



INTRODUCTION TO R

Matrix Calculus

Matrix Calculus

- `colSums()`, `rowSums()`
- Standard arithmetic possible
- Element-wise computation

lotr_matrix

```
> the_fellowship <- c(316, 556)
> two_towers <- c(343, 584)
> return_king <- c(378, 742)

> lotr_matrix <- rbind(the_fellowship, two_towers, return_king)
> colnames(lotr_matrix) <- c("US", "non-US")
> rownames(lotr_matrix) <- c("Fellowship", "Two Towers",
                             "Return King")

> lotr_matrix
```

	US	non-US
Fellowship	316	556
Two Towers	343	584
Return King	378	742

Matrix - Scalar Calculus

```
> lotr_matrix / 1.12
```

	US	non-US
Fellowship	282.1429	496.4286
Two Towers	306.2500	521.4286
Return King	337.5000	662.5000

```
> lotr_matrix - 50
```

	US	non-US
Fellowship	266	506
Two Towers	293	534
Return King	328	692

```
> lotr_matrix
```

	US	non-US
Fellowship	316	556
Two Towers	343	584
Return King	378	742

Matrix - Matrix Calculus

```
> # Definition of theater_cut omitted
```

```
> theater_cut
```

```
      [,1] [,2]  
[1,]   50   50  
[2,]   80   80  
[3,]  100  100
```

```
> lotr_matrix - theater_cut
```

```
      US non-US  
Fellowship 266   506  
Two Towers 263   504  
Return King 278   642
```

```
> lotr_matrix
```

```
      US non-US  
Fellowship 316   556  
Two Towers 343   584  
Return King 378   742
```

Matrix Calculus

```
> lotr_matrix - c(50, 80, 100)
```

	US	non-US
Fellowship	266	506
Two Towers	263	504
Return King	278	642

```
> matrix(c(50, 80, 100), nrow = 3, ncol = 2)
```

	[,1]	[,2]
[1,]	50	50
[2,]	80	80
[3,]	100	100

```
> lotr_matrix
```

	US	non-US
Fellowship	316	556
Two Towers	343	584
Return King	378	742

Matrix Multiplication

```
> # Definition of rates omitted  
> rates
```

```
      [,1] [,2]  
[1,] 1.11 1.11  
[2,] 0.99 0.99  
[3,] 0.82 0.82
```

```
> lotr_matrix * rates
```

```
      US non-US  
Fellowship 350.76 617.16  
Two Towers 339.57 578.16  
Return King 309.96 608.44
```

```
> lotr_matrix
```

	US	non-US
Fellowship	316	556
Two Towers	343	584
Return King	378	742

Matrices and Vectors

- Very similar
- Vector = 1D, matrix = 2D
- Coercion if necessary
- Recycling if necessary
- Element-wise calculus



INTRODUCTION TO R

Let's practice!