MAT2001 – Statistics for Engineers - ELA (R Code Studio), Winter Semester 2020-2021

Lab Assessment - I

By: Jonathan Rufus Samuel (20BCT0332) Date: 17.6.2021

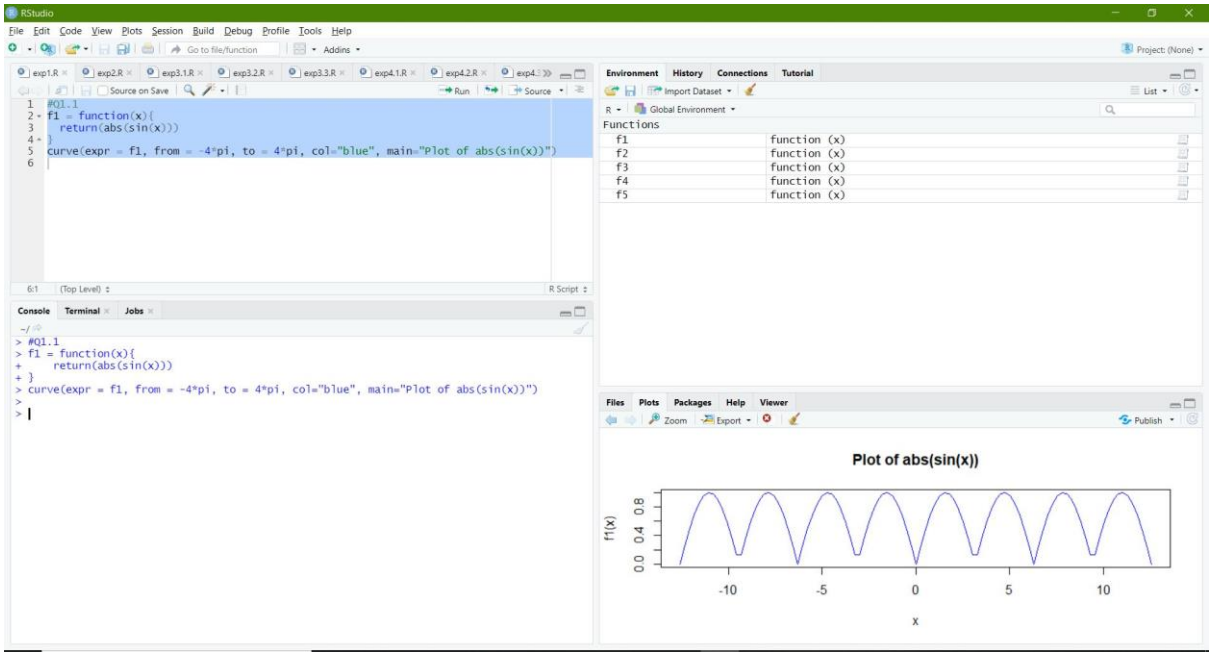
Q1) Create the following graphs using R:

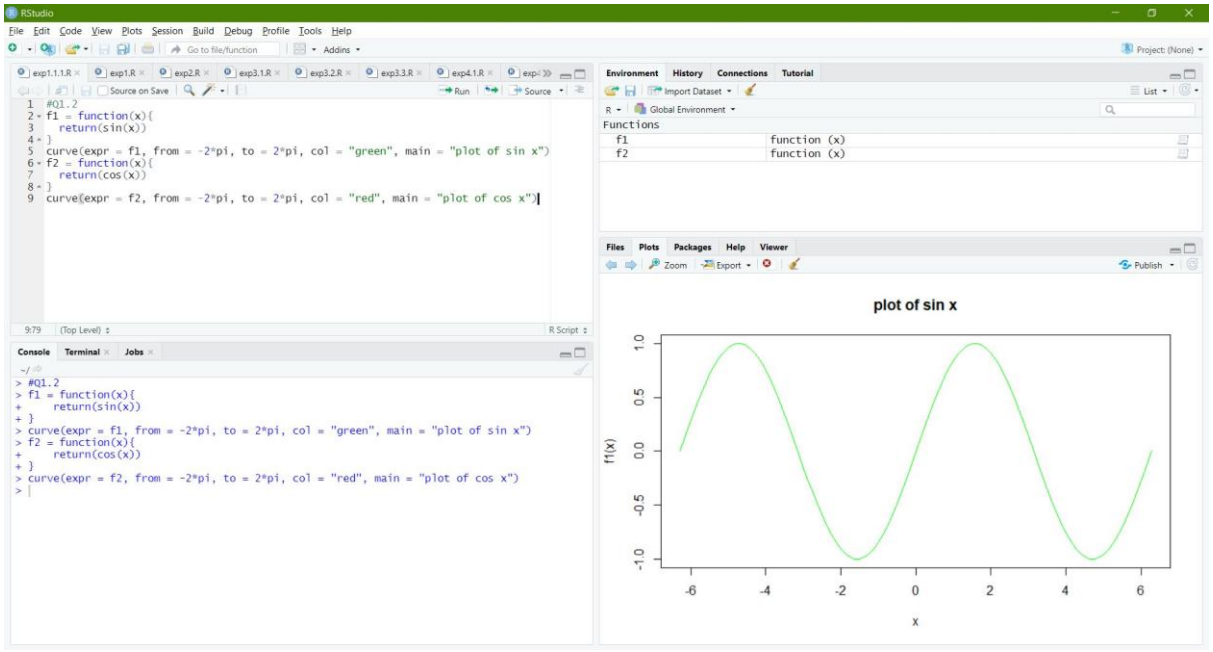
A: Code is as follows:

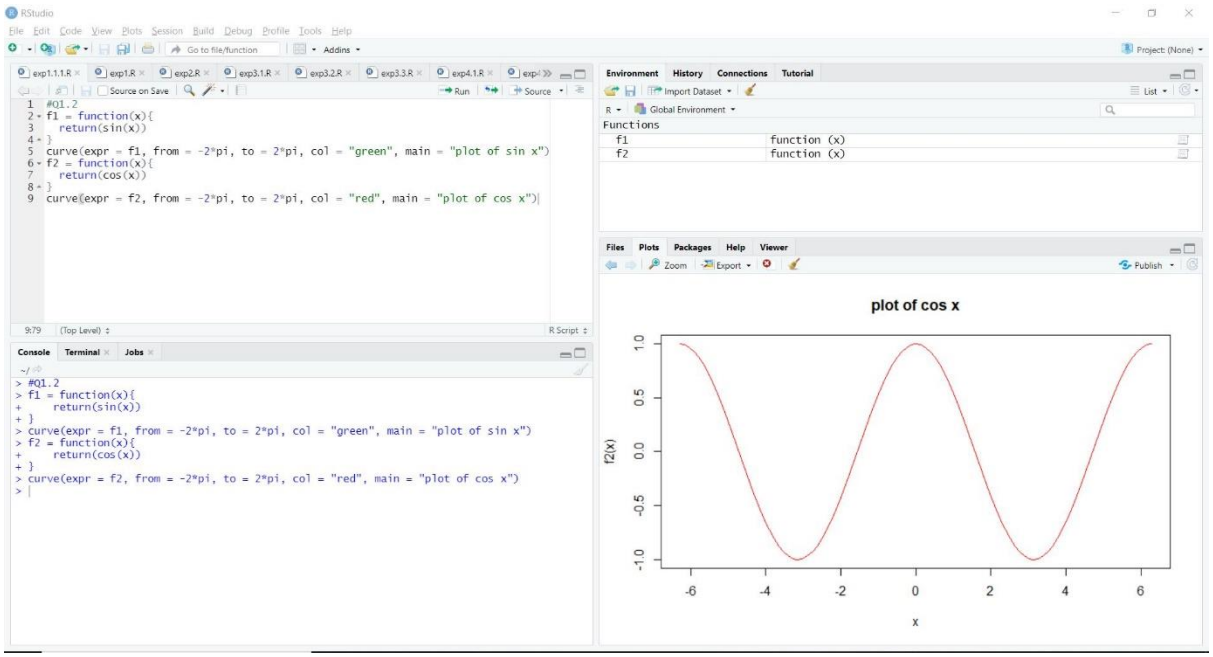
```
#Q1.1
f1 = function(x){
  return(abs(sin(x)))
}
curve(expr = f1, from = -4*pi, to = 4*pi, col="blue", main="plot of abs(sin(x))")

#Q1.2
f1 = function(x){
  return(sin(x))
}
curve(expr = f1, from = -2*pi, to = 2*pi, col="green", main="plot of sin(x)")
f2 = function(x){
  return(cos(x))
}
curve(expr = f1, from = -2*pi, to = 2*pi, col="red", main="plot of cos(x)")

#Q1.3
plot(x,y,type="n")
segments(x[-length(x)],y[-length(x)],x[-1],y[-length(x)])
points(x[-length(x)],y[-length(x)],pch=16)
points(x[-1],y[-length(x)],pch=1)

#Q1.4
f1 = function(x){
```

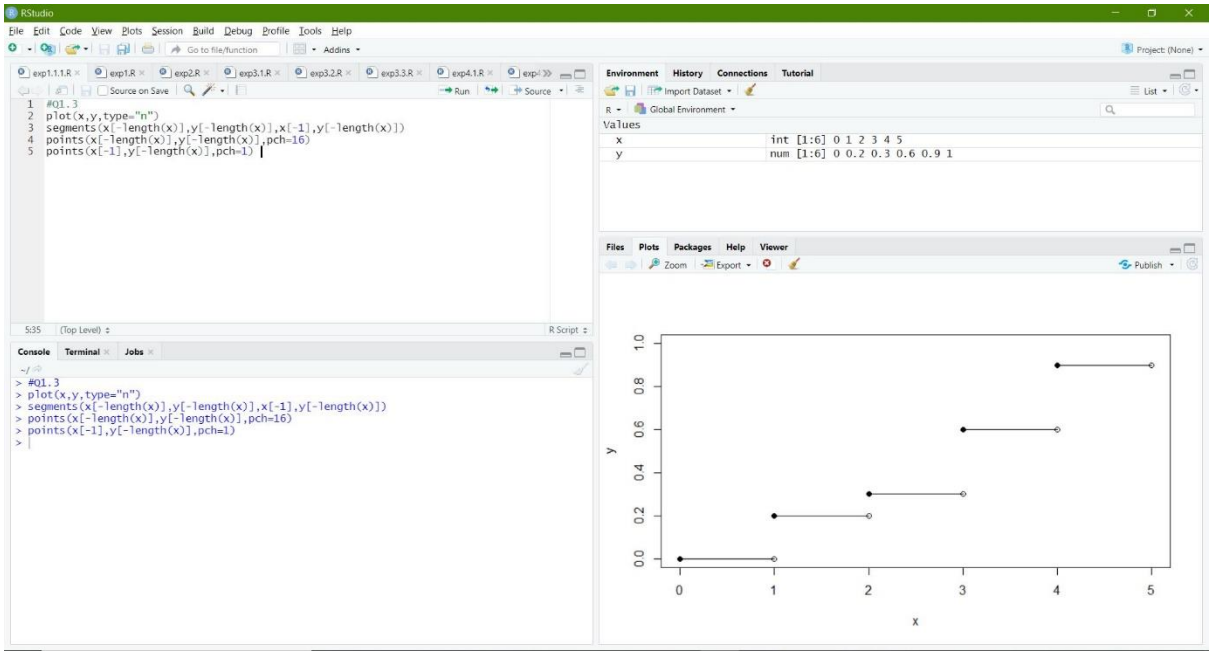
```
  return(abs(x))
}
curve(expr = f1, from = -4*pi, to = 4*pi, col="blue", main="plot of abs(x)")

#Q1.5
f1 = function(x){
  return(x^2)
}
curve(expr = f1, from = -4*pi, to = 4*pi, col="blue", main="plot of x^2")
```

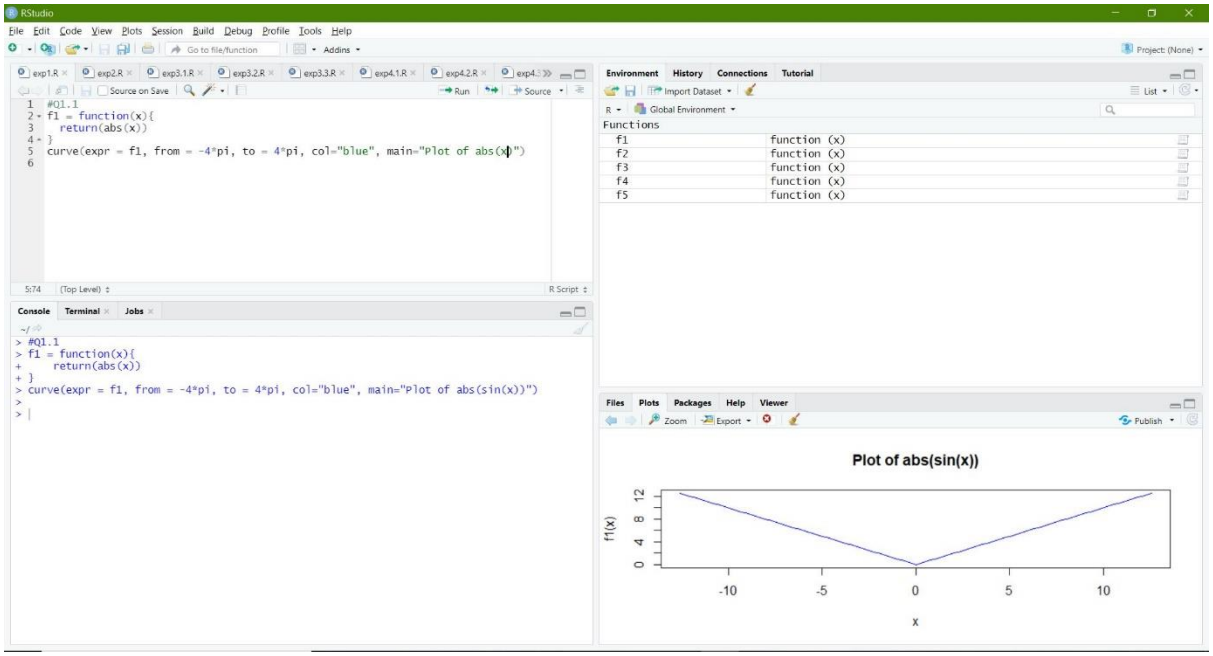
Output (via Command Window):

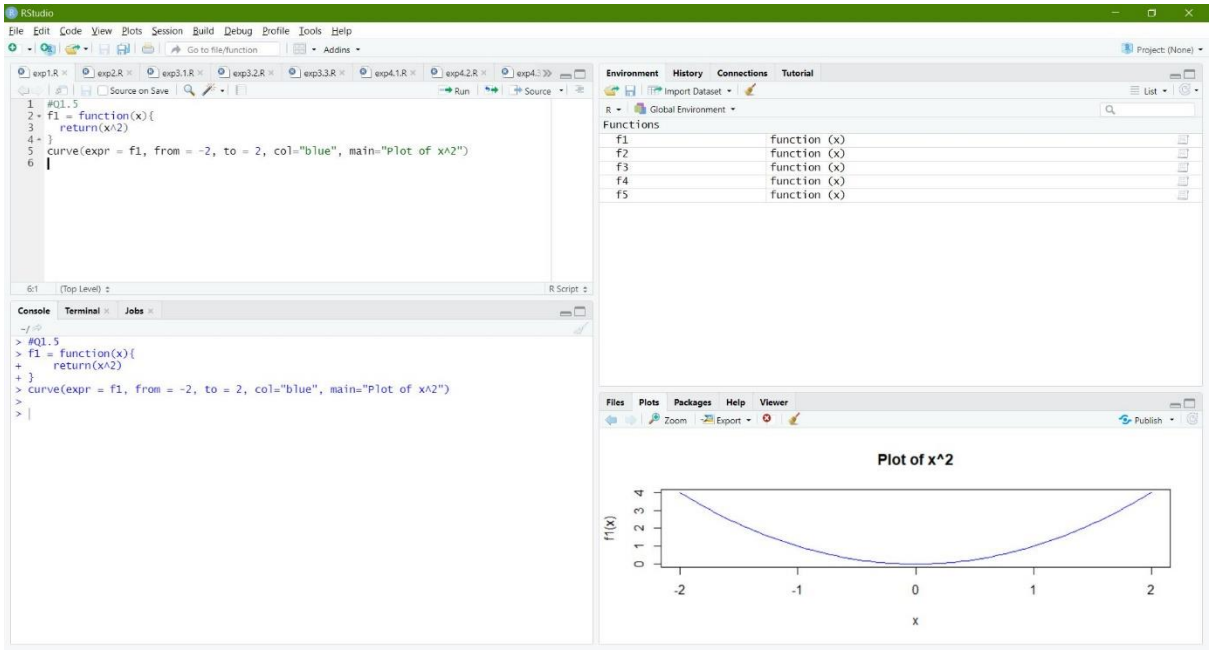



RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
exp1.1.1.R
exp1.R
exp2.R
exp3.1.R
exp3.2.R
exp3.3.R
exp4.1.R
Source on Save
Run
Source
1 #Q1.2
2 f1 = function(x){
3 return(sin(x))
4 }
5 curve(expr = f1, from = -2*pi, to = 2*pi, col = "green", main = "plot of sin x")
6 f2 = function(x){
7 return(cos(x))
8 }
9 curve(expr = f2, from = -2*pi, to = 2*pi, col = "red", main = "plot of cos x")
9:79 (Top Level)
R Script
Console Terminal Jobs
> #Q1.2
> f1 = function(x){
+ return(sin(x))
+ }
> curve(expr = f1, from = -2*pi, to = 2*pi, col = "green", main = "plot of sin x")
> f2 = function(x){
+ return(cos(x))
+ }
> curve(expr = f2, from = -2*pi, to = 2*pi, col = "red", main = "plot of cos x")
Environment History Connections Tutorial
Import Dataset
List
Global Environment
Functions
f1 function (x)
f2 function (x)
Files Plots Packages Help Viewer
Zoom
Export
Publish
plot of sin x
f1(x)
1.0
0.5
0.0
-0.5
-1.0
-6
-4
-2
0
2
4
6
x


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
exp1.1.1.R
exp1.R
exp2.R
exp3.1.R
exp3.2.R
exp3.3.R
exp4.1.R
Source on Save
Run
Source
1 #Q1.2
2 f1 = function(x){
3 return(sin(x))
4 }
5 curve(expr = f1, from = -2*pi, to = 2*pi, col = "green", main = "plot of sin x")
6 f2 = function(x){
7 return(cos(x))
8 }
9 curve(expr = f2, from = -2*pi, to = 2*pi, col = "red", main = "plot of cos x")
9:79 (Top Level)
R Script
Console Terminal Jobs
> #Q1.2
> f1 = function(x){
+ return(sin(x))
+ }
> curve(expr = f1, from = -2*pi, to = 2*pi, col = "green", main = "plot of sin x")
> f2 = function(x){
+ return(cos(x))
+ }
> curve(expr = f2, from = -2*pi, to = 2*pi, col = "red", main = "plot of cos x")
Environment History Connections Tutorial
Import Dataset
List
Global Environment
Functions
f1 function (x)
f2 function (x)
Files Plots Packages Help Viewer
Zoom
Export
Publish
plot of cos x
f2(x)
1.0
0.5
0.0
-0.5
-1.0
-6
-4
-2
0
2
4
6
x


#Q1.3
plot(x,y,type="n")
segments(x[-length(x)],y[-length(x)],x[-1],y[-length(x)])
points(x[-length(x)],y[-length(x)],pch=16)
points(x[-1],y[-length(x)],pch=1)
Values
x int [1:6] 0 1 2 3 4 5
y num [1:6] 0 0.2 0.3 0.6 0.9 1
y
x


#Q1.1
f1 = function(x){
return(abs(x))
}
curve(expr = f1, from = -4*pi, to = 4*pi, col="blue", main="Plot of abs(x)")
Functions
f1 function (x)
f2 function (x)
f3 function (x)
f4 function (x)
f5 function (x)
Plot of abs(sin(x))
f1(x)
x


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
exp1.R exp2.R exp3.1.R exp3.2.R exp3.3.R exp4.1.R exp4.2.R
Source on Save Run Source
1 #Q1.5
2 f1 = function(x){
3 return(x^2)
4 }
5 curve(expr = f1, from = -2, to = 2, col="blue", main="Plot of x^2")
6
6:1 (Top Level) R Script
Console Terminal Jobs
~/
> #Q1.5
> f1 = function(x){
+ return(x^2)
+ }
> curve(expr = f1, from = -2, to = 2, col="blue", main="Plot of x^2")
>
>
Environment History Connections Tutorial
Import Dataset List
R Global Environment
Functions
f1 function (x)
f2 function (x)
f3 function (x)
f4 function (x)
f5 function (x)
Files Plots Packages Help Viewer
Zoom Export Publish
Plot of x^2
f1(x)
0 1 2 3 4
-2 -1 0 1 2
x

Q2) Write R code to print a Fibonacci sequence using any of the loop statements:

A: Code is as follows:

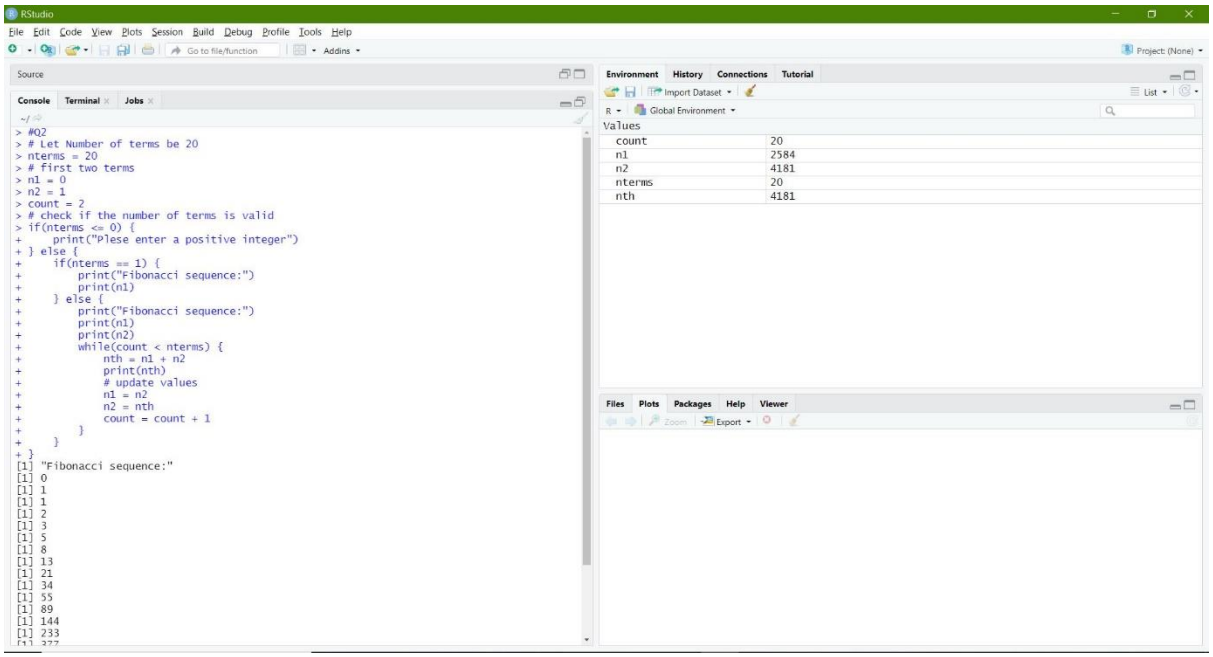
```
#Q2
# Let Number of terms be 20
nterms = 20
# first two terms
n1 = 0
n2 = 1
count = 2
# check if the number of terms is valid
if(nterms <= 0) {
  print("Plese enter a positive integer")
} else {
  if(nterms == 1) {
    print("Fibonacci sequence:")
    print(n1)
  } else {
    print("Fibonacci sequence:")
    print(n1)
    print(n2)
    while(count < nterms) {
      nth = n1 + n2
      print(nth)
      # update values
      n1 = n2
      n2 = nth
      count = count + 1
    }
  }
}
```

Output (via Command Window):

```
> #Q2
> # Let Number of terms be 20
> nterms = 20
> # first two terms
> n1 = 0
> n2 = 1
> count = 2
> # check if the number of terms is valid
> if(nterms <= 0) {
+     print("Plese enter a positive integer")
+ } else {
+     if(nterms == 1) {
+         print("Fibonacci sequence:")
+         print(n1)
+     } else {
+         print("Fibonacci sequence:")
+         print(n1)
+         print(n2)
+         while(count < nterms) {
+             nth = n1 + n2
+             print(nth)
+             # update values
+             n1 = n2
+             n2 = nth
+             count = count + 1
+         }
+     }
+ }
[1] "Fibonacci sequence:"
[1] 0
[1] 1
[1] 1
[1] 2
[1] 3
[1] 5
[1] 8
[1] 13
[1] 21
[1] 34
[1] 55
[1] 89
[1] 144
```

[1] 233
[1] 377
[1] 610
[1] 987
[1] 1597
[1] 2584
[1] 4181

Implementation on R Studio Code (via Command Window):



Q3) Write R code to find the following if:

$$A = \begin{bmatrix} 1 & 2 & -8 & 14 & 7 \\ 13 & 24 & 17 & 5 & 9 \\ 7 & 32 & 10 & 14 & 5 \\ 3 & 4 & 53 & 34 & 43 \\ 9 & 11 & 14 & -10 & 4 \end{bmatrix}$$

$$B = \begin{bmatrix} -10 & 12 & 11 & 4 & 2 \\ 9 & 21 & 7 & 13 & 8 \\ 17 & 2 & 1 & 17 & -19 \\ 2 & 7 & 5 & 3 & 4 \\ 15 & 1 & 4 & -31 & 14 \end{bmatrix}$$

(i) the eigenvalue and eigenvector of A and B.

(ii) check whether (AB)−1 = B−1A−1

(iii) dimension of 4 ∗ A5 − 5A3 + A2

(iv) replace 4th row of A by (5 -4 6 3 2) and 5th column of B by (14 9 43 24 26).

A: Code is as follows:

```
#Q3
A = c(1,13,7,3,9,2,24,32,4,11,-8,17,10,53,14,14,5,14,34,-10,7,9,5,43,4)
B = c(-10,9,17,2,15,12,21,2,7,1,11,7,1,5,4,4,13,17,3,-31,2,8,-19,4,14)
dim(A) = c(5,5)
dim(B) = c(5,5)
A
B
#Q3.1
eigen(A)
eigen(B)
#Q3.2
x = (A*B)^-1
y = A^-1 * B^-1
x
```

```
y
#Therefore it is verified as X == Y
#Q3.3
z = (4 * (A^5)) - (5*(A^3)) + (A^2)
z
#dimensions of Z is 5 x 5 matrix
#Q3.4
A
B
A_new = c(5,-4,6,3,2)
B_new = c(14,9,43,24,26)
A[4,] = A_new
B[,5] = B_new
A
```

B**Output (via Command Window):**

```
> #Q3
> A = c(1,13,7,3,9,2,24,32,4,11,-8,17,10,53,14,14,5,14,34,-10,7,9,5,43,4)
> B = c(-10,9,17,2,15,12,21,2,7,1,11,7,1,5,4,4,13,17,3,-31,2,8,-19,4,14)
> dim(A) = c(5,5)
> dim(B) = c(5,5)
> A
     [,1] [,2] [,3] [,4] [,5]
[1,]    1    2   -8   14    7
[2,]   13   24   17    5    9
[3,]    7   32   10   14    5
[4,]    3    4   53   34   43
[5,]    9   11   14  -10    4
> B
     [,1] [,2] [,3] [,4] [,5]
[1,]  -10   12   11    4    2
[2,]    9   21    7   13    8
```

```
[3,]   17    2    1   17  -19
[4,]    2    7    5    3    4
[5,]   15    1    4  -31   14
> #Q3.1
> eigen(A)
eigen() decomposition
$values
[1] 65.237708+ 0.00000i  4.280246+13.39402i  4.280246-13.39402i -9.199137+ 0.00000i
[5]  8.400937+ 0.00000i

$vectors
           [,1]                [,2]                [,3]          [,4]
[1,] 0.1431104+0i  0.3873298-0.3300622i  0.3873298+0.3300622i -0.66347869+0i
[2,] 0.3293292+0i -0.2176621+0.0211566i -0.2176621-0.0211566i  0.31679845+0i
[3,] 0.4232249+0i -0.0387338-0.1563271i -0.0387338+0.1563271i -0.38676369+0i
[4,] 0.8308060+0i  0.6035959+0.0000000i  0.6035959+0.0000000i -0.05963256+0i
[5,] 0.0412769+0i -0.3762133+0.4017552i -0.3762133-0.4017552i  0.55343705+0i
            [,5]
[1,]  0.1076409+0i
[2,] -0.1919504+0i
[3,]  0.2908784+0i
[4,]  0.6045964+0i
[5,] -0.7081112+0i

> eigen(B)
eigen() decomposition
$values
[1]  32.70316+ 0.00000i -21.55109+ 0.00000i   6.55190+10.80064i   6.55190-10.80064i
[5]   4.74412+ 0.00000i

$vectors
```

```
          [,1]          [,2]                 [,3]                 [,4]
[1,] -0.3526381+0i  0.69384832+0i  0.13355646-0.06567600i  0.13355646+0.06567600i
[2,] -0.7934667+0i -0.04667258+0i -0.34811884+0.14419030i -0.34811884-0.14419030i
[3,] -0.4111692+0i -0.70032419+0i  0.71282735+0.00000000i  0.71282735+0.00000000i
[4,] -0.2743534+0i  0.11737968+0i -0.08512726-0.08243612i -0.08512726+0.08243612i
[5,]  0.0415566+0i -0.11029158+0i -0.20160469-0.52255347i -0.20160469+0.52255347i
          [,5]
[1,] -0.14957716+0i
[2,]  0.59194943+0i
[3,] -0.76844062+0i
[4,] -0.17544646+0i
[5,] -0.07707206+0i

> #Q3.2
> x = (A*B)^-1
> y = A^-1 * B^-1
> x
          [,1]       [,2]       [,3]       [,4]       [,5]
[1,] -0.100000000 0.041666667 -0.011363636 0.017857143  0.071428571
[2,]  0.008547009 0.001984127  0.008403361 0.015384615  0.013888889
[3,]  0.008403361 0.015625000  0.100000000 0.004201681 -0.010526316
[4,]  0.166666667 0.035714286  0.003773585 0.009803922  0.005813953
[5,]  0.007407407 0.090909091  0.017857143 0.003225806  0.017857143
> y
          [,1]       [,2]       [,3]       [,4]       [,5]
[1,] -0.100000000 0.041666667 -0.011363636 0.017857143  0.071428571
[2,]  0.008547009 0.001984127  0.008403361 0.015384615  0.013888889
[3,]  0.008403361 0.015625000  0.100000000 0.004201681 -0.010526316
[4,]  0.166666667 0.035714286  0.003773585 0.009803922  0.005813953
[5,]  0.007407407 0.090909091  0.017857143 0.003225806  0.017857143
> #Therefore it is verified as X == Y
```

```
> #Q3.3
> z = (4 * (A^5)) - (5*(A^3)) + (A^2)
> z
      [,1]     [,2]      [,3]     [,4]     [,5]
[1,]      0       92    -128448   2137772     65562
[2,] 1474356  31781952    5655152     11900    232632
[3,]   65562 134054912     395100   2137772     11900
[4,]     846     3792 1672040396 181546332 587638086
[5,]  232632    637670    2137772   -394900     3792
> #dimensions of Z is 5 x 5 matrix
> #Q3.4
> A
    [,1] [,2] [,3] [,4] [,5]
[1,]    1    2   -8   14    7
[2,]   13   24   17    5    9
[3,]    7   32   10   14    5
[4,]    3    4   53   34   43
[5,]    9   11   14  -10    4
> B
    [,1] [,2] [,3] [,4] [,5]
[1,]  -10   12   11    4    2
[2,]    9   21    7   13    8
[3,]   17    2    1   17  -19
[4,]    2    7    5    3    4
[5,]   15    1    4  -31   14
> A_new = c(5,-4,6,3,2)
> B_new = c(14,9,43,24,26)
> A[4,] = A_new
> B[,5] = B_new
> A
    [,1] [,2] [,3] [,4] [,5]
```

[1,] 1 2 -8 14 7

[2,] 13 24 17 5 9

[3,] 7 32 10 14 5

[4,] 5 -4 6 3 2

[5,] 9 11 14 -10 4

> B

  [,1] [,2] [,3] [,4] [,5]

[1,] -10 12 11 4 14

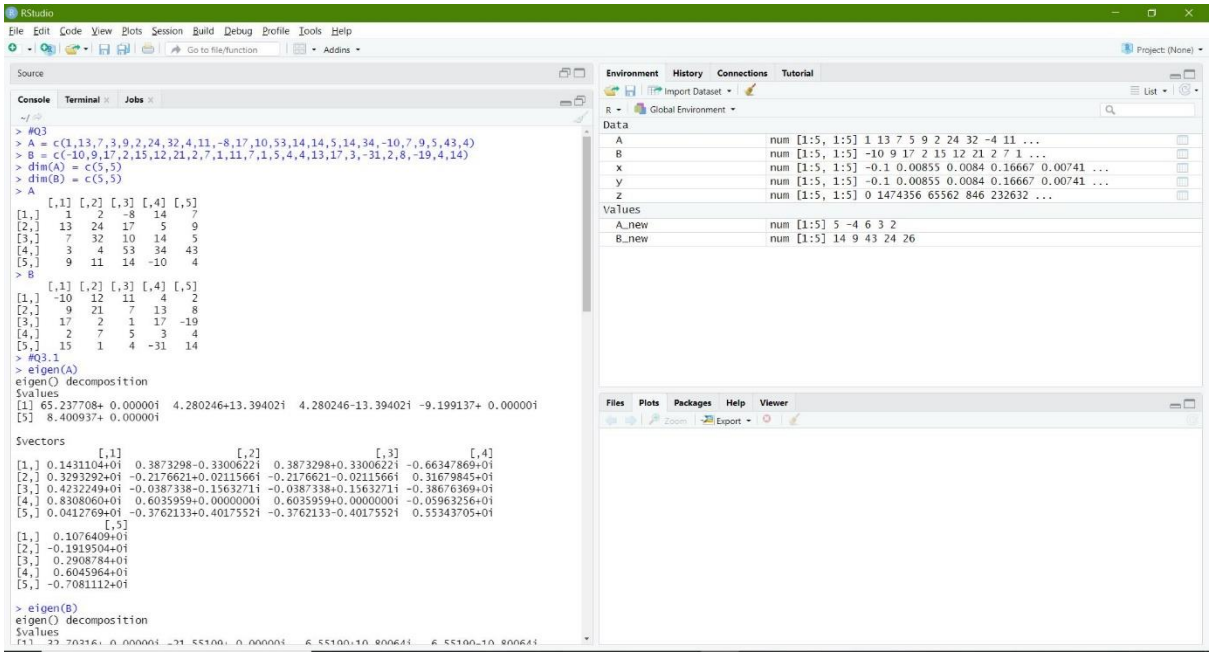
[2,] 9 21 7 13 9

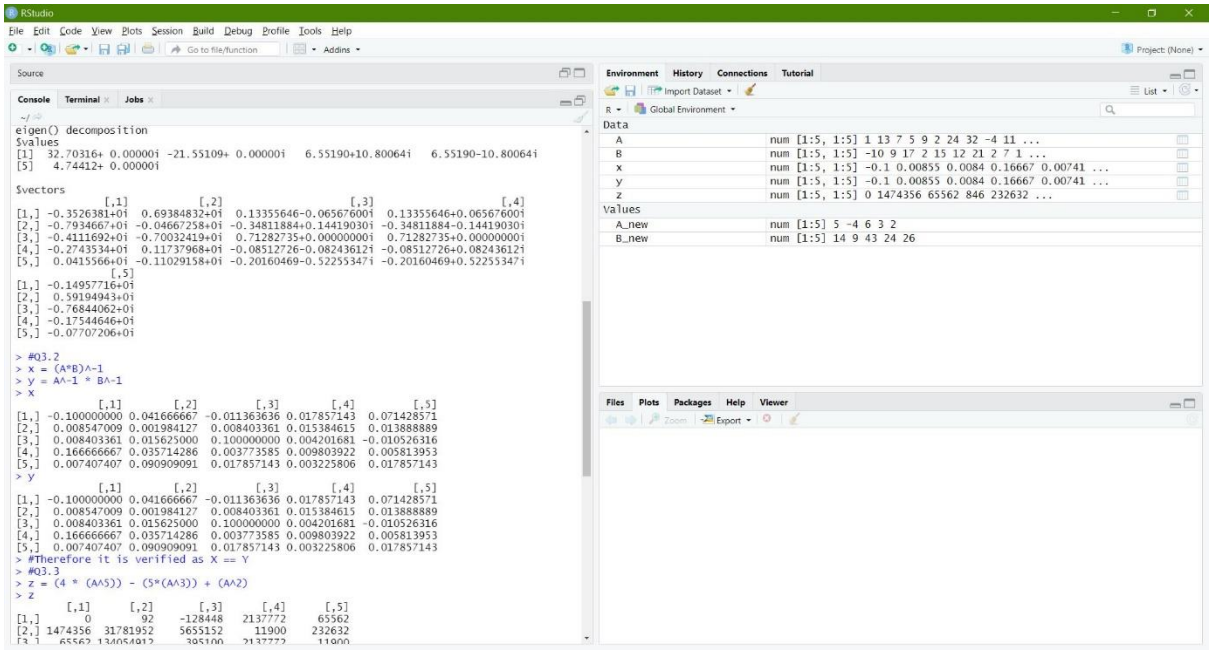
[3,] 17 2 1 17 43

[4,] 2 7 5 3 24

[5,] 15 1 4 -31 26

Implementation on R Studio Code (via Command Window):





```
eigen() decomposition
$values
[1]  32.70316+ 0.00000i -21.55109+ 0.00000i   6.55190+10.80064i   6.55190-10.80064i
[5]   4.74412+ 0.00000i

$vectors
              [,1]                  [,2]                  [,3]                  [,4]
[1,] -0.3526381+0i  0.69384832+0i  0.13355646-0.06567600i  0.13355646+0.06567600i
[2,] -0.7934667+0i -0.04667258+0i -0.34811884+0.14419030i -0.34811884-0.14419030i
[3,] -0.4111692+0i -0.70032419+0i  0.71282735+0.00000000i  0.71282735+0.00000000i
[4,] -0.2743534+0i  0.11737968+0i -0.08512726-0.08243612i -0.08512726+0.08243612i
[5,]  0.0415566+0i -0.11029158+0i -0.20160469-0.52253347i -0.20160469+0.52253347i
              [,5]
[1,] -0.14957716+0i
[2,]  0.59194943+0i
[3,] -0.76844062+0i
[4,] -0.17544646+0i
[5,] -0.07707206+0i

> #Q3.2
> x = (A*B)^-1
> y = A^-1 * B^-1
> x
             [,1]         [,2]         [,3]         [,4]         [,5]
[1,] -0.100000000 0.041666667 -0.011363636 0.017857143  0.071428571
[2,]  0.008547009 0.001984127  0.008403361 0.015384615  0.013888889
[3,]  0.008403361 0.015625000  0.100000000 0.004201681 -0.010526316
[4,]  0.166666667 0.035714286  0.003773585 0.009803922  0.005813953
[5,]  0.007407407 0.090909091  0.017857143 0.003225806  0.017857143
> y
             [,1]         [,2]         [,3]         [,4]         [,5]
[1,] -0.100000000 0.041666667 -0.011363636 0.017857143  0.071428571
[2,]  0.008547009 0.001984127  0.008403361 0.015384615  0.013888889
[3,]  0.008403361 0.015625000  0.100000000 0.004201681 -0.010526316
[4,]  0.166666667 0.035714286  0.003773585 0.009803922  0.005813953
[5,]  0.007407407 0.090909091  0.017857143 0.003225806  0.017857143
> #Therefore it is verified as X == Y
> #Q3.3
> z = (4 * (A^5)) - (5*(A^3)) + (A^2)
> z
      [,1]     [,2]      [,3]     [,4]     [,5]
[1,]     0       92   -128448  2137772    65562
[2,] 1474356 31781952   5655152    11900   232632
[3,]   65562 134054912    395100  2137772    11900
[4,]     846     3792 167204039 181546332 587638086
[5,]  232632   637670   2137772   -394900     3792
> #dimensions of Z is 5 x 5 matrix
> #Q3.4
> A
     [,1] [,2] [,3] [,4] [,5]
[1,]    1    2   -8   14    7
[2,]   13   24   17    5    9
[3,]    7   32   10   14    5
[4,]    3    4   53   34   43
[5,]    9   11   14  -10    4
> B
     [,1] [,2] [,3] [,4] [,5]
[1,]  -10   12   11    4    2
[2,]    9   21    7   13    8
[3,]   17    2    1   17  -19
[4,]    2    7    5    3    4
[5,]   15    1    4  -31   14
> A_new = c(5,-4,6,3,2)
> B_new = c(14,9,43,24,26)
> A[4,] = A_new
> B[,5] = B_new
> A
     [,1] [,2] [,3] [,4] [,5]
[1,]    1    2   -8   14    7
[2,]   13   24   17    5    9
[3,]    7   32   10   14    5
[4,]    5   -4    6    3    2
[5,]    9   11   14  -10    4
> B
     [,1] [,2] [,3] [,4] [,5]
[1,]  -10   12   11    4   14
[2,]    9   21    7   13    9
[3,]   17    2    1   17   43
[4,]    2    7    5    3   24
[5,]   15    1    4  -31   26
>
>
```