

Phil Ender's Summary of Matrix Commands in R

<http://www.philender.com/courses/multivariate/notes/matr.html>

The Matrix

```
# the matrix function
# R wants the data to be entered by columns starting with column one
# 1st arg: c(2,3,-2,1,2,2) the values of the elements filling the columns
# 2nd arg: 3 the number of rows
# 3rd arg: 2 the number of columns

> A <- matrix(c(2,3,-2,1,2,2),3,2)
> A

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

Is Something a Matrix

```
> is.matrix(A)

[1] TRUE

> is.vector(A)

[1] FALSE
```

Multiplication by a Scalar

```
> c <- 3
> c*A

      [,1] [,2]
[1,]    6    3
[2,]    9    6
[3,]   -6    6
```

Matrix Addition & Subtraction

```
> B <- matrix(c(1,4,-2,1,2,1),3,2)
> B

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

> C <- A + B
> C

      [,1] [,2]
[1,]    3    2
[2,]    7    4
[3,]   -4    3

> D <- A - B
> D

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

Matrix Multiplication

```
> D <- matrix(c(2,-2,1,2,3,1),2,3)
```

```
> D
```

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

```
> C <- D %**% A  
> C
```

```
      [,1] [,2]  
[1,]    1   10  
[2,]    0    4
```

```
> C <- A %**% D  
> C
```

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

```
> D <- matrix(c(2,1,3),1,3)  
> D
```

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

```
> C <- D %**% A  
> C
```

```
      [,1] [,2]  
[1,]    1   10
```

```
> C <- A %**% D
```

```
Error in A %**% D : non-conformable arguments
```

Transpose of a Matrix

```
> AT <- t(A)  
> AT
```

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

```
> ATT <- t(AT)  
> ATT
```

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

Common Vectors

Unit Vector

```
> U <- matrix(1,3,1)  
> U
```

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

Zero Vector

```
> Z <- matrix(0,3,1)  
> Z
```

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

Common Matrices

Unit Matrix

```
> U <- matrix(1,3,2)
> U
```

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

Zero Matrix

```
> Z <- matrix(0,3,2)
> Z
```

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

Diagonal Matrix

```
> S <- matrix(c(2,3,-2,1,2,2,4,2,3),3,3)
> S
```

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

```
> D <- diag(S)
> D
```

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

```
> D <- diag(diag(S))
> D
```

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

Identity Matrix

```
> I <- diag(c(1,1,1))
> I
```

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

Symmetric Matrix

```
> C <- matrix(c(2,1,5,1,3,4,5,4,-2),3,3)
> C
```

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

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

```
> CT <- t(C)  
> CT
```

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

Inverse of a Matrix

```
> A <- matrix(c(4,4,-2,2,6,2,2,8,4),3,3)  
> A
```

```
      [,1] [,2] [,3]  
[1,] 4 2 2  
[2,] 4 6 8  
[3,] -2 2 4
```

```
> AI <- solve(A)  
> AI
```

```
      [,1] [,2] [,3]  
[1,] 1.0 -0.5 0.5  
[2,] -4.0 2.5 -3.0  
[3,] 2.5 -1.5 2.0
```

```
> A %**% AI
```

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

```
> AI %**% A
```

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

Inverse & Determinant of a Matrix

```
> C <- matrix(c(2,1,6,1,3,4,6,4,-2),3,3)  
> C
```

```
      [,1] [,2] [,3]  
[1,] 2 1 6  
[2,] 1 3 4  
[3,] 6 4 -2
```

```
> CI <- solve(C)  
CI
```

```
      [,1] [,2] [,3]  
[1,] 0.2156863 -0.25490196 0.13725490  
[2,] -0.2549020 0.39215686 0.01960784  
[3,] 0.1372549 0.01960784 -0.04901961
```

```
> d <- det(C)  
> d
```

```
[1] -102
```

Rank of a Matrix

```
> A <- matrix(c(2,3,-2,1,2,2,4,7,0),3,3)  
> A
```

```
      [,1] [,2] [,3]
[1,]    2    1    4
[2,]    3    2    7
[3,]   -2    2    0

> matA <- qr(A)
> matA$rank

[1] 3

> A <- matrix(c(2,3,-2,1,2,2,4,6,-4),3,3)
> A
```

```
      [,1] [,2] [,3]
[1,]    2    1    4
[2,]    3    2    6
[3,]   -2    2   -4

> matA <- qr(A)
> matA$rank

[1] 2

# note column 3 is 2 times column 1
```

Number of Rows & Columns

```
> X <- matrix(c(3,2,4,3,2,-2,6,1),4,2)
> X
```

```
      [,1] [,2]
[1,]    3    2
[2,]    2   -2
[3,]    4    6
[4,]    3    1
```

```
> dim(X)
```

```
[1] 4 2
```

```
> r <- nrow(X)
> r
```

```
[1] 4
```

```
> c <- ncol(X)
> c
```

```
[1] 2
```

Computing Column & Row Sums

```
# note the uppercase S
```

```
> A <- matrix(c(2,3,-2,1,2,2),3,2)
> A
```

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

```
> c <- colSums(A)
> c
```

```
[1] 3 5
```

```
> r <- rowSums(A)
> r
```

```
[1] 3 5 0
```

```
> a <- sum(A)
> a
```

```
[1] 8
```

Computing Column & Row Means

```
# note the uppercase M
```

```
> cm <- colMeans(A)
> cm
```

```
[1] 1.000000 1.666667
```

```
> rm <- rowMeans(A)
> rm
```

```
[1] 1.5 2.5 0.0
```

```
> m <- mean(A)
> m
```

```
[1] 1.333333
```

Horizontal Concatenation

```
> A
```

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

```
> B <- matrix(c(1,3,2,1,4,2),3,2)
> B
```

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

```
> C <- cbind(A,B)
> C
```

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

Vertical Concatenation (Appending)

```
> C <- rbind(A,B)
> C
```

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

[Multivariate Course Web Page](#)

[Phil Ender, 13jul07, 23feb05](#)