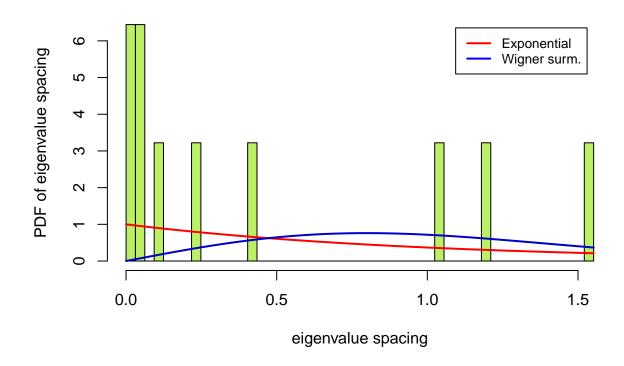
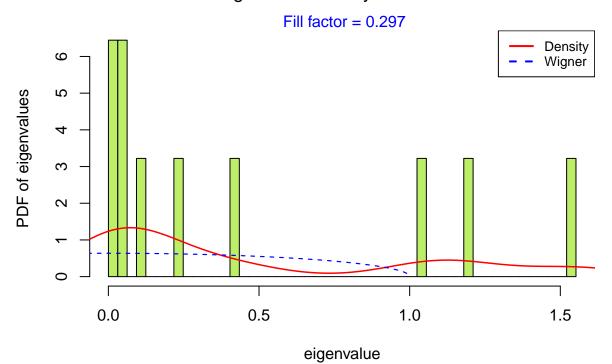
## Random Matrix Analysis

### Ali Taqi

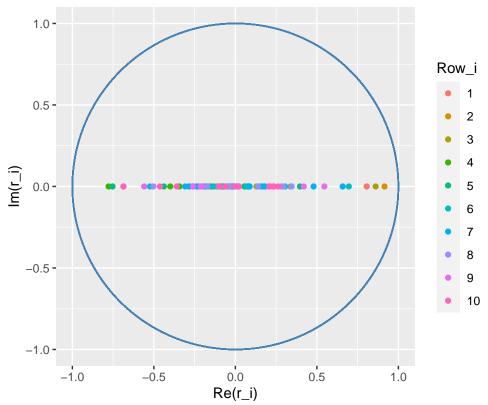
### Symmetric Stochastic Matrices

```
set.seed(23)
symm_stoch(M)
## # A tibble: 10 x 3
##
      row_i prop_reals is_real
##
      <dbl>
                  <dbl> <lgl>
##
    1
                       1 TRUE
          1
    2
           2
                       1 TRUE
##
##
    3
          3
                       1 TRUE
    4
                       1 TRUE
##
##
    5
          5
                       1 TRUE
                       1 TRUE
##
    7
          7
##
                       1 TRUE
##
    8
                       1 TRUE
                       1 TRUE
##
    9
          9
## 10
          10
                       1 TRUE
```





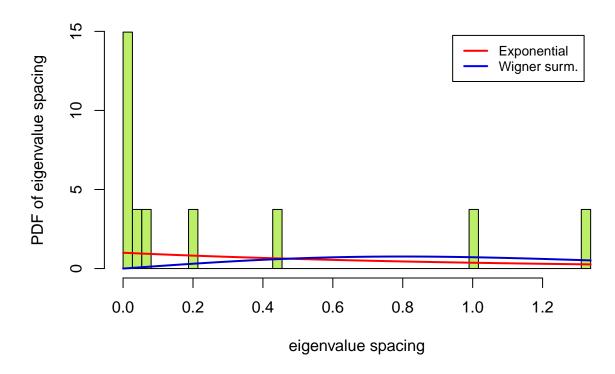
Eigenvectors: Symmetric Stochastic Matrix

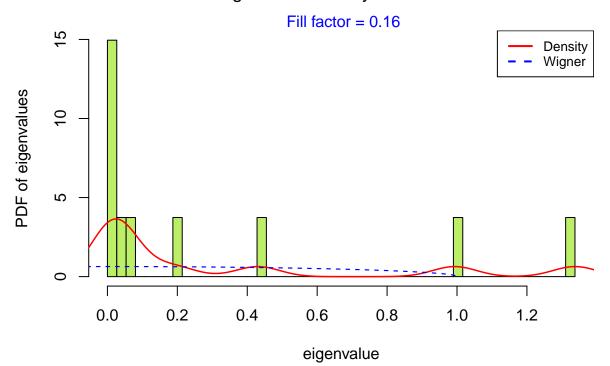


symm\_stoch(M)

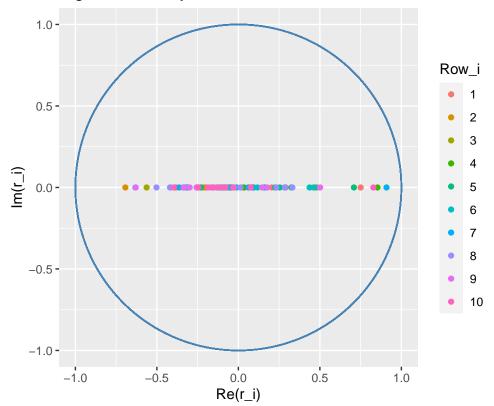
## # A tibble: 10 x 3

```
row_i prop_reals is_real
##
##
      <dbl>
                  <dbl> <lgl>
                       1 TRUE
##
    1
##
    2
           2
                       1 TRUE
    3
           3
                       1 TRUE
##
##
    4
           4
                       1 TRUE
##
    5
           5
                       1 TRUE
##
    6
           6
                       1 TRUE
    7
           7
                       1 TRUE
##
##
    8
           8
                       1 TRUE
##
    9
           9
                       1 TRUE
                       1 TRUE
## 10
          10
```





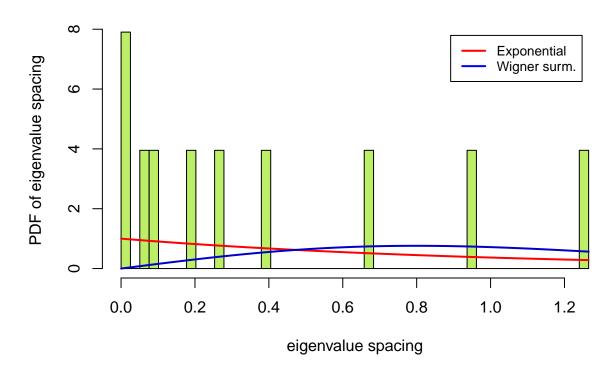
Eigenvectors: Symmetric Stochastic Matrix

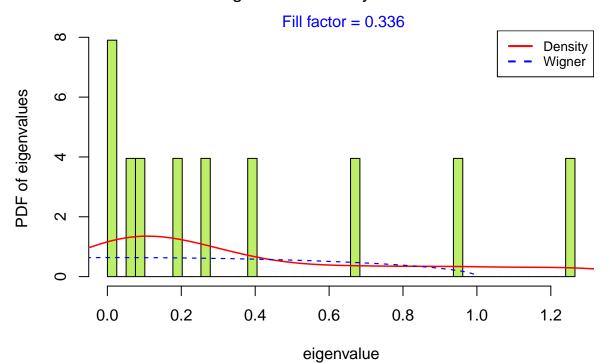


symm\_stoch(M)

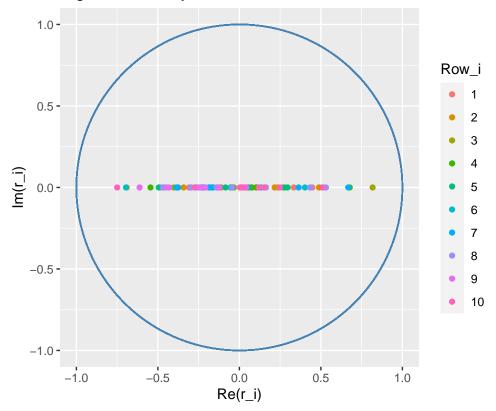
## # A tibble: 10 x 3

```
row_i prop_reals is_real
##
##
      <dbl>
                  <dbl> <lgl>
                       1 TRUE
##
    1
##
    2
           2
                       1 TRUE
    3
           3
                       1 TRUE
##
    4
           4
                       1 TRUE
##
##
    5
          5
                       1 TRUE
##
    6
          6
                       1 TRUE
    7
          7
                       1 TRUE
##
    8
                       1 TRUE
##
          8
##
    9
          9
                       1 TRUE
                       1 TRUE
## 10
          10
```





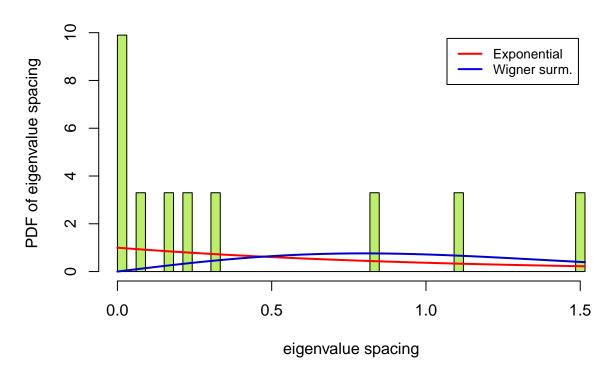
Eigenvectors: Symmetric Stochastic Matrix

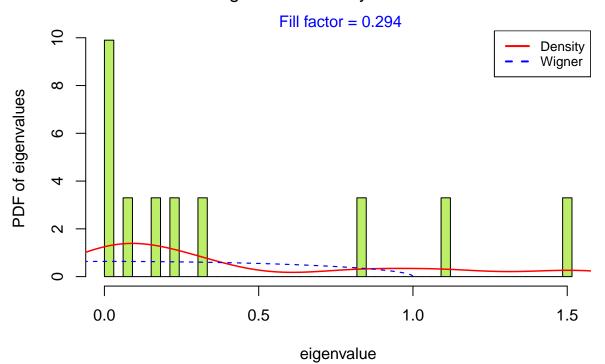


symm\_stoch(M)

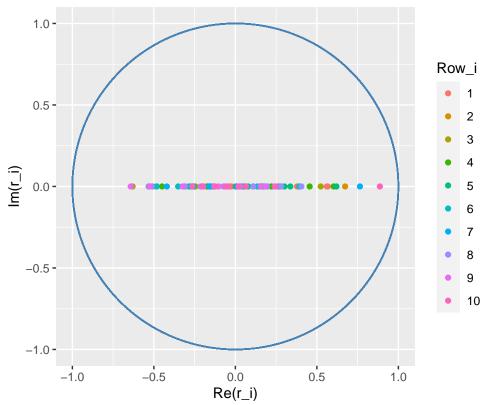
## # A tibble: 10 x 3

```
row_i prop_reals is_real
##
##
      <dbl>
                  <dbl> <lgl>
                       1 TRUE
##
    1
##
    2
           2
                       1 TRUE
    3
           3
                       1 TRUE
##
    4
           4
                       1 TRUE
##
##
    5
           5
                       1 TRUE
##
    6
           6
                       1 TRUE
    7
           7
                       1 TRUE
##
                       1 TRUE
##
    8
           8
##
    9
           9
                       1 TRUE
                       1 TRUE
## 10
          10
```





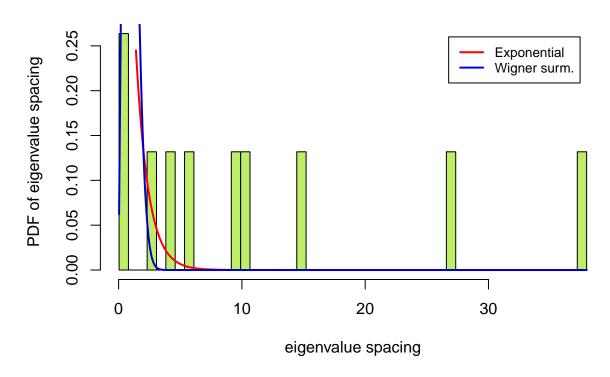
Eigenvectors: Symmetric Stochastic Matrix

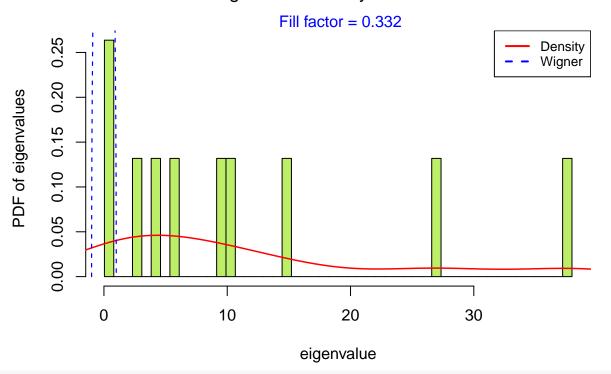


### Normal Symmetric Matrices

```
symm_norm(M)
```

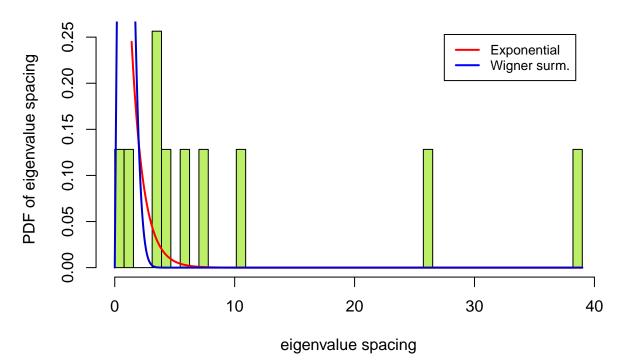
```
## # A tibble: 10 x 3
      row_i prop_reals is_real
##
                  <dbl> <lgl>
##
      <dbl>
##
                      1 TRUE
    1
          1
    2
##
          2
                      1 TRUE
    3
                      1 TRUE
##
          3
##
    4
          4
                      1 TRUE
##
    5
          5
                      1 TRUE
##
    6
          6
                      1 TRUE
          7
                      1 TRUE
##
    7
##
    8
          8
                      1 TRUE
    9
                      1 TRUE
##
          9
## 10
                      1 TRUE
         10
```

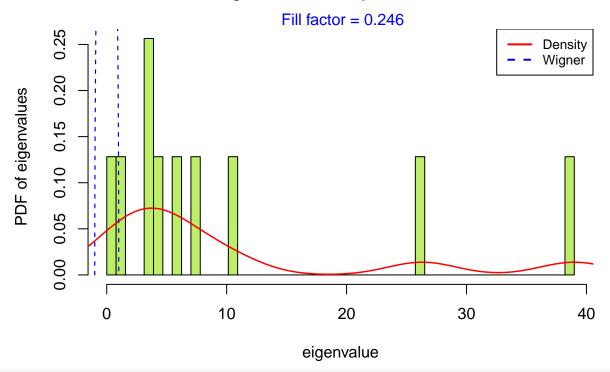




#### symm\_norm(M)

```
## # A tibble: 10 x 3
      row_i prop_reals is_real
##
      <dbl>
                  <dbl> <lgl>
##
                      1 TRUE
##
    1
          1
##
    2
          2
                      1 TRUE
    3
                      1 TRUE
##
          3
##
                      1 TRUE
    4
          4
    5
                      1 TRUE
##
          5
##
    6
          6
                      1 TRUE
##
    7
          7
                      1 TRUE
                      1 TRUE
##
    8
          8
                      1 TRUE
##
    9
          9
                      1 TRUE
## 10
         10
```

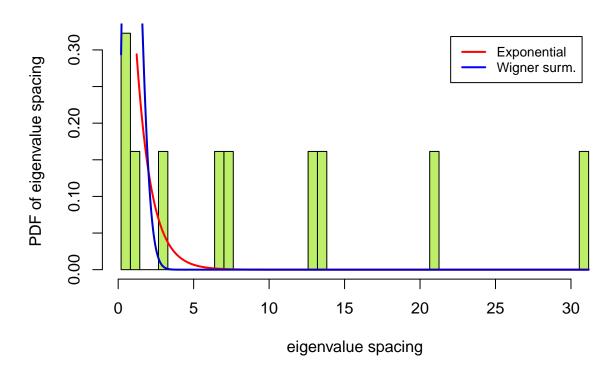


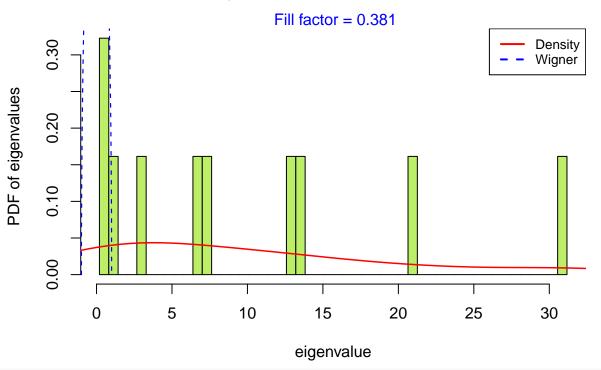


```
symm_norm(M)
```

```
## # A tibble: 10 x 3
## row_i prop_reals is_real
## <dbl> <dbl> <lgl>
```

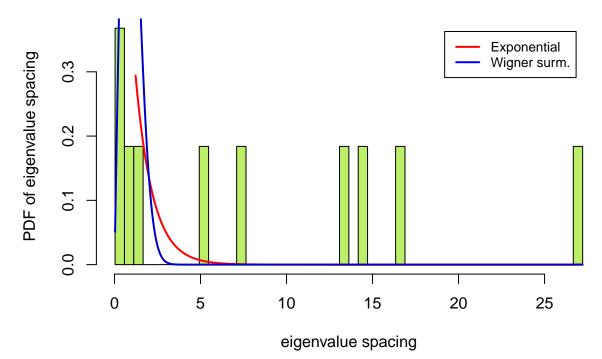
```
##
           1
                       1 TRUE
##
    2
           2
                       1 TRUE
    3
           3
                       1 TRUE
##
##
    4
           4
                         TRUE
##
    5
           5
                         TRUE
    6
           6
##
                       1 TRUE
    7
           7
                       1 TRUE
##
    8
           8
                       1 TRUE
##
                       1 TRUE
    9
##
           9
## 10
                       1 TRUE
          10
```

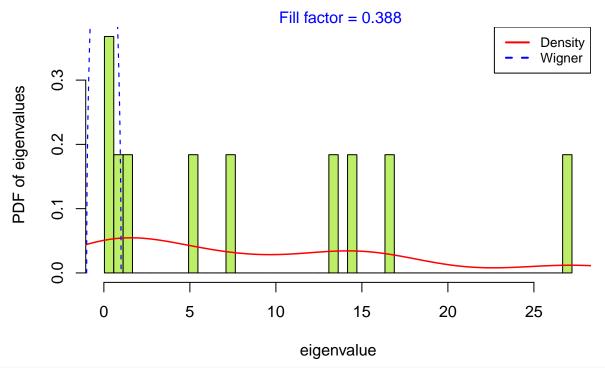




#### symm\_norm(M)

```
## # A tibble: 10 x 3
      row_i prop_reals is_real
##
      <dbl>
                  <dbl> <lgl>
##
                      1 TRUE
##
    1
          1
##
    2
          2
                      1 TRUE
    3
                      1 TRUE
##
          3
                      1 TRUE
##
          4
    4
    5
          5
                      1 TRUE
##
##
    6
          6
                      1 TRUE
                      1 TRUE
##
    7
          7
    8
                      1 TRUE
##
          8
                      1 TRUE
##
    9
          9
                      1 TRUE
## 10
         10
```

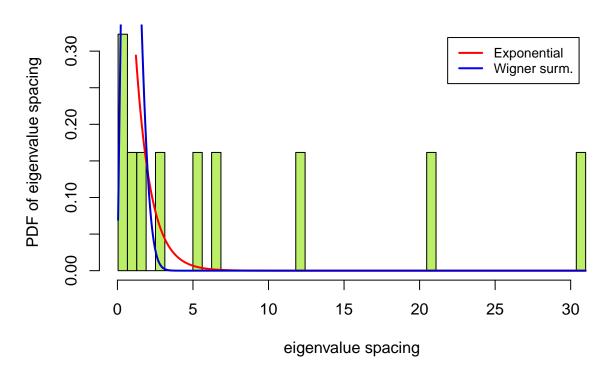


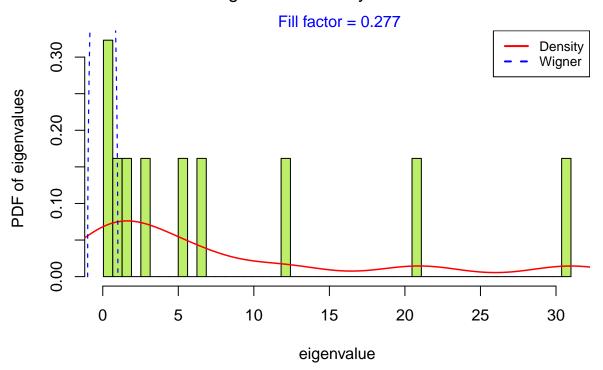


```
symm_norm(M)
```

```
## # A tibble: 10 x 3
## row_i prop_reals is_real
## <dbl> <dbl> <lgl>
```

```
##
           1
                       1 TRUE
##
    2
           2
                       1 TRUE
    3
           3
                       1 TRUE
##
##
    4
           4
                         TRUE
##
    5
           5
                         TRUE
    6
           6
##
                       1 TRUE
    7
           7
                       1 TRUE
##
    8
           8
                       1 TRUE
##
                       1 TRUE
    9
##
           9
## 10
                       1 TRUE
          10
```

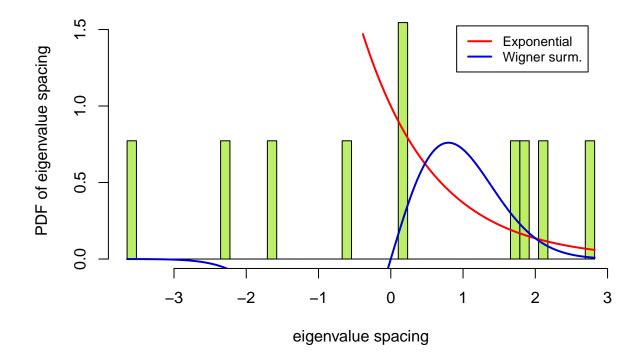


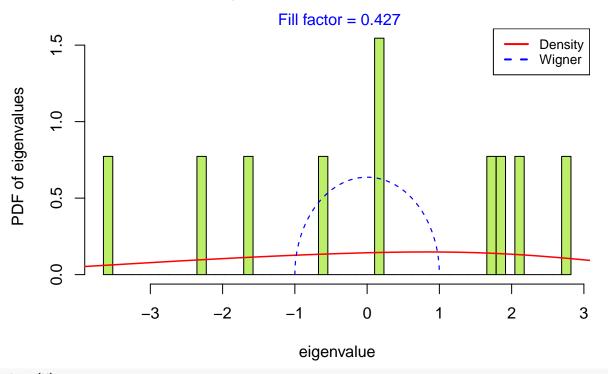


### Tridiagonal Matrices

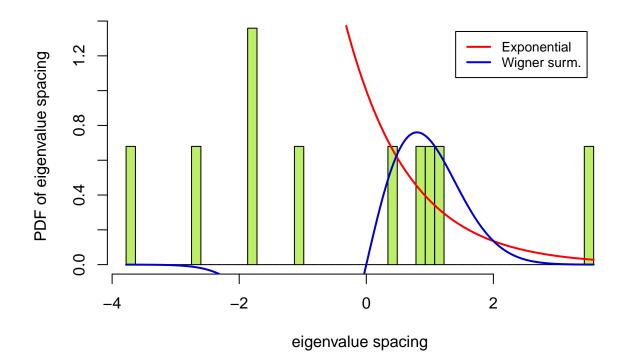
#### tridiag(M)

```
## # A tibble: 10 x 3
      row_i prop_reals is_real
##
      <dbl>
                  <dbl> <lgl>
##
                      1 TRUE
##
    1
          1
    2
          2
                      1 TRUE
##
    3
          3
                      1 TRUE
##
##
    4
          4
                      1 TRUE
          5
##
    5
                      1 TRUE
##
    6
          6
                      1 TRUE
          7
    7
                      1 TRUE
##
##
    8
          8
                      1 TRUE
    9
                      1 TRUE
##
          9
## 10
         10
                      1 TRUE
```

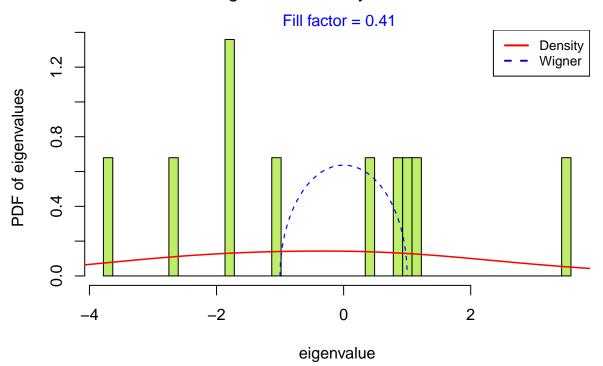




```
## # A tibble: 10 x 3
      row_i prop_reals is_real
##
##
      <dbl>
                  <dbl> <lgl>
                      1 TRUE
##
    1
          1
##
    2
          2
                      1 TRUE
    3
                      1 TRUE
##
          3
                      1 TRUE
##
    4
          4
    5
          5
                      1 TRUE
##
##
    6
          6
                      1 TRUE
                      1 TRUE
##
    7
          7
    8
                      1 TRUE
##
          8
                      1 TRUE
##
    9
          9
                      1 TRUE
## 10
         10
```



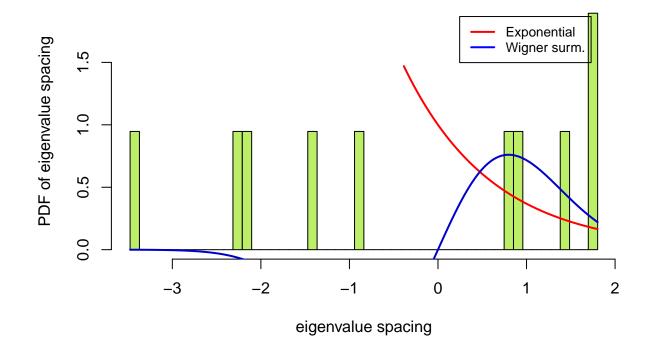
## Eigenvalue density distribution

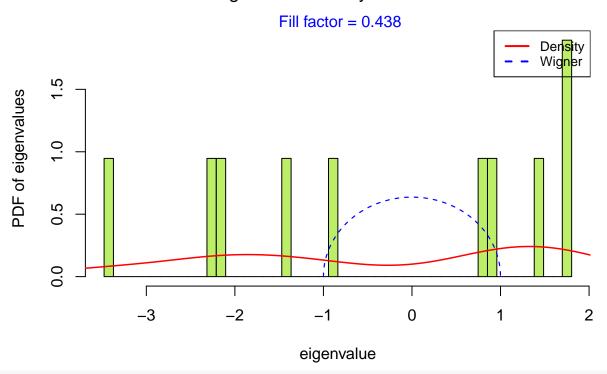


```
## # A tibble: 10 x 3
## row_i prop_reals is_real
## <dbl> <dbl> <lgl>
```

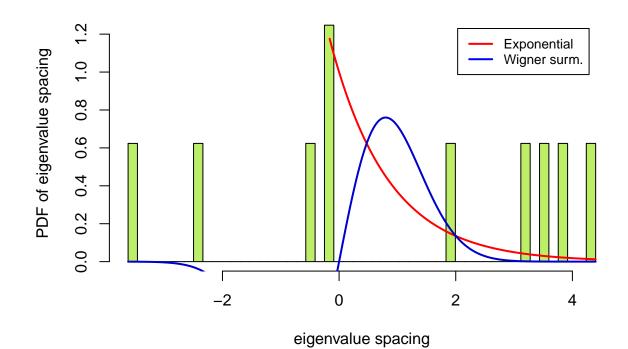
```
##
           1
                       1 TRUE
##
    2
           2
                       1 TRUE
           3
                       1 TRUE
##
##
           4
                       1 TRUE
##
    5
           5
                       1 TRUE
    6
           6
                       1 TRUE
##
                       1 TRUE
##
    8
           8
                       1 TRUE
##
    9
                       1 TRUE
##
          9
## 10
                       1 TRUE
          10
```

Eigenvalue spacing distribution (NNSD)

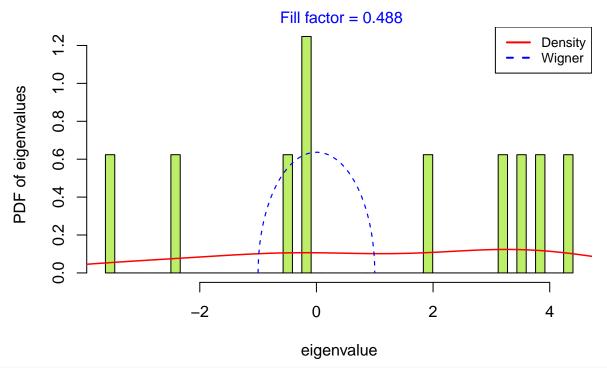




```
## # A tibble: 10 x 3
      row_i prop_reals is_real
##
##
      <dbl>
                  <dbl> <lgl>
                      1 TRUE
##
    1
          1
##
    2
          2
                      1 TRUE
    3
                      1 TRUE
##
          3
                      1 TRUE
##
    4
          4
    5
          5
                      1 TRUE
##
##
    6
          6
                      1 TRUE
    7
                      1 TRUE
##
          7
    8
          8
                      1 TRUE
##
                      1 TRUE
##
    9
          9
## 10
                      1 TRUE
         10
```



## Eigenvalue density distribution



```
## # A tibble: 10 x 3
## row_i prop_reals is_real
## <dbl> <dbl> <lgl>
```

```
##
           1
                       1 TRUE
##
    2
           2
                       1 TRUE
           3
                       1 TRUE
##
##
           4
                       1 TRUE
##
    5
           5
                       1 TRUE
    6
           6
##
                       1 TRUE
    7
           7
                       1 TRUE
##
    8
           8
                       1 TRUE
##
                       1 TRUE
    9
##
           9
         10
## 10
                       1 TRUE
```

