Introduction to R Software

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Lecture 12

Matrix Operations and Missing Data

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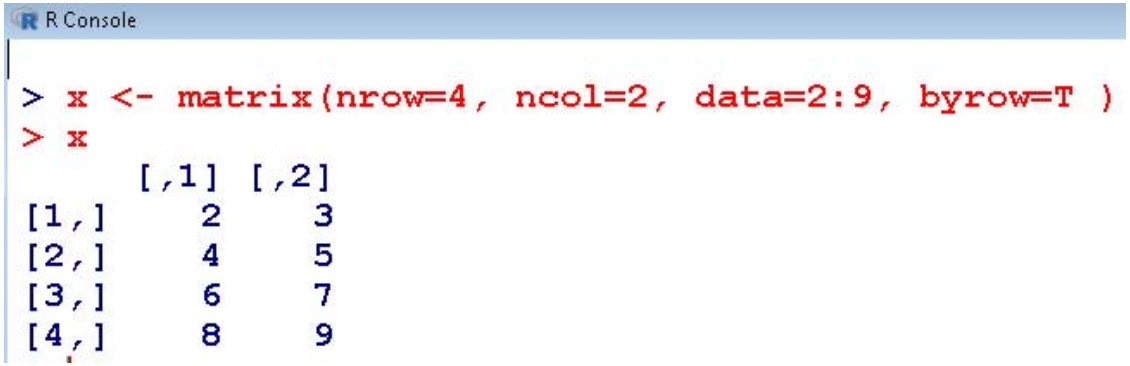
Slides can be downloaded from

http://home.iitk.ac.in/~shalab/sp

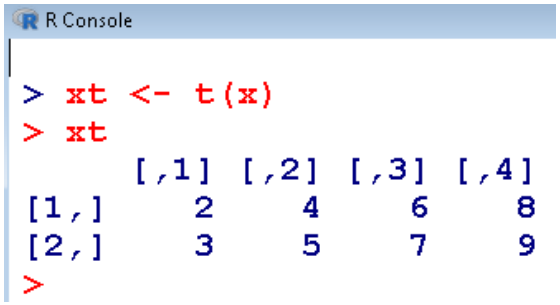
Transpose of a matrix X: X’

```
> x <- matrix(nrow=4, ncol=2, data=2:9, byrow=T )
> x
     [,1] [,2]
[1,]    2    3
[2,]    4    5
[3,]    6    7
[4,]    8    9
```



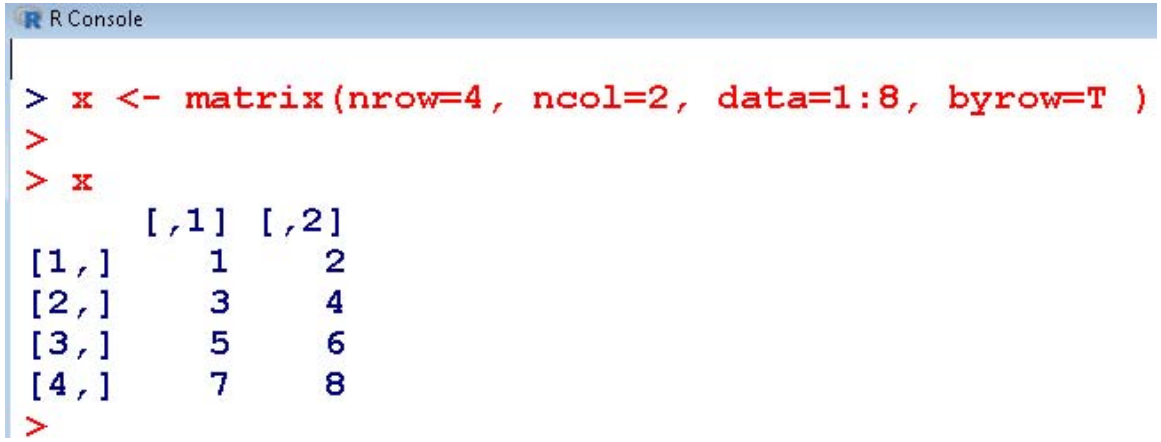
Transpose of a matrix *X*: *X*'

```
> xt <- t(x)

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



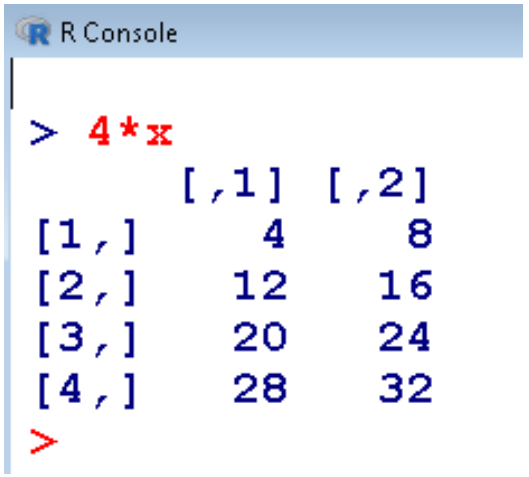
Multiplication of a matrix with a constant

```
> x <- matrix(nrow=4, ncol=2, data=1:8, byrow=T )

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



Multiplication of a matrix with a constant

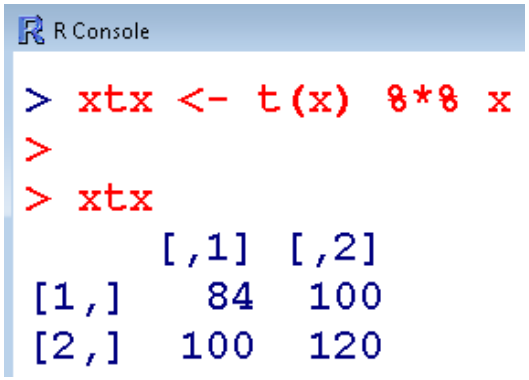
```
> 4*x
     [,1] [,2]
[1,]    4    8
[2,]   12   16
[3,]   20   24
[4,]   28   32
```



Matrix multiplication: operator %*%

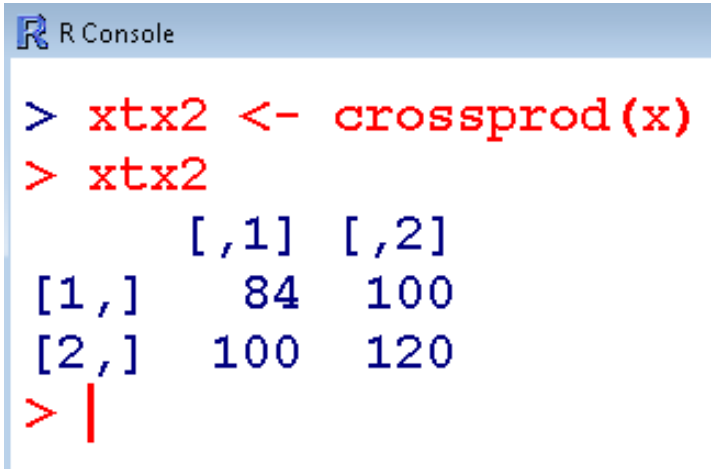
Consider the multiplication of *X'* with *X*

```
> xtx <- t(x) %*% x

> xtx
      [,1]   [,2]
[1,]   84    100
[2,]  100    120
```



Cross product of a matrix *X*- *X'X* with a function `crossprod`

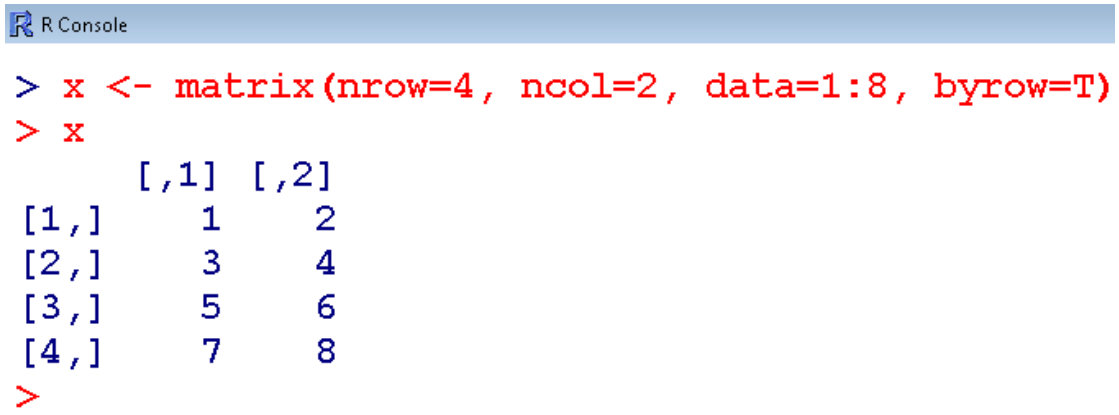
```
> xtx2 <- crossprod(x)

> xtx2
     [,1]   [,2]
[1,]   84    100
[2,]  100    120
```



Note: Command `crossprod()` executes the multiplication faster than the conventional method with `t(x)%*%x`

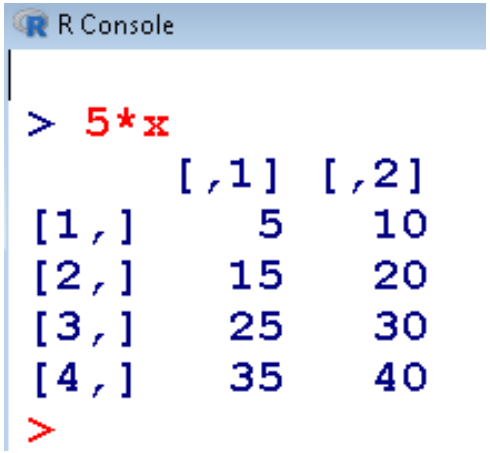
Addition and subtraction of matrices (of same dimensions) can be executed with the usual operators + and -

```
> x <- matrix(nrow=4, ncol=2, data=1:8, byrow=T)

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



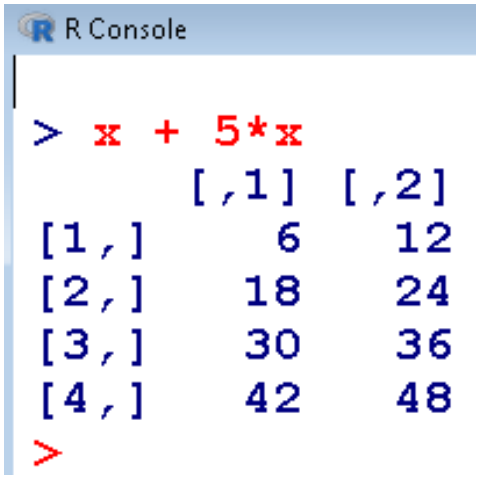
Addition and subtraction of matrices (of same dimensions!) can be executed with the usual operators + and -

```
> 5*x
     [,1] [,2]
[1,]    5   10
[2,]   15   20
[3,]   25   30
[4,]   35   40
```



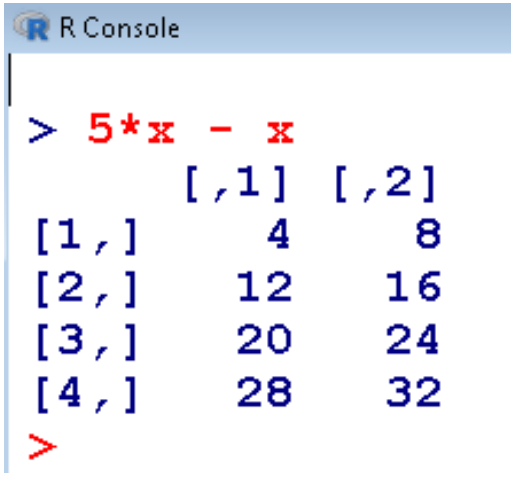
Addition and subtraction of matrices (of same dimensions!) can be executed with the usual operators + and -

```
> x + 5*x
     [,1] [,2]
[1,]    6   12
[2,]   18   24
[3,]   30   36
[4,]   42   48
```



Addition and subtraction of matrices (of same dimensions!) can be executed with the usual operators + and -

```
> 5*x - x
     [,1] [,2]
[1,]    4    8
[2,]   12   16
[3,]   20   24
[4,]   28   32
```



Inverse of a matrix

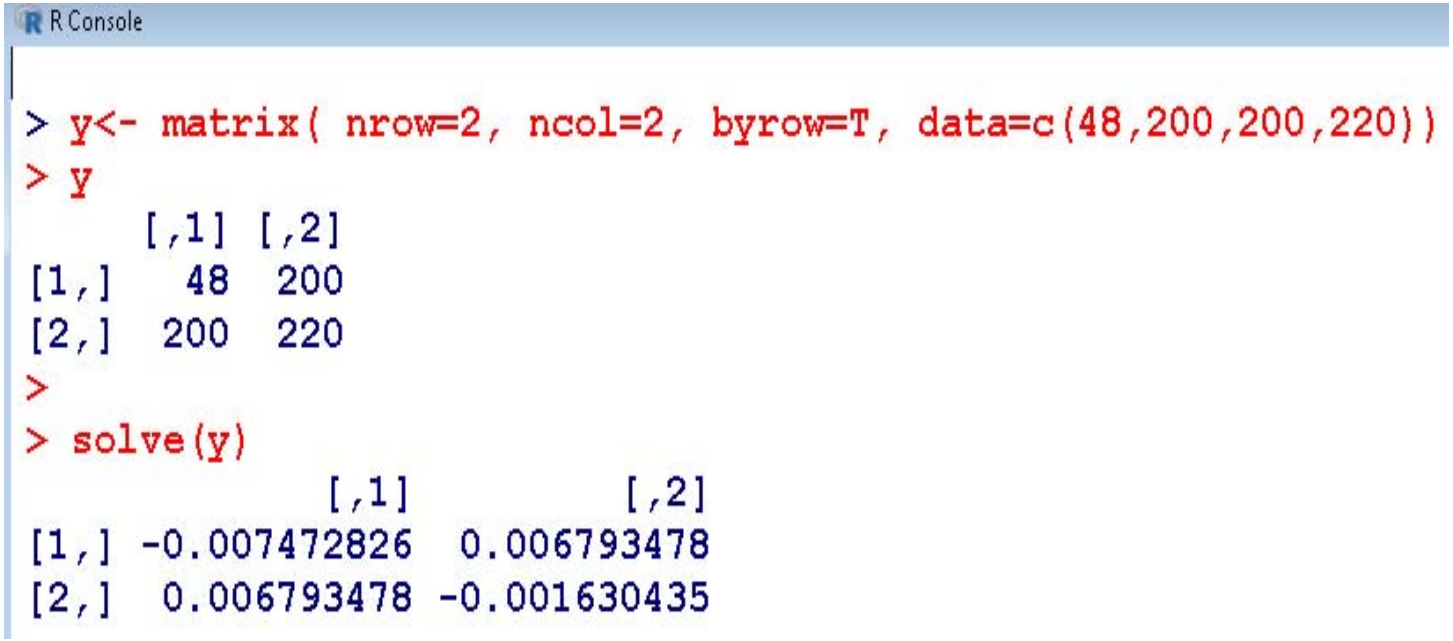
`solve()` finds the inverse of a positive definite matrix

Example:

```
> y<- matrix( nrow=2, ncol=2, byrow=T,
data=c(48,200,200,220))

> y
     [,1] [,2]
[1,]   48  200
[2,]  200  220
```

Inverse of a matrix

```
> solve(y)
           [,1]         [,2]
[1,] -0.007472826  0.006793478
[2,]  0.006793478 -0.001630435
```



Eigen Values and Eigen Vectors

`eigen()` finds the eigen values and eigen vectors of a positive definite matrix.

$$|A - \lambda I| = 0,$$

$$(A - \lambda I)b = 0$$

Eigen Values and Eigen Vectors

Example:

```
> y
     [,1] [,2]
[1,]   48  200
[2,]  200  220

> eigen(y)

eigen() decomposition
$`values`
[1] 351.70622 -83.70622

$vectors
          [,1]       [,2]
[1,] 0.5499874 -0.8351730
[2,] 0.8351730  0.5499874
```