

❖ Arrays and Matrices

Matrices in R are a set of data with dimensions (rows x columns) containing elements of the same type (all numbers or all text, etc.). To create and name a matrix in R, we use the `Matrix()` function. We can specify the number of rows (`nrow`) and columns (`ncol`), as in the example below:

```
> matrix(data , nrow , ncol , byrow)
```

- data is vector contains matrix elements entered either row by row or column by column .

- nrow is the number of rows in the matrix .

- ncol is the number of ncolumns in the matrix .

- byrow is logical statement (True or False) used to determine whether the data should be read row by row or column by column .

Example :

```
> m1=matrix(1:9, nrow = 3,ncol = 3)
```

```
> print(m1)
```

```
      [,1] [,2] [,3]
[1,]  1   4   7
[2,]  2   5   8
[3,]  3   6   9
```

Example :

```
> m1=matrix(1:12,nrow = 3,ncol = 4)
```

```
> print(m1)
```

```
      [,1] [,2] [,3] [,4]
[1,]  1   4   7  10
[2,]  2   5   8  11
[3,]  3   6   9  12
```

Example :

```
> m2=matrix(c(4,2,7,8,10,11),nrow = 2,ncol = 3)
```

```
> print(m2)
```

```
      [,1] [,2] [,3]
[1,]  4   7  10
[2,]  2   8  11
```

Example :

```
> x=1:20
```

```
> dim(x)=c(4,5)
```

```
> x
```

```
      [,1] [,2] [,3] [,4] [,5]  
[1,]  1  5  9 13 17  
[2,]  2  6 10 14 18  
[3,]  3  7 11 15 19  
[4,]  4  8 12 16 20
```

To know the value of an element in an array, the row and column numbers are determined as shown below:

Example :

```
> y[1,2]
```

```
[1] 4
```

The formula below is used to write the names of columns and rows:

```
> y[1,]
```

```
[1] 1 4 7 10
```

```
> y[1,] # الصف الاول من المصفوفة
```

```
[1] 1 4 7 10
```

```
> y[,1] # العمود الاول من المصفوفة
```

```
[1] 1 2 3
```

```
> y[-1,] # جميع القيم في المصفوفة ما عدا الصف الاول
```

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

```
[1,]  2  5  8 11
```

```
[2,]  3  6  9 12
```

-The dim command is used to dimension the array.

```
> dim(y)
```

```
[1] 3 4
```

Types of Matrices

- Identity matrix

It is a matrix whose diagonal elements are ones and the rest are zeros, as shown in the example below:

Example :

```
> y=diag(4)
> y
      [,1] [,2] [,3] [,4]
[1,]  1  0  0  0
[2,]  0  1  0  0
[3,]  0  0  1  0
[4,]  0  0  0  1
```

- Zero matrix مصفوفة الصفرية

It is a matrix in which all of its elements are zero, as shown in the example below:

Example :

```
> m3=matrix(0,nrow = 3,ncol = 4)
> m3
      [,1] [,2] [,3] [,4]
[1,]  0  0  0  0
[2,]  0  0  0  0
[3,]  0  0  0  0
```

```
> matrix(0,3,3)
```

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

- Function array()

array() to write an array with more than two dimensions, while the (dim) option gives the number of rows, columns and layers, as shown in the example above:

Example :

```
y=array(1:8,dim=c(4,2))
y
```

```

    [1,] [2]
[1,]  1  5
[2,]  2  6
[3,]  3  7
[4,]  4  8
x=y = array(1:16, dim=c(4,2,2))
x
, , 1

```

```

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

```

```

    [1,] [2]
[1,]  9 13
[2,] 10 14
[3,] 11 15
[4,] 12 16

```

❖ Operations on matrices *العمليات على المصفوفات*

1- Adding and subtracting matrices

To add and subtract matrices, we use the (m+n) instruction, provided that the two matrices have the same capacity, as shown in the following example:

Example :

```

n=matrix(c(5,1,6,3,2,8),nrow = 2,ncol = 3)
m=matrix(c(3,2,6,4,1,9),nrow = 2,ncol = 3)
m;n

```

```

    [1,] [2,] [3,]
[1,]  3  6  1
[2,]  2  4  9
    [1,] [2,] [3,]
[1,]  5  6  2
[2,]  1  3  8

```

```
> m+n
```

```
  [1] [2] [3]  
[1,]  8 12  3  
[2,]  3  7 17
```

```
> m-n
```

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

2- Matrix multiplication

- Element by element multiplication

```
> m*m
```

```
  [1] [2] [3]  
[1,]  9 36  1  
[2,]  4 16 81
```

To know the Matrix class, we use the class() instruction, as shown in the example below:

Example :

```
y=matrix(1:16,nrow = 4) # مصفوفة من اربع صفوف
```

```
y
```

```
  [1] [2] [3] [4]  
[1,]  1  5  9 13  
[2,]  2  6 10 14  
[3,]  3  7 11 15  
[4,]  4  8 12 16
```

```
> class(y) # لمعرفة فئة المصفوفة
```

```
[1] "matrix" "array"
```

- A matrix transpose *مدور المصفوفة*

It is the matrix resulting from swapping the columns with the rows. For example, $A_{n \times m}$ becomes $A_{m \times n}$ symbolized by the symbol A' .

> t(y)

```
      [,1] [,2] [,3] [,4]
[1,]  1   2   3   4
[2,]  5   6   7   8
[3,]  9  10  11  12
[4,] 13  14  15  16
```