Computational Simulation of the Eigenvalues of a Stochastic Matrix

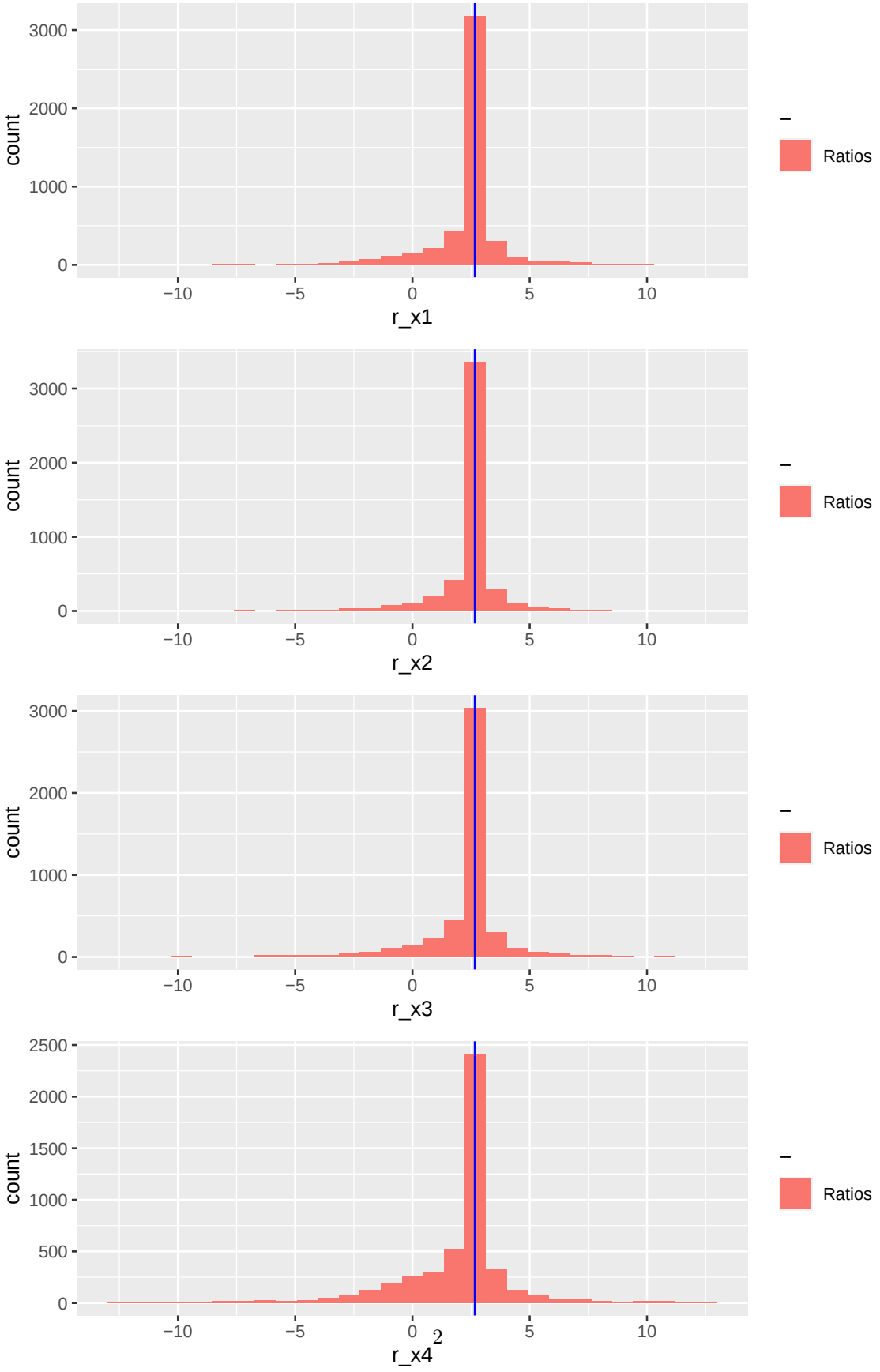
Ali Taqi

Eigenvalues of a Normal Matrix

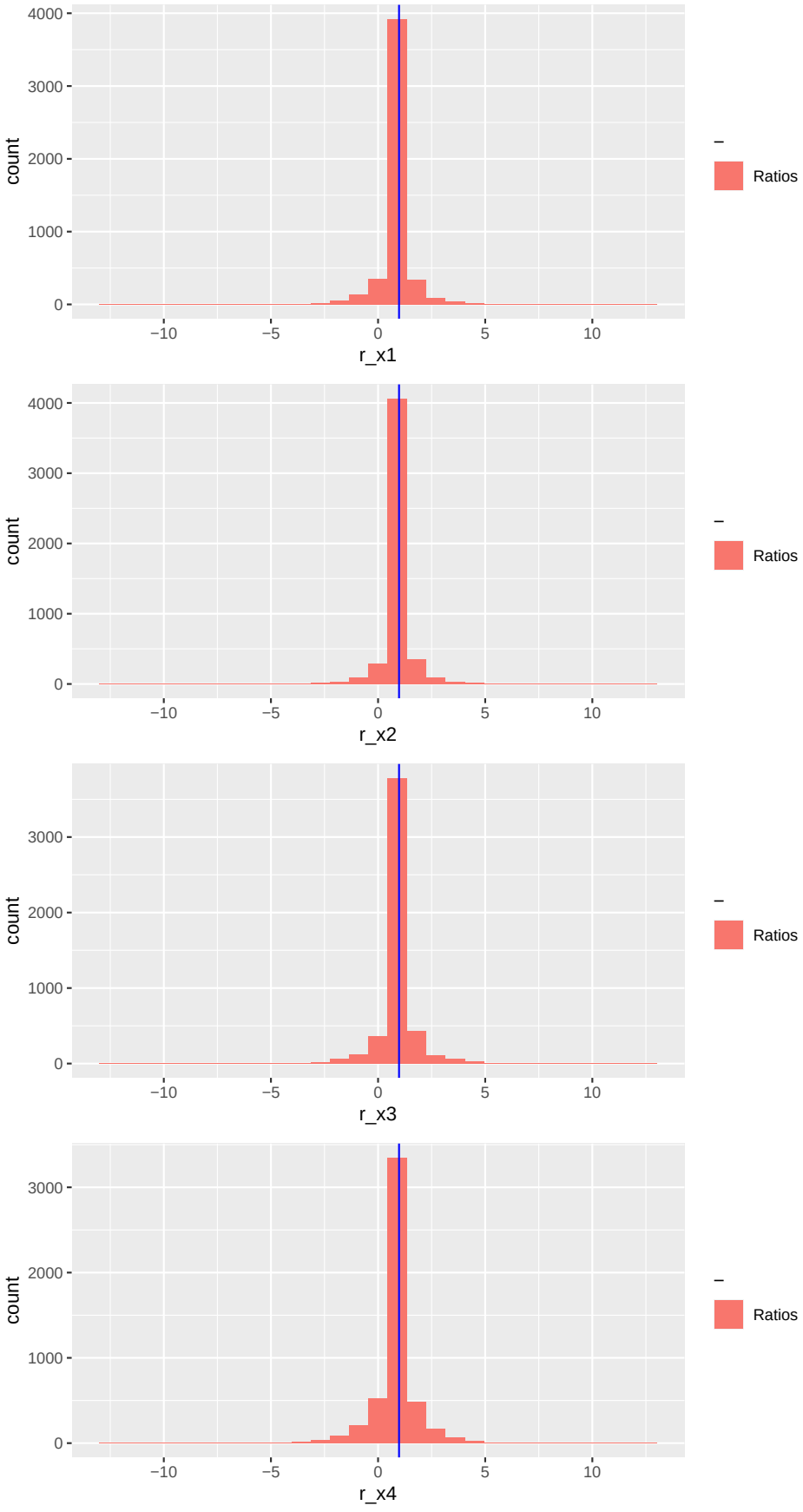
```
## [1]  2.66059061  1.05934754  0.04366624 -1.93647621
```

Ratio Visualization

Linear Ratios



Log Ratios



Eigenvalues of a Symmetric Normal Matrix

```
# Set seed
set.seed(25)
# Set parameters
M <- 7
# Generate matrix
P <- RM_normal(M, symm = T)
P
```

```
##             [,1]        [,2]        [,3]        [,4]       [,5]        [,6]
## [1,] -0.21183360  0.51129562  0.08268682  0.16878151 -1.1494680  1.1444912
## [2,]  0.51129562  0.09964504  0.92757895  0.15525886 -0.9012750 -1.4396122
## [3,]  0.08268682  0.92757895 -0.71676933  2.36776474 -1.1984535 -0.7454078
## [4,]  0.16878151  0.15525886  2.36776474 -1.58564441 -0.5101638 -1.0842603
## [5,] -1.14946795 -0.90127498 -1.19845352 -0.51016382  0.3062463 -0.9118105
## [6,]  1.14449122 -1.43961215 -0.74540777 -1.08426028 -0.9118105  0.2544739
## [7,]  0.86939683 -0.49582214  0.78898396 -0.04827783  0.2844415 -2.3449131
##             [,7]
## [1,]  0.86939683
## [2,] -0.49582214
## [3,]  0.78898396
## [4,] -0.04827783
## [5,]  0.28444148
## [6,] -2.34491308
## [7,]  0.35213987
```

```
# Run a batch
batch <- make_batch(M, B = 200, lambda = 10, complex = FALSE)
```

```
## [1]  3.79298349  2.66687288  0.77884372 -0.06059982 -1.53015048 -2.90655450
## [7] -4.24313753
```

Numerical Eigenvalue Analysis

Sorted Eigenvalues

```
##        r_x5      r_x6      r_x7 eigen_index
## 1 -4.376640 -4.239383 -4.246308           7
## 2 -3.967114 -4.251322 -4.236244           0
## 3 -4.837891 -4.227329 -4.256525           0
## 4 -4.214991 -4.243946 -4.242456           7
## 5 -2.649958 -4.300381 -4.195462           0
## 6 -6.086580 -4.200475 -4.279492           0
```

Initial Plot