Matrix Operations
R Programming

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Matrix manipulation in R are very useful in Linear Algebra. Below are list of common yet important functions in dealing operations with matrices:

- Transpose - `t`;
- Multiplication - `%*%`;
- Determinant - `det`; and,
- Inverse - `solve`, or `ginv` of MASS library
- Eigenvalues and Eigenvectors - `eigen`

Consider these matrices, $\begin{bmatrix} 3 & 4 & 5 \\ 2 & 1 & 3 \\ 6 & 5 & 4 \end{bmatrix}$ and $\begin{bmatrix} 6 & 7 & 5 \\ 4 & 5 & 8 \\ 7 & 6 & 6 \end{bmatrix}$. In R, these would be,

```
> dat1 <- c(3,4,5,2,1,3,6,5,4)
> matrix1 <- matrix(dat1, nrow = 3, ncol = 3, byrow = TRUE)
> matrix1
     [,1] [,2] [,3]
[1,]    3    4    5
[2,]    2    1    3
[3,]    6    5    4
>
> dat2 <- c(6,7,5,4,5,8,7,6,6)
> matrix2 <- matrix(dat2, nrow = 3, ncol = 3, byrow = TRUE)
> matrix2
     [,1] [,2] [,3]
[1,]    6    7    5
[2,]    4    5    8
[3,]    7    6    6
```

Transposing these, simply use `t`

```
> t(matrix1)
     [,1] [,2] [,3]
[1,]    3    2    6
[2,]    4    1    5
[3,]    5    3    4
>
> t(matrix2)
```

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

Multiplying these, would be

```
> matrix1 %*% matrix2
     [,1] [,2] [,3]
[1,]   69   71   77
[2,]   37   37   36
[3,]   84   91   94
```

For the determinant, we have

```
> det(matrix1)
[1] 27
>
> det(matrix2)
[1] 61
```

Taking the inverse of `matrix1` is achieved by `solve` or `ginv` R functions. Note that `ginv` is in MASS package, and so we have

```
> solve(matrix1)
           [,1]       [,2]        [,3]
[1,] -0.4074074  0.3333333  0.25925926
[2,]  0.3703704 -0.6666667  0.03703704
[3,]  0.1481481  0.3333333 -0.18518519
>
> library(MASS)
> ginv(matrix1)
           [,1]       [,2]        [,3]
[1,] -0.4074074  0.3333333  0.25925926
[2,]  0.3703704 -0.6666667  0.03703704
[3,]  0.1481481  0.3333333 -0.18518519
```

Finally, for eigenvalues and eigenvectors simply use `eigen`

```
> eigen(matrix1)
$values
[1] 11.238947 -2.088872 -1.150075

$vectors
           [,1]       [,2]       [,3]
[1,] -0.6017346 -0.3458537 -0.4307244
[2,] -0.3305706 -0.5288292  0.8445517
[3,] -0.7270754  0.7750644 -0.3181336
>
> eigen(matrix2)
$values
```

```
[1] 18.020246+0.000000i -0.510123+1.767726i -0.510123-1.767726i

$vectors
             [,1]                   [,2]                   [,3]
[1,] 0.5729619+0i -0.4414068-0.3843531i -0.4414068+0.3843531i
[2,] 0.5495930+0i  0.6888097+0.0000000i  0.6888097+0.0000000i
[3,] 0.6079985+0i -0.2537249+0.3443799i -0.2537249-0.3443799i
```

The output above returns the `$values`, which is the eigenvalues, and `$vectors`, the eigenvectors.

Labels

R, Tutorial