

2. Explain the following commands in R :

(a)

```
> #cbind:
> #In general takes a sequence of vector, matrix or data-frame arguments and
  combines by columns.
> #rbind:
> #In general takes a sequence of vector, matrix or data-frame arguments and
  combines by rows.
>
> cbind(1:4, 5:8)

      [,1] [,2]
[1,]    1    5
[2,]    2    6
[3,]    3    7
[4,]    4    8

> # Here it takes two sequences
> # 1:4 -- same as -- (1,2,3,4) and 5:8 -- same as (5,6,7,8)
> #and combines them as the columns of a matrix.
> #The first column of the matrix is (1,2,3,4) and
> #the second column is (5,6,7,8).
>
> rbind(1:4, 5:8)

      [,1] [,2] [,3] [,4]
[1,]    1    2    3    4
[2,]    5    6    7    8

> #Here it takes two sequences
> # 1:4 -- same as -- (1,2,3,4) and 5:8 -- same as (5,6,7,8)
> #and combines them as the rows of a matrix.
> #The first row of the matrix is (1,2,3,4) and
> #the second row is (5,6,7,8).
>
>
> rbind(c(2,3),c(4,5))

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

> #Here it takes two sequences
```

```

> # c(2,3) -- same as -- (2,3) and c(4,5) -- same as (4,5)
> #and combines them as the rows of a matrix.
> #The first row of the matrix is (2,3) and
> #the second row is (4,5).
>
> #matrix:
> #creates a matrix from the given set of values.
> matrix(1,4,7)

      [,1] [,2] [,3] [,4] [,5] [,6] [,7]
[1,]    1    1    1    1    1    1    1
[2,]    1    1    1    1    1    1    1
[3,]    1    1    1    1    1    1    1
[4,]    1    1    1    1    1    1    1

> # Here it creates a 4x7 matrix with
> #each data entry as 1.
>
> #rep(x,n)
> #replicates the values in 'x', 'n' times.
> rep(1:4,2)

[1] 1 2 3 4 1 2 3 4

> #this command replicates the sequence 1:4 --same as-- (1,2,3,4) two times.

```

(b)

```

> 1:10 #creates a vector with numbers from 1 to 10

[1] 1 2 3 4 5 6 7 8 9 10

> seq(10) #Same as 1:10

[1] 1 2 3 4 5 6 7 8 9 10

> seq(1,10,by=3) #Generate regular sequences, in progression of 3 starting
  at 1 and ending at 10

[1] 1 4 7 10

> 10:1 #creates a vector with entries from 10 to 1

```

```

[1] 10 9 8 7 6 5 4 3 2 1

> seq(from=10,to=1,by=-3) #Generate regular sequences, in progression of -3
starting at 10 and ending at 1

[1] 10 7 4 1

> seq(1,10,length=7) #Generate regular sequences of length 7 of equally
spaced values starting at 1 and ending at 10.

[1] 1.0 2.5 4.0 5.5 7.0 8.5 10.0

```

3. A matrix can be treated as a collection of row or column vectors. Given the row vectors  $u = (1, 2, 3)$  and  $v = (4, 5, 6)$  can you write a (single) statement to create the  $2 \times 3$  matrix  $A$  having  $u$  as its first row and  $v$  as its second row vector ?

**Solution:**

```

> A = rbind(c(1,2,3), c(4,5,6))
> A

      [,1] [,2] [,3]
[1,]    1    2    3
[2,]    4    5    6

```

4. Given the matrix  $C = \begin{bmatrix} 11 & 5 \\ 2 & 1 \\ 18 & 7 \end{bmatrix}$ , write the two statements to create  $s = (11, 2, 18)^T$  and  $t = (5, 1, 7)^T$ , by extracting the columns of  $C$ .

**Solution:**

```

> C = matrix(c(11,2,18,5,1,7),nrow=3)
> C

      [,1] [,2]
[1,]   11    5
[2,]    2    1
[3,]   18    7

> s = matrix(C[,1],nrow=3)
> s

      [,1]
[1,]   11
[2,]    2

```

```
[3,] 18
```

```
> t = matrix(C[,2],nrow=3)
> t
```

```
      [,1]
[1,]    5
[2,]    1
[3,]    7
```

5. Let  $D = \begin{bmatrix} 2 & -1 & 0 & 0 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ 0 & 0 & -1 & 2 \end{bmatrix}$ ,  $M = \begin{bmatrix} 2 & 8 & 14 & 20 \\ 4 & 10 & 16 & 22 \\ 6 & 12 & 18 & -24 \end{bmatrix}$ ,  $T = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ -1 & 1 & 0 & 0 & 1 \\ -1 & -1 & 1 & 0 & 1 \\ -1 & -1 & -1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 \end{bmatrix}$ ,

(a) Use the

```
> diag
```

command to create  $D$ .

**Solution:** The following commands create matrix  $D$ .

```
> a = diag(2,4)           # creates a 4x4 diagonal matrix with 2s along the
                           diagonal
> b0 = diag(-1,3,4)       # create a 3x4 matrix with s along the diagonal
> b = rbind(c(0,0,0,0),b0) # creates a 4x4 matrix with a row of 0s and
                           appends b0
> c0 = diag(-1,4,3)       # create a 4x3 matrix with s along the diagonal
> c = cbind(c(0,0,0,0),c0) # creates a 4x4 matrix with a column of 0s and
                           appends c0
> a+b+c
```

```
      [,1] [,2] [,3] [,4]
[1,]    2  -1    0    0
[2,]  -1    2  -1    0
[3,]    0  -1    2  -1
[4,]    0    0  -1    2
```

(b) Use the

```
> matrix
```

command to create  $T, M$ .

**Solution:** The following commands create matrix  $M$ .

```

> M = matrix(
+   c(seq(2,22,by=2),-24),
+   nrow = 3,
+   ncol = 4,
+   byrow = FALSE)
> M

      [,1] [,2] [,3] [,4]
[1,]    2    8   14   20
[2,]    4   10   16   22
[3,]    6   12   18  -24

```

The following commands create matrix  $T$ .

```

> T = matrix(
+   c(1,0,0,0,1, -1,1,0,0,1, -1,-1,1,0,1, -1,-1,-1,1,1, -1,-1,-1,-1,1),
+   nrow = 5,
+   ncol = 5,
+   byrow = TRUE)
> T

      [,1] [,2] [,3] [,4] [,5]
[1,]    1    0    0    0    1
[2,]   -1    1    0    0    1
[3,]   -1   -1    1    0    1
[4,]   -1   -1   -1    1    1
[5,]   -1   -1   -1   -1    1

```