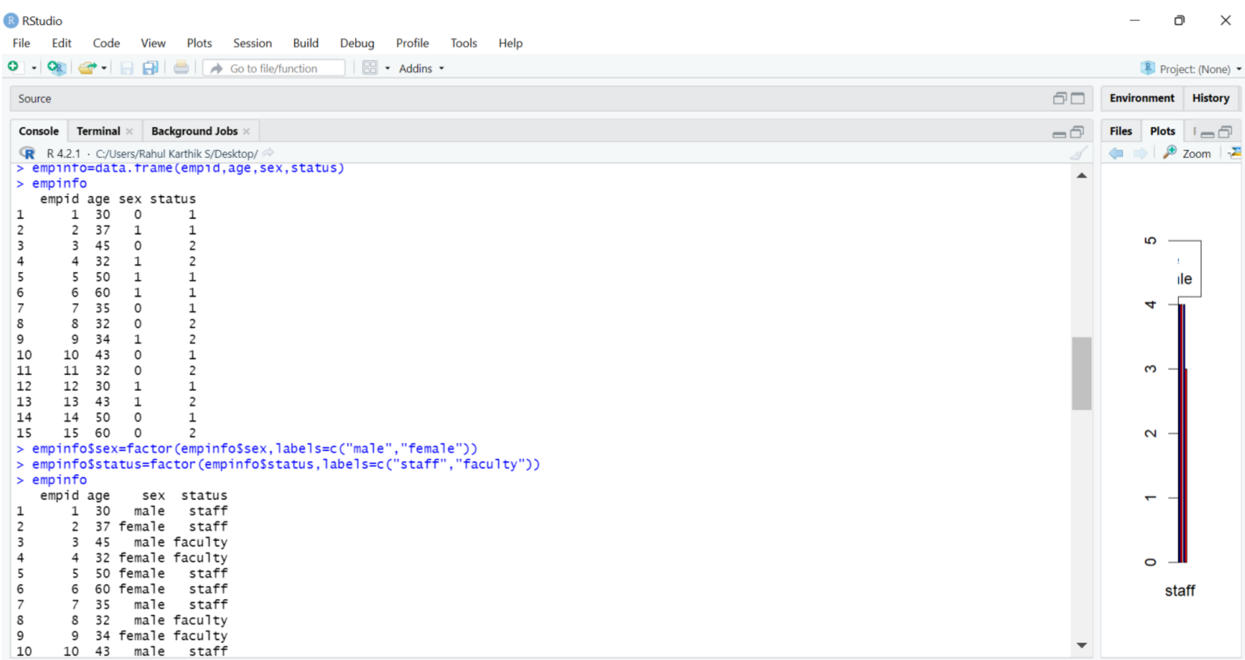
```
> sexf
 empid age sex status
2 2 37 female staff
4 4 32 female faculty
5 5 50 female staff
6 6 60 female staff
9 9 34 female faculty
12 12 30 female staff
13 13 43 female faculty
>
statuss=subset(empinfo,empinfo$status=='staff'
)
> statuss
 empid age sex status
1 1 30 male staff
2 2 37 female staff
5 5 50 female staff
6 6 60 female staff
7 7 35 male staff
10 10 43 male staff
12 12 30 female staff
14 14 50 male staff
>
statusfac=subset(empinfo,empinfo$status=='facu
lty')
> statusfac
 empid age sex status
3 3 45 male faculty
4 4 32 female faculty
8 8 32 male faculty
9 9 34 female faculty
11 11 32 male faculty
13 13 43 female faculty
15 15 60 male faculty
```

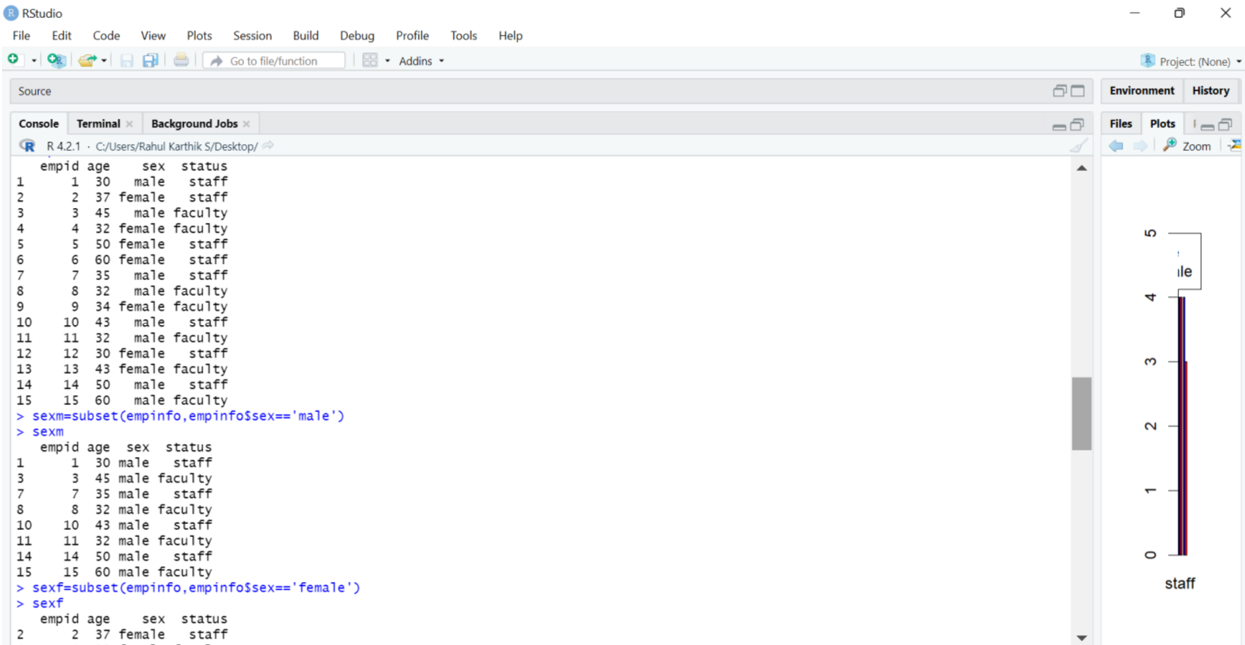
```
> summary(empinfo)
 empid age sex
status
 Min. : 1.0 Min. :30.00 male :8
staff :8
 1st Qu.: 4.5 1st Qu.:32.00 female:7
faculty:7
 Median : 8.0 Median :37.00

 Mean : 8.0 Mean :40.87

 3rd Qu.:11.5 3rd Qu.:47.50

 Max. :15.0 Max. :60.00

> summary(sexf)
 empid age sex
 status
 Min. : 2.000 Min. :30.00 male :0
staff :4
 1st Qu.: 4.500 1st Qu.:33.00 female:7
faculty:3
 Median : 6.000 Median :37.00

 Mean : 7.286 Mean :40.86

 3rd Qu.:10.500 3rd Qu.:46.50

 Max. :13.000 Max. :60.00

> summary(sexm)
 empid age sex
 status
 Min. : 1.000 Min. :30.00 male :8
staff :4
```

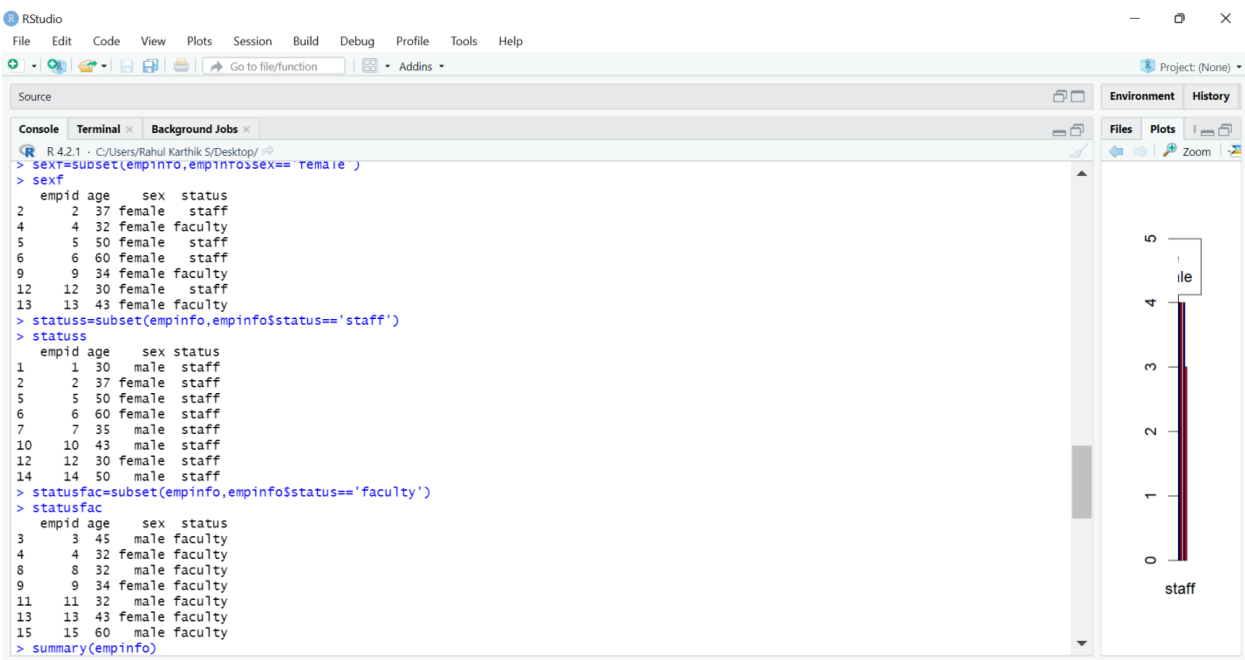
```
 1st Qu.: 6.000 1st Qu.:32.00 female:0
faculty:4
 Median : 9.000 Median :39.00

 Mean : 8.625 Mean :40.88

 3rd Qu.:11.750 3rd Qu.:46.25

 Max. :15.000 Max. :60.00

> summary(empinfo$age)
 Min. 1st Qu. Median Mean 3rd Qu.
Max.
 30.00 32.00 37.00 40.87 47.50
60.00
> table1=table(empinfo$sex)
> table1
 male female
 8 7
> table2=table(empinfo$status)
> table2
 staff faculty
 8 7
> table3=table(empinfo$sex,empinfo$status)
> table3

 staff faculty
 male 4 4
 female 4 3
> plot(empinfo$age,type="l",main="age of
subjects",xlab="empid",ylab="age in
years",col="blue")
> table4=table(empinfo$sex)
> pie(table4)
> table5=table(empinfo$sex,empinfo$status)
```

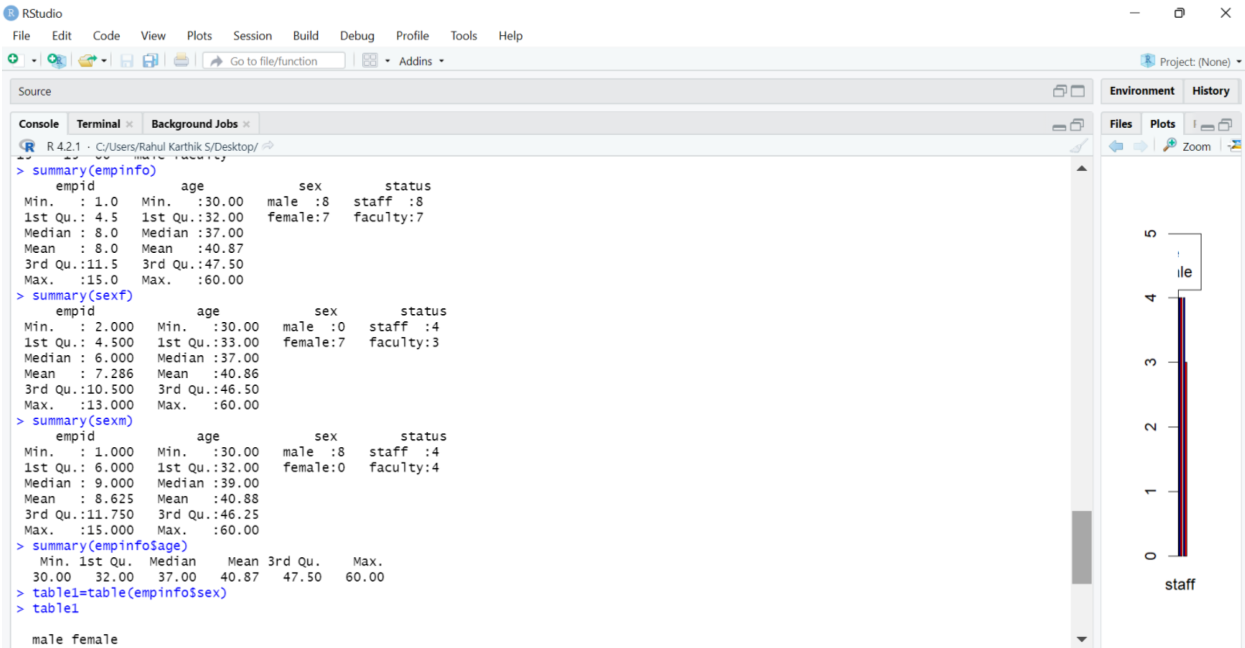
```
>
barplot(table5,beside=T,xlim=c(1,15),ylim=c(0,
5),col=c('blue', 'red'))
>
legend("topright",legend=rownames(table5),fill
=c('blue','red'))
>
```

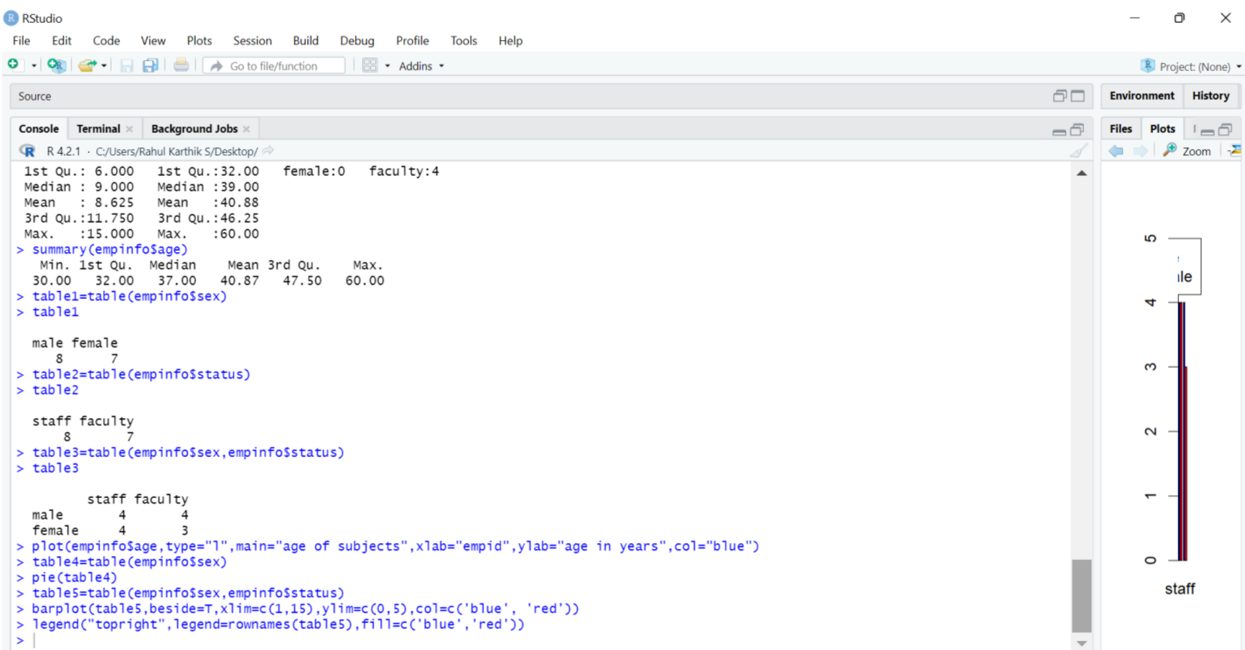




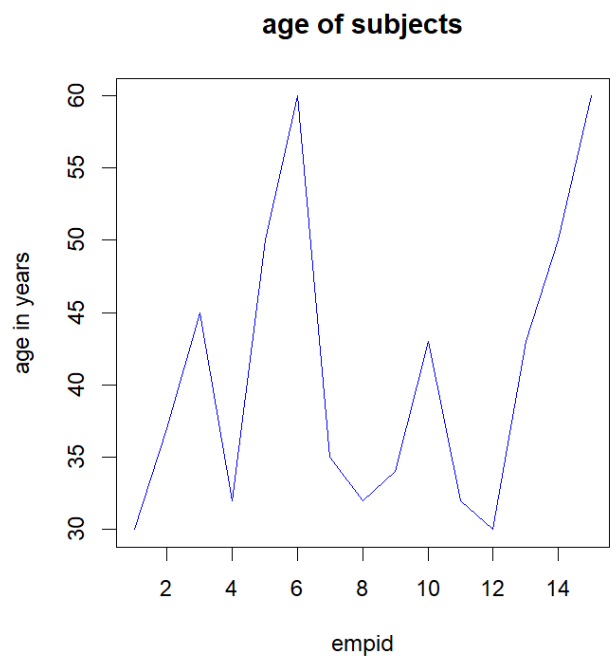

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
R 4.2.1 · C:/Users/Rahul Karthik S/Desktop/
   empid age   sex status
1   1 30   male   staff
2   2 37 female   staff
3   3 45   male faculty
4   4 32 female faculty
5   5 50 female   staff
6   6 60 female   staff
7   7 35   male   staff
8   8 32   male faculty
9   9 34 female faculty
10   10 43   male   staff
11   11 32   male faculty
12   12 30 female   staff
13   13 43 female faculty
14   14 50   male   staff
15   15 60   male faculty
> sexm=subset(empinfo,empinfo$sex=='male')
> sexm
   empid age sex status
1   1 30 male   staff
3   3 45 male faculty
7   7 35 male   staff
8   8 32 male faculty
10   10 43 male   staff
11   11 32 male faculty
14   14 50 male   staff
15   15 60 male faculty
> sexf=subset(empinfo,empinfo$sex=='female')
> sexf
   empid age   sex status
2   2 37 female   staff
staff

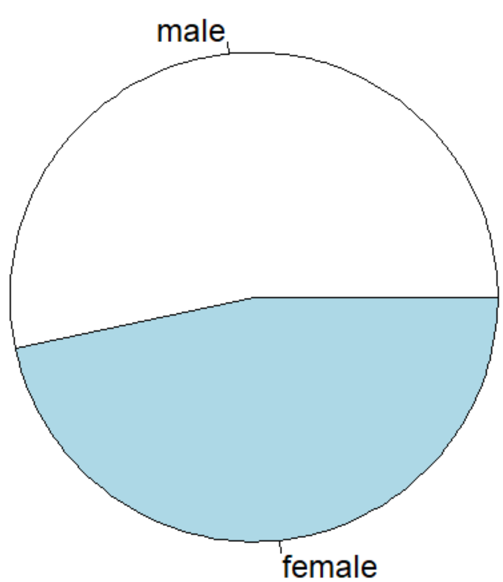

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
R 4.2.1 · C:/Users/Rahul Karthik S/Desktop/
> sexf
   empid age   sex status
2   2 37 female   staff
4   4 32 female faculty
5   5 50 female   staff
6   6 60 female   staff
9   9 34 female faculty
12   12 30 female   staff
13   13 43 female faculty
> statuss=subset(empinfo,empinfo$status=='staff')
> statuss
   empid age   sex status
1   1 30   male staff
2   2 37 female staff
5   5 50 female staff
6   6 60 female staff
7   7 35   male staff
10   10 43   male staff
12   12 30 female staff
14   14 50   male staff
> statusfac=subset(empinfo,empinfo$status=='faculty')
> statusfac
   empid age   sex status
3   3 45   male faculty
4   4 32 female faculty
8   8 32   male faculty
9   9 34 female faculty
11   11 32   male faculty
13   13 43 female faculty
15   15 60   male faculty
> summary(empinfo)
staff

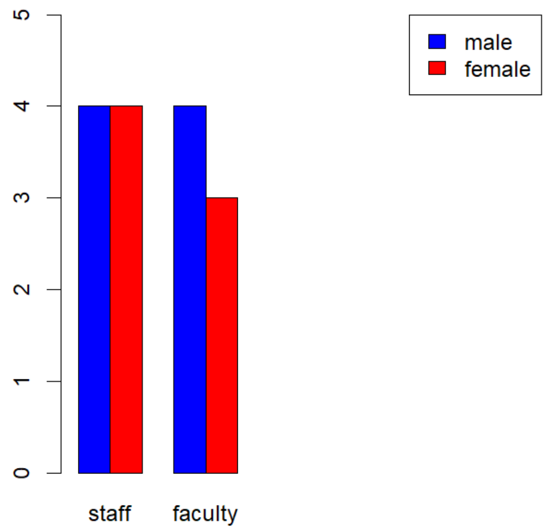

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Source
Console Terminal Background Jobs
R 4.2.1 · C:/Users/Rahul Karthik S/Desktop/
> summary(empinfo)
empid age sex status
Min. : 1.0 Min. :30.00 male :8 staff :8
1st Qu.: 4.5 1st Qu.:32.00 female:7 faculty:7
Median : 8.0 Median :37.00
Mean : 8.0 Mean :40.87
3rd Qu.:11.5 3rd Qu.:47.50
Max. :15.0 Max. :60.00
> summary(sexf)
empid age sex status
Min. : 2.000 Min. :30.00 male :0 staff :4
1st Qu.: 4.500 1st Qu.:33.00 female:7 faculty:3
Median : 6.000 Median :37.00
Mean : 7.286 Mean :40.86
3rd Qu.:10.500 3rd Qu.:46.50
Max. :13.000 Max. :60.00
> summary(sexm)
empid age sex status
Min. : 1.000 Min. :30.00 male :8 staff :4
1st Qu.: 6.000 1st Qu.:32.00 female:0 faculty:4
Median : 9.000 Median :39.00
Mean : 8.625 Mean :40.88
3rd Qu.:11.750 3rd Qu.:46.25
Max. :15.000 Max. :60.00
> summary(empinfo$age)
Min. 1st Qu. Median Mean 3rd Qu. Max.
30.00 32.00 37.00 40.87 47.50 60.00
> table1=table(empinfo$sex)
> table1
male female
Environment History
Files Plots
Zoom
staff


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Source
Console Terminal Background Jobs
R 4.2.1 · C:/Users/Rahul Karthik S/Desktop/
1st Qu.: 6.000 1st Qu.:32.00 female:0 faculty:4
Median : 9.000 Median :39.00
Mean : 8.625 Mean :40.88
3rd Qu.:11.750 3rd Qu.:46.25
Max. :15.000 Max. :60.00
> summary(empinfo$age)
Min. 1st Qu. Median Mean 3rd Qu. Max.
30.00 32.00 37.00 40.87 47.50 60.00
> table1=table(empinfo$sex)
> table1
male female
8 7
> table2=table(empinfo$status)
> table2
staff faculty
8 7
> table3=table(empinfo$sex,empinfo$status)
> table3
staff faculty
male 4 4
female 4 3
> plot(empinfo$age,type="l",main="age of subjects",xlab="empid",ylab="age in years",col="blue")
> table4=table(empinfo$sex)
> pie(table4)
> table5=table(empinfo$sex,empinfo$status)
> barplot(table5,beside=T,xlim=c(1,15),ylim=c(0,5),col=c('blue', 'red'))
> legend("topright",legend=rownames(table5),fill=c('blue','red'))
Environment History
Files Plots
Zoom
staff

Graph:


age of subjects
age in years
30
35
40
45
50
55
60
2
4
6
8
10
12
14
empid


male
female

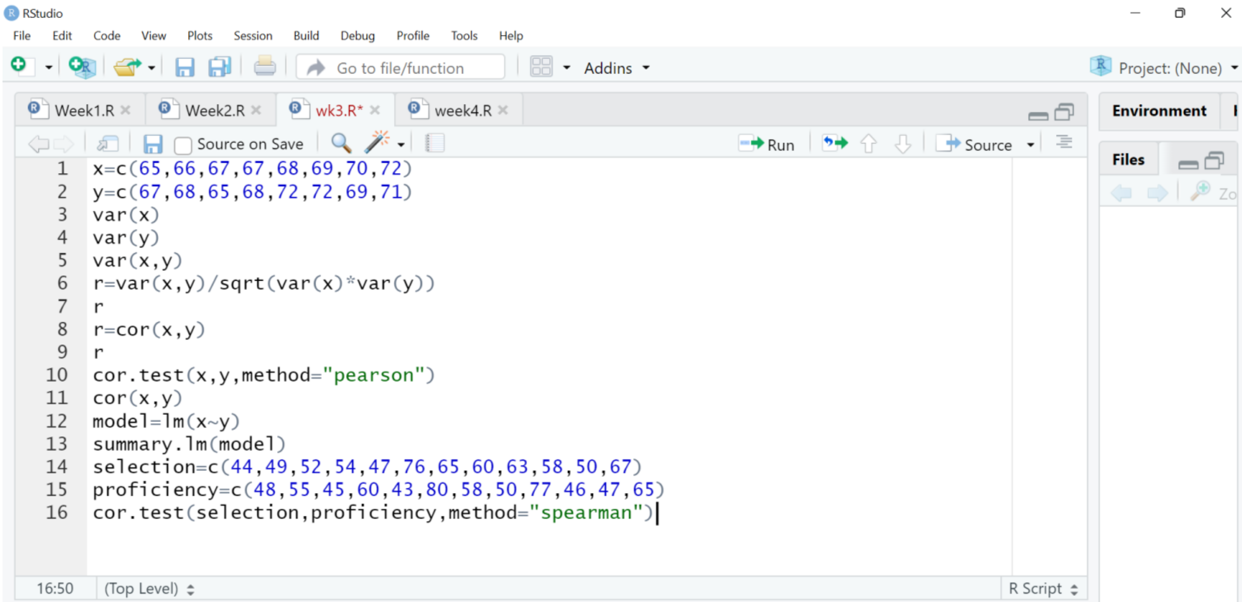

male
female
0
1
2
3
4
5
staff
faculty

<u>Week – 3</u>

Aim: To calculate the correlation coefficient using R- Programming Language.

Program Code:

```
x=c(65,66,67,67,68,69,70,72)

y=c(67,68,65,68,72,72,69,71)

var(x)

var(y)

var(x,y)

r=var(x,y)/sqrt(var(x)*var(y))

r

r=cor(x,y)

r

cor.test(x,y,method="pearson")

cor(x,y)

model=lm(x~y)

summary.lm(model)

selection=c(44,49,52,54,47,76,65,60,63,58,50,67)

proficiency=c(48,55,45,60,43,80,58,50,77,46,47,65)

cor.test(selection,proficiency,method="spearman")
```



Output:

```
> x=c(65,66,67,67,68,69,70,72)

> y=c(67,68,65,68,72,72,69,71)

> var(x)

[1] 5.142857

> var(y)

[1] 6.285714

> var(x,y)

[1] 3.428571

> r=var(x,y)/sqrt(var(x)*var(y))

> r

[1] 0.6030227

> r=cor(x,y)

> r

[1] 0.6030227

> cor.test(x,y,method="pearson")
```

```
        Pearson's product-moment correlation

data:  x and y
t = 1.8516, df = 6, p-value = 0.1135
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.1767627  0.9177238
sample estimates:
      cor
0.6030227

> cor(x,y)
[1] 0.6030227
> model=lm(x~y)
> summary.lm(model)

Call:
lm(formula = x ~ y)

Residuals:
    Min      1Q  Median      3Q     Max
-1.9091 -1.5000 -0.5454  1.3864  2.9091

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  30.3636    20.3377   1.493    0.186
y             0.5455     0.2946   1.852    0.114
```

```
Residual standard error: 1.954 on 6 degrees of freedom
Multiple R-squared:  0.3636,  Adjusted R-squared:  0.2576
F-statistic: 3.429 on 1 and 6 DF,  p-value: 0.1135

> selection=c(44,49,52,54,47,76,65,60,63,58,50,67)
> proficiency=c(48,55,45,60,43,80,58,50,77,46,47,65)
> cor.test(selection,proficiency,method="spearman")

  Spearman's rank correlation rho

data:  selection and proficiency
S = 80, p-value = 0.01102
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.7202797
```

```
> x=c(65,66,67,67,68,69,70,72)
> y=c(67,68,65,68,72,72,69,71)
> var(x)
[1] 5.142857
> var(y)
[1] 6.285714
> var(x,y)
[1] 3.428571
> r=var(x,y)/sqrt(var(x)*var(y))
> r
[1] 0.6030227
> r=cor(x,y)
> r
[1] 0.6030227
> cor.test(x,y,method="pearson")

        Pearson's product-moment correlation

data:  x and y
t = 1.8516, df = 6, p-value = 0.1135
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.1767627  0.9177238
sample estimates:
      cor
0.6030227

> cor(x,y)
[1] 0.6030227
> model=lm(x~y)
> summary.lm(model)
```

```
> model=lm(x~y)
> summary.lm(model)

Call:
lm(formula = x ~ y)

Residuals:
    Min      1Q  Median      3Q     Max
-1.9091 -1.5000 -0.5454  1.3864  2.9091

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  30.3636    20.3377   1.493    0.186
y             0.5455     0.2946   1.852    0.114

Residual standard error: 1.954 on 6 degrees of freedom
Multiple R-squared:  0.3636,    Adjusted R-squared:  0.2576
F-statistic: 3.429 on 1 and 6 DF,  p-value: 0.1135

> selection=c(44,49,52,54,47,76,65,60,63,58,50,67)
> proficiency=c(48,55,45,60,43,80,58,50,77,46,47,65)
> cor.test(selection,proficiency,method="spearman")

        Spearman's rank correlation rho

data:  selection and proficiency
S = 80, p-value = 0.01102
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.7202797
```

<u>**Week – 4**</u>

Definition: Multiple regression generally explains the relationship between multiple independent variables and one dependent variable.

The multiple regression equation takes the following form:

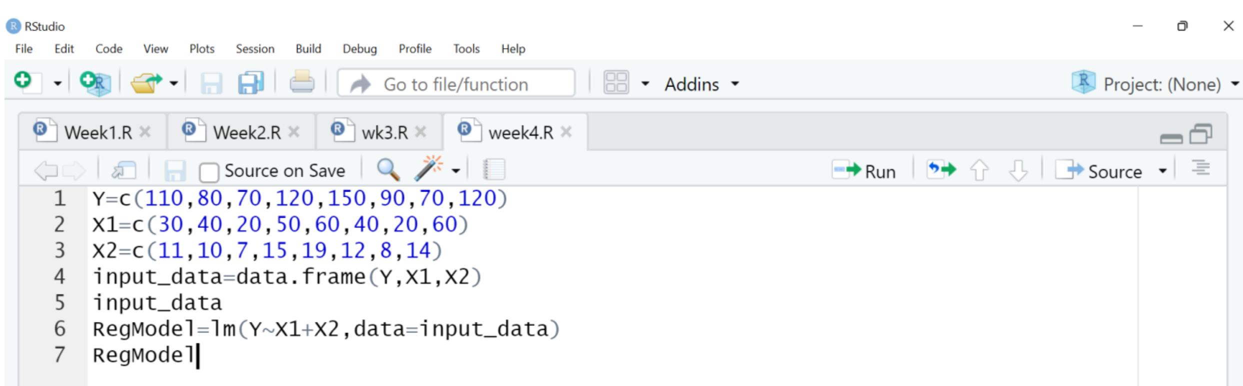
$$y = b_1x_1 + b_2x_2 + \cdots + b_nx_n + c$$

Problem 1: *The sale of a product in lakhs of rupees (Y) is expected to be influenced by two variables namely the advertising expenditure (X1) and the number of sales persons (X2) in a region. Sample data on 8 regions of a state has given the following results.*

Area	Y	X1	X2
1	110	30	11
2	80	40	10
3	70	20	7
4	120	50	15
5	150	60	19
6	90	40	12
7	70	20	8
8	120	60	14

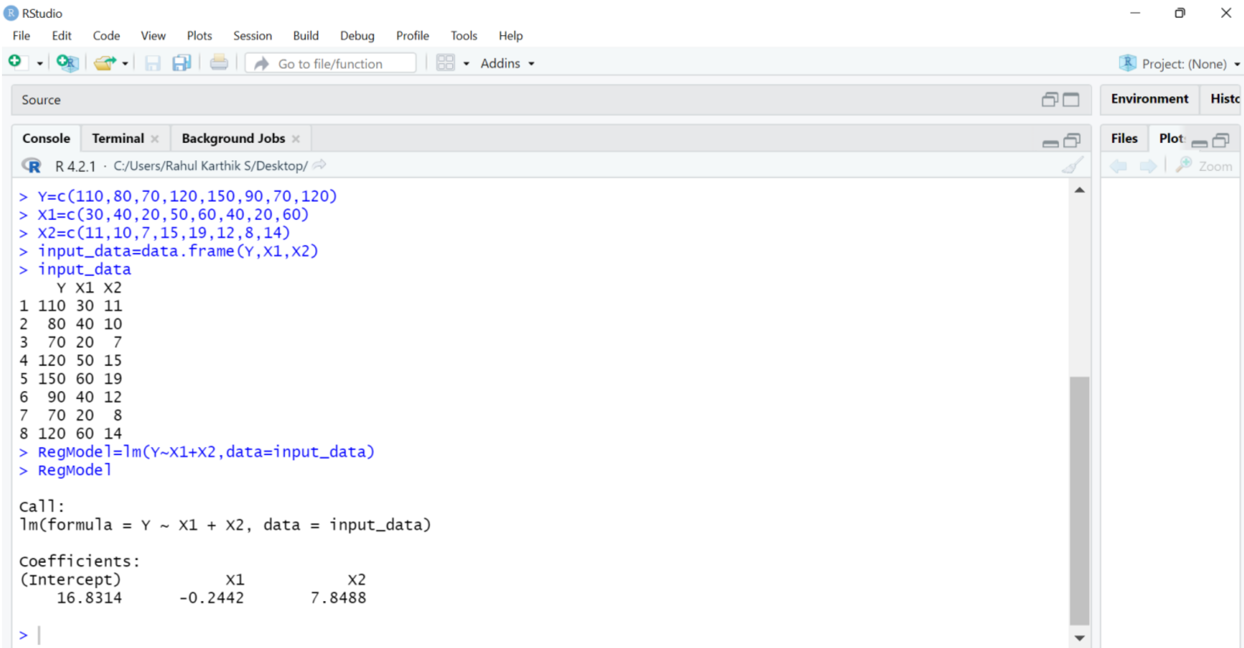
Program Code:

```
Y=c(110,80,70,120,150,90,70,120)

X1=c(30,40,20,50,60,40,20,60)

X2=c(11,10,7,15,19,12,8,14)

input_data=data.frame(Y,X1,X2)

input_data

RegModel=lm(Y~X1+X2,data=input_data)

RegModel
```



Output:

```
> Y=c(110,80,70,120,150,90,70,120)
> X1=c(30,40,20,50,60,40,20,60)
> X2=c(11,10,7,15,19,12,8,14)
> input_data=data.frame(Y,X1,X2)
> input_data
    Y X1 X2
1 110 30 11
2  80 40 10
3  70 20  7
4 120 50 15
5 150 60 19
6  90 40 12
7  70 20  8
8 120 60 14
> RegModel=lm(Y~X1+X2,data=input_data)
> RegModel

Call:
lm(formula = Y ~ X1 + X2, data = input_data)

Coefficients:
(Intercept)           X1           X2
    16.8314      -0.2442       7.8488
```



RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Source
Environment
Console
Terminal
Background Jobs
R 4.2.1 · C:/Users/Rahul Karthik S/Desktop/
Files
Plot
Zoom

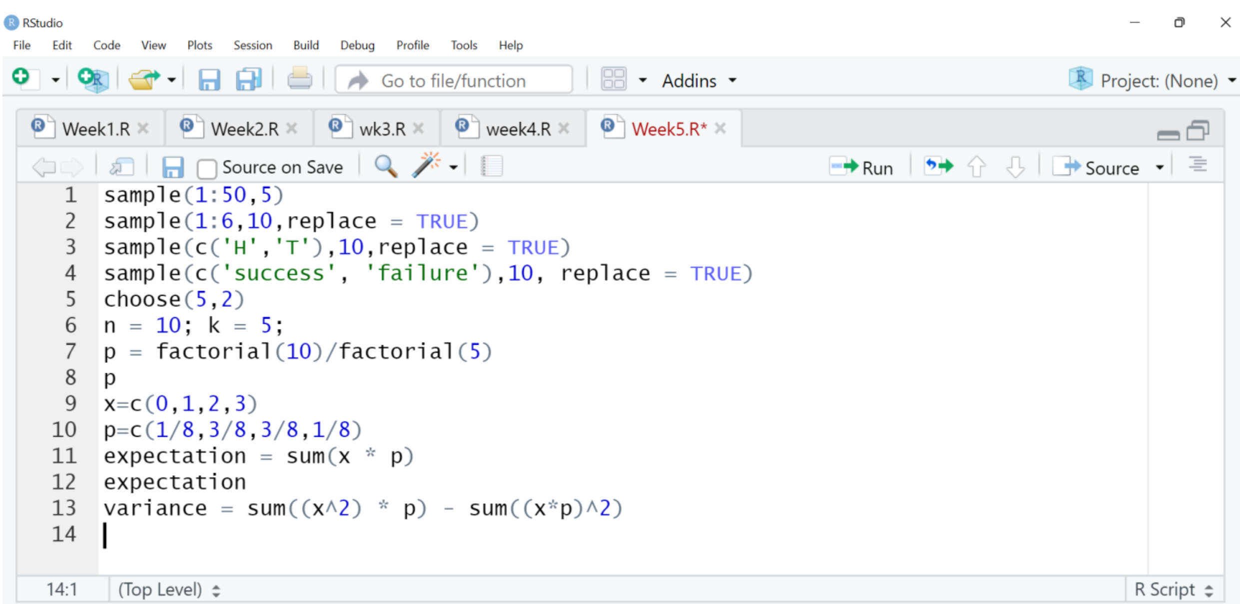
```
> Y=c(110,80,70,120,150,90,70,120)
> X1=c(30,40,20,50,60,40,20,60)
> X2=c(11,10,7,15,19,12,8,14)
> input_data=data.frame(Y,X1,X2)
> input_data
    Y X1 X2
1 110 30 11
2  80 40 10
3  70 20  7
4 120 50 15
5 150 60 19
6  90 40 12
7  70 20  8
8 120 60 14
> RegModel=lm(Y~X1+X2,data=input_data)
> RegModel

Call:
lm(formula = Y ~ X1 + X2, data = input_data)

Coefficients:
(Intercept)           X1           X2  
    16.8314      -0.2442       7.8488  

> 
```

Week – 5

Aim: To conduct random experiments with the probability concepts using R- Programming Language.

Program Code:

```
sample(1:50,5)

sample(1:6,10,replace = TRUE)

sample(c('H','T'),10,replace = TRUE)

sample(c('success', 'failure'),10, replace = TRUE)

choose(5,2)

n = 10; k = 5;

p = factorial(10)/factorial(5)

p

x=c(0,1,2,3)

p=c(1/8,3/8,3/8,1/8)

expectation = sum(x * p)

expectation

variance = sum((x^2) * p) - sum((x*p)^2)
```



Output:

```
> sample(1:50,5)

[1] 13 39 42 26 44

> sample(1:6,10,replace = TRUE)

 [1] 1 2 3 3 5 3 5 3 1 1

> sample(c('H','T'),10,replace = TRUE)

 [1] "H" "T" "T" "H" "T" "H" "H" "T" "T" "T"

> sample(c('success', 'failure'),10, replace = TRUE)

 [1] "failure" "success" "failure" "success" "success" "failure"
"failure" "success" "success" "success"

> choose(5,2)

[1] 10

> n = 10; k = 5;

> p = factorial(10)/factorial(5)

> p

[1] 30240

> x=c(0,1,2,3)

> p=c(1/8,3/8,3/8,1/8)

> expectation = sum(x * p)

> expectation

[1] 1.5

> variance = sum((x^2) * p) - sum((x*p)^2)

>
```

```
> sample(1:50,5)
[1] 13 39 42 26 44
> sample(1:6,10,replace = TRUE)
 [1] 1 2 3 3 5 3 5 3 1 1
> sample(c('H','T'),10,replace = TRUE)
 [1] "H" "T" "T" "H" "T" "H" "H" "T" "T" "T"
> sample(c('success', 'failure'),10, replace = TRUE)
 [1] "failure" "success" "failure" "success" "success" "failure" "failure" "success" "success" "success"
> choose(5,2)
[1] 10
> n = 10; k = 5;
> p = factorial(10)/factorial(5)
> p
[1] 30240
> x=c(0,1,2,3)
> p=c(1/8,3/8,3/8,1/8)
> expectation = sum(x * p)
> expectation
[1] 1.5
> variance = sum((x^2) * p) - sum((x*p)^2)
> 
```

Week - 6

Name: Rahul Karthik S
Register Number: 21BEC1851

Binomial Distribution: A rv X is said to follow binomial distribution if it assumed only non-negative values and its pmf is given by:

$$P(X=x)=p(x)=\begin{cases} \binom{n}{x} p^x q^{n-x}; x = 0, 1, 2, \dots n; q = 1 - p \\ 0, otherwie \end{cases}$$

dbinom(x,size=n,prob=p)
Aim: Computation and Plotting Binomial Distributions.

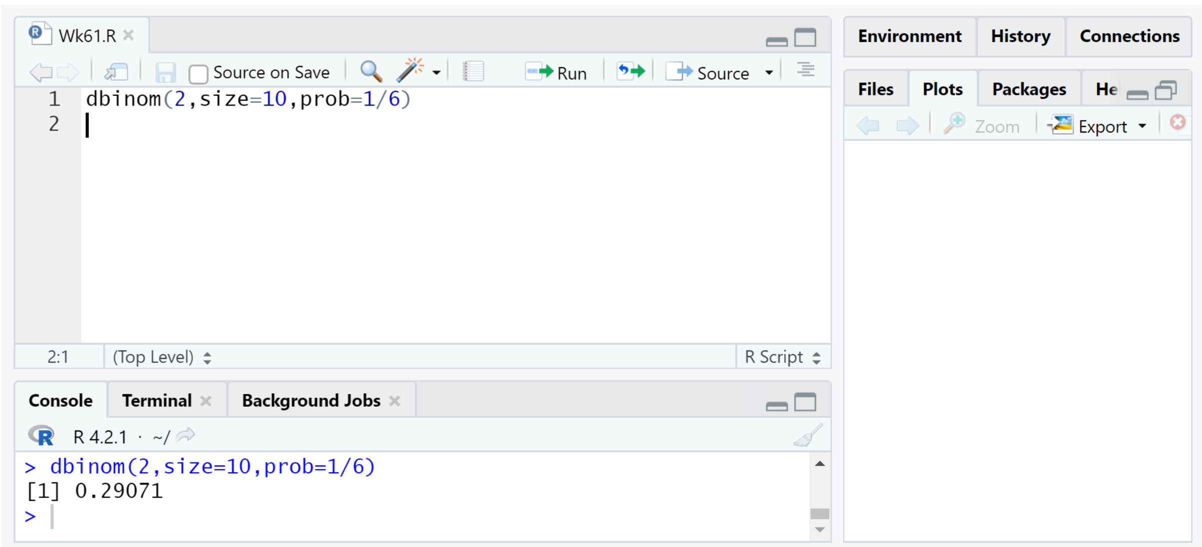
PROBLEM 1: Find the probability of getting two "2" among ten dice.

PROGRAM CODE:

```
dbinom(2,size=10,prob=1/6)
```

OUTPUT:

```
> dbinom(2,size=10,prob=1/6)
[1] 0.29071
```



PROBLEM 2: Find BIN(n=10,P=1/6) and visualise binomial plots.

PROGRAM CODE:

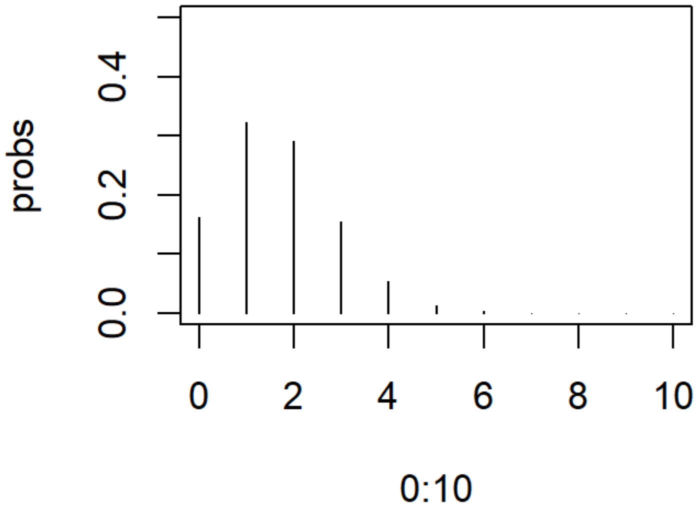
```
n=10;p=1/6
probs=dbinom(x=c(0:n),size=n,prob=p)
probs=round(probs,4);
x=0:n;
```

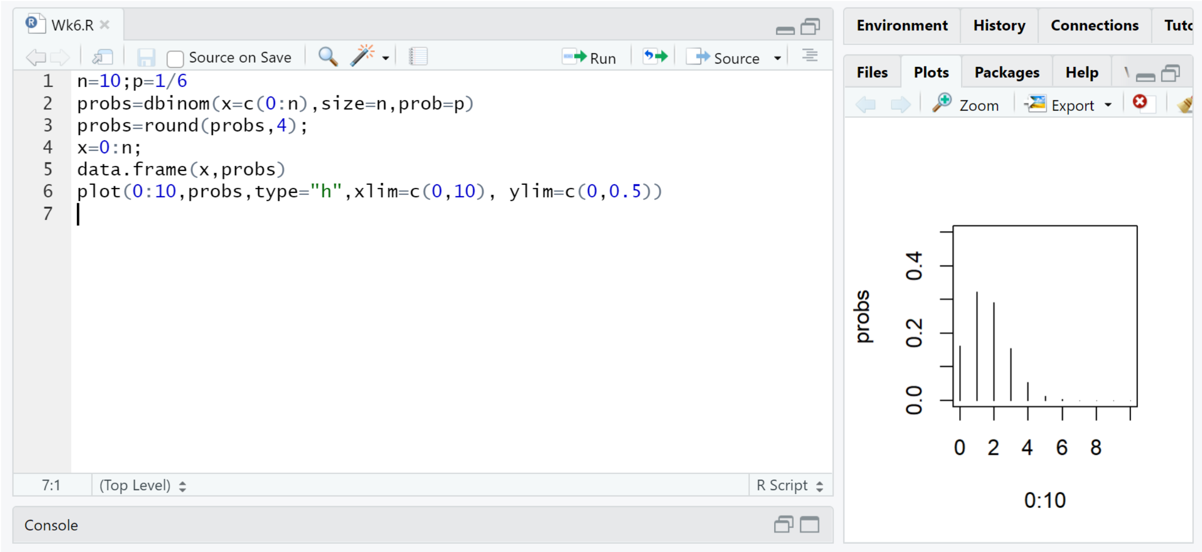
```
data.frame(x,probs)
plot(0:10,probs,type="h",xlim=c(0,10), ylim=c(0,0.5))
```

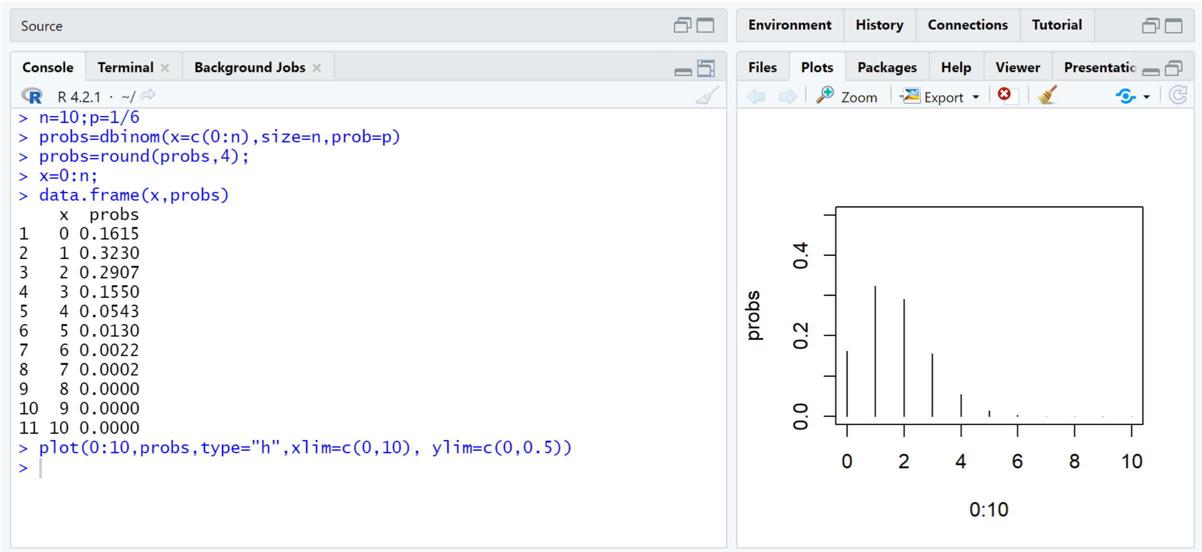
OUTPUT:

```
> n=10;p=1/6
> probs=dbinom(x=c(0:n),size=n,prob=p)
> probs=round(probs,4);
> x=0:n;
> data.frame(x,probs)
    x  probs
1   0 0.1615
2   1 0.3230
3   2 0.2907
4   3 0.1550
5   4 0.0543
6   5 0.0130
7   6 0.0022
8   7 0.0002
9   8 0.0000
10  9 0.0000
11 10 0.0000
> plot(0:10,probs,type="h",xlim=c(0,10), ylim=c(0,0.5))
>
```

GRAPH:







PROBLEM 3: For a Binomial(7,1/4) random variable named X,
i. Compute the probability of two success
ii. Compute the Probabilities for whole space
iii. Display those probabilities in a table
iv. Show the shape of this binomial Distribution

PROGRAM CODE:

(i)

```
dbinom(2,7,1/4)
```

(ii)

```
p=dbinom(0:7,7,1/4)
round(p,4)
```

(iii)

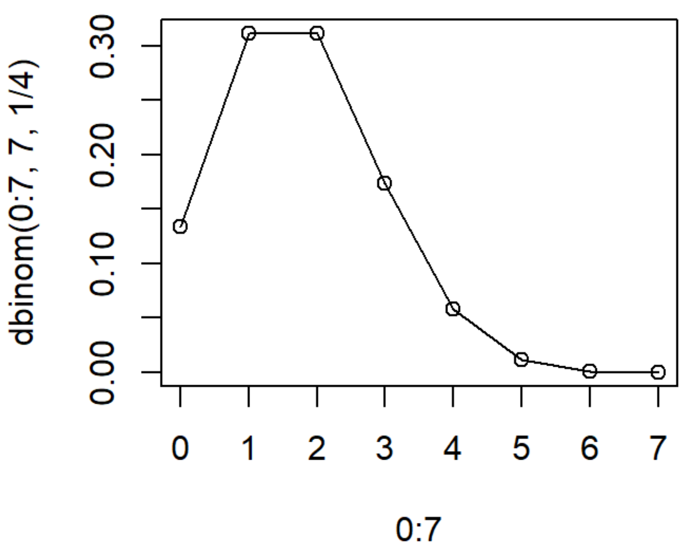
```
p=data.frame(0:7,dbinom(0:7,7,1/4))
round(p,4)
```

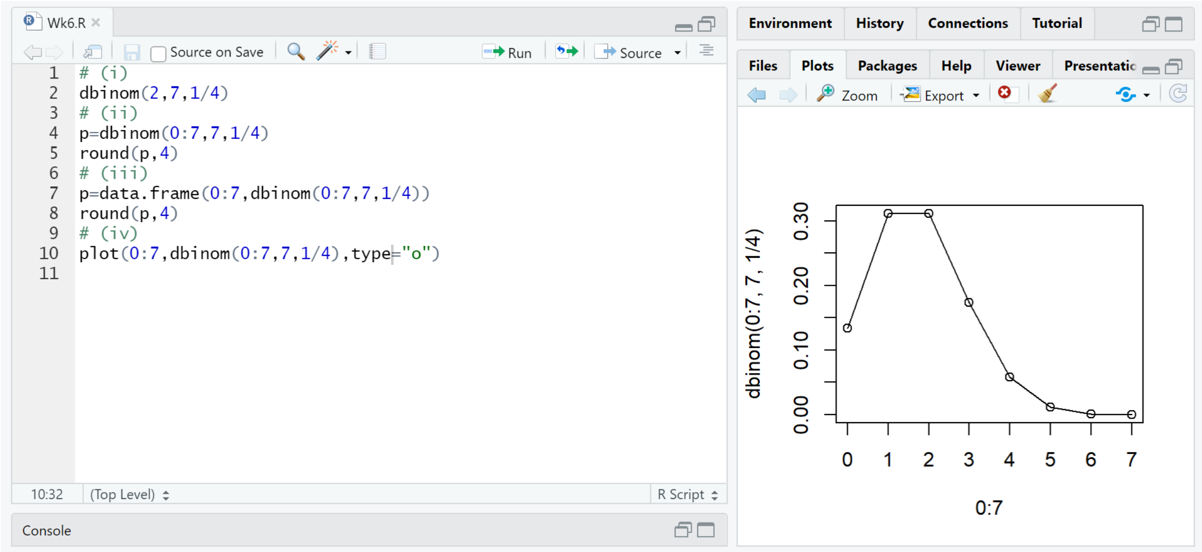
(iv)
plot(0:7,dbinom(0:7,7,1/4),type="o")

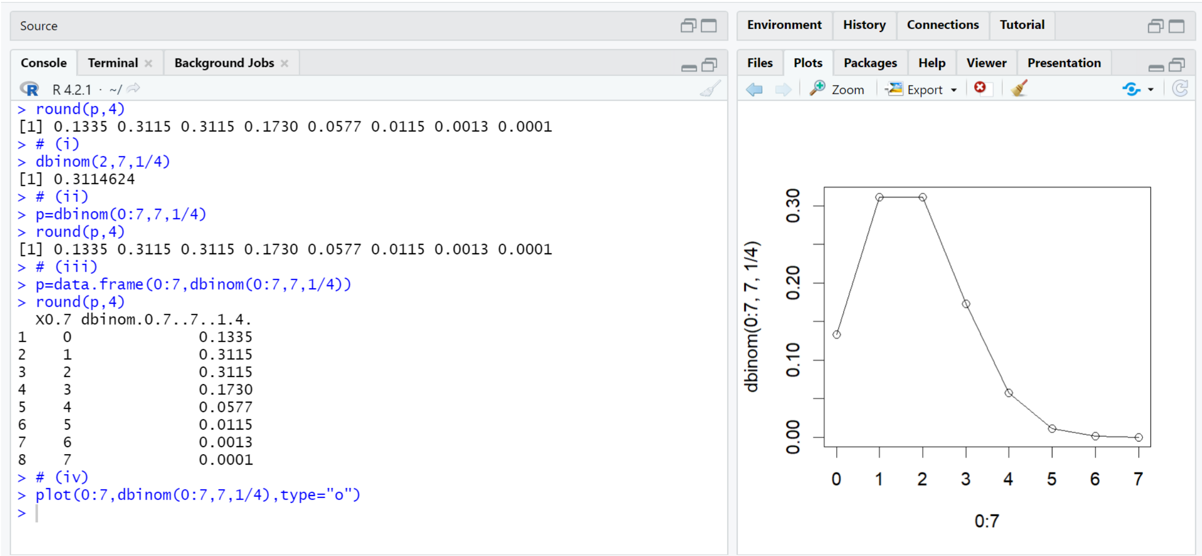
OUTPUT:

```
> round(p,4)
[1] 0.1335 0.3115 0.3115 0.1730 0.0577 0.0115 0.0013 0.0001
> # (i)
> dbinom(2,7,1/4)
[1] 0.3114624
> # (ii)
> p=dbinom(0:7,7,1/4)
> round(p,4)
[1] 0.1335 0.3115 0.3115 0.1730 0.0577 0.0115 0.0013 0.0001
> # (iii)
> p=data.frame(0:7,dbinom(0:7,7,1/4))
> round(p,4)
  X0.7 dbinom.0.7..7..1.4.
1    0              0.1335
2    1              0.3115
3    2              0.3115
4    3              0.1730
5    4              0.0577
6    5              0.0115
7    6              0.0013
8    7              0.0001
> # (iv)
> plot(0:7,dbinom(0:7,7,1/4),type="o")
```

GRAPH:







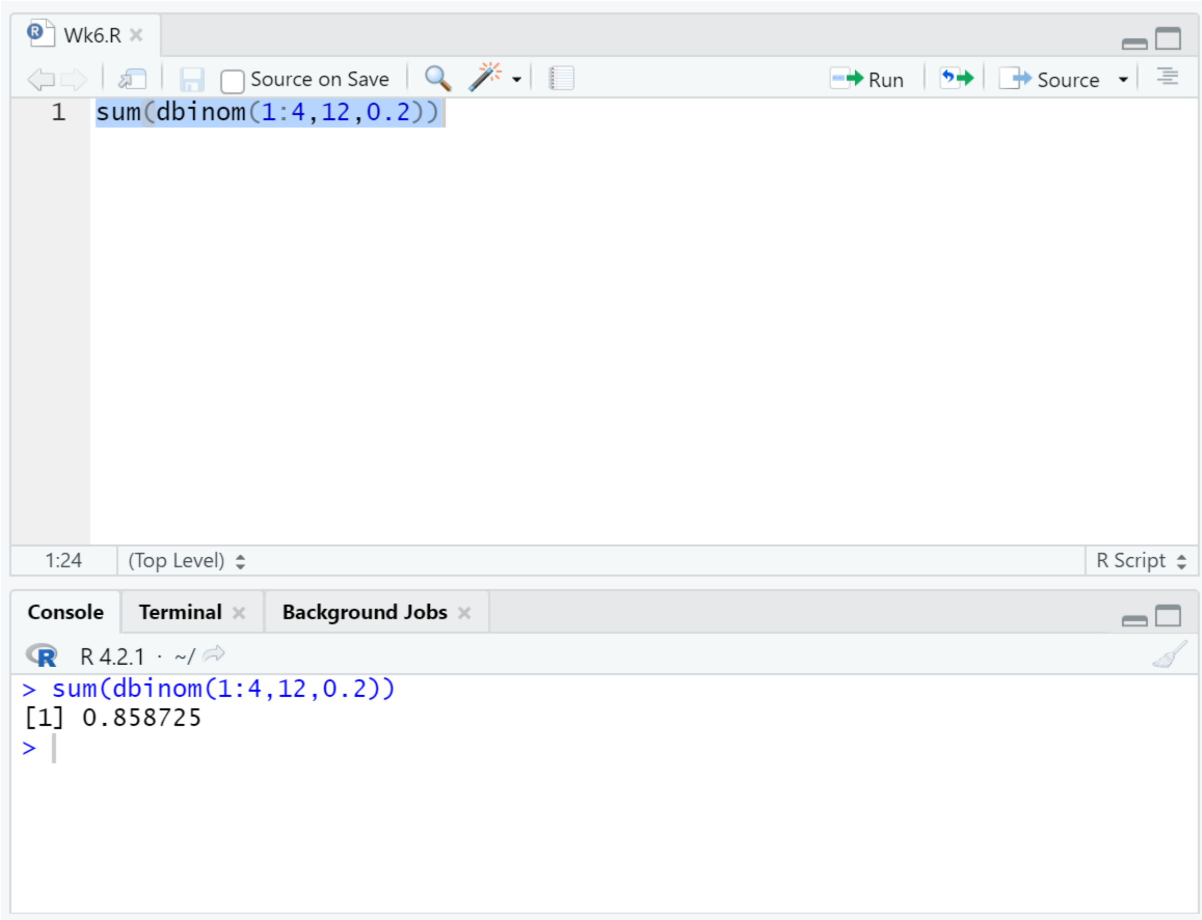
PROBLEM 4: Suppose there are twelve multiple choice questions in an English class quiz. Each question has five possible answers, and only one of them is correct. Find the probability of having four or less correct answers if a student attempts to answer every question at random.

PROGRAM CODE:

```
sum(dbinom(1:4,12,0.2))
```

OUTPUT:

```
> sum(dbinom(1:4,12,0.2))
[1] 0.858725
```



PROBLEM 5: If 10% of the Screws produced by an automatic machine are defective, find the probability that out of 20 screws selected at random, there are

(i) Exactly 2 defective

(ii) At least 2 defectives

(iii) Between 1 and 3 defectives (inclusive)

PROGRAM CODE:

(i)

dbinom(2,20,0.10)

(ii)

1-dbinom(1,20,0.1)

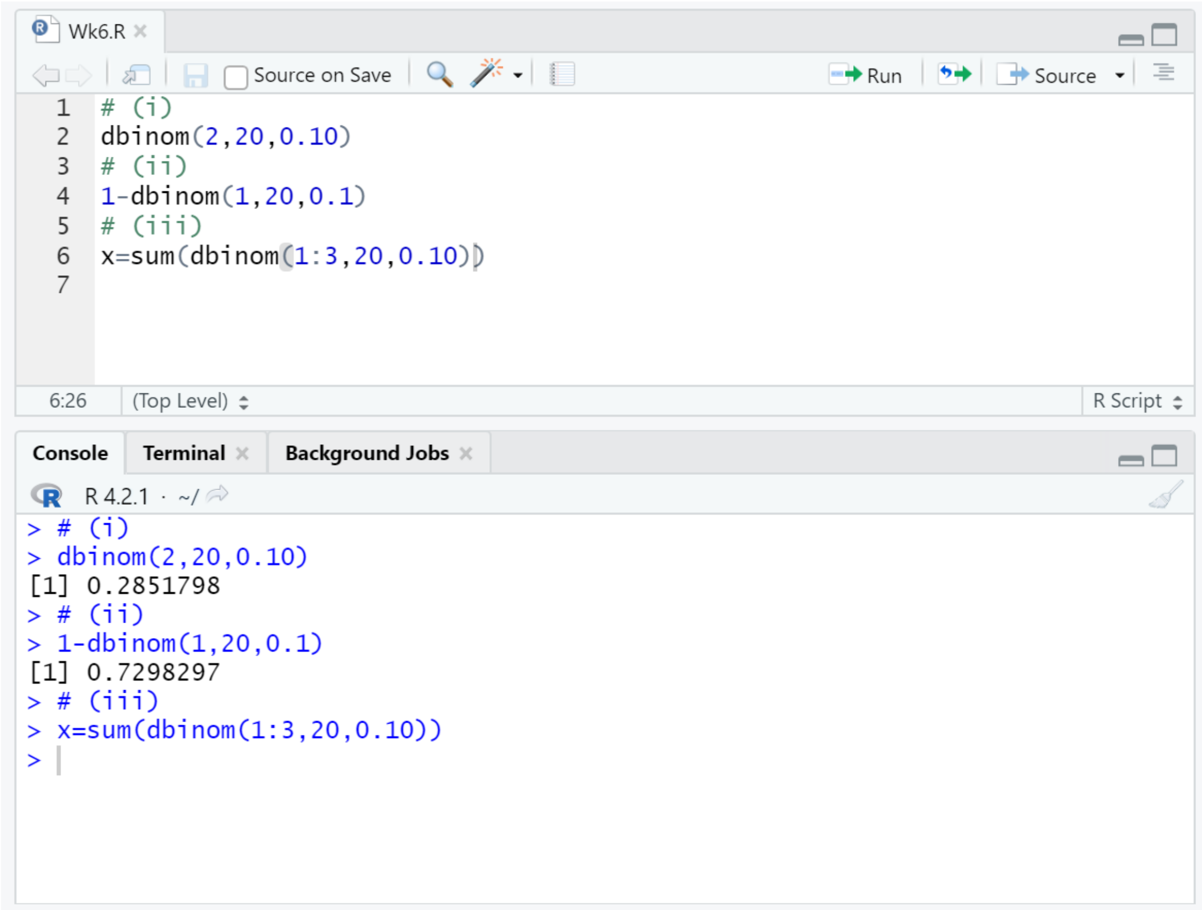
(iii)

x=sum(dbinom(1:3,20,0.10))

OUTPUT:

> # (i)

```
> dbinom(2,20,0.10)
[1] 0.2851798
> # (ii)
> 1-dbinom(1,20,0.1)
[1] 0.7298297
> # (iii)
> x=sum(dbinom(1:3,20,0.10))
```



PROBLEM 6:Show that in Binomial distribution variance is less than mean with Binomial variable follows (7,1/4)

PROGRAM CODE:

```
n=7
p=1/4
px=dbinom(0:n,n,p)
x=0:n
Ex=sum(x*px)
Ex
var=sum(x^2*px)-Ex^2
var
```

Wk6.R

```r
n=7
p=1/4
px=dbinom(0:n,n,p)
x=0:n
Ex=sum(x*px)
Ex
var=sum(x^2*px)-Ex^2
var
```

Console — R 4.2.1 · ~/

```
> # (i)
> dbinom(2,20,0.10)
[1] 0.2851798
> # (ii)
> 1-dbinom(1,20,0.1)
[1] 0.7298297
> # (iii)
> x=sum(dbinom(1:3,20,0.10))
> n=7
> p=1/4
> px=dbinom(0:n,n,p)
> x=0:n
> Ex=sum(x*px)
> Ex
[1] 1.75
> var=sum(x^2*px)-Ex^2
> var
[1] 1.3125
>
```

Result: The code ran successfully and the output is noted.

Week 7:

Name: Rahul Karthik S
Register Number: 21BEC1851

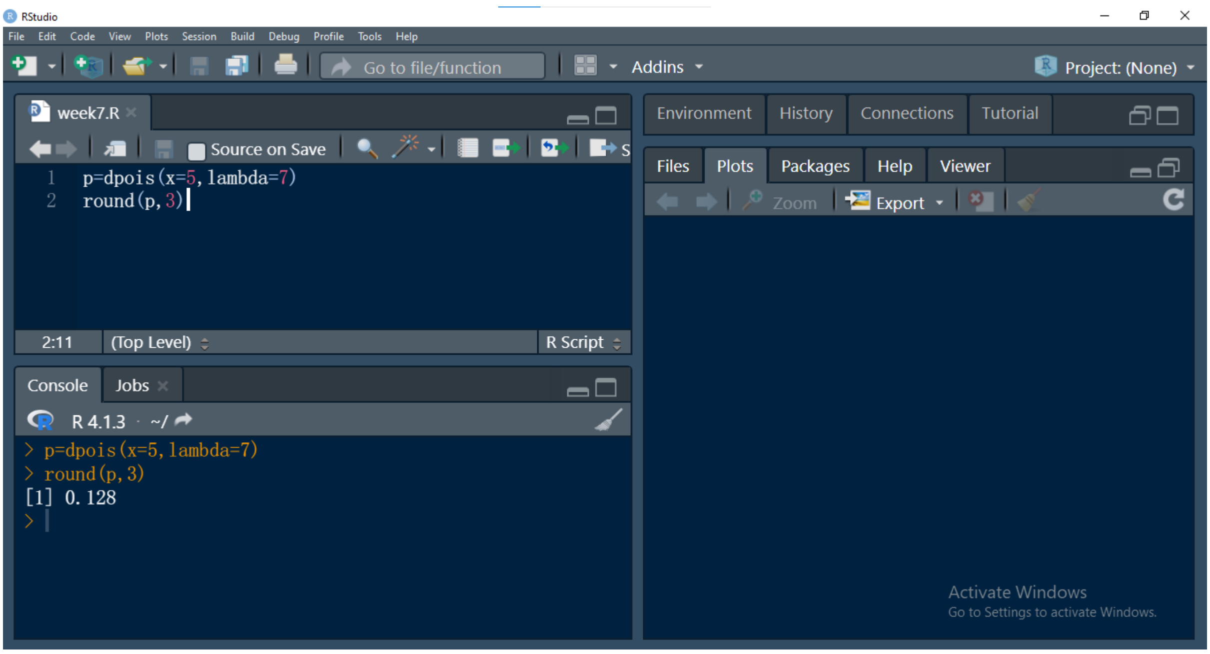
Poisson Distribution: The random variable X is said to follow the poisson distribution if and only if

$$p[X=x]=\frac{e^{-\lambda}\lambda^{x}}{\lfloor x},x=0,1,2,.....$$

Problem 1
Find P(X=5) with parameter 7 upto 3 decimal places.

Program Code:
```
p=dpois(x=5,lambda=7)
round(p,3)
```

Output:
```
> p=dpois(x=5,lambda=7)
> round(p,3)
[1] 0.128
```

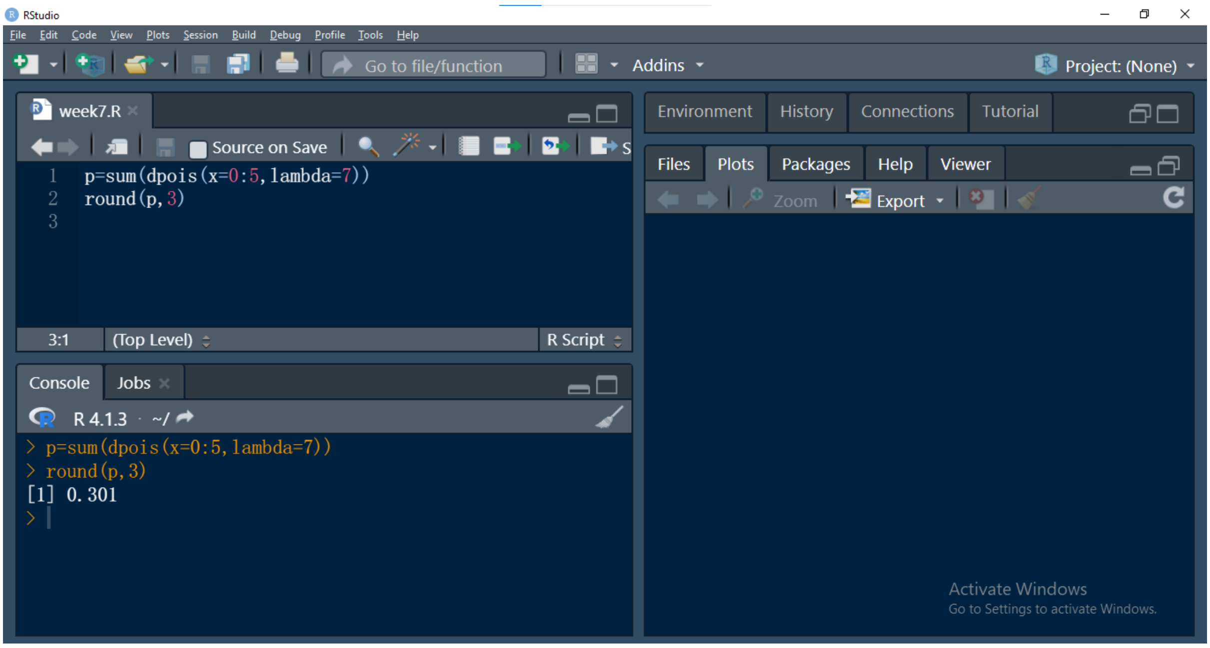


Problem 2
FindP(X=0)+P(X=1)+…+P(X=5) with parameter 7

Program Code:
```
p=sum(dpois(x=0:5,lambda=7))
round(p,3)
```

Output:

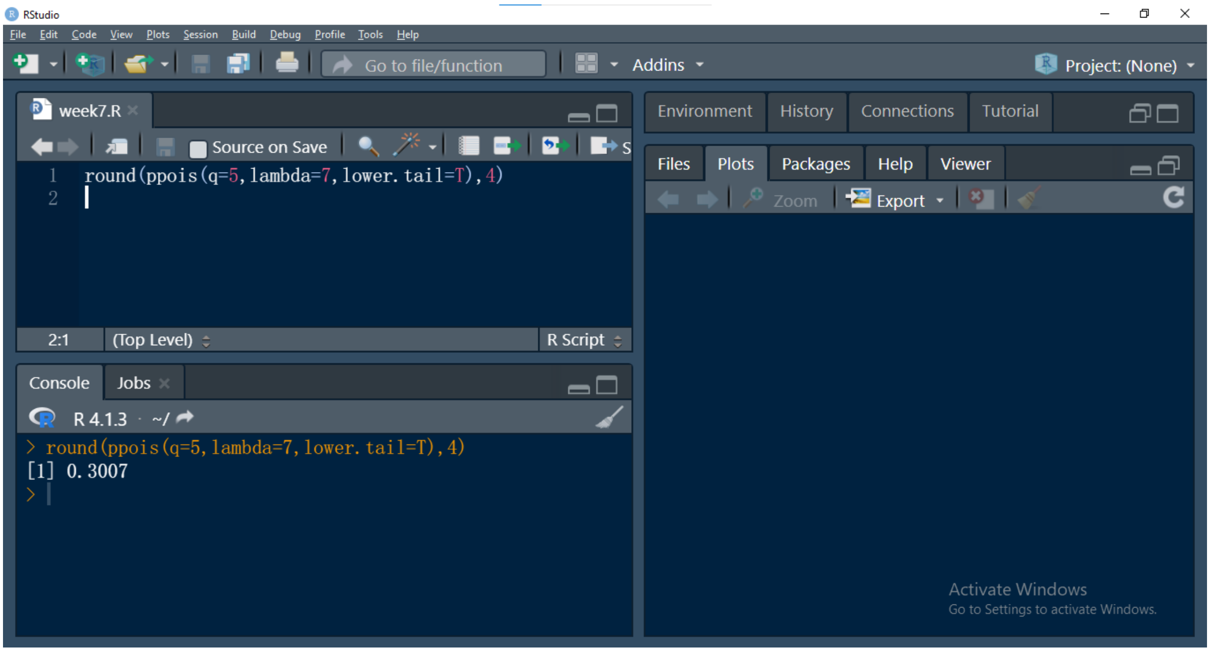
> p=sum(dpois(x=0:5,lambda=7))
> round(p,3)
[1] 0.301



Problem 3
Find P(X≤5) with parameter 7

Program Code:
round(ppois(q=5,lambda=7,lower.tail=T),4)

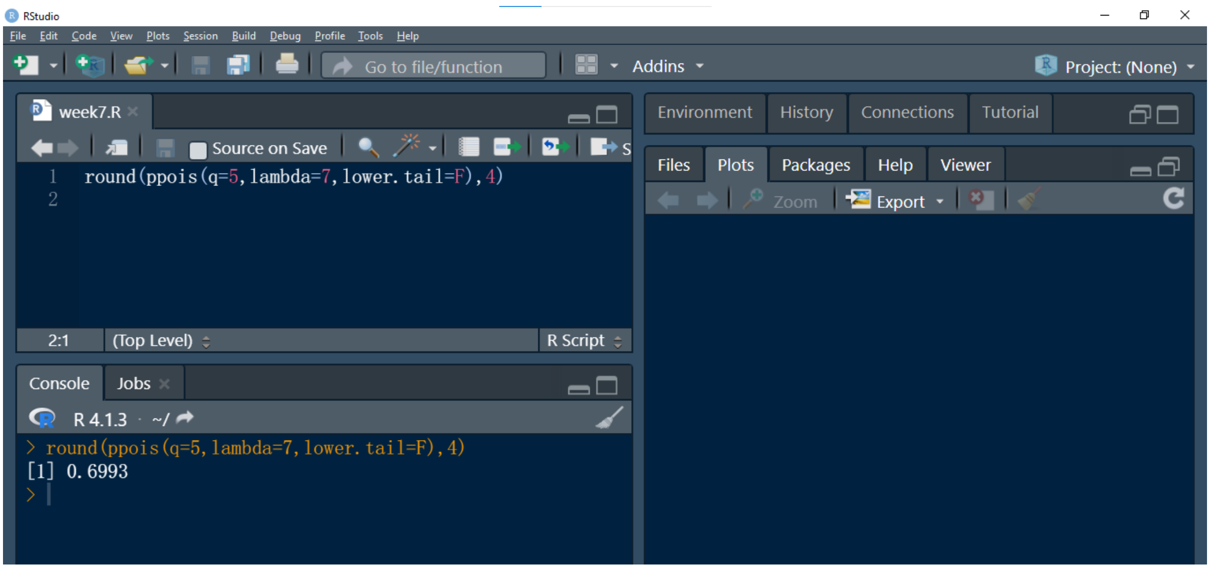
Output:
> round(ppois(q=5,lambda=7,lower.tail=T),4)
[1] 0.3007



Problem4
Find P(X>5) with parameter 7

Program Code:
round(ppois(q=5,lambda=7,lower.tail=F),4)

Output:
> round(ppois(q=5,lambda=7,lower.tail=F),4)
[1] 0.6993



Problem 5
Poisson distribution with parameter 2
1. How to obtain a sequence from 0 to 10
2. Calculate P(0),(1)... (10) when lambda =2 and Make the output prettier

3. Find P(X<=6)
4. Sum all probabilities
5. Find P(X>6)
6. Make a table of the first 11 Poisson probabilities and cumulative probabilities when lambda=2 obtains the output prettier.
7. Plot the probabilities Put some labels on the axes and give the plot a title

Program Code:

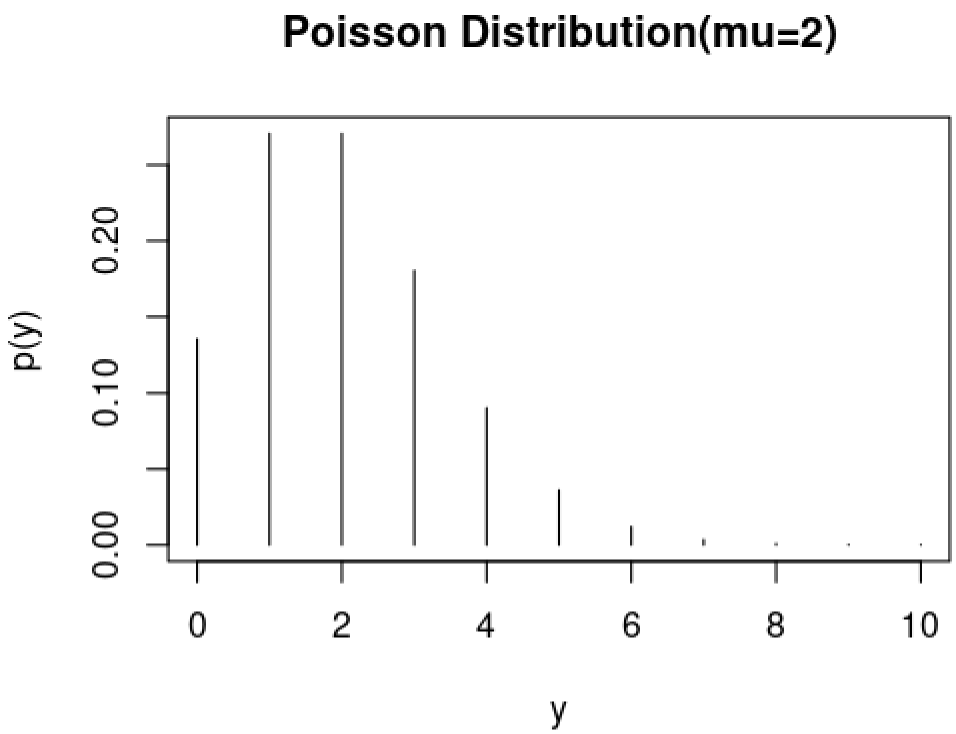
```
#1
0:10
#2
round(dpois(0:10, 2), 3)
#3
ppois(6, 2)
#4
sum(dpois(0:6, 2))
#5
1-ppois(6, 2)
#6
round(cbind(0:10,dpois(0:10,2),ppois (0:10,2)),3)
#7
plot(0:10,dpois(0:10,2),type="h",xlab="y",ylab="p(y)",main="Poisson Distribution(mu=2)")
```

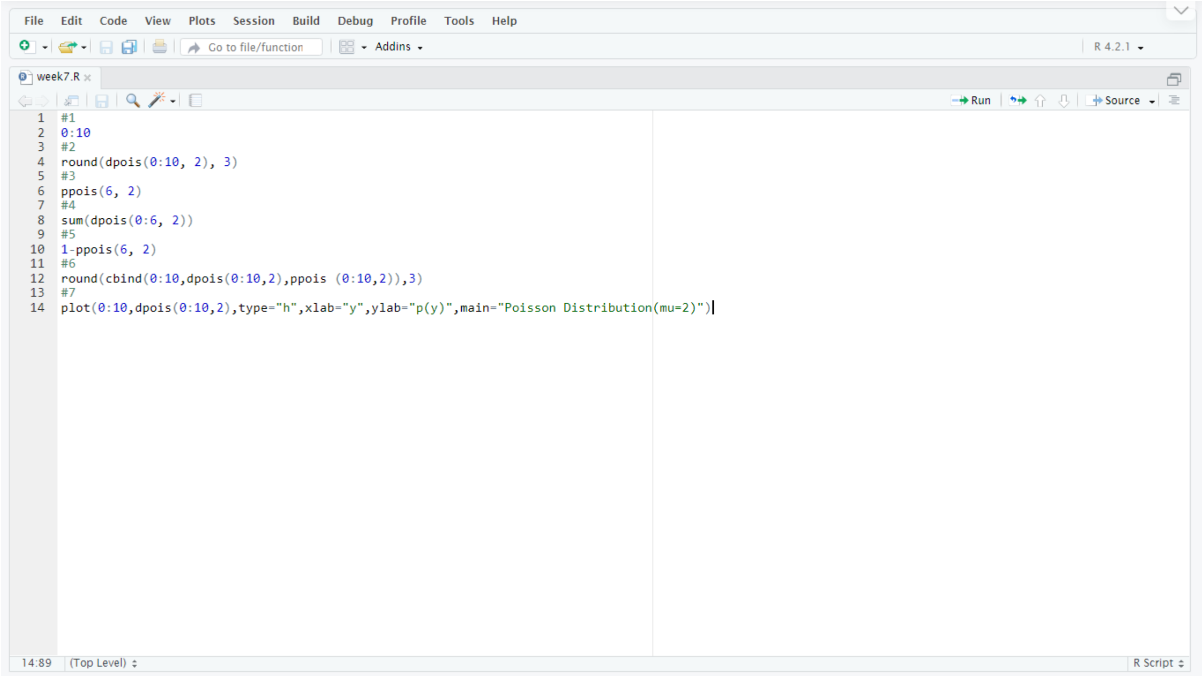
Output:

```
> #1
> 0:10
 [1]  0  1  2  3  4  5  6  7  8  9 10
> #2
> round(dpois(0:10, 2), 3)
 [1] 0.135 0.271 0.271 0.180 0.090 0.036 0.012 0.003 0.001 0.000 0.000
> #3
> ppois(6, 2)
[1] 0.9954662
> #4
> sum(dpois(0:6, 2))
[1] 0.9954662
> #5
> 1-ppois(6, 2)
[1] 0.004533806
> #6
> round(cbind(0:10,dpois(0:10,2),ppois (0:10,2)),3)
      [,1]  [,2]  [,3]
 [1,]    0 0.135 0.135
 [2,]    1 0.271 0.406
 [3,]    2 0.271 0.677
 [4,]    3 0.180 0.857
 [5,]    4 0.090 0.947
 [6,]    5 0.036 0.983
```

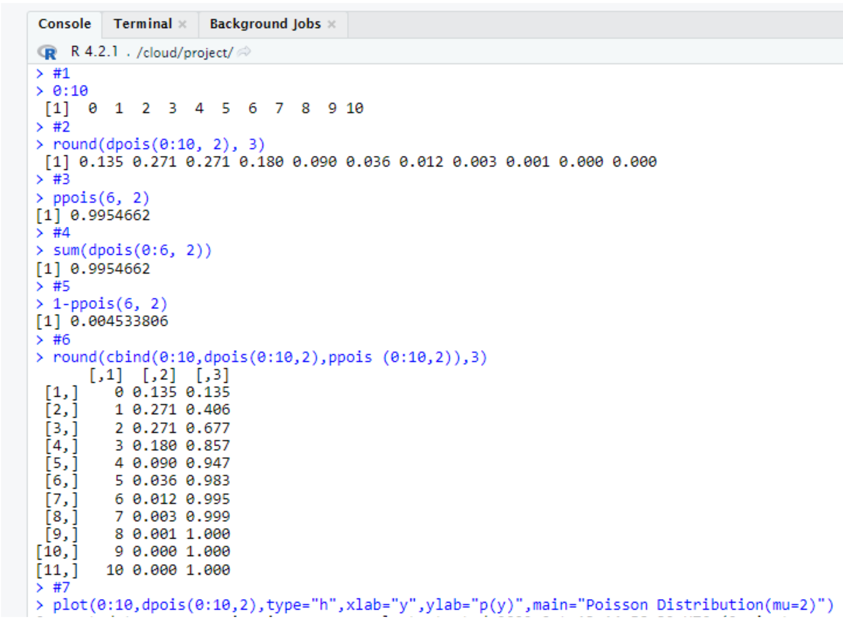
```
 [7,]    6 0.012 0.995
 [8,]    7 0.003 0.999
 [9,]    8 0.001 1.000
[10,]    9 0.000 1.000
[11,]   10 0.000 1.000
> #7
> plot(0:10,dpois(0:10,2),type="h",xlab="y",ylab="p(y)",main="Poisson Distribution(mu=2)")
```

Plot:





```
File  Edit  Code  View  Plots  Session  Build  Debug  Profile  Tools  Help
Go to file/function    Addins    R 4.2.1
week7.R
Run    Source
#1
0:10
#2
round(dpois(0:10, 2), 3)
#3
ppois(6, 2)
#4
sum(dpois(0:6, 2))
#5
1-ppois(6, 2)
#6
round(cbind(0:10,dpois(0:10,2),ppois (0:10,2)),3)
#7
plot(0:10,dpois(0:10,2),type="h",xlab="y",ylab="p(y)",main="Poisson Distribution(mu=2)")
14:89  (Top Level)    R Script
```



```
Console  Terminal  Background Jobs
R 4.2.1 . /cloud/project/
> #1
> 0:10
 [1]  0  1  2  3  4  5  6  7  8  9 10
> #2
> round(dpois(0:10, 2), 3)
 [1] 0.135 0.271 0.271 0.180 0.090 0.036 0.012 0.003 0.001 0.000 0.000
> #3
> ppois(6, 2)
[1] 0.9954662
> #4
> sum(dpois(0:6, 2))
[1] 0.9954662
> #5
> 1-ppois(6, 2)
[1] 0.004533806
> #6
> round(cbind(0:10,dpois(0:10,2),ppois (0:10,2)),3)
      [,1]  [,2]  [,3]
 [1,]    0 0.135 0.135
 [2,]    1 0.271 0.406
 [3,]    2 0.271 0.677
 [4,]    3 0.180 0.857
 [5,]    4 0.090 0.947
 [6,]    5 0.036 0.983
 [7,]    6 0.012 0.995
 [8,]    7 0.003 0.999
 [9,]    8 0.001 1.000
[10,]    9 0.000 1.000
[11,]   10 0.000 1.000
> #7
> plot(0:10,dpois(0:10,2),type="h",xlab="y",ylab="p(y)",main="Poisson Distribution(mu=2)")
```

Problem 6

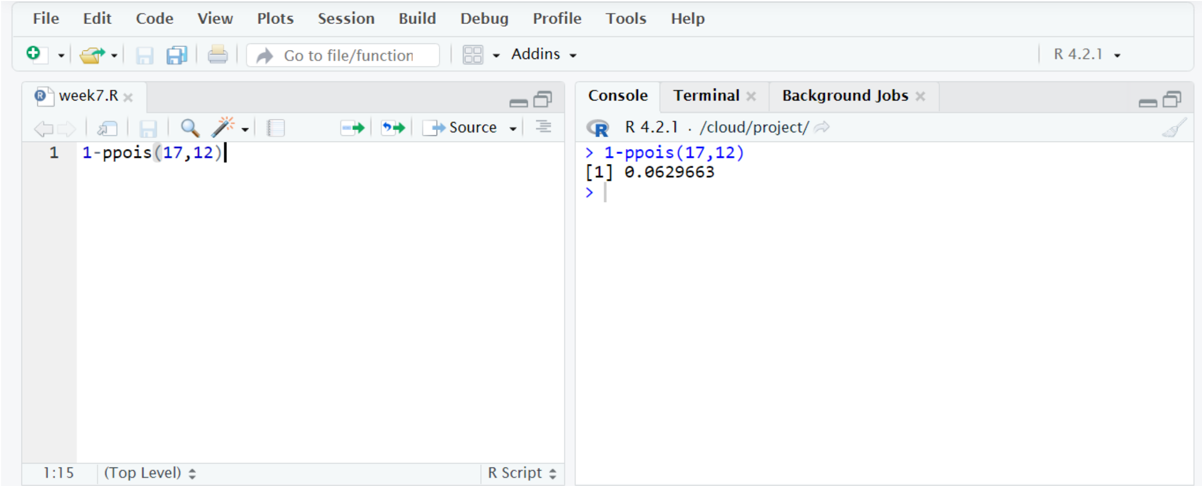
If there are twelve cars crossing a bridge per minute on average, Find the probability of having 17 or more cars crossing the bridge in a particular minute

Program Code:

1-ppois(17,12)

Output:

[1] 0.0629663


File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 4.2.1
week7.R
Source
1 1-ppois(17,12)
1:15
(Top Level)
R Script
Console
Terminal
Background Jobs
R 4.2.1 · /cloud/project/
> 1-ppois(17,12)
[1] 0.0629663
>

Week - 8
Normal Distribution

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$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad , \qquad -\infty < x < +\infty$$

R has 4 different built-in functions to generate normal distribution.

dnorm() - It gives height of the probability distribution at each point for a given mean and standard deviation.
y=dnorm(x, mean=mu, sd=sigma)

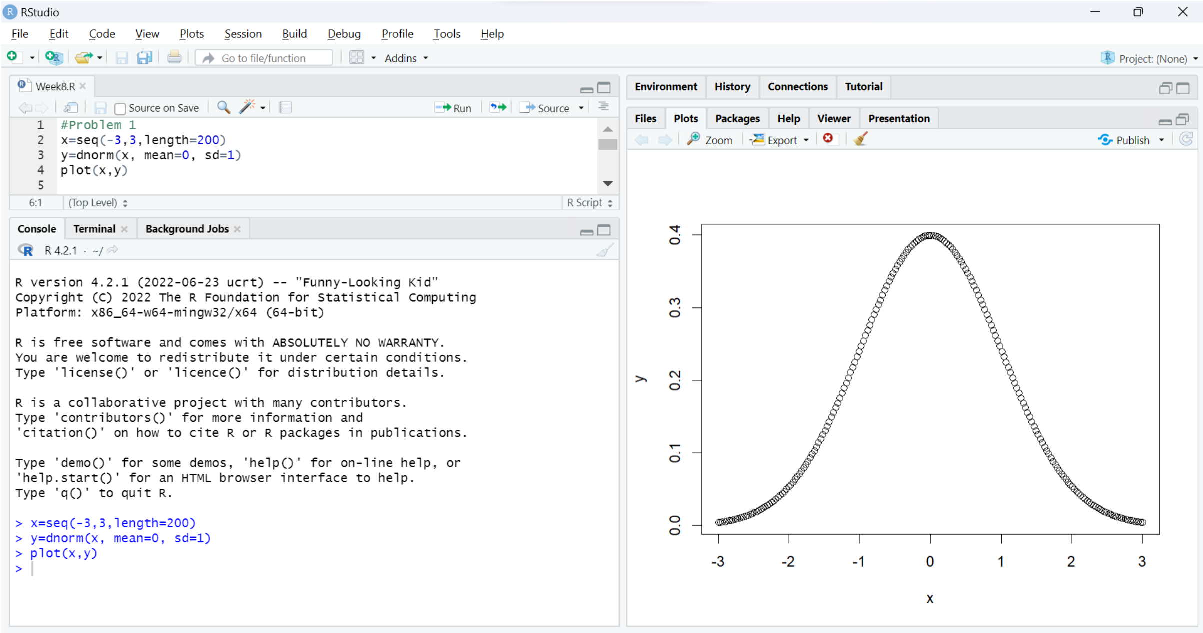
pnorm() - It gives the probability of normally distributed r.v to be less than the value of a given number. It is also called cumulative distribution function.
y=pnorm(x, mean=mu, sd=sigma)

qnorm() - It takes probability value and gives a number whose cumulative value matches the probability value.
y=qnorm(x, mean=mu, sd=sigma)

rnorm() - It is used to generate random numbers whose distribution is normal.
y=rnorm(n)

Problem 1: Plot a sequence of 200 numbers with x=-3 to 3 with mean 0 and sd 1
Program Code:

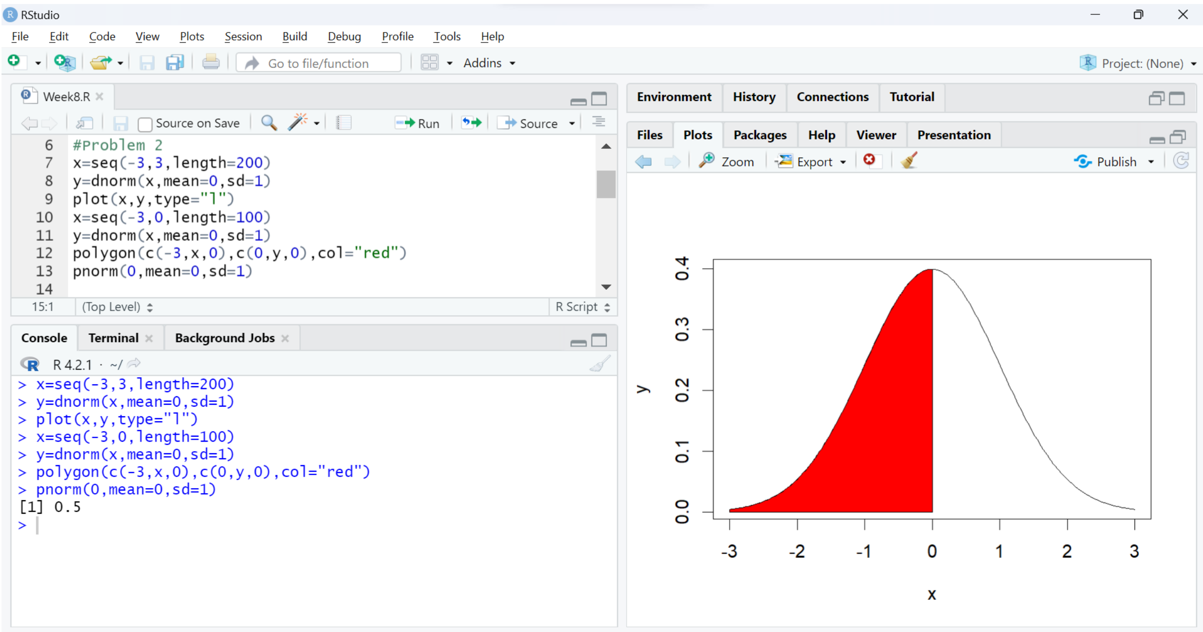
```
x=seq(-3,3,length=200)
y=dnorm(x, mean=0, sd=1)
plot(x,y)
```



Problem 2: To find the area under the curve to the left of the mean 0 and sd 1 with a sequence of 200 numbers with x=-3 to3.

Program Code:

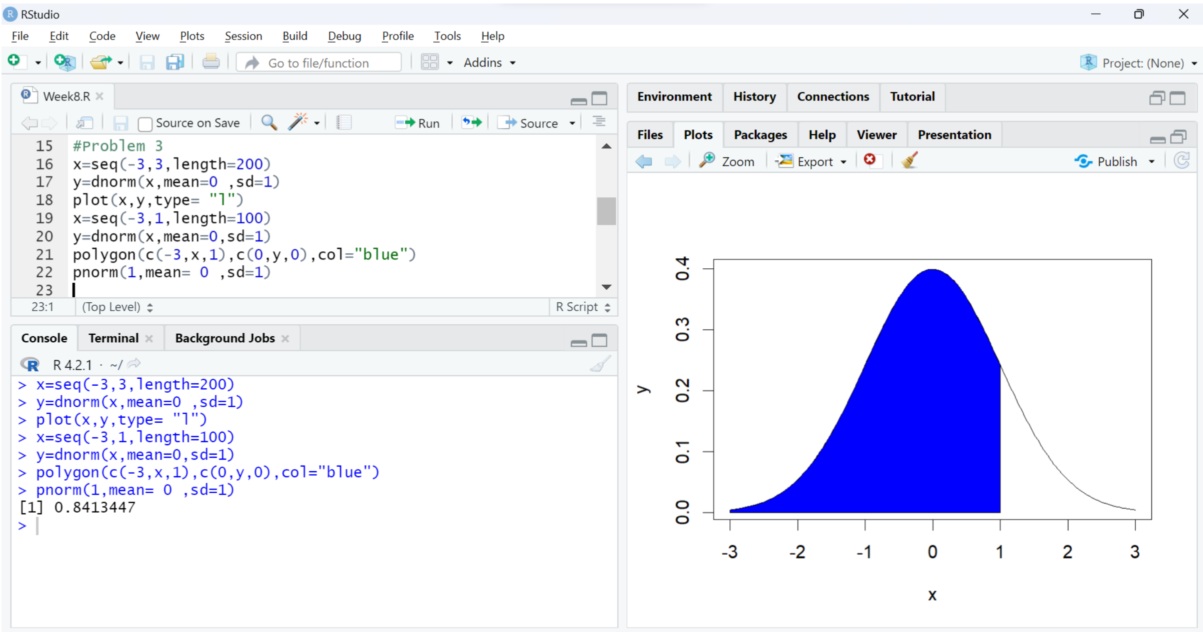
```
x=seq(-3,3,length=200)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l")
x=seq(-3,0,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(-3,x,0),c(0,y,0),col="red")
pnorm(0,mean=0,sd=1)
```



Problem 3: To find area to the left of x=1

Program Code:

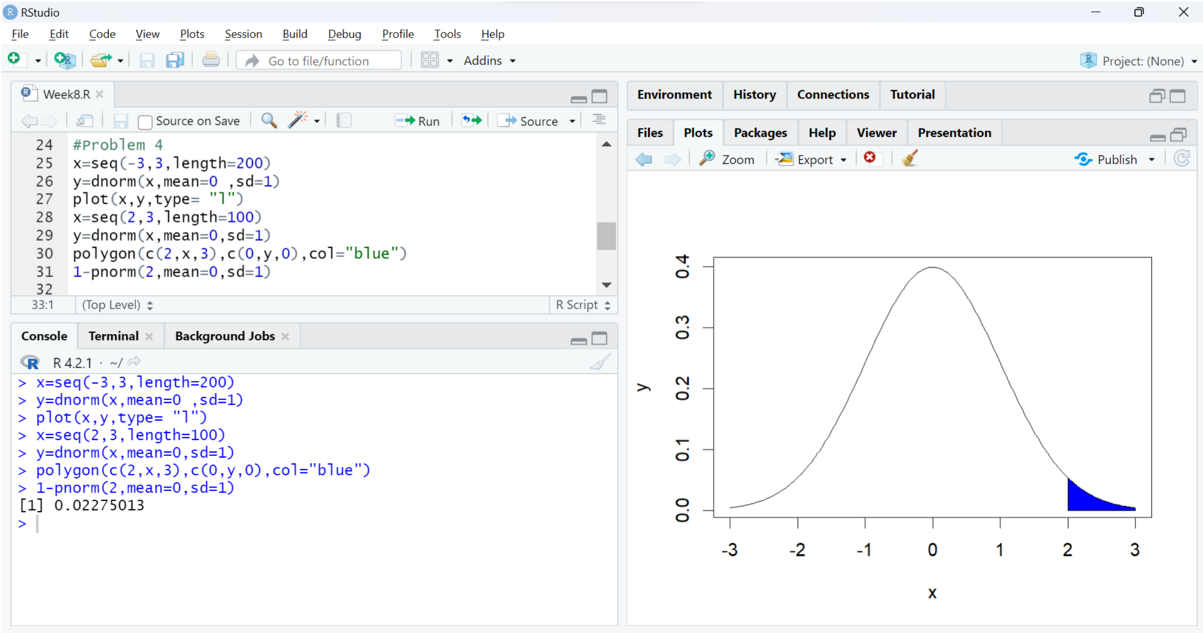
```
x=seq(-3,3,length=200)
y=dnorm(x,mean=0 ,sd=1)
plot(x,y,type= "l")
x=seq(-3,1,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(-3,x,1),c(0,y,0),col="blue")
pnorm(1,mean= 0 ,sd=1)
```



Problem 4: Find the area to the right of x=2.

Program Code:

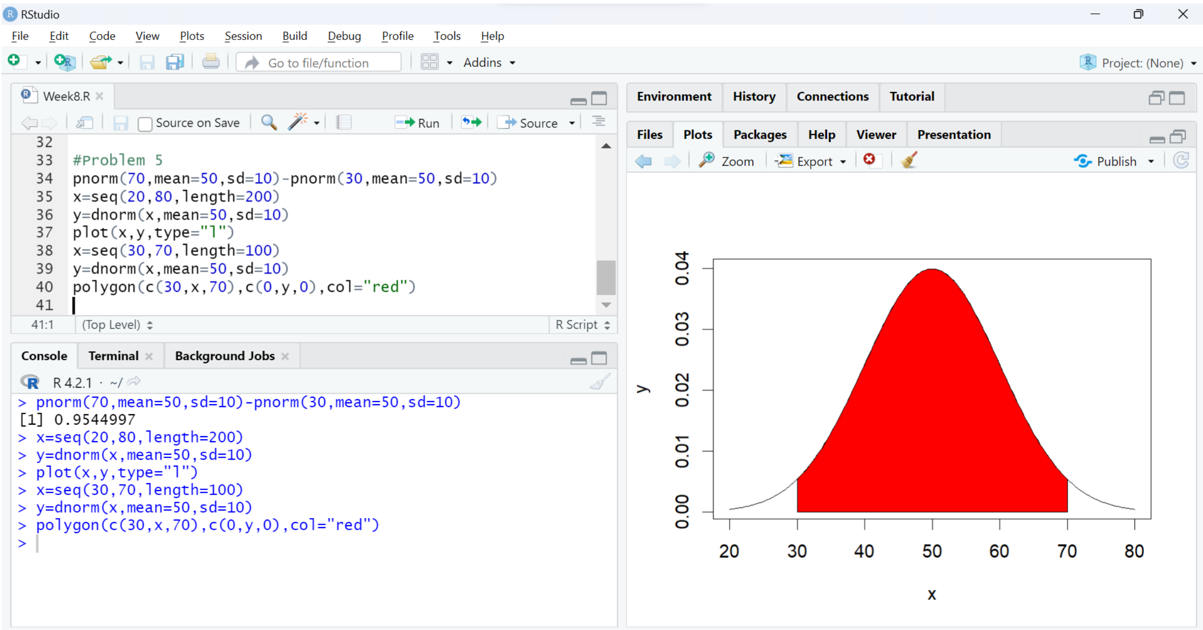
```
x=seq(-3,3,length=200)
y=dnorm(x,mean=0 ,sd=1)
plot(x,y,type= "l")
x=seq(2,3,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(2,x,3),c(0,y,0),col="blue")
1-pnorm(2,mean=0,sd=1)
(# 1-pnorm give the area of the right extreme portion of the normal curve with x=2)
```



Problem 5: Find P(30<X<70) with mean=50 and standard deviation=10.

Program Code:

```
x=seq(20,80,length=200)
y=dnorm(x,mean=50,sd=10)
plot(x,y,type="l")
x=seq(30,70,length=100)
y=dnorm(x,mean=50,sd=10)
polygon(c(30,x,70),c(0,y,0),col="red")
pnorm(70,mean=50,sd=10)-pnorm(30,mean=50,sd=10)
```



Week 9 & 10

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Week 9:

Problem 1: Suppose that 12% of apples harvested in an orchard last year was rotten. 30 out of 214 apples in a harvest sample this year turns out to be rotten. At .05 significance level, can we reject the null hypothesis that the proportion of rotten apples in harvest stays below 12% this year?

The null hypothesis is that p ≤ 0.12. H0:p=P0 H1:p>Po

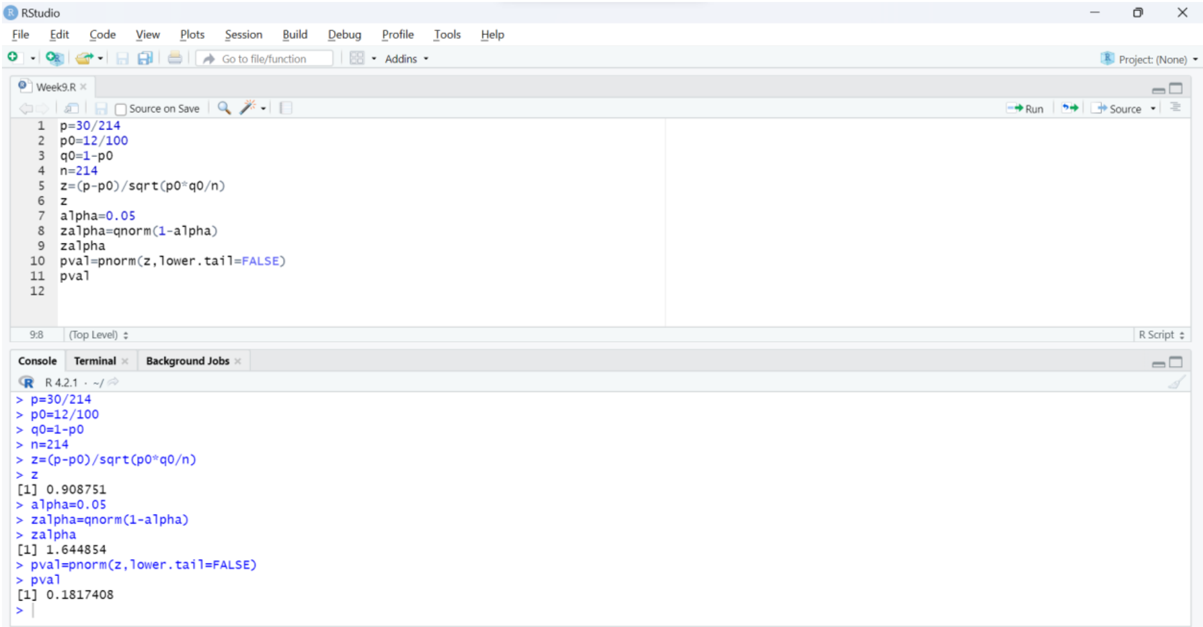
Program Code:

```
p=30/214
p0=12/100
q0=1-p0
n=214
z=(p-p0)/sqrt(p0*q0/n)
z
alpha=0.05
zalpha=qnorm(1-alpha)
zalpha
pval=pnorm(z,lower.tail=FALSE)
pval
```

Output:

```
> p=30/214
> p0=12/100
> q0=1-p0
> n=214
> z=(p-p0)/sqrt(p0*q0/n)
> z
[1] 0.908751
> alpha=0.05
> zalpha=qnorm(1-alpha)
> zalpha
[1] 1.644854
> pval=pnorm(z,lower.tail=FALSE)
> pval
[1] 0.1817408
```

(The p-value, or probability value, tells you how likely it is that your data could have occurred under the null hypothesis.)



Interpretation:

The test statistic 0.90875 is not greater than the critical value of 1.6449. Hence, at 0.05 significance level, we do not reject the null hypothesis that the proportion of rotten apples in harvest stays below 12% this year.

p-value is greater than the 0.05 significance level, we do not reject the null hypothesis that the proportion of rotten apples in harvest stays below 12% this year.

Problem 2: The mean breaking strength of the cables supplied by a manufacturer is 1800 with a s.d of 100. By a new technique in the manufacturing process, it is claimed that the breaking strength of the cable has increased. In order to test this claim, a sample of 50 cables is tested and it is found that the mean breaking strength is 1850. Can we support the claim?

H0:xbar=mu   H1: xbar~=mu

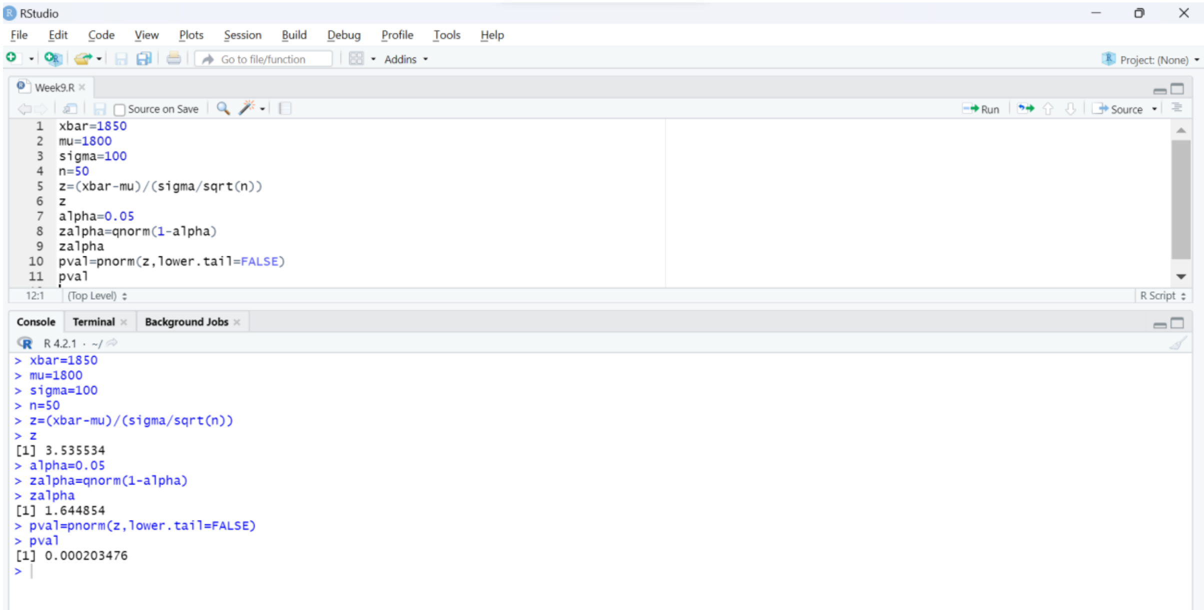
Program Code:

```
xbar=1850
mu=1800
sigma=100
n=50
z=(xbar-mu)/(sigma/sqrt(n))
z
alpha=0.05
zalpha=qnorm(1-alpha)
zalpha
pval=pnorm(z,lower.tail=FALSE)
pval
```

Output:

```
> xbar=1850
> mu=1800
> sigma=100
> n=50
```

```
> z=(xbar-mu)/(sigma/sqrt(n))
> z
[1] 3.535534
> alpha=0.05
> zalpha=qnorm(1-alpha)
> zalpha
[1] 1.644854
> pval=pnorm(z,lower.tail=FALSE)
> pval
[1] 0.000203476
```



Week 10:

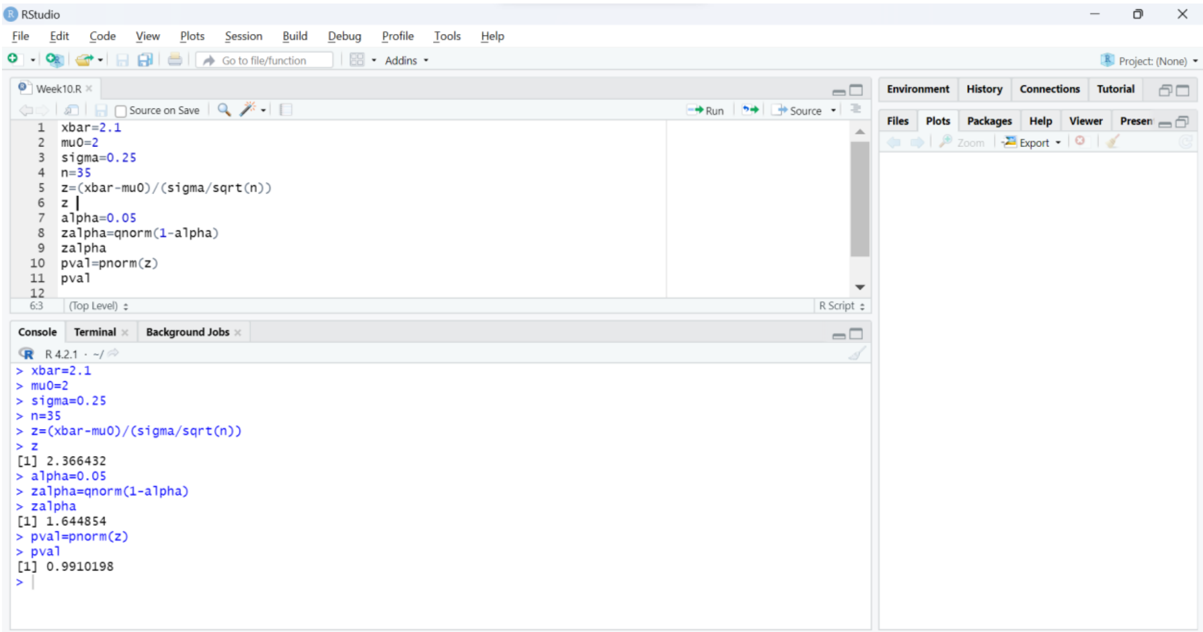
Problem 1: Suppose the food label on a cookie bag states that there is at most 2 grams of saturated fat in a single cookie. In a sample of 35 cookies, it is found that the mean amount of saturated fat per cookie is 2.1 grams. Assume that the population standard deviation is 0.25 grams. At a 0.05 significance level, can we reject the claim on the food label?

Program Code:

```
xbar=2.1
mu0=2
sigma=0.25
n=35
z=(xbar-mu0)/(sigma/sqrt(n))
z
alpha=0.05
zalpha=qnorm(1-alpha)
zalpha
pval=pnorm(z)
pval
```

Output:

```
> xbar=2.1
> mu0=2
> sigma=0.25
> n=35
> z=(xbar-mu0)/(sigma/sqrt(n))
> z
[1] 2.366432
> alpha=0.05
> zalpha=qnorm(1-alpha)
> zalpha
[1] 1.644854
> pval=pnorm(z)
> pval
[1] 0.9910198
>
```



Interpretation:

The test statistic 2.3664 is greater than the critical value of 1.6449. Hence, at 0.05 significance level, we reject the claim that there is at most 2 grams of saturated fat in a cookie. The upper tail p-value of the test statistic is less than the significance level 0.05, we reject the null hypothesis that $\mu \leq 2$.

Problem 2: An outbreak of salmonella-related illness was attributed to ice produced at a certain factory. Scientists measured the level of Salmonella in 9 randomly sampled batches of ice cream. The levels(in MPN/g) were:

0.593 0.142 0.329 0.691 0.231 0.793 0.519 0.392 0.418

0.593	**0.142**	**0.329**	**0.691**	**0.231**	**0.793**	**0.519**	**0.392**	**0.418**

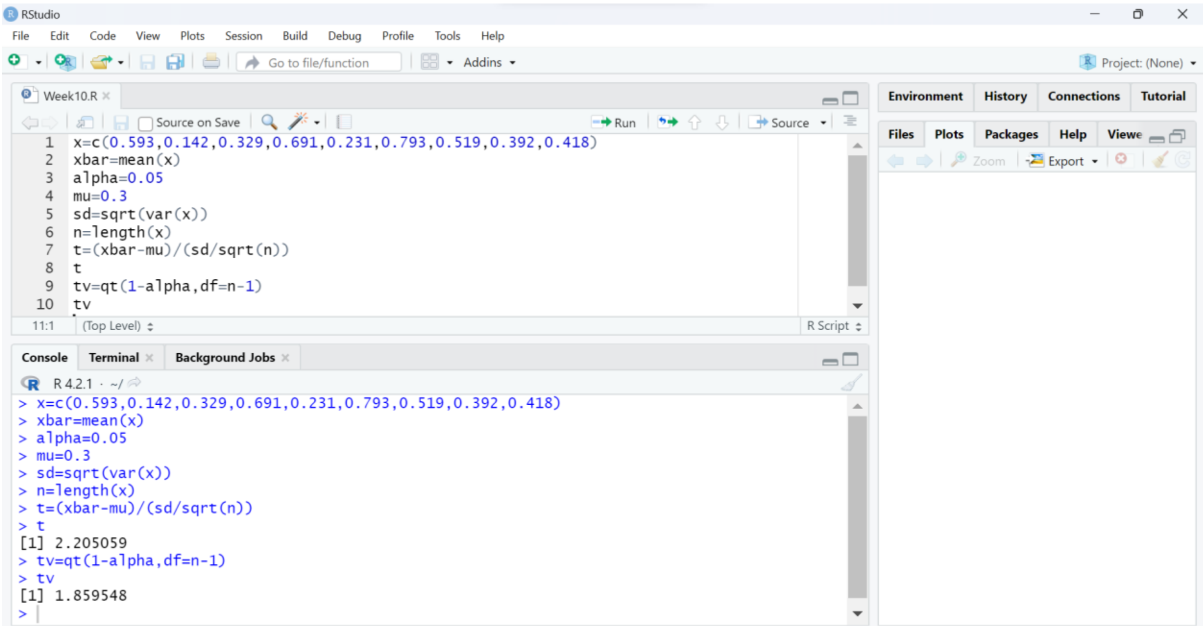
Is there evidence that the mean level of Salmonella in ice cream is greater than 0.3 MPN/g?

Program Code:

```
x=c(0.593,0.142,0.329,0.691,0.231,0.793,0.519,0.392,0.418)
xbar=mean(x)
alpha=0.05
mu=0.3
sd=sqrt(var(x))
n=length(x)
t=(xbar-mu)/(sd/sqrt(n))
t
tv=qt(1-alpha,df=n-1)
tv
```

Output:

```
> x=c(0.593,0.142,0.329,0.691,0.231,0.793,0.519,0.392,0.418)
> xbar=mean(x)
> alpha=0.05
> mu=0.3
> sd=sqrt(var(x))
> n=length(x)
> t=(xbar-mu)/(sd/sqrt(n))
> t
[1] 2.205059
> tv=qt(1-alpha,df=n-1)
> tv
[1] 1.859548
>
```



Interpretation:

From the output we see that the t = 2.205059>1.859548. Reject H0.Hence, there is moderately strong evidence that the mean Salmonella level in the ice cream is above 0.3MPN/g.

Result/ Inference:

The code ran successfully and output was verified..